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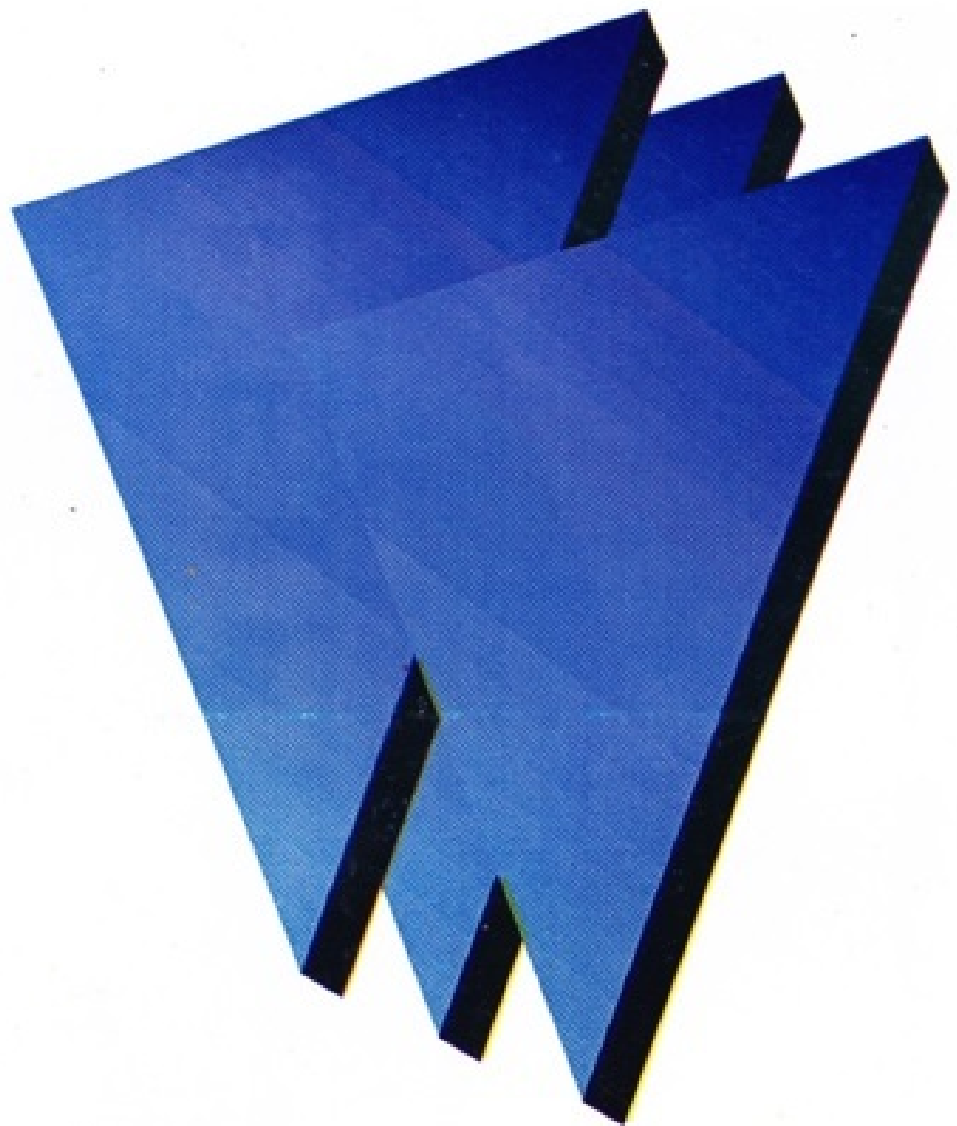
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Factor Analysis of Physiotherapists on the Implementation of Telephysiotherapy in Indonesia

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ABSTRACT

Telephysiotherapy is a long-distance physiotherapy service using technology, including voice or video calls. In Indonesia, telephysiotherapy is not popular compared to abroad, so researchers want to analyze the factors of physiotherapists on implementation of telephysiotherapy in Indonesia. This research was a correlational analytic descriptive study with a cross-sectional approach. The independent variables are the attitude, readiness, knowledge, and motivation of physiotherapists in Indonesia in addition, the dependent variable is the implementation of telephysiotherapy with 117 physiotherapists in Indonesia as subjects. Questionnaire used and tested for validity and reliability. By Chi-Square test, the result found that attitude variable obtained a p-value of 0.034 ($p < 0.05$) and OR value of 2.561, which means that a positive attitude increases the implementation of telephysiotherapy by 2 times, while on the readiness variable the p-value 0.008 ($p < 0.05$) with OR 3.237 which means high readiness increases 3 times the implementation of telephysiotherapy and on the variables of knowledge and motivation shows a p-value of 0.042 ($p < 0.05$) with an OR value of 2.415 which means high knowledge and motivation increase the implementation of telephysiotherapy 2 times greater than low knowledge and motivation. This study found that the majority of physiotherapists in Indonesia have a positive attitude and readiness, knowledge, and high motivation towards the implementation of telephysiotherapy in Indonesia, but more physiotherapists in Indonesia have not implemented telephysiotherapy. On the other hand, there is a relationship between the attitude, readiness, knowledge, and motivation of physiotherapists towards the implementation of telephysiotherapy in Indonesia.

Keywords: Attitude, Knowledge, Motivation, Telehealth, Telemedicine

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INTRODUCTION

The World Health Organization (WHO) officially reported a case of pneumonia without a clear cause, in Hubei Province, China in December 2019. This disease is caused by a

type of corona virus, SARS-CoV-2, which was later named COVID-19. This virus has spread throughout the world and was declared a pandemic¹. To suppress the spread of the virus, several countries have implemented physical distancing lockdowns to minimize physical

interaction, but this policy has an impact on people's access to health facilities^{2,3}. In response to this, the government has begun to direct health workers and the public to utilize telemedicine as a long-distance health service⁴.

Telemedicine is the use of electronic communications and applications to provide health services to patients without direct face-to-face contact^{5,6}. Telemedicine is used abroad to treat pulmonary, musculoskeletal, and neurological cases with the same satisfactory results as direct or face-to-face services⁷⁻¹⁰. In the field of physiotherapy, telemedicine has developed under the name telephysiotherapy. Telephysiotherapy is a long-distance physiotherapy service using telecommunications technology, either via voice calls or video calls. Clinically, telephysiotherapy includes rehabilitation and habilitation services which include examination, monitoring, prevention, intervention, education, and evaluation¹¹.

Telephysiotherapy is a global trend that can be implemented by physiotherapists during the pandemic to improve secondary health-care. In Indonesia, telephysiotherapy is still not that massive compared to abroad. It is assumed that physiotherapists in Indonesia still have obstacles in implementing it, both technological knowledge, understanding in its application, attitude and readiness in implementing this service method¹².

Attitude is a reaction or response that is still closed from a person to a stimulus or object. Attitude is how people think or evaluate something. Newcomb, a social psychologist, stated that attitude is readiness or willingness to act and is not the implementation of certain motives. In other words, the function of attitude is not yet an open reaction (action) or activity, but rather a behavioral predisposition or closed reaction¹³.

Readiness is a very important factor in a life process. By having good preparation, the resulting results will be better than the results achieved without good preparation. Readiness is a person's overall condition that makes him ready to respond or answer in a certain way to a situation. Adjustments to conditions at some point will have an effect or tendency to respond. According to Thorndike, readiness is a prerequisite for subsequent learning¹⁴.

Readiness can come from knowledge. Knowledge is information or information that is used as a basis for making decisions, acting,

understanding, and pursuing certain goals or strategies¹⁵. Physiotherapists working in North Gujarat were found to have sufficient knowledge about telephysiotherapy. Namely, 57.14% while 38.78% did not know telephysiotherapy at all, but only 9% of physiotherapists regularly use telephysiotherapy¹⁶. Meanwhile, at the motivation level, physiotherapists agree that they want patients to consult via telerehabilitation, namely 8-14%¹⁷.

Motivation is a force that can encourage someone to move in the desired direction in achieving a goal¹⁵. Motivation plays a role in supporting an activity¹⁸. Previous research has revealed that telephysiotherapy is one of the most adaptive solutions for providing physiotherapy services during the pandemic, which can also motivate physiotherapists¹². In contrast to this, based on the results of a preliminary study conducted on physiotherapists in Indonesia using a questionnaire, the researchers found that 12 out of 15 physiotherapists had not implemented telephysiotherapy, so this research aimed to analyze internal factors, including attitude, readiness, motivation, and knowledge of physiotherapy. regarding the implementation of telephysiotherapy in Indonesia.

METHOD

The type of research carried out in this research is descriptive analytical correlation with a cross sectional study approach with the independent variables attitude, readiness, knowledge and motivation of physiotherapists in Indonesia and the dependent variable is the implementation of telephysiotherapy. The sample in this study was 117 physiotherapists in Indonesia who were willing to fill out informed consent and research questionnaires. This research also complies with ethics No.E.5a/097/KEPK-UMM/VI/2022.

The sampling method used by researchers is non-probability with total sampling. This research was conducted in Indonesia online from January 2022 to February 2022.

The measuring tool used is a questionnaire created by researchers based on domains related to the variables studied, namely attitude, readiness, motivation and knowledge of physiotherapists. The steps for developing a

questionnaire are as follows: (a) Examining the theory of each variable studied; (b) Formulate the instrument grid; (c) Arranging question items; (d) Testing on respondents with the same characteristics as the research sample; (e) Analyzing test results; (f) Revise and (g) Finalize the formulation of questionnaire items and instruments. The questionnaire was created using a standard validity test (Pearson Product Moment Correlation) with a value of <0.3 and reliability (Cronbach's Alpha) with a value of $p>0.60$.

To answer the research questions, data analysis was carried out consisting of univariate and bivariate tests. Univariate tests for sample characteristics were presented in percentage proportions (%) and bivariate test analysis carried out normality and correlation tests. Normality test uses Kolmogorov-Smirnov ($n>50$) and correlation test uses Chi-Square.

RESULTS

Based on sample characteristics, the research found the following data.

Table 1. Characteristics of Respondents

Characteristics	N	%
Age		
Late Teens	31	26
Early Adulthood	66	56
Late Adulthood	9	8
Early Elderly	9	8
Elderly	1	1
Late Elderly	1	1
Gender		
Male	51	44
Female	66	56
Education		
Associate Degree III	26	22
Associate Degree IV	12	10
Bachelor	65	56
Master	13	11

Table 2. Analysis of Physiotherapist Factors on the Implementation of Telephysiotherapy in Indonesia

Variable	Do Telephysiotherapy				Total	p-value	OR
	Yes		Not Yet				
Attitude	N	%	N	%	N	%	
Positive	22	18.8	42	35.9	64	54.7	0.034*
Negative	9	7.7	44	37.6	53	45.3	
Readiness							

Doctoral	1	1
Work Period		
≤5 years	68	58
>5 years	49	42

Source: Primary Data, 2022

Characteristics of respondents based on age along with several age groups, the highest age was in early adulthood with an age range of 26-35 years totaling 66 individuals (56%), the second most common age was in late adolescence with 17-25 years old totaling 31 people (26%). Besides that, male respondents and bachelor's degree education dominate the characteristics of respondents. The majority of respondents' work experience was less than or equal to 5 years. Based on the practice location, the characteristics of the research respondents can be seen in the following picture.



Figure 1. Characteristics of Respondents Based on Practice Location

Figure 1 shows the characteristics of respondents based on practice locations spread across several provinces in Indonesia. The provinces where the physiotherapy practice was located filled out the questionnaire as many as 23 provinces and the provinces with the largest number of people who filled out the research questionnaire were East Java Province with 40 people (34%), South Sulawesi 17 people (15%), DKI Jakarta 6 people (4%). Meanwhile, the few provinces that filled out the research questionnaire were 1 person (1%) each from Aceh, Maluku and Papua.

Low	9	7.7	49	41.9	58	49.6	0.008*	3,237
High	22	18.8	37	31.6	59	50.4		
Knowledge								
Low	10	8.5	46	39.3	56	47.9	0.042*	2.415
High	21	17.9	40	34.2	61	52.1		
Motivation								
Low	0	0	3	2.6	56	47.9	0.042*	2.415
High	31	26.5	83	70.9	61	52.1		

Source: Primary Data, 2022

Based on Table 2, the results of the correlation test using chi-square show that the p-value for each variable is less than 0.05 ($p < 0.05$), which means there is a relationship between all independent variables (attitude, readiness, knowledge, and motivation) and the dependent variable (implementation of telephysiotherapy). Besides that, the OR (Odd Ratio) value shows the strength of the relationship between each variable. Attitude can increase the implementation of telephysiotherapy by 2,561 times compared to negative attitudes, readiness increase 3,237 times, and knowledge and motivation increase 2,415 times the implementation of telephysiotherapy in Indonesia.

DISCUSSION

The Relationship between Physiotherapists' Attitudes towards the Implementation of Telephysiotherapy in Indonesia

From the results of the research carried out, it can be concluded that there is a relationship between attitudes towards the implementation of telephysiotherapy. Attitude is a person's reaction or response to an object or other particular thing¹⁹. A person's attitude is closely influenced by personal experience. Experience can be gained from a physiotherapist's educational journey as well as experience during his work. Apart from that, other influences that are considered important in forming a person's attitudes include age, length of work, mass media, and environmental factors of the subject. The higher a person's level of education and age, the easier it will be to receive information and respond to it. So everything that has been mentioned above greatly influences the birth of a person's attitude which can be either positive or negative. Attitudes are certain rules in terms of feelings,

thoughts and predispositions for a person's actions and behavior towards something in the surrounding environment. A person who likes an object means they have a positive and favorable attitude, whereas if the person doesn't like it, then that person has a negative and unfavorable attitude²⁰.

To be able to apply technology in all fields, especially health, is certainly not easy. The implementation of information technology-based health services also has obstacles in its implementation²¹. Telehealth is still not widely implemented in Indonesia. The many obstacles and obstacles that are generally faced influence this. Lack of awareness or knowledge of health workers, including physiotherapists, namely telephysiotherapy, influences physiotherapists in responding to it²².

Attitude has a strong relationship to the implementation of telephysiotherapy. This is because attitude describes a person's response or assessment of something²³. The formation of a person's attitudes can be caused by several factors. Starting from personal experience, existing social norms, culture, mass media, and self-confidence²⁰. This relationship shows that the more positive a person's attitude towards something, the more optimal its implementation will be²⁴.

The Relationship between Physiotherapist Readiness and the Implementation of Telephysiotherapy in Indonesia

Research shows that there is a relationship between readiness and implementation of telephysiotherapy. Readiness plays a role in a person to show that someone's condition has met the eligibility requirements. There are many factors that influence a person's readiness which are important in every individual. Starting from internal factors in the form of physical and psychological. From the research results, it

shows that the productive age dominates the respondents because their physical condition is still quite good at this productive age, namely early adulthood (26-35 years). Likewise with psychology which can be described from desires and intelligence which are directly proportional to the level of education that dominates the research respondents. Internal factors, formed from self-motivation, work experience, physical, psychological and expectations. Physicality is closely related to health which will influence the results of a person's actions and social adjustments. If a person experiences physical problems, it can affect a person's readiness, and vice versa. Psychic is related to intelligence, memory, needs that are met, there is a desire or motivation to learn, there is attention and being able to concentrate. Physical and psychological well-being will influence the results of actions that influence a person's readiness²⁵.

The low quantity of telephysiotherapy users in Indonesia is influenced by various things that have become challenges and obstacles so far²². There are at least 6 main obstacles from research conducted by Khalifa (2013)²⁶, namely related to individual barriers (covering behavior, attitudes, readiness, self-confidence, etc.), professional barriers (covering the nature of work of health workers), technical barriers (covering implementation infrastructure), organizational barriers (covering management of health service facilities), financial barriers (covering money and funding), and legal barriers (including regulations and rules). Limited infrastructure in some areas, especially regarding information technology, is a major obstacle in implementing telephysiotherapy due to individual and technical barriers. So it can influence a physiotherapist's readiness to implement telephysiotherapy.

From the results of this research, it was found that the relationship between the readiness of physiotherapists and the implementation of telephysiotherapy is relatively strong. From research conducted by Syarip et al., (2018)²⁵, some several aspects and factors influence a person's readiness, which are generally divided into internal and external factors as well as a person's physical and spiritual aspects.

The Relationship between Physiotherapist Knowledge and the Implementation of Telephysiotherapy in Indonesia

The results of research on data analysis carried out concluded that there was a relationship between knowledge and the implementation of telephysiotherapy. High knowledge increases the implementation of telephysiotherapy compared to low knowledge. This research is in line with research by Maylin, Antono & Rani (2019)²⁷ that respondents who use telemedicine a lot are found in the group with good knowledge, while those who use telemedicine in the rare category are more often found in the group with poor knowledge and there is a relationship between knowledge and use of telemedicine services during the COVID-19 pandemic. So, the better the knowledge about the use of telephysiotherapy, the more optimal it will be for individuals to use telephysiotherapy during the COVID pandemic. The higher the physiotherapist's knowledge about implementing telephysiotherapy, the easier it will be to implement telephysiotherapy²⁸.

Knowledge is the most basic knowledge to shape a person's actions to carry out a goal. Knowledge is knowing or understanding when someone has seen (witnessed, experienced or re-studied) the object being observed or seen²⁹. Good knowledge can be influenced by a number of factors, namely knowing about the existence of telephysiotherapy, understanding the use of telephysiotherapy, being able to apply and analyze the use of telephysiotherapy. Abilities that can be obtained from knowledge include being able to explain or know the definition of telephysiotherapy, knowing the origins of telephysiotherapy, explaining, stating the implementation of telephysiotherapy. In terms of understanding, someone who understands the implementation of telephysiotherapy is able to explain, conclude and interpret the implementation of telephysiotherapy or something that has previously been understood about telephysiotherapy and understands the use of communication technology as well as the knowledge gained by someone who is able to apply telephysiotherapy easily. able to analyze the effectiveness of telephysiotherapy in physiotherapist services during the Covid-19 pandemic³⁰.

Apart from these factors, there are other factors such as the media used to obtain information and the physiotherapist's experience in using telephysiotherapy. Information communication media in several forms of media such as television, radio, books, magazines, newspapers, the internet, and so on have a big influence on the level of knowledge of physiotherapists. Physiotherapists get information regarding telephysiotherapy from information media³¹.

The source of knowledge arises from internal experience that is gained and the knowledge gained is reviewed. The experience gained becomes knowledge for individuals subjectively so that the more experience one gets, the better the knowledge will be. The experience that is gained and attached becomes knowledge to the individual independently so that the more experience gained, the better the knowledge will be²⁸. Several other studies regarding a person's level of knowledge suggest that knowledge is the factor that most influences a person's behavior²⁹.

The Relationship between Physiotherapist Motivation and the Implementation of Telephysiotherapy in Indonesia

From the results of the data analysis research carried out, it can be concluded that there is a relationship between motivation and the implementation of telephysiotherapy. High motivation increases the implementation of telephysiotherapy compared to low motivation. The stronger the motivation a physiotherapist has, the more likely it is that the physiotherapist will show strong behavior to achieve a goal. Motivation has a role in doing one's work. Carrying out a goal does not exist without motivation, no motivation means there is no purpose for someone to do it¹⁸. Motivation is important because with motivation it is hoped that every person will want and be enthusiastic about implementing telephysiotherapy²⁸. Physiotherapist motivation arises when there is a driving force, self-will, willingness to implement it, being able to form a skill in carrying out telephysiotherapy, having responsibility and having a goal for carrying out telephysiotherapy³².

The factors that influence physiotherapist motivation are internal (inside) or external (outside) factors. Motivation within a person to try to achieve satisfaction that exists within a person³³. The formation of the

physiotherapist's own motivation occurs because there is a desire that arises naturally from within which arouses high enthusiasm or moves the physiotherapist to do something to achieve satisfaction or the goal of carrying out telephysiotherapy. Motivation within physiotherapists such as internal encouragement to carry out telephysiotherapy, physiotherapists' desire to use social media in physiotherapist services, physiotherapists want to continue serving patients even during the Covid-19 pandemic³⁴.

Extrinsic (outside) motivation comes from outside a person, there is support from verbal communication and non-verbal communication provided by closeness between close friends. Motivation from outside the physiotherapist is all that is obtained from opinions or encouragement from other colleagues³⁵. The use of telephysiotherapy has received good support from fellow medical personnel who provide health services and support from patients who receive health services during the Covid-19 pandemic in Indonesia. This has proven that health services using telephysiotherapy are very good for patients who live far from health service centers who can use various information technology tools to support telephysiotherapy in order to provide good equipment to patients to improve their health status, such as telephone calls to health services, text messaging, and internet-based applications. The existence of support from the government in implementing telephysiotherapy increases the confidence of the public and medical personnel, especially physiotherapists, in implementing telephysiotherapy to improve health services. The government supports the implementation of telephysiotherapy in Indonesia by issuing a circular issued by the Minister of Health No.HK.02.01/MENKES/303/2020 regarding the implementation of health services utilizing information and communication technology to avoid the spread of COVID-19 in Indonesia³⁶.

Government assistance can form regulations that can regulate the implementation of telephysiotherapy so that the use of telephysiotherapy in health services becomes an official service in Indonesia³⁵. External motivation can increase one's own motivation, so that external motivation can be used to strengthen the achievement of planned goals. External motivation has great power to change an individual's will from not wanting to

to being willing to carry out an activity such as carrying out telephysiotherapy³⁴. Apart from that, factors that can support the implementation of telephysiotherapy are the Covid-19 pandemic because of policies related to travel restrictions to prevent the spread of transmission of the Covid-19 virus³⁷. WHO calls on every country to plan long-term goals to develop health information technology services, namely E-Health, in various health fields. The ease of using technology can give rise to self-confidence in wanting to apply it in individuals, that is, the system is useful and creates a feeling of comfort when using it. The more good influence it has on users using information technology, the greater the interest that arises in people in using information technology²⁹.

The limitation of this research is the limited sample of researchers who are willing to fill out the research questionnaire. Researchers were only able to reach physiotherapist respondents from 23 provinces, which may not represent all physiotherapists in Indonesia, even though they had used an online questionnaire. For this reason, it is hoped that future research can combine online and offline questionnaires and collaborate with professional organizations, both central and branch, to increase the participation of Indonesian physiotherapists as research respondents.

CONCLUSIONS

This research found that the majority of physiotherapists in Indonesia have a positive attitude and high readiness, knowledge and motivation towards implementing telephysiotherapy in Indonesia, but uniquely, there are more physiotherapists in Indonesia who have not implemented telephysiotherapy in their services. On the other hand, a relationship was found between the attitude, readiness, knowledge and motivation of physiotherapists towards the implementation of telephysiotherapy in Indonesia.

Further research regarding other factors that may be stronger in influencing the implementation of telephysiotherapy, using both qualitative and quantitative studies, is still needed with sample coverage in each province in Indonesia. Researchers also feel that support from professional organizations and higher physiotherapy education is necessary for the

implementation of telephysiotherapy to be more massive and reach a wider area.

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CONFLICT OF INTEREST

The authors declare no conflict of interest

REFERENCES

1. Silva LRB, Seguro CS, de Oliveira CGA, Santos POS, de Oliveira JCM, de Souza Filho LFM, et al. Physical Inactivity Is Associated With Increased Levels of Anxiety, Depression, and Stress in Brazilians During the COVID-19 Pandemic: A Cross-Sectional Study. *Front Psychiatry*. 2020 Nov 17;11.
2. Hagger MS, Keech JJ, Hamilton K. Managing Stress during the Coronavirus Disease 2019 Pandemic and Beyond: Reappraisal and Mindset Approaches. *Stress and Health*. 2020 Aug 14;36(3):396–401.
3. Rosyanti L, Hadi I. Dampak Psikologis dalam Memberikan Perawatan dan Layanan Kesehatan Pasien COVID-19 pada Tenaga Profesional Kesehatan. *Health Information : Jurnal Penelitian*. 2020 Jun 30;12(1):107–30.
4. Machmud M, Masmuh A, Nasirin C, Salahudin, Baharuddin T, Musa AEZ. Artificial Intelligence In The Public Health Sector: The Use Of Telemedicine In Indonesia During Covid-19 | *PalArch's Journal of Archaeology of Egypt / Egyptology*. *PalArch's Journal of Archaeology of Egypt* [Internet]. 2020 Nov 2 [cited 2021 Jan 9];17(7):10106–18. Available from: <https://archives.palarch.nl/index.php/jae/article/view/4047>
5. Chang MC, Boudier-Rev  ret M. Usefulness of telerehabilitation for stroke patients during the COVID-19 pandemic. *Am J Phys Med Rehabil*. 2020;Publish Ah:1–5.

6. Song X, Liu X, Wang C. The role of telemedicine during the COVID-19 epidemic in China - Experience from Shandong province. *Crit Care*. 2020;24(1):1–4.
7. Castrodad IMD, Recai TM, Abraham MM, Etcheson JI, Mohamed NS, Edalatpour A, et al. Rehabilitation Protocols Following Total Knee Arthroplasty: a Review of Study Designs and Outcome Measures. *Ann Transl Med [Internet]*. 2019 Oct [cited 2020 Jul 6];7(S7):S255–S255. Available from: [/pmc/articles/PMC6829007/?report=abstract](https://pubmed.ncbi.nlm.nih.gov/32454919/)
8. Cottrell MA, Russell TG. Telehealth for musculoskeletal physiotherapy. *Musculoskelet Sci Pract*. 2020;(January).
9. Jiang S, Xiang J, Gao X, Guo K, Liu B. The Comparison of Telerehabilitation and Face-to-Face Rehabilitation after Total Knee Arthroplasty: A Systematic Review and Meta-Analysis. *J Telemed Telecare [Internet]*. 2018 May 1 [cited 2020 Jul 6];24(4):257–62. Available from: <https://pubmed.ncbi.nlm.nih.gov/28027679/>
10. Turolla A, Rossetini G, Viceconti A, Palese A, Tommaso G. Musculoskeletal Physical Therapy During the COVID-19 Pandemic: Is Telerehabilitation the Answer. Oxford University Press; 2020. 1–56 p.
11. Adhikari SP, Shrestha P, Dev R. Feasibility and Effectiveness of Telephone-Based Telephysiotherapy for Treatment of Pain in Low-Resource Setting: A Retrospective Pre-Post Design. *Pain Res Manag [Internet]*. 2020 [cited 2022 Apr 7];2020. Available from: <https://pubmed.ncbi.nlm.nih.gov/32454919/>
12. Kurniawati N, Aulia DA, Sativani Z, Pandini EA, Qoriah YA, Fadhilah ND, et al. Tele-fisioterapi sebagai Pendekatan Inovatif dan Adaptif terhadap Kualitas Hidup Pasien Stroke selama Pandemi COVID-19. *Fisioterapi. Jurnal Ilmiah Fisioterapi*. 2021;21(1):37–50.
13. Rahmadi A, Lestari Y, Yenita Y. Hubungan Pengetahuan dan Sikap Terhadap Rokok Dengan Kebiasaan Merokok Siswa SMP di Kota Padang. *Jurnal Kesehatan Andalas*. 2013 Jan 1;2(1):25.
14. Husaini FA, Asriyadi F. Studi Korelasi Sikap dan Kesiapan Penerapan Evidence-Based Practice pada Mahasiswa Profesi Ners UMKT Tahun 2019. *Borneo Student Research*. 2020;2(1):7884.
15. Wahyuningsih A, Purnamasari V. Kinerja Perawat Dilihat Dari Pengetahuan Dan Motivasi Perawat. *JURNAL PENELITIAN KEPERAWATAN*. 2016;2(2).
16. Soni KM, Khatri SM. Use of Tele-physiotherapy as a treatment tool by physiotherapists in North Gujarat: A Survey. *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) e-ISSN [Internet]*. 2020 [cited 2022 Apr 7];19:21–5. Available from: www.iosrjournals.org
17. Lawford BJ, Bennell KL, Kasza J, Hinman RS. Physical Therapists' Perceptions of Telephone-and Internet Video-Mediated Service Models for Exercise Management of People With Osteoarthritis. 2017; Available from: <http://www.abs.gov.au/websitedbs/d3310114.nsf/home/remoteness+structure>
18. Suharn, Purwanti. Upaya Meningkatkan Motivasi Belajar Siswa. *G-Couns: Jurnal Bimbingan dan Konseling*. 2019;3(1):73–82.
19. Nursalam. *Metodologi Penelitian Ilmu Keperawatan*. 5th ed. Salemba Medika; 2020.
20. Siswadi GA. Integrasi Pendidikan Agama Hindu dalam Pembelajaran Bahasa Sansekerta. Nilacakra; 2019.
21. Kausar LIE. Pemanfaatan Teknologi Informasi Berbasis Internet terhadap Perkembangan Home Care di Indonesia. *Dinamika Kesehatan Jurnal Kebidanan dan Keperawatan*. 2020 Jan 2;10(1):212–23.
22. Ardiansyah A, Rusfian EZ. Eksplorasi Aspek – aspek Penghambat Penerimaan User Telemedicine pada Daerah Tertinggal di Indonesia. *Journal of Education, Humaniora and Social Sciences (JEHSS)*. 2020 Dec 2;3(2):671–81.

23. Kusumawardani AS, Muljono P. Hubungan Sikap dan Motivasi Kerja dengan Kinerja Kader Posyandu. *Jurnal Sains Komunikasi Dan Pengembangan Masyarakat [JSKPM]*. 2018;2(2):223–38.
24. Siboro MD, Surjoputro A, Budiyantri RT. Faktor-faktor yang Mempengaruhi Penggunaan Layanan Telemedicine Pada Masa Pandemi Covid-19 di Pulau Jawa. *Jurnal Kesehatan Masyarakat*. 2021 Sep 30;9(5):613–20.
25. Syarif SM, Suherman A, Yayat Y. Identifikasi Faktor-faktor yang Mempengaruhi Kesiapan Kerja Siswa Teknik Perbaikan Bodi Otomotif. *Journal of Mechanical Engineering Education*. 2019 Jan 30;5(2):261.
26. Khalifa M. Barriers to Health Information Systems and Electronic Medical Records Implementation. A Field Study of Saudi Arabian Hospitals. *Procedia Comput Sci*. 2013;21:335–42.
27. Maylin S, Antono S, Rani B. Faktor-Faktor Yang Mempengaruhi Penggunaan Layanan Telemedicine Pada Masa Pandemi Covid-19 Di Pulau Jawa. *Jurnal Kesehatan Masyarakat*. 2019;3(2):58–66.
28. Widianingrum T. Annual Membership Census. *Public Opinion Quarterly*. 2017.
29. Sa'idah N. Analisis Penggunaan Sistem Pendaftaran Online (E-Health) berdasarkan Unified Theory of Acceptance and Use of Technology (UTAUT). *Jurnal Administrasi Kesehatan Indonesia*. 2017 Dec 20;5(1):72.
30. Masturoh I, Anggita N. Metodologi Penelitian Kesehatan. In: Pusat Pendidikan Sumber Daya Manusia Kesehatan Kementerian Kesehatan Republik Indonesia. 2018.
31. Notoatmodjo S. Metodologi Penelitian Kesehatan. Jakarta: Rineka Cipta; 2018.
32. Tanuwibowo MH, Setiawan R. Pengaruh Budaya Organisasi Dan Motivasi Kerja Terhadap Kinerja Karyawan Pada PT Lestari Purnama Perkasa. *Jurnal Agora*. 2015;3(2):60–9.
33. Huda W Al. Teori-Teori Motivasi. Jurusan Ilmu Perpustakaan dan Komunikasi Universitas Islam Negeri Ar-raniry. 2015;
34. Septianti D, Frastuti M. Pengaruh Penggunaan Media Berbasis Internet, Motivasi Intrinsik dan Motivasi Ekstrinsik Terhadap Minat Berwirausaha Online Mahasiswa Universitas Tridianti Palembang. *Jurnal Ilmiah Ekonomi Global Masa Kini*. 2019 Dec 23;10(2):130.
35. Manurung EI. Kajian Literature : Penggunaan Telehealth Program Dalam Pelayanan. *Jurnal Ilmu Kesehatan Insan Sehat*. 2021;9(2):148–55.
36. Istifada R, Sukihananto S, Laagu MA. Pemanfaatan Teknologi Telehealth pada Perawat di Layanan Homecare. *Nursing Current*. 2017;5(1):51–61.
37. Riyanto A. Faktor-Faktor yang Mempengaruhi Pelaksanaan Telemedicine (Systematic Review). *Jurnal Manajemen Informasi Kesehatan Indonesia (JMIKI)*. 2021;9(2):165–74.

Article Review

A Review of Family Caregiver's Responses of Care to Patients Undergoing Hemodialysis

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ABSTRACT

The limitations of CKD patients require families to care for family members who suffer from CKD. This research analyzes family experiences in caring for family members with CKD. This research method uses a descriptive design with a scoping review approach. Article searches used four journal databases: PubMed, ScienceDirect, EBSCO, and Google Scholar. Articles that met the inclusion criteria, including a publication range from 2015 to 2022 in English and Indonesian and free access to the full-text PDF, were evaluated before selection. The research results based on a review of 10 articles show that family members have different responses in caring for CKD sufferers. Acceptance of known kidney disease indicates coping with solid efforts. The family will also continue to fight to get the best treatment for the patient's recovery. Apart from that, the family and the patient can make decisions regarding the continuation of the patient's therapy program. Families need emotional support from the surrounding environment. Psychological responses will increase along with the lack of family acceptance of the condition of the patient being treated.

Keywords: Caregiver, Caring, Hemodialysis

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INTRODUCTION

Family members often cooperate to provide care or medical treatment for those afflicted with chronic kidney disease (CKD). Family members, in their role as caregivers, bear a crucial responsibility in activities such as administering medication and ensuring compliance, aiding in daily care duties, arranging and facilitating transportation for medical appointments, overseeing the health of the patient, advocating on behalf of the patients, and providing emotional support ¹. This familial responsibility confers advantages to both patients and healthcare professionals. The participation of family members in patient care is linked to enhanced behavior, self-care,

and compliance with medical therapy, along with improved quality of life, lowered risk of death, alleviated symptoms of anxiety and sadness, and reduced probability of hospitalization. Family members are essential in supporting healthcare practitioners in the treatment of patients with chronic renal illness ².

The presence of family is essential in providing care to individuals with deteriorating health conditions. As patients' health declines and their need for care becomes more demanding, caregivers are tasked with performing increasingly complex care responsibilities. Hence, caregivers assume a vital role in delivering care to

individuals with illnesses or impairments throughout the progression of their conditions. Family-centered care has been proposed as a viable solution for this issue since it aims to meet the requirements of both patients and their relatives³. The preparation of families for the care of hemodialysis patients entails several key components: the adoption of a family-centered approach, the provision of comprehensive education beginning in infancy, the utilization of interventions that prioritize the preparedness of carers, and the facilitation of effective communication between healthcare practitioners and family members and fostering strong connections between families and patients⁴. Creating psycho-educational support groups can empower families by providing them with crucial information and emotional assistance necessary for successful therapy⁵.

Individuals responsible for the care of patients undergoing hemodialysis face a significant likelihood of experiencing emotional and psychological difficulties, reduced quality of life, and heightened load. Due to the extended duration of treatment, they experience a range of psychosocial issues⁶. Family members frequently bear a

significant weight when it comes to taking care of individuals undergoing hemodialysis. The problems and burdens escalate as the disease advances. Families have various challenges encompassing physical, emotional, and financial hardships⁷.

The patient getting care may also be impacted by familial responsibilities. Research has indicated that family responsibilities are linked to a dearth of social assistance and diminished quality of life in terms of health for both patients and their families⁸. The existence of disturbances in the quality of life and the stressors faced by families of hemodialysis patients impose a dual load on the patients and impair the treatment process⁹. This can diminish the capacity of families to provide hemodialysis treatment for patients suffering from chronic renal disease.

An analysis of family experiences in the management of hemodialysis patients is crucial for caregivers to avoid encountering overwhelming loads that may hinder patient care. The goal of this systematic study is to give a complete assessment of the obstacles that families confront in providing care for relatives with chronic kidney disease (CKD).

METHOD

The author intends to use Scoping Review research as a research design. A scoping review is used as an introduction to a systematic review, aiming to identify the types of evidence available on the topic discussed, providing an overview of how research is conducted on a particular subject or field, and identifying essential characteristics or factors associated with a study. Study. Concepts, and explains systematic reviews. Two from the same educational institution, one lecturer and one student, wrote this scoping review¹².

The preparation of this scoping review used guidance from the expanded Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) in the scoping review checklist. A customized review includes (1) Identification of documents through systematic search, (2) Filtering articles based on title and abstract, (3) Assessment of the suitability of the

article in full text, (4) Critical Appraisal, (5) inclusion of related articles.

Publications exploring the impact of acupressure on increasing breast milk production were one of the inclusion criteria for this study. Other criteria are publications published between 2015 and 2022, articles written in Indonesian and English, complete and easily accessible reports, and essays published in two languages. Meanwhile, the exclusion criteria are gray literature in newspapers, news, etc. There are ten articles among the 64 original articles. After this first screening, 236 of 1,577 articles were removed due to inappropriate titles or abstracts. Ten of the original fourteen publications were found to be applicable and consistent with this study after a second round of screening using established inclusion criteria.

Table 1. outlines the criteria used to determine whether information was included and excluded in the review.

Inclusion	Exclusion
1. English-language studies from any country	1. Studies not in English
2. Studies published in 2015 or later (to 2020)	2. Studies before 1950 or missing abstracts
3. Original research (qualitative, descriptive, cross sectional, cohort, mixed methods, experiment)	3. Systematic reviews and literature reviews
4. Role of caregivers included in articles	4. Other/unspecified caregivers

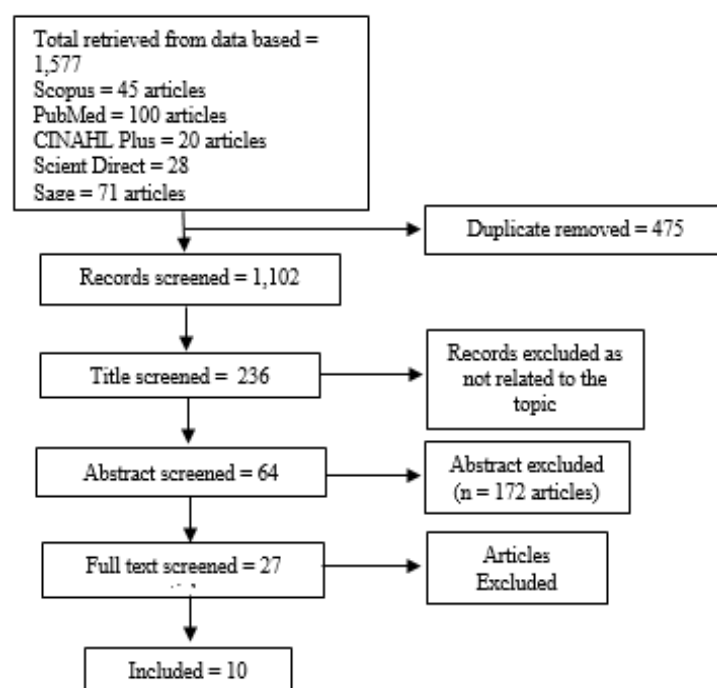


Figure 1. PRISMA Flowchart

Table 2. Data Charting

No	Title, author	Population/setting	Country	Outcome	Interview/in-depth/fGD
1	Caregiver Experience in Pediatric Dialysis 11	35 caregivers of children	US	1. The process of medicalizing caregiving, which includes aspects such as diagnosing and initiating treatment, managing the sickness, and considering future possibilities. 2. Emotional adjustment (including the initial and intense stage, acceptance, personal	Semi-structured interviews

				<p>growth, and medical strain)</p> <p>3. Pragmatic adaptation involves making practical modifications in different areas of life, such as dealing with disruptions, changing life goals and self-perception, and managing the financial implications that result from these adaptations.</p> <p>4. Social adjustment encompasses various aspects such as the potential for forming relationships, the possibility of encountering risks in relationships, the act of advocating for oneself, the functioning of one's family, and the quality of personal relationships.</p>	
2	An inquiry was conducted employing interview approaches to explore the viewpoints of individuals suffering from end-stage renal disease (ESRD) and their carers regarding advance care planning ¹²	There are 24 patients and 15 carers.	Australia	<p>1. The act of expressing fundamental principles (such as avoiding pointless and demeaning care, reassessing the conditions of dialysis, defining a meaningful existence, and declining to become a source of inconvenience).</p> <p>2. Engaging in discussions that address topics such as mortality, surrendering to the unavoidable reality of death, and relieving existential anxiety.</p> <p>3. Facilitating comprehension (addressing sensitive topics and aiding caregivers in dispute)</p> <p>4. Factors that pose difficulties to patient autonomy include familial influence to prolong dialysis treatment, reduced caregiving ability due</p>	Semi-structured interviews.

				to grieving, and utilizing support systems.	
				5. Experiencing decisional disempowerment due to a lack of medical transparency and feeling disappointed by the clinical disinterest.	
3	Family caregivers in South-West Nigeria who offer assistance to individuals suffering from end-stage renal disease recount their personal encounters ¹³	15 family caregivers	Nigeria	<ol style="list-style-type: none"> 1. Alienation from oneself and others 2. Perpetual onus 3. "a person exhibiting foolish behavior and being subjected to constant manipulation or instability." 4. duty to provide care 5. fostering a more intimate connection 	Semi-structured interviews
4	An investigation into the perceptions of family carers regarding the palliative care requirements of individuals undergoing dialysis for end-stage renal disease ¹⁴	18 family caregivers	Canada	<ol style="list-style-type: none"> 1. Difficulties encountered in navigating the healthcare system. 2. Responsibilities and challenges faced by caregivers 3. Perspectives on palliative care 4. Management of symptoms 5. The process of making decisions. Challenges faced by caregivers encompass various aspects, including physical, emotional, social, and economic factors. 	In-depth
5	An investigation was done in an American public healthcare facility to measure the level of knowledge about treatment choices for renal failure among elderly patients and their family members. The study's goal was to measure people's understanding of dialysis and the	A collective of 21 people were present, consisting of 15 patients and 6 members of their families.	US	<ol style="list-style-type: none"> 1. They doubt the feasibility of adopting a conservative approach to safeguarding their own or their family members' welfare. 2. Develop a thorough conceptual understanding of the fundamental principles of dialysis. 3. Dialysis is the sole feasible remedy for renal failure, as any other option would lead to mortality. 	Semi-structured interviews.

	implications of not receiving treatment ¹⁵				
6	A research investigation was carried out in Singapore to examine the viewpoints on decision-making among elderly individuals suffering from end-stage renal disease and their carers ¹⁶	23 pasien 7 caregivers.	Singapore	<ol style="list-style-type: none"> 1. The patient taking part in the decision-making process. The significance of the family in the decision-making process. The decision-making process heavily weighs the doctor's opinion. 2. Elements that impact the process of making decisions 	in-depth interviews
7	To determine the significance of social support in the setting of peritoneal dialysis, a study was started. A qualitative descriptive strategy was employed to gather data for the investigation. Method or methodical process ¹⁷	The study had a cohort of 15 patients and 6 family members. There were 11 nurses included in the study.	Western Canada.	<ol style="list-style-type: none"> 1. Emotional support refers to social assistance that specifically addresses emotional needs and facilitates the successful management of emotions. 2. Peritoneal dialysis tasks and tasks associated with everyday life (instrumental support) 3. Gaining information, receiving information, and acquiring knowledge (informational support) 4. Confirmation/external Self-assurance and self-belief aid in the assessment of one's capabilities. 	Semi-structured interview
8	Iranian family caregivers' viewpoints and first-hand encounters in the specialized treatment of hemodialysis patients ¹⁸	25 hemodialysis family caregivers	Iran	<ol style="list-style-type: none"> 1. Overwhelming responsibility of caregiving 2. Carer stress 3. Feeling emotionally drained or depleted. 	in-depth interviews
9	Experiences of Family Members Regarding Dialysis and Kidney Transplantation ¹⁹	49 family members	AS	<ol style="list-style-type: none"> 1. Assuming the role of a care partner involves unforeseen obligations and disturbances to sleep patterns. 2. Unfavorable psychological reactions in patients (such as depression) and family members 	Focus groups

				(such as anxiety) in response to treatment.	
				3. Insufficient information and logistical inconveniences regarding the delivery and logistics of therapy, including medication regimen.	
				4. patient morbidity refers to the occurrence of health problems and exhaustion specifically associated to dialysis treatment.	
10	An investigation into the viewpoints and firsthand encounters of caregivers responsible for persons undergoing hemodialysis in Iran: Examining the provision of care within a context characterized by uncertainty ²⁰	20 hemodialysis family caregivers	Iran	1. The perpetual endeavor to acquire knowledge. 2. Dedication and commitment to the spiritual connection while being held captive by illness.	Unstructured interviews

RESULTS AND DISCUSSION

Family Response Information Seeking

Families will look for the correct information to determine the therapy to be given. Information from healthcare providers regarding dialysis services, procedural actions, side effects, and other vital facts will be sought to recover patients. The lack of clear information causes intense disappointment for families and patients. Families may also have reduced interest in treatment due to the need for more information. Families may choose services of alternative medicine if the obtained health information is not adequate.

Coping Mechanism

Family coping in caring for family members has different responses. Acceptance of the recognized kidney disease indicates strong coping. Families will also continue to struggle to obtain the best treatment for the

recovery of patients. Family coping that is weak will be characterized by despair, thoughts of Mortality and the depletion of one's vitality while tending to the needs of the family. Financial exhaustion might contribute to families' inability to manage.

Decision-Making

Families, as well as patients, may make decisions. Patients can also make decisions regarding the sustainability of the patient therapy program. Families can discuss with patients regarding the decisions to be taken. In-depth communication with patients will affect the acceptance of patients regarding the outcome of the decisions that have been made. However, patient autonomy in decision-making must also be considered. The patient has the right to determine actions related to their health.

Burden

Families will continuously feel fatigued in treating patients. Patients with renal failure

need to undergo weekly dialysis therapy. Families feel physical fatigue in performing direct treatments on patients, both at home and in hospitals. The costly treatment process can also be a factor in financial fatigue. People who do not have health insurance will feel this impact. Families of patients will also feel emotional and social fatigue in response.

Social Limitation

Patients with dialysis will experience minimal, intermediate, or even total difficulties. Families should spend much time to provide care. Families will be preoccupied with efforts to heal the patients. Communication with the surrounding environment and even peers will be reduced. Feelings of loneliness or isolation will arise and cause emotional problems.

Psychological Disorder

Physical fatigue and emotions that families experience during the treatment period of CKD patients will cause psychological responses to occur. Families can feel stress, depression, anxiety, and pressure on the conditions they face. Families need emotional Support from their surroundings. Psychological responses will increase in line with the lack of family acceptance of the condition of the treated patients.

Data Characteristics

By the inclusion criteria, 10 articles were found. The analysis results indicated six themes: information seeking, coping mechanisms, decision-making, burden, social limitations, and psychological disorders. The responses of the families of patients while treating the patients with hemodialysis were found in the study articles about family experiences of treating patients (7 studies) ²¹, decision-making (2 studies) ²², and Support of social needs (1 study) ¹⁵. All studies that were reviewed to determine their themes utilized qualitative designs. The participants in the qualitative studies numbered more than 15, with an average of 20 participants. Regarding the origin of the studies, there were 3 studies from the United States^{19,20}, 2 studies from Canada ^{23,24}, 2 research from Iran ²⁵, and 1 study each from Singapore ²⁵, Nigeria ²⁰, and Australia ²⁰. The studies employed various methods of data collecting, including semi-structured interviews (5 studies), unstructured interviews (1 research), in-depth interviews (3 studies), and focus group talks (1 study).

Table 3. Constructs of Family Caregiver Responses

Construct	References									
	1	2	3	4	5	6	7	8	9	10
Information seeking										
Obtaining data, acquiring knowledge, and gaining insights (informational support)							•			
Medicalization of caregiving (with subthemes: diagnosis and beginning, disease management, and future prospects)	•									
Issues related to treatment administration and organization, include lack of information, drug schedule, and practical challenges.									•	
Lack of medical clarity and unhappiness with clinician disinterest might lead to decisional disempowerment.		•								
Difficulties encountered when navigating the healthcare system				•						
Limited comprehension of the practical aspects of dialysis					•					
There is a lack of acknowledgment about the possibilities for conservative management as a realistic choice for one's self or their family members' health.					•					

Construct	References									
	1	2	3	4	5	6	7	8	9	10
Coping										
Validation from others and belief in oneself (endorsement and self-assurance).							•			
Expressing fundamental principles (such as avoiding ineffective and disrespectful care, reassessing the conditions of dialysis, defining a meaningful existence, and rejecting the notion of becoming a burden),		•								
Engaging in discussions that involve topics such as mortality, surrendering to the certainty of death, and easing existential anxiety.		•								
Alienation from oneself and others			•							
"A person displaying foolish behavior and being subjected to being thrown or moved around."			•							
The perpetual endeavor to acquire knowledge										•
Dedication and commitment to the spiritual connection with the experience of illness										•
Pragmatic adaptation refers to the process of making practical adjustments in response to disruptions, such as changes in life goals, sense of self, and financial consequences.	•									
Decision making										
The patient's participation in the process of making decisions.						•				
Factors that provide a challenge to patient autonomy include familial pressures to continue dialysis, the decreased capacity of caretakers due to grieving, and the use of support as a means of influence.		•								
The significance of familial involvement in the process of determining decisions						•				
It is essential to include the doctor in the decision-making process.						•				
Factors influencing the process of making decisions						•				
By promoting mutual understanding (by tackling tough subjects and assisting carers in resolving conflicts),		•								
Exclusively consider dialysis as the sole therapeutic option for renal failure, as any other choice would result in mortality.					•					
Burden										
Caregiver burdens: physical, emotional, social, and economic dimensions				•						
The heavy burden of care								•		
Emotional exhaustion								•		
Never-ending burden			•							
Social limitation										
Social adjustment encompasses various aspects such as the potential for forming relationships, the potential risks involved in relationships, the act of advocating for oneself, the functioning of one's family, and the quality of personal relationships.	•									

Construct	References									
	1	2	3	4	5	6	7	8	9	10
Duty to provide care			•							
Fostering a more intimate connection			•							
Assuming the role of a care partner involves unforeseen duties and disturbances to one's sleep.									•	
Psychological disorder										
Views on palliative care				•						
Psychological treatment can lead to negative reactions in patients, such as sadness, and in family members, such as worry.									•	
Caregiver stress								•		
Management of symptoms				•						
Incidence of patient morbidity, including dialysis-related health complications and weariness.									•	
Providing assistance for emotional needs and effectively handling emotions (emotional support)							•			
Emotional adaptation (early and intense stage, acceptance, personal development, and the stress of medical treatment and psychological strain),			•							

The primary trend identified in the responses from family caregivers was their proactive quest for information. The study encompasses the examination of obtaining information, receiving information, and learning, which is sometimes referred to as informational assistance the medicalization of caregivers (including themes of diagnosis and initiation, disease management, and future prospects); the delivery and logistics of treatment (including insufficient information, medication regimen, and logistical inconveniences); feeling disempowered in decision-making (due to a lack of medical transparency and disappointment with clinical disinterest); challenges in navigating the health system; limited understanding of the realities of dialysis; and a lack of Considering Conservative management is a feasible choice for taking care of oneself or one's family ^{16,20}. Caregivers play a vital and irreplaceable role in delivering care for patients undergoing kidney dialysis. Healthcare professionals specialized in nephrology must possess a thorough comprehension of the complex nature and substantial obligations associated with this role. Integrating caregivers' evaluation of needs into routine clinical care is essential, especially when deciding when to start dialysis. Specialized training and support sessions should be offered by kidney health professionals to address specific care responsibilities, imparting information, aid,

and readiness for both dialysis and non-dialysis tasks that must be carried out at home ²⁶.

The second issue examined in regards to the reactions of family caregivers was coping. This includes the elements of seeking validation and confidence from external sources, as well as developing a strong belief in oneself (appraisal support). It also entailed articulating core concepts (such as the avoidance of fruitless and undignified therapy, reassessing the conditions of dialysis, defining a meaningful existence, and declining to be a source of hardship). Furthermore, it involved participating in challenging discussions that recognize the reality of mortality and failure, embracing the unavoidable nature of death, and alleviating existential anxiety. Additionally, it entailed experiencing a sense of detachment from oneself and others, comparable to being tossed around foolishly. Moreover, it entailed a perpetual endeavor to get knowledge and expertise, alongside following a spiritual or celestial journey while confronting the obstacles of disease Ultimately, it required a practical response to disturbances, the modification of life objectives and one's perception of self, and the handling of the financial repercussions of the situation ^{19, 25, 27}.

Research has explored coping mechanisms in chronic illnesses other from cancer, indicating that various tactics can

assist patients in overcoming negative occurrences and alleviating their distress¹. A correlation has been discovered between the utilization of adaptive coping mechanisms and improved quality of life (QoL), decreased reliance on escape avoidance, and heightened psychological distress among individuals with chronic illnesses. Denial is a coping mechanism that is linked to both mental health and a lower quality of life, accompanied by poorer physical and social functioning. Hence, there exists a direct relationship between coping resources and mental health and quality of life (QoL), suggesting that an individual's ability to handle and endure life's difficulties through a feeling of personal agency leads to improved mental well-being.²

The study also examined the decision-making process as a third part of family caregiver reactions. This entailed patients engaging in the decision-making process, taking into account patient autonomy (including the impact of familial pressures to continue dialysis, the decrease in carer capacity due to grief, and the utilization of support systems), Facilitating family involvement in decision-making, comprehending the physician's role in decision-making, analyzing the factors influencing decision-making, fostering mutual understanding (including addressing sensitive subjects and aiding conflicted carers), and assessing dialysis as the sole treatment for kidney failure and any alternative choices that may lead to mortality^{3,4}.

To optimize care for individuals afflicted with chronic kidney disease (CKD), the implementation of advanced care planning (ACP) is of paramount importance. This empowers individuals to reflect carefully and express their future care preferences in alignment with their goals and values. Advance Care Planning (ACP) necessitates the development of strategies that effectively support carers in adequately preparing for their role as surrogate decision-makers. Furthermore, it is imperative to build a support structure for caregivers who are incapable of making end-of-life decisions as a result of their own profound sorrow⁵. The primary objective of ACP is to designate a surrogate decision-maker who will actively support and represent the interests of the patient. This study consistently demonstrated that without

engaging in Advance Care Planning (ACP) discussions, families had a significantly reduced probability of understanding patients' treatment preferences or appropriately assessing patients' quality of life^{6,7}.

The carer stresses the critical importance of family involvement in the care and medication decision-making process. This approach aligns with the palliative care model, which prioritizes the patient and their family in the provision of care. The process of deciding on follow-up care planning is more effectively communicated through informal means over a period of time, gradually increasing awareness rather than being discussed all at once⁸. The most significant unmet needs in healthcare during the final six months of a patient's life include effectively managing emotions related to prognosis and the fear of spreading, finding a balance between the needs of caregivers and patients, taking into account the impact of care on employment, and making decisions in a context of uncertainty⁹.

The fourth subject explored in the study was the concept of care burden, which refers to the anguish experienced by caregivers or families as a result of providing care for patients¹⁰. The burden of care is influenced by various factors, such as the patients' self-care capabilities, the presence of concomitant chronic diseases, the educational background of individuals involved, as well as the ages of both patients and family members. Consequently, patients with limited self-care abilities may have a higher prevalence of chronic diseases, lower educational attainment, and an aging family population. The family's caregiving responsibilities will intensify²¹. This load encompasses physical, psychological, social, and financial dimensions. The heightened responsibilities of providing care and the diminished quality of life might give rise to difficulties, such as the emergence of depression. There is a strong correlation between an increase in caregiving responsibilities and a decline in families' capacity to provide care, as the duties associated with caregiving can have profound and detrimental impacts on individuals. The magnitude of stress that families experience when providing care for patients with chronic diseases is a substantial and frequently disregarded affliction²². The presence of care burdens has a detrimental impact on the well-being of families, perhaps leading to a

decrease in the level of care provided and a deterioration in the health conditions of individuals with chronic illnesses¹⁵. The deterioration of patients' illnesses can exacerbate the caregiving obligations and give rise to self-perpetuating cycles. Without appropriate intervention, it may result in progressive exhaustion for the families²⁰.

Family caregivers of palliative care patients frequently bear significant physical, emotional, and financial burdens in their role as caregivers. The responsibilities of the caregiver progressively escalate in a non-linear fashion from the moment of the initial diagnosis until the eventual demise of the patients¹⁹. Patients who get treatment may also be impacted by the responsibilities and obligations of their family. Research has indicated that family responsibilities are linked to a dearth of social assistance and diminished quality of life in terms of health for both patients and their families²³. The occurrence of disturbances in the quality of life and the obligations placed on families encountered by hemodialysis patients creates a dual burden on them and obstructs the treatment process²⁴. In essence, this can reduce the ability of families to administer hemodialysis treatment for those suffering from chronic renal illness. Family caregivers bear the responsibility of providing comprehensive care that encompasses several dimensions of well-being, such as physical, psychological, social, and spiritual components²⁵.

The sixth aspect of family caregiver reactions revolved around societal constraints. This encompassed aspects of social adaptation (including opportunities and risks in relationships, advocacy, family functioning, and personal connections), the duty to provide care, fostering a stronger bond, and assuming the role of a caregiver (unexpected obligations and disturbances in sleep patterns)^{20,28}. Patients and their family caregivers may feel socially isolated. Family caregivers perceive family members with illnesses as actively choosing to isolate themselves socially, deliberately declining offers from peers to socialize. Patients and family caregivers articulate their requirements for assistance and additional resources¹⁵. Effective holistic care enables caregivers to support daily living by alleviating the responsibilities of caregiving and mitigating emotions of loneliness and

limited personal autonomy¹⁶. Nurses can also engage in collaboration with family carers of individuals suffering from chronic kidney disease (CKD) to organize psycho-educational support groups. These support groups offer specialized information and assistance to family caregivers of individuals with certain diseases²⁰.

The final issue explored was psychological disorder. Caregivers of patients undergoing hemodialysis face a heightened susceptibility to emotional and psychological challenges, diminished quality of life, and amplified responsibilities. Due to the extended duration of therapies, they experience a range of psychosocial issues. Typically, they encounter heightened work demands, restricted personal and social engagements, and financial difficulties. Additionally, they endure fatigue. Feelings experienced by individuals may include rage, melancholy, helplessness, guilt, loneliness, lack of independence, fear, vulnerability, and disrespect for their health. Access to intervention and support information is crucial for caregivers, as it can enhance their quality of life and their capacity to successfully manage the care of their patients. Effective caregiving for hemodialysis patients necessitates caregivers possessing adequate knowledge, specialized skills, education, and supervision in order to facilitate improved adherence to treatment protocols¹³.

A significant number of individuals suffering from renal disease experience considerable unaddressed requirements for palliative care, encompassing both physical and mental symptoms¹³. The palliative approach to dialysis care is shifting from a traditional focus on dialysis as a form of rehabilitation care to an approach that emphasizes both patient comfort and their individual preferences and treatment goals. This change aims to enhance the overall well-being and mitigate symptoms for end-stage dialysis patients. Palliative care can be administered to patients of all ages and stages who are suffering from serious illnesses, and it is not just restricted to persons who have opted to discontinue treatment²⁶. In order to achieve this objective, the incorporation of palliative care into the protocols of nephrological treatment at an early stage could enhance the capacity to make informed decisions, plan To ensure proper

care after therapy and offer support to individuals suffering from advanced chronic kidney disease (CKD) and their families in the terminal phase of their lives²⁷.

Presently, there is a deficiency in the availability of renal palliative care²⁵. Palliative care for renal (kidney) patients is an expanding field within the realm in the field of nephrology. Renal palliative care is a specialized approach that aims to alleviate the physical and emotional difficulties associated with severe kidney disease. It aims to enhance the well-being of patients and their families by managing symptoms, offering support to caregivers, and developing plans for ongoing care. Integrating palliative care is essential for addressing the complex impacts of advanced renal illness on patients. Individuals suffering from advanced renal disease receive superior medical treatment and experience a more positive end-of-life journey in comparison to those with other severe chronic illnesses¹.

Limitations of the studies in this review

The papers included in this systematic review each have their limitations. Weaknesses in the study may encompass factors such as research methodologies, sample size, screening instruments, and other related issues.

CONCLUSIONS

Based on a review of 10 articles, the research results show that family members have different responses in caring for CKD sufferers. Acceptance of known kidney disease indicates a solid effort to address it. The family will also continue to fight to get the best treatment for the patient's recovery. The family will continue to feel tired in caring for the patient. People with kidney failure need to undergo weekly dialysis therapy. Families feel physically exhausted from providing direct treatment to patients at home and in the hospital. The family and patient can also decide to continue the patient's therapy program. The family will look for the correct information to determine the therapy to be given. Input from healthcare providers regarding dialysis services, procedural procedures, side effects, and other vital facts will be sought to help the patient recover. Families need emotional support from the

surrounding environment. Psychological responses will increase along with the lack of family acceptance of the condition of the patient being treated.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest

REFERENCES

1. Kokorelias KM, Gignac MAM, Naglie G, Cameron JL. Towards a universal model of family-centered care: A scoping review. *BMC Health Serv Res*. 2019;19(1). <https://doi.org/10.1186/s12913-019-4394-5>
2. Gerogianni G, Polikandrioti M, Babatsikou F, et al. Anxiety–depression of dialysis patients and their caregivers. *Medicina (Lithuania)*. 2019;55(5). <https://doi.org/10.3390/medicina55050168>
3. Sherman DW. A review of the complex role of family caregivers as health team members and second-order patients. *Healthcare (Switzerland)*. 2019;7(2). <https://doi.org/10.3390/healthcare7020063>
4. Ebadi A, Sajadi SA, Moradian ST, Akbari R. Suspended Life Pattern: A Qualitative Study on Personal Life Among Family Caregivers of Hemodialysis Patients in Iran. *Int Q Community Health Educ*. 2018;38(4):225-232. <https://doi.org/10.1177/0272684X18773763>
5. Baghcheghi N, Koohestani HR. Designing and psychometric properties of coping strategies scale for family caregivers of hemodialysis patients. *Acta Facultatis Medicae Naissensis*. 2021;38(3):257-269. <https://doi.org/10.5937/afmnai38-29501>
6. Abed MA, Khalifeh AH, Khalil AA, Darawad MW, Moser DK. Functional health literacy and caregiving burden

- among family caregivers of patients with end-stage renal disease. *Res Nurs Health*. 2020;43(5):529-537. <https://doi.org/10.1002/nur.22060>
7. Alnazly E. Predictors of the burden on family carers of patients on hemodialysis in Jordan. *Eastern Mediterranean Health Journal*. 2020;26(5):565-572. <https://doi.org/10.26719/emoji.19.097>
 8. Mahmoudian A, Chafjiri RT, Alipour A, Shamsalinia A, Ghaffari F. The design and evaluation of psychometric properties for a questionnaire on elderly abuse by family caregivers among older adults on hemodialysis. *Clin Interv Aging*. 2018;13:555-563. <https://doi.org/10.2147/CIA.S149338>
 9. Surendran P, Venugopal V, Dongre A, Paninjukunnath R. Perceived challenges faced by family caregivers of chronic kidney disease patients and suggested solutions: A qualitative study. *Int J Med Sci Public Health*. Published online 2018;1. <https://doi.org/10.5455/ijmsph.2018.0307819032018>
 10. Abebe A, Arba A, Paulos K, et al. The Lived Experience of Primary Family Caregivers of Patients on Hemodialysis Treatment in Southern Ethiopia: A Phenomenological Study. *Int J Nephrol Renovasc Dis*. 2022;15:41-52. <https://doi.org/10.2147/IJNRD.S353191>
 11. Wightman A, Zimmerman CT, Neul S, Lepere K, Cedars K, Opel D. Caregiver Experience in Pediatric Dialysis. *Pediatrics*. 2019;143(2). <https://doi.org/10.1542/peds.2018-2102>
 12. Sellars M, Clayton JM, Morton RL, et al. An Interview Study of Patient and Caregiver Perspectives on Advance Care Planning in ESRD. *American Journal of Kidney Diseases*. 2018;71(2):216-224. <https://doi.org/10.1053/j.ajkd.2017.07.021>
 13. Oyegbile YO, Brysiewicz P. Family caregiver's experiences of providing care to patients with End-Stage Renal Disease in South-West Nigeria. *Journal of Clinical Nursing*. 2017;26(17-18):2624-2632. doi:10.1111/jocn.13689
 14. Maddalena V, O'Shea F, Barrett B. An Exploration of Palliative Care Needs of People With End-stage Renal Disease on Dialysis: Family Caregiver's Perspectives. *Journal of palliative care*. 2018;33(1):19-25. <https://doi.org/10.1177/0825859717747340>
 15. Karlin J, Chesla CA, Grubbs V. Dialysis or Death: A Qualitative Study of Older Patients' and Their Families' Understanding of Kidney Failure Treatment Options in a US Public Hospital Setting. *Kidney medicine*. 2019;1(3):124-130. <https://doi.org/10.1016/j.xkme.2019.04.003>
 16. Han E, Haldane V, Koh JJK, et al. Perspectives on decision making amongst older people with end-stage renal disease and caregivers in Singapore: A qualitative study. *Health expectations : an international journal of public participation in health care and health policy*. 2019;22(5):1100-1110. <https://doi.org/10.1111/hex.12943>
 17. Fox DE, Quinn RR, James MT, Venturato L, King-Shier KM. Social Support in the Peritoneal Dialysis Experience: A Qualitative Descriptive Study. *Canadian Journal of Kidney Health and Disease*. 2020;7. <https://doi.org/10.1177/2054358120946572>
 18. Eslami A, Rabiei L, Shirani M, Masoudi R. Dedication in caring of hemodialysis patients: Perspectives and experiences of Iranian family caregivers. *Indian Journal of Palliative Care*. 2018;24(4):486-490. https://doi.org/10.4103/IJPC.IJPC_204_17
 19. DePasquale N, Cabacungan A, Ephraim PL, Lewis-Boyér L, Powe NR, Boulware LE. Family Members' Experiences With Dialysis and Kidney Transplantation. *Kidney Medicine*. 2019;1(4):171-179. <https://doi.org/10.1016/j.xkme.2019.06.001>
 20. Rabiei L, Eslami AA, Abedi HA, Masoudi R, Sharifirad GR. Caring in an atmosphere of uncertainty: perspectives

- and experiences of caregivers of peoples undergoing hemodialysis in Iran. *Scandinavian journal of caring sciences*. 2016;30(3):594-601. <https://doi.org/10.1111/scs.12283>
21. Bansal AD, O'Connor NR, Casarett DJ. Perceptions of hospitalized patients and their surrogate decision-makers on dialysis initiation: A pilot study. *BMC Nephrol*. 2018;19(1). <https://doi.org/10.1186/s12882-018-0987-1>
 22. Salehi-tali S, Ahmadi F, Zarea K, Fereidooni-Moghadam M. Commitment to care: the most important coping strategies among family caregivers of hemodialysis patients. *Scand J Caring Sci*. 2018;32(1):82-91. <https://doi.org/10.1111/scs.12432>
 23. Grubbs V, Moss AH, Cohen LM, et al. A palliative approach to dialysis care: A patient-centered transition to the end of life. *Clinical Journal of the American Society of Nephrology*. 2014;9(12):2203-2209. <https://doi.org/10.2215/CJN.00650114>
 24. Morris SM, King C, Turner M, Payne S. Family carers providing Support to a person dying in the home setting: A narrative literature review. *Palliat Med*. 2015;29(6):487-495. <https://doi.org/10.1177/0269216314565706>
 25. Hoang VL, Green T, Bonner A. Informal caregivers' experiences caring for people receiving dialysis: A mixed-methods systematic review. *J Ren Care*. 2018;44(2):82-95. <https://doi.org/10.1111/jorc.12235>
 26. Jafari H, Ebrahimi A, Aghaei A, Khatony A. The relationship between care burden and quality of life in caregivers of hemodialysis patients. *BMC Nephrol*. 2018;19(1). <https://doi.org/10.1186/s12882-018-1120-1>
 27. Eirini G, Georgia G. Caregivers of Patients on Haemodialysis. In: *Caregiving and Home Care*. InTech; 2018. <https://doi.org/10.5772/intechopen.72400>

Original Article

Difference in Knowledge regarding Reproductive Health and HIV/AIDS between Students in Natural Sciences Major and Social Sciences Major

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ABSTRACT

Knowledge regarding HIV/AIDS in Papua among adolescents is still very limited, while there is a 3% HIV prevalence among adolescents. This study aims to determine the difference in knowledge regarding reproductive health and HIV/AIDS between students in Natural Sciences major and Social Sciences major at urban and rural senior high schools in Papua Province. This was a cross-sectional study. The Slovin formula was applied for sample calculation to obtained a total sample of 159 students in Natural Science and Social Sciences majors at SMA Negeri 4 of Jayapura City and SMA Negeri 1 of Keerom District in Papua Province. The study samples were selected using a purposive sampling technique. Statistical tests in this study applied the Mann-Whitney test. The results of the study showed that there was a difference in the level of knowledge regarding HIV/AIDS between students in the Natural Sciences major and Social Sciences major at urban and rural senior high schools ($p=0.003$). It can be concluded that the level of knowledge of students in natural Sciences majors was higher than that of students in natural Sciences majors at urban and rural senior high schools. Students in Natural Sciences major had a more positive attitude towards HIV/AIDS prevention than students in Social Sciences major studies at urban and rural senior high schools. It is expected that further researchers can develop research variables and research subjects as well as research methods to explore the topic related to the incidence of HIV/AIDS among adolescents.

Keywords: HIV/AIDS, Knowledge, Attitude, Adolescents.

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INTRODUCTION

Papua often experiences complex health problems. An infectious disease that is still a concern is HIV/AIDS. The cumulative number of HIV infection cases reported as of June 2016 placed Papua in the top ten provinces with the most cases by 22,426 cases. As for AIDS cases, Papua was one of the provinces that reported the most AIDS cases from 1987 to June 2016, namely 13.335 cases. Meanwhile,

the highest incidence of AIDS cases or AIDS Case Rate per 100,000 populations in Papua was 416.9 cases per 100,000 population¹.

A study conducted by Asti (2019) showed that most of students at urban and rural senior high schools had a low level of knowledge regarding HIV/AIDS by 55.2%, followed by the moderate category by 24.7%, and the high category by 20.1%. Furthermore,

most of students at urban senior high schools had a moderate level of knowledge, while most of students at rural senior high schools had a high level of knowledge². The level of knowledge, attitudes, and self-motivation had an effect on HIV/AIDS preventive behavior among students at urban senior high schools in Sragen District³.

HIV prevalence among students aged 15-24 in Papua is 3%. The main cause of the HIV epidemic in Papua is unsafe sexual intercourse. In addition, it is due to the low level of education and knowledge regarding HIV. According to UNICEF (United Nations International Children's Emergency Fund), knowledge regarding HIV has increased but is still limited⁴. The 2010 RISKESDAS survey showed that 42% of the population aged 15 years and over had never heard of HIV/AIDs⁵.

WHO declared AIDS as a global problem. The dominant AIDS transmission in Indonesia is currently related to sexual behavior⁴. In 2015, AIDS-related deaths reached 110,000 among children in the age group of <15 years. In 2016, there were 1,872 AIDS sufferers in Indonesia, including school-aged children and university students⁶. According to data derived from the Indonesian Child Protection Commission (KPAI) it is known that as many as 32% of students aged 14 to 18 years in big cities in Indonesia (Jakarta, Surabaya and Bandung) have had premarital sex. Furthermore, it was proven that 62.7% of students had lost their virginity while still studied in junior high school⁷.

Most cases of HIV infection occur in productive age of 25-49 years, followed by 20-14 years and 15-19 years. According to UNICEF, the number of deaths due to AIDS among students around the world increased by 50% in 2005 – 2012 and it shows an alarming trend. Around 71,000 students aged 10-19 years died due to AIDS in 2005 which increased to 110,000 in 2012. Among new HIV cases in 2011, 18% of them were children in the age group of 15-24 years⁴.

Intervention of counseling on student reproductive health was found to be effective to increase the knowledge and attitudes of students both in the Natural Sciences and Social Sciences groups and there was no significant

difference in the mean score of knowledge and attitudes between the two groups of students. In addition, there was a difference in knowledge regarding reproductive health between students in the Natural Sciences and Social Sciences groups and there was no difference in attitudes towards premarital sexual intercourse between the two groups of students at SMAN 1 of Temanggung. Moreover, there was no correlation between knowledge regarding reproductive health and attitudes towards premarital sexual intercourse among the two groups of students at SMAN 1 of Temanggung⁹.

Furthermore, based on the results of other study, there was a difference in knowledge regarding reproductive health between students in Natural Sciences major and Social Sciences major. In contrast, there was no significant difference in attitude des between the two groups of students and there was no correlation between knowledge and attitudes of students regarding reproductive health¹⁰.

Based on the explanation above, it can be known that HIV/AIDS is a threat to students with low knowledge and attitudes about HIV/AIDS. In addition, HIV transmission is caused by a lack of knowledge. This study aims to determine the difference in knowledge regarding reproductive health and HIV/AIDS between students in natural Sciences major and Social Sciences major at urban and rural senior high schools in Papua Province.

METHOD

This was a cross sectional study. The current study was conducted in June 2020 with a population of students in natural science and social Sciences major s at SMA Negeri 4 of Jayapura City and SMA Negeri 1 of Keerom District. It was obtained a total sample of 159 who were selected using a purposive sampling technique. Data were collected by distributing questionnaires to students in natural science and social Sciences major s at SMA Negeri 4 of Jayapura City and SMA Negeri 1 of Keerom District. Data were analyzed using the Mann Whitney test.

RESULTS

Table 1. Distribution Characteristics of Students in Natural Science and Social Sciences majors at Urban and Rural Senior High Schools.

Characteristic	Natural Sciences n (%)	Social Sciences n (%)	Total n (%)
Age (years)			
14 -17	103 (97.2)	49 (46.2)	187 (100.0)
18 -19	3 (2.8)	4 (3.8)	7 (100.0)
Gender			
Male	39 (66.1)	20 (33.9)	59 (100.0)
Female	67 (67.0)	33 (33.0)	100(100.0)
Grade			
X	16 (34.7)	30 (65.2)	46 (100.0)
XI	17 (73.9)	6 (26.)	23 (100.0)
XII	73 (81.1)	17 (18.9)	90 (100.0)
Location			
Urban	41 (50.6)	40 (49.4)	81 (100.0)
Rural	65 (83.4)	13 (16.7)	78 (100.0)
Total	106 (66.7)	53 (33.3)	100 (100.0)

Table 1 showed that most of respondents in the Natural Sciences major and in the Social Sciences major were at the age of 17 years (82.89) and 15 years (62.50), respectively. Based on gender, there were more

female respondents, both in Natural Sciences majors (67.00%) and Social Sciences major (33.00%). Furthermore, there were more students in Natural Sciences major, both in urban and rural areas.

Table 2. Distribution of Information Sources regarding HIV/AIDs.

Characteristic	Natural Sciences n (%)	Social Sciences n (%)	Total n (%)
Teachers	77 (72,6)	29 (27,4)	106 (100.0)
Parents	47 (68,1)	22 (31,9)	69 (100.0)
Healthcare Workers	74 (73,3)	27 (26,7)	101 (100.0)
Friends	30 (76,9)	9 (23,1)	39 (100.0)
Newspaper	18 (85,7)	3 (14,3)	21 (100.0)
Magazine	6 (66,7)	3 (33,3)	9 (100.0)
Television	0 (0,0)	1 (100.0)	1 (100.0)
Radio	3 (50,0)	3 (50,0)	6 (100.0)
Internet	78 (75,5)	25 (24,3)	103 (100.0)

Table 2 revealed that based on the Source of Information regarding HIV/AIDS, students in Natural Sciences major in urban and rural areas got a lot of information from the Internet (75.58%), teachers (72.64%), and healthcare

workers (73.27 %). Meanwhile, students in Social Sciences major in urban and rural areas got a lot of information regarding HIV/AIDS from teachers (27.36%), the Internet (42.8%), and healthcare workers (26.73%).

Table 3. Bivariate Analysis Using Mann Whitney Test on the Difference in the Level of Knowledge regarding HIV/AIDS among Students at Urban and Rural Senior High Schools.

Level of Knowledge	Natural Sciences n (%)	Social Sciences n (%)	Total n (%)	p-value
High	16 (84.2)	3 (15.8)	19 (100.0)	0.003
Moderate	82 (71.9)	32 (28.1)	114 (100.0)	
Low	8 (39.77)	18 (69.2)	26 (100.0)	
Total	106 (66.7)	53 (33.3)	159 (100.0)	

Table 3 shows the results of bivariate analysis to determine the difference in the level of knowledge and attitudes regarding HIV/AIDS between students in natural sciences and social studies majors in urban and rural areas using the Mann Whitney test, since the data were not normally distributed. The result of the analysis for the level of knowledge variable obtained a p-value of (0.003) < 0.05 which meant that there was a difference in the level of knowledge regarding HIV/AIDS between students in Natural Sciences major and Social Sciences major in urban and rural areas. Meanwhile, the result of the analysis for the difference in attitude variable between students in Natural Sciences major and Social Sciences major in urban and rural areas used a paired t test since the data were normally distributed. It was obtained a p value of (0.002) < 0.05 which meant that there was a difference in attitude between students in Natural Sciences major and Social Sciences major in urban and rural areas.

DISCUSSION

According to the National Family Planning Coordinating Board (BKKBN), adolescence begins at the age of 10 years and ends at the age of 21 years¹. Adolescents belong to an age group that is vulnerable to exposure to HIV/AIDS. Based on the Ministry of Health in 2016, most cases of HIV infection occur in productive age of 25-49 years, followed by 20-14 years and 15-19 years¹. According to UNICEF, the number of deaths due to AIDS among students around the world increased by 50% in 2005 – 2012⁴.

Based on gender, most of the respondents in this study were female students, both in Natural Sciences majors and Social Sciences major in rural and urban areas. Furthermore, there were more students in Natural Sciences major, both in urban and rural areas. A study conducted by Cahyani, et al (2019) it was also found that distribution of respondents' characteristic by gender was dominated by female students by 57%, compared to male students by 42%¹¹.

The result of this study indicated that the Source of Information regarding HIV/AIDS, students in Natural Sciences and Social Sciences majors, both in urban and rural areas, was dominated by teachers and the Internet media. Such finding is in line with the

result of a previous study which found that the majority of sources of information regarding HIV/AIDS came from the media (47.7%)¹². A study conducted by Rahma (2018) showed that 64.3% of respondents had a low level of knowledge regarding sexuality¹³. Furthermore, it was found that the majority of students obtained information regarding sexuality from friends with a percentage of 38.6%. There was a significant correlation between knowledge regarding sexuality and sexual behavior. The results of a study conducted by Suminat, et al (2012) further showed that there was a correlation between sexual behavior in dating among adolescents and information sources from parents and peers. In contrast, there was no correlation between sexual behavior in dating among adolescents and information sources from media and teachers¹⁴.

Based on the results of this study, it was found that most of students in Natural Sciences major in rural and urban areas had a high level of knowledge regarding HIV/AIDS, while students in Social Sciences major in rural and urban areas had a low level of knowledge regarding HIV/AIDS. There was a difference in the level of knowledge regarding HIV/AIDS between students in natural Sciences major and Social Sciences major at urban and rural senior high schools. The level of knowledge was found to be higher among students in Natural Sciences major compared to students in Social Sciences major. The results of similar studies showed that most of respondents had a moderate level of knowledge regarding HIV/AIDS by 66.1%, the majority of information sources were from electronic media by 49.2%. Furthermore, most of respondents had a positive behavior towards HIV/AIDS prevention by 52.5%, the level of knowledge and attitudes of respondents were significant factors related to HIV/AIDS preventive behavior, and attitude was the most significant factor for students' behavior towards HIV/AIDS prevention¹⁵. The study finding is also in line with the study conducted by Wulandari (2019) which revealed that there was a significant difference in the level of knowledge and attitudes between before and after health education about HIV/AIDS among the students at Parongpong State SHS in Cihanjuang village¹⁶.

Based on a study conducted by Mentari, et al (2015), it was found that there was a significant difference in the level of knowledge regarding reproductive health between students

in natural Sciences major and Social Sciences major. Most of students in Natural Sciences major had a high level of knowledge regarding reproductive health, while most of students in Social Sciences major had a moderate level of knowledge¹⁰. Based on the result of a study conducted by Isnaini (2017), most of students at Gadjah Mada SHS of Bandar Lampung had a poor level of knowledge regarding HIV/AIDS by 49.5%, while the percentage in the good category was only 20%⁷. The results of a similar study showed that there was a significant difference in the level of knowledge regarding sexuality between students in rural and urban areas¹⁸.

A study conducted by Wiriyana, et al (2017) further showed that there were significant differences in the level of knowledge, attitudes and actions regarding HIV/AIDS prevention among members and non-members of the AIDS and Drug Concern Student Group (KSPAN)¹⁹. The level of knowledge, attitudes and actions of KSPAN members were better compared to non-members of KSPAN¹⁹. Moreover, a study conducted by Situmeang, et al (2017) showed that lack of knowledge regarding HIV/AIDS was related to negative stigma towards PLHIV²⁰.

Bivariate analysis on the level of knowledge regarding HIV/AIDS showed that there was a difference in the level of knowledge regarding HIV/AIDS between students in natural Sciences major and Social Sciences major at urban and rural senior high schools. Such finding is in line with the result of similar study which showed that there was a significant correlation between the provision of health education and changes in attitudes towards HIV/AIDS among high school students²¹. According to Lawrence Green and Marshall Kreuter in Sciavato (2007) a person's knowledge is one of the predisposing factors to changes in his or her behavior. High level of knowledge is expected to encourage a positive attitude about HIV/AIDS. Researchers realize that there were still limitations in this study including less varied research variables.

CONCLUSION

Based on the results of this study, there was a difference in knowledge regarding reproductive health and HIV/AIDS between students in natural Sciences major and social

Sciences major at urban and rural senior high schools in Papua Province. Educational institutions are expected to be able to organize activities for student knowledge improvement such as seminars, talk shows. In addition, further researchers should develop research variables and use other methods to observe the level of knowledge and attitudes of adolescents related to HIV/AIDS.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Departemen Kesehatan Republik Indonesia. Situasi Penyakit HIV AIDS di Indonesia. Jakarta: Departemen Kesehatan Republik Indonesia: 2016.
2. Asti HT, Fatiah M. Implementasi Metode Peer Education Dalam Meningkatkan Pengetahuan dan Sikap Tentang HIV/AIDS Pada Remaja. *Jurnal Pengabdian Masyarakat Al-Irsyad (JPMA)*. 2022 Jul 30;4(1):45-52.
3. Indratmoko W, Bejo Raharjo SK, Setiyadi NA. Pengaruh Pengetahuan, Sikap, Dan Motivasi Diri Terhadap Perilaku Pencegahan HIV/AIDS Pada Siswa-Siswi SMA Perkotaan Di Kabupaten Sragen. (*Skripsi Thesis*, Universitas Muhammadiyah Surakarta): 2013.
4. UNICEF Indonesia. Ringkasan Kajian Respon terhadap HIV & AIDS. Jakarta: UNICEF Indonesia. 2012.
5. Kementerian Kesehatan Republik Indonesia. Hasil Riset Kesehatan Dasar 2010. Kementerian Kesehatan Republik Indonesia: 2010.
6. Kementerian Kesehatan Republik Indonesia. Infodatin 2020. Kementerian Kesehatan Republik Indonesia: 2020. Retrieved from <https://www.kemkes.go.id/downloads/resources/download/pusdatin/infodatin%202020%20HIV.pdf>
7. Komisi Penanggulangan AIDS. Strategi nasional penanggulangan HIV dan AIDS, 2007-2010 : lampiran surat keputusan Menteri Koordinator Bidang Kesejahteraan Rakyat/Ketua Komisi Penanggulangan AIDS Nasional nomor 07/Kep/Menko/Kesra/III/2007. Jakarta:

- Komisi Penanggulangan AIDS: 2007. Retrieved from <https://catalogue.nla.gov.au/Record/4582110>
8. Udu WSA, Wiradirani PYW. Pengaruh Intervensi Penyuluhan Terhadap Pengetahuan Dan Sikap Remaja Tentang Kesehatan Reproduksi. *Medula: Jurnal Ilmiah Fakultas Kedokteran Universitas Halu Oleo*; 2014; 1(2), 71-5.
9. Mentari DD, Sahir E, Iryawan A. Comparison of Reproductive Health Knowledge and Attitude towards Premarital Sexual Intercourse between Natural Sciences and Social Sciences Students of SMAN 1 Temanggung. *Nexus Kedokteran Komunitas*. 2015;4(2) 16-27.
10. Mentari DD. Perbedaan Pengetahuan Kesehatan Reproduksi dan Sikap Hubungan Seksual Pranikah Siswa IPA Dan IPS SMAN 1 Temanggung dalam Bina Tegar Remaja. *UNS*: 2015.
11. Cahyani AN, Yunus M, Ariwinanti D. Pengaruh penyuluhan kesehatan reproduksi terhadap tingkat pengetahuan dan sikap remaja tentang hubungan seksual pranikah. *Sport Science and Health*. 2019 Nov 28;1(2):92-101.
12. Tiranda M, Setiyawati N, Rahmawati A. Adolescents' Attitude toward HIV/AIDS Prevention in Yogyakarta. *Kesmas: Jurnal Kesehatan Masyarakat Nasional (National Public Health Journal)*. 2018 Nov 1;13(2):65-9.
13. Rahma M. Hubungan antara pengetahuan seksualitas dengan perilaku seksual remaja di SMA Negeri 1 Subang. *Jurnal Bidan Midwife Journal*. 2018 Mar 7;4(1):17-25.
14. Suminar, R. and Chusnul, M., 2012. Korelasi Sumber Informasi Media dan Lingkungan Pergaulan dengan Perilaku Seksual Remaja dalam Berpacaran (Studi Kasus pada Siswa Kelas XI di Satu SMA Kota Surakarta Tahun 2012). *Jurnal Kesehatan Masyarakat Universitas Diponegoro*, 1(2), p.18767.
15. Nugrahaeni DK, Zaqiya S. The relationship between previous tuberculosis treatment and HIV status with multidrug-resistant tuberculosis. *KEMAS: Jurnal Kesehatan Masyarakat*. 2019 May 21;14(3):347-52.
16. Wulandari IS, Namah I. Penyuluhan Kesehatan Tentang HIV/AIDS Terhadap Pengetahuan Dan Sikap Pada Siswa Sma Negeri Parongpong Desa Cihanjuang Kecamatan Bandung Barat. *Jurnal Skolastik Keperawatan*. 2019 Jun 11;5(1):56-62.
17. Isnaini N. Pengetahuan Siswa SLTA Tentang HIV/AIDS di Sekolah Menengah Tingkat Atas (SMA) Gajah Mada Bandar Lampung Tahun 2017. *Holistik Jurnal Kesehatan*. 2017;11(4):223-8.
18. Kusumastuti UN. Perbedaan Pengetahuan Seksual Remaja Putri Yang Tinggal Di Desa Dan Kota. *Developmental and Clinical Psychology*. 2012;1(1), 63-68.
19. Wiryana IG, Hanim D, Lestari A. Knowledge, Attitudes, and Practice of HIV/AIDS Members and Nonmembers Kelompok Siswa Peduli AIDS dan Narkoba. *Nexus Kedokteran Komunitas*. 2017;6(2).
20. Situmeang B, Syarif S, Mahkota R. Hubungan pengetahuan HIV/AIDS dengan stigma terhadap orang dengan HIV/AIDS di kalangan remaja 15-19 tahun di Indonesia (analisis data SDKI tahun 2012). *Jurnal Epidemiologi Kesehatan Indonesia*. 2017 Oct 10;1(2).
21. Tarigan P, Wulandari IS. Perubahan Sikap Siswa Sman 1 Parongpong Terhadap HIV/AIDS Setelah Dilakukan Pendidikan Kesehatan. *Malahayati Nursing Journal*. 2020 Mar 10;2(2):317-25.

Original Article

Relationship Between Age, Gender, and Marital Status with The Intention to Disclose HIV Status Among PLHIV

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ABSTRACT

Globally, Human Immunodeficiency Virus (HIV) remains a public health problem. The World Health Organization (WHO) reports 39.0 million (33.1-45.7 million) people living with HIV by the end of 2022, with two-thirds (25.6 million) in the African region. Based on national data in 2022, West Java has the 3rd highest number of HIV cases based on data and reporting from 2010-2022, which amounted to 52,970 cases, so it is necessary to disclose the status to the closest people to prevent transmission. HIV-positive status disclosure is the decision of PLWHA to disclose personal information about their disease and transmit it to others. This study aims to determine the relationship between age, gender, and marital status in disclosing HIV status in PLWHA. This study is a quantitative research, analytic research design with a cross-sectional design conducted on 74 PLWHA in Sumedang Regency Hospital. Data were analyzed using the chi-square test and Fisher's exact test. The results of bivariate analysis showed age $P=0.033$ and OR 2.739 (CI 95% 1.184-6.337), gender $P=0.002$ and OR 5.091 (CI 95% 1.712-15.139), single marital status $P=0.004$ and OR 4.4381 (CI 95% 1.628-12.099). (CI 95% 1.628-12.099) so that it is known that the variable most associated with disclosure of HIV-positive status in PLWHA at Sumedang District Hospital and the most associated with disclosure of HIV-positive status.

Keywords: PLHIV, Age, Gender, Marital Status, Intention to Disclose HIV-Positive Status.

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INTRODUCTION

Globally, Human Immunodeficiency Virus (HIV) remains a public health problem. The World Health Organization (WHO) reports 39.0 million (33.1-45.7 million) people living with HIV by the end of 2022, with two-thirds of them (25.6 million) in the African region¹. The United Nations Program on HIV and AIDS (UNAIDS) reported 1.3 million (1-1.7 million) new cases of HIV infection, the lowest number in recent decades².

Along with the national problem, HIV cases in West Java are also a major problem.

Specifically, in data in West Java in 2021, the number of HIV cases was 4,531 cases or an increase of 2.94%, the average number of cases per year was 4,488.67 in the last 3 years³. Based on national data in 2022, West Java has the third highest number of HIV cases based on data and reporting from 2010-2022, which amounted to 52,970 cases⁴.

disclosing one's HIV-positive status, or revealing one's HIV-positive diagnosis to others is a complex and multifaceted issue that is influenced by various factors. The disease process that develops without symptoms over a long period of time (window period) which can even reach ten years is one of the reasons why

HIV patients do not disclose their disease status. Disclosure of HIV positive status is the decision of PLWHA to disclose their personal information about the disease that is likely to be transmitted and transmitted to others but disclosure of HIV positive status is not an easy thing to do by PLWHA. Based on the results of previous studies, the level of intention to disclose HIV-positive status among PLHIV is still around 22%, -58%^{5,6,7,8}.

In Indonesia, the disclosure rate of HIV patients to their partners ranges from 16.7% to 78.2%^{9,10}. various individual and environmental factors have been identified to be associated with HIV disclosure intentions. Although there have been many studies that have uncovered various factors that influence HIV disclosure, there are limited studies that identify PLHIV's decision to disclose their HIV-positive status,

especially in the West Java population. Therefore, this study aimed to analyze the association between age, gender, and marital status with disclosure intention among PLHIV.

METHODS

This study is a quantitative study with an analytic research design with a cross-sectional design. Cross sectional research is research to study the dynamics of correlation⁽¹¹⁾ This study will be conducted at Sumedang Regional Hospital, West Java Province in October-December 2023. The population in this study were 130 HIV patients who had not disclosed their positive HIV status to their closest people and the sample size in this study was 74 PLWHA using convenience sampling technique.

RESULTS

Table 1. Intention to Disclose HIV Status and Characteristics of PLHIV

Characteristics	Intention Revealing HIV positive status				Total	
	No		Yes			
	n	%	n	%	n	%
Total	53	71.6	21	28.4	74	100
Age (mean, SD)	29.4	9.01	37.2	11.8		
1 8 -25 years	21	84.0	4	16.0	25	33.8
26- 4 5 years	28	71.8	11	28.2	39	52.7
4 6- 6 5 years	4	40.0	6	60.0	10	13.5
Gender						
Man	42	82.4	9	17.6	51	68.9
Woman	11	47.8	12	52.2	23	31.1
Marital status						
Not married yet	36	83.7	7	16.3	43	58.1
Marry	17	58.6	12	41.4	29	39.2
Widow widower	0	0	2	100	2	2.7
Education						
No School	0	0	0	0	0	0
Elementary School	0	0	1	100	1	1.4
Junior High School	3	83.3	3	16.7	6	8.1
Senior High School	48	52.4	15	47.6	63	85.1
Higher Education	2	50%	2	50%	4	5.4
Type of work						
Not yet/Not working	3	75.0	1	25.0	4	5.4
Housewife	1	33.3	2	66.7	3	4.1
Self - employed	39	79.6	10	20.4	49	66.2
TNI/Police /PNS	1	100	0	0	1	1.4
Other	9	52.9	8	47.1	17	23.0
Income						
Do not have	2	50.0	2	50.0	4	5.4
Below UMR	31	75.6	10	24.4	41	55.4
Above UMR	20	69.0	9	31.0	29	39.2

Length of HIV Suffering						
1-5 Years	52	74.3	18	25.7	70	94.6
6-10 Years	1	25.0	3	75.0	4	5.4
Clinical Stage						
Stage I	26	68.4	12	31.6	38	51.4
Stage II	6	100	0	0	6	8.1
Stage III	19	73.1	7	26.9	26	35.1
Stage IV	2	50.0	2	50.0	4	5.4
Source transmission						
Heterosexual	14	58.3	10	41.7	24	32.4
Homosexual	26	83.9	5	16.1	31	41.9
IDUS/ IDU	5	83.3	1	16.7	6	8.1
Maternal	0	0	1	100	1	1.4
Tattoos/Needles	0	0	1	100	1	1.4
Not identified	8	72.7	3	27.3	11	14.9

Table 1 explains that the study was conducted on 74 people with HIV/AIDS. The results showed that the majority of respondents (68.9%) were male and more than half (52.7%) of respondents were in the age range of 26-45 years with the majority (85.1%) having a high school education. Based on clinical disease characteristics and disease characteristics, almost all respondents (94.6%) had HIV for 1-5 years with more than half (51.4%) clinical stage 1 and almost half of respondents (41.9%) were infected through sexual intercourse.

After analyzing the characteristics of respondents, researchers conducted bivariate analysis using the chi square test and Fisher's exact test and determined the odds ratio (OR) to determine the odds of intention to disclose HIV status.

Table 2. Relationship between Age, Gender and Marital Status with Intention to Disclose HIV Status in PLHIV

Variable	p-value	OR (95% CI)
Age		
18 -25 years	0.033 ^b	2,739
26- 4 5 years		(1,184-6,337)
4 6- 6 5 years		
Gender		
Man	0.002 ^a	5,091
Woman	*	(1,712-15,139)
Marital status		
Not married yet	0.004 ^b	4,438
Marry		(1,628-12,099)
Widow widower		

Table 2 describes the results of bivariate analysis between independent and dependent variables. Only one variable was found to be statistically associated with HIV disclosure intentions: age with $P = 0.033$ and OR 2.739 (95% CI 1.184-6.337),

meaning those aged 26-45 years were more likely to have disclosure intentions among their partners. Gender had a $P = 0.002$ and OR 5.091 (95% CI 1.712-15.139), meaning women were more likely to have the intention to disclose. Status variable has a value of $P = 0.004$ OR 4.4381 (95% CI 1.628-12.099) which means that the marital status of PLHIV who are married has a greater chance of having the intention to disclose HIV status.

DISCUSSION

1. Characteristics of PLHIV and Intention to Disclose Positive HIV Status in PLHIV

This study shows that the characteristics of PLHIV are part of the background of HIV-positive disclosure behaviour. In a previous study, age characteristics, averaged 41.57 years for males and 38.99 years for females, and there were statistically significant differences between males and females in ethnicity, religion, residential status, and family size in terms of education level, occupation, and monthly household income^{11,12}.

The characteristics in this study indicate that the majority of PLWHA are male and more than half of PLWHA are in the age range of 26-45 years with a majority of high school educational background, in the large dictionary of Indonesian language (KBBI) education comes from the basic word didik (educate) which is to maintain and provide training (teaching, leadership) regarding morals and intelligence of the mind¹³. The results of research in Sarawak, educational differences

are a background that can be statistically related to openness intentions¹².

Marital status shows that more people are not married. Research conducted in Nigeria shows that *disclosing HIV positive status* occurs more often between partners or sexual partners than disclosing HIV positive status to relatives/family members, friends, pastors/imams or co-workers/employers¹⁴.

Based on characteristics disease journey clinical and characteristic disease, almost All PLHIV have HIV for 1-5 years with clinical stage more from half are stage 1 as well almost half respondents infected through connection homosexual. Study results before The results of research in Southern Ethiopia identified clinical stages disease is very important For push *disclosing HIV status* and minimizing stigma for encourage living people with HIV for do matter, revealing their status.

Disclosing HIV positive status is influenced by sociodemographics, one of which is path / source infection heterosexual¹⁵. According to other research, non-disclosure of HIV serostatus to sexual partners has a significant relationship with HIV risk behaviour. This is consistent with studies conducted in Jamaica, Cape Town, South Africa and Cameroon where HIV risk behaviour was reported mostly among patients who did not disclose their HIV status to sexual partners. Similar findings were also documented in research conducted in Johannesburg, South Africa. This could be caused by the possibility that PLWHA who do not know their number of sexual partners are not encouraged to use condoms during sexual intercourse¹⁶.

2. Relationship between Age, Gender and Marital Status with Intention to Reveal Positive HIV Status in PLHIV

There is a relationship between age and disclosing HIV positive status full, and partial disclosure of HIV positive status is rare in all age groups, this shows a pattern of early and late disclosure of HIV positive status. Programs disclosing HIV positive status must emphasize the importance of disclosing HIV positive status gradually, starting at a younger age, to maximize benefits¹⁷. Based on the results of another study of 371 participants, the average age was 37 ± 12 years, 79.3%¹².

Age shows that there is a relationship with the intention to disclose HIV positive status. In accordance with several studies which reveal that the majority of individuals who have the intention of disclosing their HIV positive status are adults¹⁸. Disclosing HIV positive status is influenced by the characteristics of the respondent, namely adult age¹⁵ and openness intentions are higher at ages 39-59 years⁶. Research in *the Republic of Congo* revealed that there is a relationship between age and *disclosing HIV positive status*¹⁹. Based on The results of research in Sarawak, analysis showed that among men, the percentage of *disclosing HIV positive status* was 66.7% compared to women (70.2%)¹². Based on the results of research conducted²⁰, *reveal HIV positive status* significantly higher in married participants compared to single people and in PLHIV aged 39-59 years.

There are other reasons why PLHIV do not want to reveal their status, among them the main reasons for not disclosing it include fear of losing their partner, feeling embarrassed about being HIV positive and fear of stigma.

Intention to disclose HIV status based on gender shows that there are differences between the groups of men and women, statistically there is a very significant relationship between gender and intention to disclose HIV positive status. In line with previous research that found statistically significant differences in the intention to disclose HIV status between men and women, the pattern of HIV status disclosure was higher in women compared to men⁷. Another study conducted in Nigeria showed that disclosing HIV positive status was the most influential factor in disclosing HIV positive status was gender¹⁴. Research in the Republic of Congo shows that gender is related to disclosing HIV positive status¹⁹.

Research conducted in Nigeria shows that *disclosing HIV positive status* mostly occurs between partners or sexual partners rather than disclosing HIV positive status to relatives/family members, friends, pastors/imams or co-workers/employers.

The most influential factor in *disclosing HIV positive status* is type. Several studies report *disclosing HIV positive status* as a way to limit stigma. Almost all studies highlight that there is a fear of stigma and social exclusion associated with *disclosing HIV positive status*¹⁴. Intention to disclose HIV positive status based

on marital status differs and has a significant relationship. Based on the results of previous research, respondents who have an official partner or discuss it with their sexual partner before taking an HIV test will be more open about their status to their sexual partner²¹. Other research says it reveals HIV positive status is significantly higher in the married⁶. Other research conducted in Nigeria shows that disclosing HIV positive status HIV positive states most often occurs between couples¹⁴. In another study conducted in China, the proportion of disclosing HIV positive status to sexual partners was lowest among couples without official marriage ties²². Results of other research in Yogyakarta It was found that marital status was related to openness behaviour²¹. However, based on the results of research conducted in the African continent of Ghana, marital status is not a dominant factor in openness²¹. According to research results in Ethiopia, more than a quarter of adults living with HIV did not disclose their HIV-positive status to sexual partners. The percentage of PLWHA who disclose their HIV-positive status to sexual partners is 76.03%²⁴.

Intention to reveal the HIV positive status of respondents from the results of this study during interviews, some respondents said they tended to avoid communication such as disclosing HIV to their partners and considered it very personal information and wanted to protect themselves from embarrassment so they had no intention of disclosing. This research revealed how much Respondents' intention to be open, of the 21 (28.4%) respondents who had the intention to be open, 16 respondents (21.6%) said they had quite the intention to be open, 1 respondent (1.4%) said they intended to reveal their status, 4 (5.4) respondents were very willing and there were 10 (13.5%) said they had no intention and 43 (58.1%) said they had no intention at all during the discussion.

In short interviews, respondents also revealed the time needed to reveal their HIV status, including 15 (20.3%) respondents who said it took 1 year to reveal their HIV status to their partner, 4 (5.4%) respondents said it took 6 months to reveal their HIV status and There were 2 respondents who had just been diagnosed, 2 (2.7%) who wanted to immediately reveal their status within 1 month of the respondent being diagnosed with HIV.

In several research studies conducted in Nigeria, Ethiopia and Indonesia, the level of

status discrepancy was revealed HIV among PLHIV in couples it is still low^{5,8,9} research studies conducted in Kilombero (Tanzania), in Malaysia (Sarawak), it has shown that the level of openness is around 56-58% who reveal test results, their HIV to their partners^{6,7}. The problem of disclosing HIV positive status to a partner is very complex because it is related to the wide impact that will be received by both the individual suffering from HIV and their partner²⁵.

In general, the results of this study conclude that special attention is needed for women aged 18-25 years and 46-65 years, with the majority of PLHIV being male and unmarried, to facilitate their intention to open up, especially to those closest to them (partners). Official/unofficial partner, family or partner sharing needles), disclosing HIV positive status is also influenced by differences in characteristics. Openness regarding HIV status information is very important in preventing transmission to partners or close people. The strategy that can be taken is to optimize partner involvement before carrying out VCT.

CONCLUSIONS

The research results showed that the majority of respondents were men and more than half of the respondents were in the age range of 26-45 years, the majority were single and the majority had a high school educational background. Based on the characteristics of the clinical course and disease characteristics, almost all PLHIV have had HIV for 1-5 years with more than half of the clinical stage being stage 1 and almost half of PLHIV were infected through homosexual relations and the results of this study also prove that there is a relationship between age, gender and status. marriage with the intention of disclosing HIV status.

Implications of this research: Disclosure of HIV status is an important behaviour that has implications for HIV treatment and prevention, the intention to disclose HIV positive status is also something that can support preventing and reducing HIV transmission in the community, with the intention to reveal HIV positive status to sexual partners or partners sharing needles, will allow everyone to take steps to stay healthy. However, the level of intention to disclose HIV positive status is still relatively low. This shows the need

for planning and intervention to help PLHIV carry out their intention to reveal their HIV positive status

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CONFLICTS OF INTEREST

The authors declare no conflict of interest

REFERENCES

1. WHO. *HIV statistics, globally and by WHO region*, 2023. World Health Organization; 2023. Available from: <https://cdn.who.int/media/docs/default-source/hq-hiv-hepatitis-and-stis-library/j0294-who-hiv-epi-factsheet-v7.pdf>
2. UNAIDS. *The Path That Ends AIDS 2023 UNAIDS Global AIDS Update*. UNAIDS; 2023. Retrieved from <https://www.unaids.org/en/resources/documents/2023/global-aids-update-2023>
3. Dinas Kesehatan Jawa Barat. *Jumlah Kasus HIV Berdasarkan Kelompok Umur di Jawa Barat*. Dinas Kesehatan Jawa Barat; 2021. Available from: <https://opendata.jabarprov.go.id/id/data-set/jumlah-kasus-hiv-berdasarkan-kelompok-umur-di-jawa-barat>
4. Kementerian Kesehatan Republik Indonesia. *Laporan Eksekutif Perkembangan HIV AIDS Dan Penyakit Infeksi Menular Seksual (PIMS) Triwulan I Tahun 2023*. Kementerian Kesehatan Republik Indonesia; 2023.
5. Olley BO, & Olaseni AO. Development of a screening instrument for HIV/AIDS Self Disclosure Intention (HIV-SDI-Index). *African Journal for the Psychological Studies of Social Issues*, 2016; 19(3), 1-15.
6. John ME, & Chipwaza B. HIV status disclosure among adults attending care and treatment clinic in Kilombero district, South-Eastern Tanzania. *International Journal of Africa Nursing Sciences*, 2022; 17, 100434.
7. Lemin AS., Rahman MM., & Pangarah, CA. Factors affecting intention to disclose HIV status among adult population in Sarawak, Malaysia. *Journal of environmental and public health*, 2018. 2018.
8. Dessalegn NG., Hailemichael RG., Shewa-Amare A., Sawleshwarkar S., Lodebo B., Amberbir A., & Hillman, RJ. HIV Disclosure: HIV-Positive Status Disclosure To Sexual Partners Among Individuals Receiving HIV Care In Addis Ababa, Ethiopia. *Plos One*. 2019; 14(2), e0211967.
9. Candra IW, Dewi AGIA. Pengungkapan Diri (Self Disclosure) Pada Orang Dengan HIV/AIDS (Odha). *Jurnal Ilmu Dan Teknologi Kesehatan*. 2017;4 (2), 133-145.
10. Pujilestari NI, Daramatasia W, Qodir A. Hubungan Keterbukaan Status HIV Dengan Stigma Diri Pada Orang Dengan HIV/AIDS. *Media Husada Journal Of Nursing Science*. 2020;1.
11. Notoatmodjo S. *Metodologi Penelitian Kesehatan*. Jakarta: PT Rineka Cipta; 2012.
12. Modi RA., McGwin GL., Willig JH., Westfall AO., Griffin R. L., Amico R., ... & Mugavero MJ. Factors Associated With HIV Disclosure Status Among Iengage Cohort Of New To HIV Care Patients. *AIDS Patient Care Stds*. 2020;34(5):213-27.
13. Yatimah D. *Landasan Pendidikan*. Jakarta: CV. Alungadan Mandiri; 2017.
14. Agboola DIA., Evans HD., Hewson, Pappas Y. Factors Influencing HIV Disclosure Among People Living With HIV/AIDS In Nigeria: A Systematic Review Using Narrative Synthesis and Meta-Analysis. *Public Health*. 2016;136:13-28.
15. Yu Y., Qin K., Xiao F., Cai H., Sun, Y., Li J., ... & Wei Z. HIV Disclosure Among Sexually Infected People Living With HIV And AIDS In China: Prevalence, Influencing Factors, And

- Negative Outcomes. *AIDS Behav.* 2023;27(7):2411-29.
16. Damtie Y., Kefale B., Yalew M., Arefaynie M., Adane B., Muche A., ... & Adane M. HIV Risk Behavior And Associated Factors Among People Living With HIV/AIDS In Ethiopia: A Systematic Review And Meta-Analysis. *Plos One.* 2022; 17(7), e0269304.
 17. Atwiine B, Kiwanuka J, Musinguzi N, Atwine D, Haberer Je. Understanding The Role Of Age In HIV Disclosure Rates And Patterns For HIV-Infected Children In Southwestern Uganda. *AIDS Care.* 2015;27(4):424-30.
 18. Yang H, Li X, Stanton B, Fang X, Lin D, Naar-King S. HIV-Related Knowledge, Stigma, And Willingness To Disclose: A Mediation Analysis. *AIDS Care.* 2006;18(7):717-24.
 19. Kitetele FN., Dageid W., Lelo GM., Akele CE., Lelo PV., Nyembo P. L., ... & Kashala-Abotnes E. HIV Disclosure To Infected Children Involving Peers: A New Take On HIV Disclosure In The Democratic Republic Of Congo. *Children (Basel).* 2023;10(7), 1092.
 20. Hallberg D, Kimario Td, Mtuya C, Msuya M, Björling G. Factors Affecting HIV Disclosure Among Partners In Morongo, Tanzania. *International Journal of Africa Nursing Sciences.* 2019;10:49-54.
 21. Rukmi DK. Analisis Faktor Yang Berhubungan Dengan Keterbukaan Status HIV Seropositif Wanita Penderita HIV/AIDS Terhadap Pasangan Seksual Di LSM Victory Yogyakarta. *Media Ilmu Kesehatan.* 2018;7(2):114-22.
 22. Peng W., Song X., Zhang C., Chen Y., Zhou Q., Välimäki MA., & Li X. The Proportion Of HIV Disclosure To Sexual Partners Among People Diagnosed With HIV In China: A Systematic Review And Meta-Analysis. *Frontiers In Public Health.* 2022, 10, 1004869.
 23. Adam A, Fusheini A, Ayanore Ma, Amuna N, Agbozo F, Kugbey N, Et Al. HIV Stigma And Status Disclosure In Three Municipalities In Ghana. *Ann Glob Health.* 2021;87(1):49.
 24. Endalamaw A., Assefa Y., Geremew D., Belete H., Dachew B.A., Belachew A., ... & Wilson R. Disclosure of HIV seropositivity to sexual partner in Ethiopia: A systematic review. *Women's health,* 2021; 17, 17455065211063021.
 25. Sulaiman A, Yona S, Maria R. Keterbukaan Status HIV Dan Penggunaan Kondom Pada Pasangan HIV-Serodiscordant. *Jurnal Penelitian Kesehatan Suara Forikes.* 2021;12(2), 201-204.

Original Article

The Association of HIV and Syphilis among Men Who Have Sex with Men: An Integrated Biological and Behavioral Survey

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ABSTRACT

Increasing rates of syphilis in diverse geographical settings demand that people should have a heightened awareness of syphilis, especially in high-risk patients, including those who are MSM contracting HIV-positive. This study aimed to assess the association of HIV and syphilis among men who have sex with men (MSM) in Depok and Bogor using an Integrated Biological and Behavioral Survey 2018/2019. A cross-sectional study was conducted involving 750 eligible participants. Inclusion criteria: MSM living in study location, aged over 15, and had sexual relations with men at least once in the previous year. A prevalence ratio was obtained through multivariate Cox regression analysis. This study found that 11.3% of subjects were identified as having syphilis, and 20.1% were declared positive for HIV. The final model evidence a PR value of 2.46; 1.59-3.81 with a p-value of 0.00 for the risk of MSM infected with HIV to develop syphilis. Overall, HIV has a statistically significant relationship with the incidence of syphilis after being adjusted by the use of condoms with non-permanent partners and STI screening. Integrated intervention techniques, HIV testing, and enhanced awareness are required to reduce HIV, syphilis, and co-infection; targeting MSM and other vulnerable groups is in urge.

Keywords: HIV, Syphilis, MSM

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INTRODUCTION

Sexually transmitted infections (STIs) have significant implications for sexual and reproductive health, including stigmatization, infertility, cancer, and pregnancy complications, and an increased risk of contracting HIV. The World Health Organization (WHO) estimates that in 2020, there were approximately 374 million new STI cases worldwide, with 156 million cases of Trichomoniasis, 129 million cases of Chlamydia, 82 million cases of Gonorrhea, and 7.1 million cases of syphilis ¹. These infections pose a serious threat to public health and require

effective preventative measures, such as comprehensive sex education, access to STI testing and treatment, and the use of barrier methods during sexual activity. Failure to address this issue could result in significant long-term health consequences for individuals and communities.

Syphilis is caused by the bacterium *Treponema pallidum*, which commonly spreads by direct contact with a syphilitic sore ². It developed to the secondary stage to include symptoms such as skin rashes and mucous membrane lesions. The disease rates are climbing rapidly, especially among gays, bisexuals, and men who have sex with men (MSM) ³⁻⁵. Between 2020 and 2021,

reported primary and secondary cases increased around 29% in the United States, while the majority (36%) of these cases occurred only in MSM and men who have sex with men and women. Notably, the highest cases of syphilis among MSM occur in areas with HIV prevalence of more than 5% and lower-middle-income countries ⁵.

Numerous studies from diverse geographic locations documented that the clinical course of HIV was associated with increasing syphilis cases^{6,7}. A significant increase followed the increase in HIV rates in syphilis infections⁸. Syphilis causes inflammatory genital ulcers and lesions, which can increase the risk of HIV transmission by increasing HIV shedding and acquisition by providing a portal of entry to HIV ⁹.

In Indonesia, the highest HIV prevalence recorded as of September 2022 was among men (71%), while the number of HIV cases in the MSM group reached 27.5% ¹⁰. Also, a previous study confirmed MSM with HIV infection are more likely to develop syphilis with a HR= 4.53; 2.24-9.17 ¹¹. A similar trend was also found in China, where the prevalence of syphilis is relatively high among HIV-positive MSM (14.9%; 12.7–17.2). These figures alert the increasing number of vulnerable groups against STIs, mostly syphilis.

Given the continued risk of syphilis transmission and its close association with HIV infection among MSM, this study addresses the issue using a large Integrated Biological and Behavioral Survey. Few studies have been conducted to determine the prevalence and risk factors of syphilis among MSM in Indonesia; however, a smaller sample size may be the limitation. This study aims to evaluate the prevalence of syphilis and determine the risk factors of syphilis among MSM in Depok and Bogor.

METHOD

A cross-sectional study was designed using a large Integrated Biological and Behavioral Survey (STBP 2018/2019). STBP study participants were 750 individuals identified as MSM living in Bogor and Depok. Men aged over 15 and who had sexual relations with men at least once in the last year were eligible for the study. Study participants completed a structured questionnaire about their sexual and health behaviors over time and

provided biological samples at each study visit. The participants provided written informed consent before enrolling.

The purpose of this research is to examine the correlation between HIV status (as an independent variable) and the occurrence of syphilis in MSM (dependent variable). We also assessed the other associated factors, including age, education, employment, marital status, symptoms, Hepatitis B and Hepatitis C status, number of partners, having a permanent partner, consistency of condom use, circumcision, STI screening, STI treatment, information exposure, gathering behavior, and residence. All data was compiled from STBP, with HIV and syphilis variables specifically being obtained from the rapid test results.

Univariate analysis was used to summarize the descriptive frequency for each variable. Stratification analysis was used to determine confounding variables. Multivariate analyses were used in Cox regression to identify the estimation of HIV against syphilis infections after adjusting confounders. Factors that were determined as confounders (Prevalence ratio discrepancy $\geq 10\%$) in the stratification analysis were considered when computing the final model.

RESULTS

The demographic characteristics of STBP participants at baseline are described in Table 1 below.

Table 1. Participants' Demographic Characteristics

Characteristics	Frequency	%
Age		
≤35	653	87,07
>35	97	12,93
Occupation		
Employed	550	73,33
Unemployed	200	26,67
Marital status		
Not married	659	87,87
Married	60	8,00
Divorced	31	4,13
Education		
High	575	76,67
Low	175	23,33

The overall participants were predominantly aged ≤ 35 years, employed (73.33%), not married (87.87%), and had a higher educational background (76.67%).

The biological examinations (syphilis

status, HIV status, Hepatitis B, and Hepatitis C), and social behavior was displayed on table 2.

Table 2. Distribution of behavioural characteristics, health access, and environment

Variable	Frequency	%
Syphilis		
Positive	85	11,33
Negative	665	88,67
HIV		
Positive	207	27,64
Negative	542	72,36
Syphilis symptoms		
Detected	90	12,00
Undetected	660	88,00
Hepatitis B		
Positive	38	5,07
Negative	712	94,93
Hepatitis C		
Positive	3	0,40
Negative	747	99,60
Number of partners		
>1	232	31,18
0-1	512	68,82
Permanent partner		
Yes	343	45,73
No	407	54,27
Selling sex to men		
Yes	261	34,80
No	489	65,20
Buying sex from men		
Yes	75	10,00
No	675	90,00
Use of condoms		
In a permanent partner		
Consistent	158	21,07
Inconsistent	185	24,67
N/A	407	54,27
Use of condoms in non-permanent couples		
Consistent	136	18,13
Inconsistent	160	21,33
N/A	454	60,53
Use of condoms in transgender couples		
Consistent	7	0,93
Inconsistent	11	1,47
N/A	732	97,60
Circumcision		
Yes	730	97,33

No	20	2,67
STI screening		
Never	591	78,80
Ever	159	21,20
STI treatment		
Never	90	56,60
Ever	69	43,40
Information exposure		
Unexposed	526	70,13
Exposed	224	29,87
Gathering behavior		
Yes	735	98,00
No	15	2,00
Residence		
With family/female partner	476	65,56
With a male friend/partner/transvestite	73	10,06
Alone	177	4,38

The results showed that 11% of the total 750 respondents were identified as having syphilis and 27% were declared HIV positive and based on the history of the symptoms experienced, most admitted that they did not show any symptoms of syphilis. In the results of hepatitis tests, both hepatitis B and C, <5% positive cases were found. From personal confessions, 68% have 0-1 partners, 54% do not have a permanent partner, more than 30% of respondents admit to selling commercial sexual services to men, and only 10% buy services from other men.

The results of assessing the consistency of condom use in different categories of partners show that only 21% consistently use condoms, both in regular and casual partners. Meanwhile, <1% of transgender sexual partners consistently use condoms. Moreover, almost 80% of respondents underwent circumcision. From the results of data collection on screening and treatment history, only around 21% had ever had an STI examination, and 43% had had STI treatment. Only a third of respondents had ever been exposed to information related to syphilis.

In terms of social behaviour, as many as 98% of respondents have the habit of gathering in various public facilities, and most of them admit to living with their family/partner. Woman/wife (65%).

Table 3. The Association of HIV and Syphilis Stratified by Covariates

Covariates	Syphilis (+)				Syphilis (-)				Prevalence Ratio (PR)			Homogeneity test
	HIV (+)		HIV (-)		HIV (+)		HIV (-)		Crude	Adjusted	ΔPR (%)	
	n	%	n	%	n	%	n	%				
Age												
≤35	35	19,13	34	7,25	148	80,87	435	92,75	2,81	2,83	0,71	0,43
>35	9	37,50	7	9,59	15	62,50	66	90,41	(1,98-4,17)	(1,91-4,19)		
Occupation												
Employed	35	20,59	30	7,92	135	79,41	349	92,08	2,81	2,78	1,08	0,49
Unemployed	9	24,32	11	6,75	28	75,68	152	93,25	(1,89-4,17)	(1,87-4,13)		
Marital status												
Not married	38	20,11	39	8,32	151	79,89	430	91,68	2,81	2,75	2,18	0,23
Married	3	27,27	2	4,08	8	72,73	47	95,92	(1,89-4,17)	(1,86-4,07)		
Divorced	3	42,86	0	0,00	4	57,14	24	100				
Education												
High	40	23,12	35	8,73	133	76,88	366	91,27	2,81	2,66	5,6	0,95
Low	4	11,76	6	4,26	30	88,24	135	95,74	(1,89-4,17)	(1,79-3,95)		
Syphilis's symptoms												
Detected	8	22,22	3	5,66	28	77,78	50	94,34	2,81	2,84	1,06	0,58
Undetected	36	21,05	38	7,77	135	78,95	451	92,23	(1,89-4,17)	(1,90-4,24)		
Hepatitis B												
Positive	6	28,57	2	11,76	15	71,43	15	88,24	2,81	2,72	3,31	0,87
Negative	38	20,43	39	7,43	148	79,57	486	92,57	(1,89-4,17)	(1,82-4,05)		
Hepatitis C												
Positive	0	0,00	1	50,00	1	100	1	50,00	2,81	2,80	0,36	0,88
Negative	44	21,36	40	7,41	162	78,64	500	92,59	(1,89-4,17)	(1,89-4,15)		
No. of partners												
>1	11	25,58	10	5,29	32	74,42	179	94,71	2,81	2,68	4,85	0,10
0-1	33	20,25	31	8,91	130	79,75	317	91,09	(1,89-4,17)	(1,81-3,95)		
Permanent partner												
Yes	19	19,39	17	6,97	79	80,61	227	93,03	2,81	2,82	0,36	0,95
No	25	22,94	24	8,05	84	77,06	274	91,95	(1,89-4,17)	(1,90-4,18)		
Selling sex to men												
Yes	15	22,06	15	7,77	53	77,94	178	92,23	2,81	2,81	0,00	0,97
No	29	20,86	26	7,45	110	79,14	323	92,55	(1,89-4,17)	(1,89-4,17)		
Buying sex from men												
Yes	6	35,29	4	6,90	11	64,71	54	93,10	2,81	2,82	0,36	0,28
No	38	20,00	37	7,64	152	80,00	447	92,36	(1,89-4,17)	(1,90-4,17)		

Use of condom in permanent partner												
Consistent	13	20,63	9	9,47	50	79,37	86	90,53	2,81	2,69	4,46	0,80
Inconsistent	6	17,14	8	5,37	29	82,86	141	94,63	(1,89-4,17)	(1,81-3,99)		
N/A	25	22,94	24	8,05	84	77,06	274	91,95				
Use of condom in non-permanent partner												
Consistent	8	21,05	9	9,18	30	78,95	89	90,82	2,81	2,58	8,9*	0,01*
Inconsistent	9	32,14	1	0,76	19	67,86	131	99,24	(1,89-4,17)	(1,76-3,77)		
N/A	27	19,15	31	9,94	114	80,85	281	90,06				
Use of condom in transgender couple												
Consistent	0	0,00	1	20,00	2	100	4	80,00	2,81	2,81	0,00	0,98
Inconsistent	0	0,00	1	11,11	2	100	8	88,89	(1,89-4,17)	(1,89-4,18)		
N/A	44	21,67	39	7,39	159	78,33	489	92,61				
Circumcision												
Yes	44	21,78	40	7,59	158	78,22	487	92,41	2,81	2,81	0,00	0,91
No	0	0,00	1	6,67	5	100	14	93,33	(1,89-4,17)	(1,89-4,16)		
STI screening												
Never	24	17,52	31	6,84	113	82,48	422	93,16	2,81	2,55	10,19*	0,99
Ever	20	28,57	10	11,24	50	71,43	79	88,76	(1,89-4,17)	(1,70-3,83)		
STI treatment												
Never	10	27,78	8	14,81	26	72,22	46	85,19	2,81	2,65	6,04	0,22
Ever	10	29,41	2	5,71	24	70,59	33	94,29	(1,89-4,17)	(1,29-5,39)		
Information exposure												
Unexposed	26	20,80	28	6,98	99	79,20	373	93,02	2,81	2,73	2,93	0,59
Exposed	18	21,95	13	9,22	64	78,05	128	90,78	(1,89-4,17)	(1,84-4,05)		
Gathering behavior												
Yes	43	21,50	40	7,49	157	78,50	494	92,51	2,81	2,80	0,36	0,49
No	1	14,29	1	12,50	6	85,71	7	87,50	(1,89-4,17)	(1,89-4,15)		
Residence												
With family/female partner	23	17,83	20	5,76	106	82,17	327	94,24	2,81	2,80	0,36	0,54
With a male friend/partner/transvestite	3	13,64	5	10,00	19	86,36	45	90,00	(1,89-4,17)	(1,88-4,08)		
Alon	18	36,00	16	12,60	32	64,00	111	87,40				

*Confounders: $\Delta PR \geq 10\%$ or substantial justification

STI screening was considered a confounder in assessing the association of HIV with the incidence of syphilis. However, by considering the substance assumption, the variable consistency of the use of condoms in non-permanent partners is still included in the modelling even though the PR difference is <10%. It was also identified that there was a potential interaction between HIV and consistent use of condoms in casual partners (p-value <0.05) on syphilis.

After being included in multivariate modeling, it appears that the interaction variable is not significant enough to explain the difference in the risk of syphilis due to HIV between those who are consistent and inconsistent in using condoms in casual or non-permanent partners (p value > 0.05), so the interaction is ignored and the final model is obtained (Table 4).

Table 4. Final Adjusted Model of the Association of HIV with Syphilis

Variable	Adj.PR	95% CI		p-value
		Lower	Upper	
HIV				
Positive	2,46	1,59	3,81	0,000
Negative	Ref.			
Use of condoms in non-permanent partner				
Consistent	Ref.			
Inconsistent	0,62	0,28	1,36	0,231
N/A	1,06	0,61	1,83	0,837
STI screening				
Never	0,62	0,39	0,98	0,042
Ever	Ref.			

Table 4 shows an assessment of the relationship between HIV and the incidence of syphilis after controlling for the variables of condom use in casual partners and STI examination. Respondents who were identified as HIV positive had more than double the risk of experiencing syphilis compared to those who were HIV-negative.

DISCUSSION

This cross-sectional population-based study using an Integrated Biological and Behavioral Survey sample showed that the overall prevalence of syphilis among MSM in Depok and Bogor City was 11.3%. This prevalence of syphilis is lower than that reported in a previous study among MSM in Southeast Asia studies, which ranged between

12-14%^{12,13}. However, our studies found various factors associated with an increased probability of syphilis infection. This information will be critical for the prevention of syphilis in Indonesia.

Syphilis is a growing public health concern, and the prevalence of syphilis is increasing among MSM globally^{14,15}. This study addresses the tendency of a large number of HIV-positive MSM and explores the risk estimate by considering other covariates. The present study suggests that HIV-positive participants were associated with syphilis (PR= 2.46; 1.59-3.81) with a prevalence of 20.1% cases. The prevalence ratio was obtained after being adjusted by consistency of condom use with sexual non-permanent partners and STI screening. It is also important to highlight that these findings were slightly higher than the rate reported in a recent study in Jiangsu Province, which reported 13.64% of active syphilis infection¹⁶.

Compared with heterosexual men, MSM is more likely to have a history of multiple STIs, including HIV, syphilis, gonorrhea, lymphogranuloma venereum (LGV), enteric STIs, HPV, human herpes virus (HHV-8), hepatitis B, and possibly hepatitis A and C. As the main focus of the study, the prevalence of active syphilis infection is even higher in HIV-positive MSM than in the general MSM population, and it ranges from 1.8 to 9.7%. This might be attributable to the social behavior reason. It is well established that the MSM is the most vulnerable group of people who are being at a high level of risk of HIV and STIs due to unprotected anal sex, heterosexuality, and multiple sex partners^{17,18}.

Risky behaviors that put people at greater risk of contracting HIV include having anal or vaginal sex without a condom and suffering from other sexually transmitted infections (STIs) such as syphilis, herpes, chlamydia, gonorrhea, and bacterial vaginosis¹⁹. Recently, in the United States, about half of MSM who suffer from primary and secondary syphilis are also living with HIV²⁰. Skin sores caused by STDs such as syphilis allow HIV to enter the body more easily. In addition, it is possible to contract HIV because behavior and circumstances that put you at risk of contracting other STDs can also provide a greater risk of contracting HIV²⁰.

Although some studies evidence the linkage between HIV infection and syphilis

incidence among gays, there is no definitive explanation for the pathway. Refugio and Klausner proposed a few hypotheses from the literature review ²¹. First, the increasing depletion of CD4 T-cells in persons with HIV reduces the host's ability to protect itself against infections ²². Second, it's also possible that HIV infection is simply a cover for engaging in syphilis-promoting behaviors. It has been claimed that the availability of highly active antiretroviral treatment (HAART) may have indirectly boosted syphilis incidence by increasing sexual risk behavior. Furthermore, HIV-infected MSM may engage in other risk-reduction behaviors such as serosorting (i.e., sex partners are only HIV-infected men) or strategic positioning, in which the HIV-infected person assumes the receptive role during anal sex rather than the insertive role, which is more likely to transmit HIV ²³.

Although this study prevents the risk of bias by controlling association estimation by several covariates, we acknowledged its limitations. Since it was a cross-sectional study, a chronological event between independent and dependent variables exists. This study cannot explain which cases were infected first, whether HIV infection or syphilis infection. Moreover, bias due to participants' responses is possible owing to the fact that this secondary data is collected by someone else, and we could not control over the data collection process.

CONCLUSION

Based on the results of this study, HIV is related to the incidence of syphilis in MSM. In this variable, STI testing is a confounding variable, and there is a potential interaction between HIV and consistent condom use in irregular partners. In the final model assessing the relationship between HIV and the incidence of syphilis after controlling for the variables of condom use in casual partners and STI examination, it was found that the risk of syphilis in HIV-positive respondents was 2.4 times. Risk factor screening in key populations as a way to prevent and control HIV and STIs, it is hoped that government institutions (Ministry of Health, District/City Health Services, Health Service Facilities, NGOs related to HIV and STIs) can work together to increase outreach to risk groups such as MSM.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest

REFERENCES

1. WHO. Sexually transmitted infections (STIs) [Internet]. WHO. 2023 [cited 2024 Jan 11]. Available from: [https://www.who.int/news-room/fact-sheets/detail/sexually-transmitted-infections-\(stis\)](https://www.who.int/news-room/fact-sheets/detail/sexually-transmitted-infections-(stis))
2. Van Gerwen OT, Muzny CA, Marrazzo JM. Sexually transmitted infections and female reproductive health. Vol. 7, *Nature Microbiology*. Nature Research; 2022. p. 1116–26.
3. Solomon MM, Mayer KH. Evolution of the syphilis epidemic among men who have sex with men. Vol. 12, *Sexual Health*. CSIRO; 2015. p. 96–102.
4. Abara WE, Hess KL, Fanfair RN, Bernstein KT, Paz-Bailey G. Syphilis trends among men who have sex with men in the United States and Western Europe: A systematic review of trend studies published between 2004 and 2015. Vol. 11, *PLoS ONE*. Public Library of Science; 2016.
5. CDC. Sexually Transmitted Disease Surveillance [Internet]. U.S. Department of Health & Human Services. 2021 [cited 2024 Jan 11]. Available from: <https://www.cdc.gov/std/statistics/2021/default.htm>
6. Tsuboi M, Evans J, Davies EP, Rowley J, Korenromp EL, Clayton T, et al. Prevalence of syphilis among men who have sex with men: a global systematic review and meta-analysis from 2000–20. *Lancet Glob Health*. 2021 Aug 1;9(8):e1110–8.
7. Mahmud S, Mohsin M, Mueyed A, Islam MM, Hossain S, Islam A. Prevalence of HIV and syphilis and their co-infection among men having sex with men in Asia: A systematic review and meta-analysis. *Heliyon*.

- 2023 Mar 1;9(3).
8. Ribeiro A, Trevizol A, Oluwoye O, McPherson S, McDonnell MG, Briese V, et al. HIV and syphilis infections and associated factors among patients in treatment at a specialist alcohol, tobacco, and drugs center in São Paulo's "cracolândia". *Trends Psychiatry Psychother*. 2020 Jan 1;42(1):1–6.
9. Buchacz K, Patel P, Taylor M, Kerndt PR, Byers RH, Holmberg SD, et al. Syphilis increases HIV viral load and decreases CD4 cell counts in HIV-infected patients with new syphilis infections. *AIDS*. 2004 Oct 21;18(15):2075–9.
10. Kementerian Kesehatan. Executive Report on The Development of HIV AIDS and Sexually Transmitted Infections Diseases in 2022 [Internet]. 2022 [cited 2024 Jan 11]. Available from: https://siha.kemkes.go.id/portal/files_upload/Laporan_TW_3_2022.pdf
11. Kawi N, Sihotang E, Nisa T, Hui B, Causer L, Januraga P, et al. Incidence and risk factors for syphilis infection among men who have sex with men: A cohort study from an urban sexual health clinic in Jakarta, Indonesia. *Int J STD AIDS* [Internet]. 2022 [cited 2024 Jan 11];33(12):1065–72. Available from: https://journals.sagepub.com/doi/10.1177/09564624221125079?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%20%200pubmed
12. Colby D, Nguyen NA, Le B, Toan T, Thien DD, Huyen HT, et al. HIV and Syphilis Prevalence Among Transgender Women in Ho Chi Minh City, Vietnam. *AIDS Behav*. 2016 Dec 1;20:379–85.
13. Prabawanti C, Bollen L, Palupy R, Morineau G, Girault P, Mustikawati DE, et al. HIV, sexually transmitted infections, and sexual risk behavior among transgenders in Indonesia. *AIDS Behav*. 2011 Apr;15(3):663–73.
14. Pham QD, Nguyen TV, Hoang CQ, Cao V, Khuu N Van, Phan HTT, et al. Prevalence of HIV/STIs and associated factors among men who have sex with men in An Giang, Vietnam. *Sex Transm Dis*. 2012;39(10):799–806.
15. Muessig KE, Tucker JD, Wang BX, Chen XS. HIV and syphilis among men who have sex with men in China: The time to act is now. Vol. 37, *Sexually Transmitted Diseases*. 2010. p. 214–6.
16. Chen L, Yang J, Ma Q, Pan X. Prevalence of active syphilis infection and risk factors among HIV-positive MSM in Zhejiang, China in 2015: A cross-sectional study. *Int J Environ Res Public Health*. 2019 May 1;16(9).
17. Ekouevi DK, Bitty-Anderson AM, Gbeasor-Komlanvi FA, Konu YR, Sewu EK, Salou M, et al. Low prevalence of syphilis infection among key populations in Togo in 2017: A national cross-sectional survey. *Archives of Public Health*. 2019 Sep 5;77(1).
18. Duy Pham Q, Vu Nguyen T, Duy Nguyen P, Hoang Le S, Tho Tran A, Thanh Nguyen L, et al. Men who have sex with men in southern Vietnam report high levels of substance use and sexual risk behaviours but underutilise HIV testing services: a cross-sectional study. *Sex Transm Infect* [Internet]. 2015;91(3):178–82. Available from: <http://sti.bmj.com/>
19. National Institutes of Health. What factors make HIV more likely? [Internet]. US Department of Health and Human Services. 2023. Available from: <https://www.nichd.nih.gov/health/topics/hiv/conditioninfo/factors>
20. CDC. Detailed STD Facts - Syphilis [Internet]. U.S. Department of Health & Human Services. 2023 [cited 2024 Jan 11]. Available from: <https://www.cdc.gov/std/syphilis/stdfact-syphilis-detailed.htm#:~:text=In%20the%20United%20States%2C%20about,P%26S%20syphilis%20also%20have%20HIV.&text=Additionally%2C%20MSM%20who%20are%20HIV,get%20HIV%20in%20the%20future.&text=Genital%20sores%20caused%20by%20syphilis,and%20acquire%20HIV%20infection%20sexually.>
21. Refugio ON, Klausner JD. Syphilis incidence in men who have sex with

- men with human immunodeficiency virus comorbidity and the importance of integrating sexually transmitted infection prevention into HIV care. Vol. 16, Expert Review of Anti-Infective Therapy. Taylor and Francis Ltd; 2018. p. 321–31.
22. Burchell AN, Allen VG, Gardner SL, Moravan V, Tan D, Grewal R, et al. High incidence of diagnosis with syphilis co-infection among men who have sex with men in an HIV cohort in Ontario, Canada. *BMC Infect Dis.* 2015 Aug 1;15(1).
23. Eaton LA, Kalichman SC, Cain DN, Cherry C, Stearns HL, Amaral CM, et al. Serosorting Sexual Partners and Risk for HIV Among Men Who Have Sex with Men. *Am J Prev Med.* 2007 Dec;33(6):479–85.

The Effect of Integrated Ovitrap in Reducing The Transovarial Transmission Index in DHF Endemise Areas

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ABSTRACT

Dengue hemorrhagic fever is a health problem in Indonesia. Pontianak City as the city center of West Kalimantan Province has an important role in the spread of dengue fever. An effective integrated model for vector control is needed to reduce the incidence of dengue fever in endemic areas. We carried out an intervention using the integrated CTVVC and SAMT model for 4 weeks in 100 homes as an intervention group. To determine the impact of implementing this model, blood samples were examined from the population and Aedes Spp eggs were collected into 2 groups, namely the intervention group and the control group for 4 weeks, namely 3 weeks. before the intervention and 3 weeks after. The egg samples were then colonized into adult mosquitoes with an average age of 7 days. Next, the analysis was carried out according to the immunocytochemical method of streptavidin-biotin peroxidase complex (ISBPC) and Polymerase Chain Reaction Transcription Reaction (PCR). The measurement results show that the DENV transovarial index in the intervention area is lower than in the control area, namely 40% and 50%, as well as the DENV infection index in the population shows that DENV infection is higher compared to the intervention. area, namely 26.47% and 22.50%. However, statistical analysis did not show the effect of the CTVVC-SAMT integration model on DENV transovarial transmission index and DENV infection in the population with P value: 0.66, P value: 0.109. This research succeeded in identifying the DENV-3 type.

Keywords: Integrated Ovitrap, Transovarial Transmission of DENV, *Aedes aegypti*.

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INTRODUCTION

Dengue Hemorrhagic Fever (DHF) is one of the health problems in Indonesia. All regions in Indonesia are at risk of contamination due to dengue fever because the transmitters, both the virus and the mosquitos, are widespread in residential housings and public facilities throughout

Indonesia. Based on today's available reports, DHF has become an endemic problem in 33 provinces, 436 regencies, 605 districts and 1800 villages. In 2014 to 2017, it reached 52.61/100,000 population with a case fatality rate (CFR) of 0.72%.¹

In 2009, the DBD CFR in West Kalimantan Province ranked 2nd in Indonesia, although the number of sufferers was only

979 cases compared to West Java with 35,453 cases, and Jakarta with 27,964 cases however, the CFR reached 3.38 %; previously was Jambi whose CFR reached 3.67%. The increase in DHF cases occurs every year. In 2017, there were 5,049 cases of DHF with 68 deaths, in five districts, including Pontianak City, which was declared as an Extraordinary Event. The West Kalimantan Province ranked 2nd in the Kalimantan Islands region after East Kalimantan, with a total of 5,762 DHF cases.²

DHF in Pontianak City is a disease that always occurs every year (endemic), and still has the potential to cause an outbreak. During 2009 – 2016, the DHF morbidity rate showed a fluctuating trend in which the incidence rate (IR) in 2009 was very sharp, namely 728.8 per 100,000 population; however, from 2010 to 2016, it significantly declined in 2010 (IR: 14.2), in 2011 (IR: 28.3), in 2012 (IR: 23.1), and in 2013 (IR: 17.06), and it increased in 2016 (IR: 58.85).³

The various risk factors for DHF in Pontianak City, namely: the geographical environmental condition that is located right on the Equator, with an altitude ranging from 0.10 meters to 1.50 meters above sea level, and categorized as a lowland (less than 500 m) with high levels of mosquito populations. The temperature of Pontianak City ranges between 26.8 to 28.8°C; such an optimal temperature along with the rainfall. This temperature is ideal (20 to 30°C) for the life of *Aedes aegypti*. The increase in the air temperature causes the incubation period of the extrinsic disease agent to be shorter, and the pattern of the Dengue virus spread has a tendency to increase over time⁴

In general, the *Aedes aegypti* control and prevention programs in various countries, including Indonesia, still depend on fogging to extinguish the adult mosquitoes. This is costly, creating vector resistance due to inappropriate doses, and does not have a long impact since the mosquito larvae are not perished. The resistance of *Aedes aegypti* to organophosphate in Salatiga City ranges from 16.6 to 33.3 percent, while against 0.8% malathion reaches 66 to 82 percent. WHO only recommends fogging not for routine, yet only in areas that have been clearly identified. Research in Bandung shows that *Aedes aegypti* is also resistant to Allethrin, Permethrin, and Cypermethrin with a Lethal

Time of 90% (LT90), ranging from 9 to 43 hours.⁵

In controlling dengue fever, WHO recommends the best way to control *Aedes aegypti* mosquitoes aimed at their habitat in residential areas.⁶ One of the vector control methods for *Aedes aegypti* without insecticides that have succeeded in reducing vector density in several countries is the use of egg traps (ovitrap). This tool was developed first by Fay and, later used by the Central for Diseases Control and Prevention (CDC) in *Aedes aegypti* surveillance.

The Sticky Autocidal Mosquito Trap (SAMT) is a device designed to effectively trap mosquitoes (Figure 5). The results of the research of using the SAMT tool showed that it was effective in reducing the density of *Aedes sp* mosquitoes in endemic areas, but had not been able to prevent the transovarial spread of the dengue virus from the mother mosquito to the next generation. This is because the tool immediately kills adult mosquitoes and larvae, but it cannot confirm and calculate the presence of the virus in trapped mosquitoes or larvae. Besides, the spread pattern of viruses that live and reproduce in addition to the *Aedes sp* mosquito is also in humans. A person infected with the dengue virus is a very effective source of transmission, entering from and outside the region dynamically, even becoming the most dangerous source of transmission, especially in people with the virus who do not show symptoms or only show symptoms of low-grade fever so they are late in seeking treatment, and they can go anywhere.⁷ Patients generally come to the hospital after 4 to 5 days since someone contracting the virus in their bloodstream. During that time there has also been an escalation of horizontal virus transmission which is similar to a measurement sequence: one to two, two to four, and so on. This is also a cause of delay in carrying out focus fogging.

WHO recommends that the best control of dengue vectors be carried out in their habitat,⁶ Previous studies have intervened using the SAMT method, the results were effective in reducing the density of *Aedes* larvae, but not effective in reducing the DENV transovarial transmission index, because the study did not involve the community. Community is one of the two important factors in the emergence of dengue

fever, namely humans and DENV⁸. Therefore, this study combines two methods into one, combining the SAMT method and the Community-based Vector Control (CBTVC) method which aims to reduce mosquito density and also prevent vertical transmission of the virus (Transovarial DENV), and reduce DENV transmission in the population. in endemic areas

METHOD

The design in this research using a quasi-experimental design. This research uses an Interrupted time-series design with a nonequivalent no-treatment control group time series⁹. This time-series study is usually for field research, which generally has a lot of external variables and cannot be controlled so that the power of selecting independent variables and measuring repeatedly in series before and after treatment can maintain consistency/validity and reliability of measurement effects, and minimize the effects of external variables. In this research design, the effect of the treatment was deduced from the comparison of measurements made several times before and after treatment. The intervention (X₁) in this research used The integrated Community-Based Total Vector Control And Sticky Autocidal Mosquito Trap model in the treatment area located inside and outside the home, while in the control area (X₀) there was no intervention. The research design scheme can be described as follows:

Treatment group (the integrated model of CBTVC and SAMT):

$O_1 \rightarrow O_2 \rightarrow O_3 \rightarrow X_1 \rightarrow O_4 \rightarrow O_5 \rightarrow O_6$

Control Group:

$O_1 \rightarrow O_2 \rightarrow O_3 \rightarrow X_0 \rightarrow O_4 \rightarrow O_5 \rightarrow O_6$

Description:

X₁ = Intervention

X₀ = Control without treatment

O₁₋₂ = Observation before treatment per week

O₃₋₄ = Observation after treatment per week

The sample was determined by purposive sampling based on 5 (five) criteria, namely (1) one of the high-endemic areas of DHF for 4 consecutive years had DHF cases. (2) equal characteristics of the area (settlement, vegetation, and topography), (3) there were fatal cases of DHF in the last 2 years, (4) there were new cases of more than 1 (one) case in the last 3 months before the research, and (5) has a distance of about > 5

km between the study locations (between the treatment location and the comparison location). The number of samples needed in this study were 200 people (heads of families) in 200 houses in 2 research locations, each location was taken 100 people.¹⁰ The selection of 2 locations for the study area was based on the above 5 criteria, namely: Sungai Jawi Dalam Village, West Pontianak Sub-District, and Batu Layang Village, North Pontianak Sub-District. The intervention and control areas were determined randomly, the Sungai Jawi Village as the control area and the Batu Layang Village as the intervention area. Treatment implementation technique: application of an integrated CBTVC-SAMT model (Figure 6) to the intervention area was carried out for 4 weeks. The sampling technique for population blood is based on the general clinical symptoms of DHF, namely: Fever, Headache, Nausea and Vomiting and Fatigue^{11,12}. The data collection technique calculated the effect of the CBTVC-SAMT integrated model on the transovarial transmission index of DENV in *Aedes aegypti* and DENV infection in the population 6 times consecutively, namely 3 times before and 3 times after treatment, with an interval of 1 (one) week, both in intervention and control areas.

RESULTS

1. Transovarial Transmission Index of DENV in *Aedes aegypti*

Dengue virus examination on *Aedes aegypti* mosquitoes using the IHC method from eggs. An egg sample attached to the filter paper was sent to the UGM Parasitology Laboratory. Eggs were identified microscopically, enlargement of 400 and 600 times to see the condition and presence of the eggs done before the rearing process (hatching).

The mosquitoes used were *Aedes aegypti* mosquitoes with a mean age of 7 days, full of 10% sugar water solution. Each glass preparation contains 10 head squash preparations. Especially for positive and negative control mosquitoes were taken from the Laboratory of Parasitology, FK UGM mosquitoes. Following the immunocytochemical method of streptavidin-biotin peroxidase complex (ISBPC) which has been prepared and standardized by Umniyati.

DENV detection was carried out starting from material preparation, staining and microscopic examination with a magnification of 40x, 100x, 400x, and 1000x.¹³

Figure 1 shows that at a positive infection rate (+), at 400x magnification, brownish grains of sand are seen scattered among the brain tissue, but almost no cells show a brown color in the cytoplasm. On positive (++) the grains of sand were more spread out and found 1-10 cells showing brown color in their cytoplasm per field of view at 400x magnification. On positive (+++) the distribution of sand grains is more widespread and 10-100 cells are found showing a brown color on the cytoplasm so that the infection can be seen at a magnification of 100x. The picture of positive infection rates (+++), (++), and (+) can be found on preparations in the control group, whereas in the treatment group only a positive infection rate (+) was obtained.

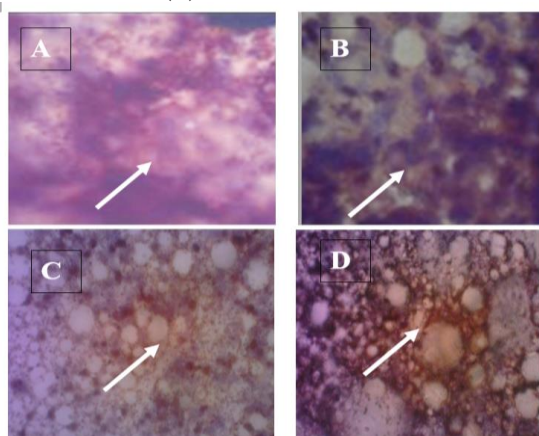


Figure 1. Photomicrograph of head squash with a magnification of 100x10 which shows positive Dengue antigen in the form of brownish hexagonal granules that spread on the mosquito brain tissue of the treatment group (figure C) and the control group (figure D). Figure A is a negative control of non-*Aedes aegypti* mosquito preparations and Figure B is a positive control for an antigen from mosquitoes infected with the Dengue virus with an incubation period of 7 days.

The results of the analysis in Table 1 show that the transovarial transmission index of DENV in *Aedes aegypti* in the intervention area was smaller, namely 40%, compared to the control area, which was 50%.

Table 1. Distribution of *Aedes aegypti* Head squash samples in the Study Area.

PRE/ POST	Week	Intervention Area			Control Area		
		Head squash	(+) VirDen	Transovarial DENV (%)	Head squash	(+) VirDen	Transovarial DENV (%)
Pre	I	100	15	15	100	10	10
	II	100	0	0	100	10	10
	III	100	10	10	100	15	15
Post	IV	100	5	5	100	0	0
	V	100	10	10	100	5	5
	VI	100	0	0	100	10	10
Total		600	40	40	600	50	50

The results of the analysis in Figure 2 show the comparison between before and after treatment there is a tendency to decrease, from 10% to 5% at week 4, compared to the control area there is an increase at week 4, namely from 5% to 15%

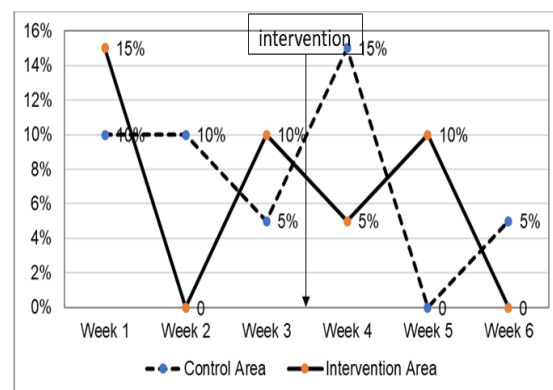


Figure 2 Comparison of transovarial transmission index of DENV in *Aedes aegypti* before and after treatment.

2. The DENV infection in the population

The results of the analysis in Table 2 show that the The DENV infection in the intervention area is smaller, namely 25%, compared to the comparison area, which is 55%.

Table 2. Distribution of Respondents infected with DENV in the Study Area.

PRE/ POST	Week	Intervention Area			Control Area		
		Blood supply	(+) DENV	DENV infection %	Blood supply	(+) DENV	DENV infection %
Pre	1	11	2	18,18	9	2	22,22
	II	8	1	12,50	15	4	26,67
	III	0	0	0	10	3	30,00
Post	IV	2	0	0	11	2	18,18
	V	13	4	30,77	15	3	20,00
	VI	7	2	28,57	8	4	50,00
Total		41	9	22,50	68	18	26,47

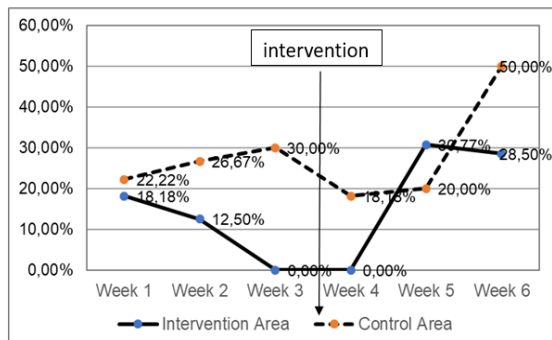


Figure 3 Comparison of the level of DENV infected

The results of the analysis in Figure 3 show that the comparison before and after treatment there was no tendency to decline in the DENV infection index, both in the intervention and control areas.

The results of the examination of the *Aedes aegypti* mosquito using the Polymerase Chain Reaction Transcription Reaction (RT-PCR) method found DEN3. More details can be seen in Figure 4 below.

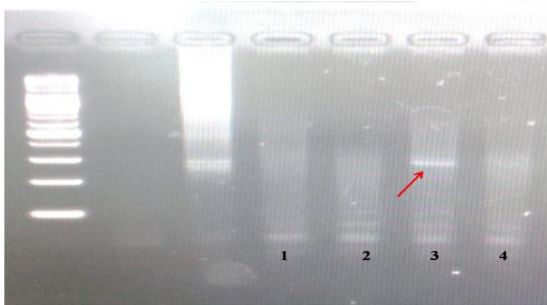


Figure 4. DNA marker, negative control, positive control, sample numbers 1, 2, 3 and 4.

Examination of the dengue virus types in *Aedes aegypti* mosquitoes using the RT-PCR method. Based on the results of observations and documentation of the results of electrophoresis with Gel Doc as shown in Figure 4, it shows in sample number 3 positive DENV-3 from *Aedes aegypti* was taken in Batu Layang Sub-District, North Pontianak Sub-District.

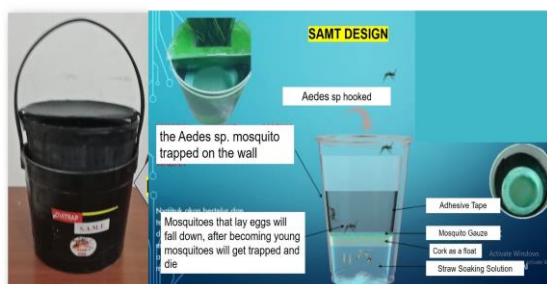


Figure 5. The Design and Workings Of The SAMT Ovitrap Which Has Been Applied To The Treatment Group.



Figure 6. The Integrated CBTVC-SAMT Model.

3. The effect between mean transovarial transmission index of DENV in *Aedes aegypti* before and after the intervention.

Table. 3 Analysis of the effect between transovarial transmission index (TTI) of DENV in *Aedes aegypti* and DENV infection in the population

Transovarial Transmission Index (TTI)	Research Area (Mean + Standard Deviation)		p
	Intervention	Control Area	
TTI Pre	8.33+7.63	11.60+2.88	0,66*
TTI Post	5.00+5.00	5.00+5.00	0,65**

* Pairs samples t-test

**Wilcoxon Signed Ranks Test

4. The effect between mean DENV infection in the population before and after the intervention.

Table 4. Analysis of the effect DENV infection in the population

Transovarial Transmission Index (TTI)	Research Area (Mean + Standard Deviation)		p
	Intervention	Control Area	
TTI Pre	8.33+7.63	11.60+2.88	0,66*
TTI Post	5.00+5.00	5.00+5.00	0,65**

* Pairs samples t-test

**Wilcoxon Signed Ranks Test

DISCUSSION

The results of this research show that the percentage of transovarial transmission index of DENV with the Integrated Community-Based Total Vector Control and Sticky Autocidal Mosquito Trap model was 40% lower than that of the control area, namely 50%. This condition is still lower when compared to previous studies in endemic areas of Pontianak City, namely the transovarial transmission index of DENV in 2012 of 76.6%.¹⁴

Although the results of the study using the CBTVC-SAMT integrated model do not have a significant effect on the transovarial transmission index. However, it can be seen that the results of examining the mosquito samples by PCR in Figure 1 show that the positive (+) infection rate is lower in the intervention area compared to the control area, namely the positive infection rate (+ + +). This mechanism can occur because a number of *Aedes* mosquitoes are trapped in the SAMT in the intervention area, causing damage to mosquito morphology, and affecting the autophagy process of *Aedes aegypti* and disruption of virus proliferation in mosquito cells. This can be sure that DENV as an intracellular parasite Obligate is very dependent on the condition of the host cell, if the cell is damaged it can interfere with the virus growth process, even DENV will die. Based on the results of virological research, it shows that the specific conditions that cause virus propagation in different organs during the embryogenesis process or at the final stage of mosquito life can vary.^{15,12,16,17,18}

Table 3 shows that there is no effect in the results of the Integrated CBTVC-SAMT intervention model on the Transovarial Transmission index, both in the intervention and control areas. This shows that this model does not directly affect the transovarial transmission index, but has a direct effect on larvae density, as previous studies by Saepudin M, et al. Showed that SAMT had an effect on *Aedes* larvae density and had no effect on the Transovarial Transmission Index. [9] This happens because of several factors that directly have a tendency to increase the DENV Transovarial Transmission Index, namely the habit of biting, the presence of patients in the

environment/family, spatial (environmental conditions), as well as residents.

The existence of environmental factors as confounding variables affects the intervention, namely population density, humidity, temperature, and the presence of predators in the two regions. High population density affects the occurrence of faster transmission because the distance from one house to another is close together. Apart from that, the existence of a house that is close to each other can increase the temperature and humidity which is more optimal for both vector reproduction and the extrinsic incubation period for the dengue virus is shorter. The optimum temperature for the development of *Aedes spp* is 25-27°C and the optimum humidity is at 70-90%, this is closely related to the extrinsic incubation period of dengue virus in mosquitoes from 11-14 days to 7-12 days, the virus will move throughout the body, including the salivary glands of mosquitoes, with an increase in temperature of 2°C The extrinsic incubation period for DENV will be shortened and more mosquitoes will be infected available for a longer period of time. In addition, mosquitoes will bite more often because dehydrated and thus further increasing human-mosquito contact.

Tidal environmental conditions can worsen sanitation and increase new breeding places for mosquitoes especially during high tide after heavy rains, water quickly fills natural reservoirs such as used cans, used buckets, and used glasses of mineral water. Based on the results of the virtual index calculation in the two regions, "medium to high" shows that these areas are at high risk as a breeding ground for the *Aedes* mosquito. Thus the intervention carried out within 4 weeks has not succeeded in reducing transovarial transmission index of DENV, because it cannot detect eggs in natural water reservoirs.

The presence of predators *Micronecta*, known as water insects, will increase along with the availability of food in the water reservoir. The presence of a *Micronecta* predator is believed to have preyed on the infected larvae vertically. According to Mardihusodo et al., (2007), every infected adult mosquito will have a transovarial transmission in the next generation, the dengue virus will develop

following the mosquito life cycle. As explained by Mardihusodo et al., a gravid female *Aedes aegypti* mosquito infected with Dengue virus acts as a host to the ovum (egg) in the mosquito's uterus, which eventually propagates in the embryo in the egg. Furthermore, the Dengue virus uses larvae to image as a living medium for its propagation. Humans can be infected with the dengue virus when the mosquitoes that emerge from their puppys in the water first bite and suck blood.

This is also related to the optimal humidity which has a direct effect on increasing the population of female gravid mosquitoes to lay their eggs in water reservoirs, then after hatching they become larvae instar 1 and 2 as a source of food for predators. Thus the increase and decrease in transovarial transmission index of DENV are not determined by interventions using standardized Integrated CBTVC-SAMT model or Ovitrap modifications, but due to the presence of predators in water reservoirs in the study area.

The biting habit of mosquitoes is influenced by the presence of a virus in the mosquito's body, resulting in behavioral changes that lead to an increase in vector competence or the ability of mosquitoes to spread viruses, where mosquitoes become less reliable at sucking blood, even though they repeatedly thrust the proboscis but fail to suck blood, so the mosquitoes move from one person to another, as a result, the risk of virus transmission becomes even greater. The *Aedes* mosquito gets the virus when it sucks the blood of people whose blood contains the virus or gets it by transovarial transmission, where since the egg, the mosquito has contained the virus passed down by its mother.

The entry of infected *Aedes* mosquitoes from outside the study area cannot be limited and controlled, because of the large ecological area, all areas in open conditions have access roads to other areas. This directly affected the spread of the dengue virus during the intervention, so the increase and decrease in transovarial transmission index of DENV can be determined by other than the intervention.

Another factor is the technical examination of the virus is only taken from *Aedes spp* eggs, breeding is carried out in the laboratory until it reaches an adult mosquito

aged 7 days for head squash examination, so it does not describe the real transovarial transmission index of DENV. According to the results of the treatment in the Ovitrap index (AOI) area before and after treatment, it shows a small number both in the intervention and control areas, namely 12% in the control area and 5% in the treatment area.

The results of this research showed that the percentage of the level of DENV infected with the Integrated model of CBTVC-SAMT was 22.50% lower than that of the control area, which was 26.47%. The results of the study using the Integrated model of CBTVC-SAMT showed no statistically significant effect in the level of DENV infected. This is in line with the number of mosquitoes and larvae trapped in the intervention area which affects the population, it also affects the number of bites of mosquitoes that are infused in people around the patient.

Table 4 shows that there is no effect in the results of the Integrated model of CBTVC-SAMT intervention on the incidence of DENV infection in both the intervention and control areas. This shows that this model does not have a direct effect on the incidence of DENV infection in the population, but has a direct effect on larval density, as Saepudin M, et al, previous research showed that SAMT had an effect on *Aedes* larvae density and had no effect on the rate of DENV infection.⁷ The existence of compliance with CBTVC to increase community participation also does not have a significant effect on the incidence of infection in the population.²⁰²¹ This is followed by a change in behavior that takes a long time. besides the incidence of DENV infection is directly influenced by the habit of biting vectors, vector density, vector movement from one place to another; as well as the presence of sufferers in the environment/family, mobilization and exposure to mosquitoes, age and sex; also influenced by environmental conditions: rainfall, temperature, sanitation, and population density.²² Another thing that has a direct effect on the occurrence of DHF incidence is the number of viruses that attack the population of an area, and is highly correlated with the increase in cases both in quantity and quality, namely severe dengue, dengue / DSS.

Virulence of dengue virus is also one of the factors that determine the occurrence of infection in hosts, among the most virulent strains is the *Dengue* strain 3 as evidenced by the results of the research found DENV-3 as the main virus strain which is the most virulent strain. This virulence was shown by the discovery of different fatal cases before the intervention in the two intervention areas, CFR di Batu Layang Village was higher, namely 7.14% compared to the Sungai Jawi Dalam Exit 4.44%.²³ Thus, the effect in virulence in these two locations has an effect on the increased incidence of dengue transovarially over time.

Population mobility affects increasing horizontal Dengue virus transmission. A person who has dengue virus dynamically enters and exits the research area becomes a very effective source of transmission, the most dangerous source of transmission is people with the virus who are asymptomatic or only showing symptoms of low-grade fever because they can go anywhere. High mobility in urban areas plays an important role in the transmission of DENV than the mobility of *Aedes aegypti* itself.²⁴⁻²⁶

This condition is exacerbated by delays in going to the hospital or health services, which will become a mobile and effective source of transmitting the virus horizontally or vertically. Sufferers generally come to the hospital after 4 to 5 days since a person has the virus in their bloodstream. During that time there has also been an escalation of horizontal virus transmission which is similar to a measurement sequence: one to two, two to four, and so on. This is also a cause of delay in carrying out focus fogging. Along with population mobility and movement, a transovarial transmission has become more widespread throughout the world, for example in Malaysia, Thailand, and Singapore, and Indonesia. Such transmission also occurs in several DHF endemic sub-districts in Yogyakarta City, in several DHF endemic districts in Central Java, and also in Sampit, Kotawaringin Timur Regency, Central Kalimantan. This will likely continue to expand to other areas in Indonesia.²⁷¹⁹

Some of the limitations of this research include the difficulty in controlling the entry of *Aedes* mosquitoes from outside the study area. The entry of *Aedes* mosquitoes from outside the area may exist because the

scope of the study is only limited to a radius of 100 houses around the patient's house (+ 500 meters). At the research location, this was difficult to control because almost all areas were in an open condition (having access roads to other areas). Efforts to create a buffer area will reduce the number of existing housing population. The existence of climate change and the physical environment which directly affect the breeding pattern of *Aedes spp* mosquitoes in the area. Also, the intervention activities for the application of Integrated CBTVC-SAMT model was carried out in two different regions and did not compare with other types of ovitrap, so it was not possible to determine the effectiveness of Integrated CBTVC-SAMT model as a trap for *Aedes Aegypti*.

The entry of predators into SAMT was also inevitable, with worms, ants, and lizards trapped, and frogs attracted to mosquitoes trapped on ovitrap. For control purposes, this is beneficial because it is supportive. However, this condition can affect the ability to modify SAMT and also the results of research, especially the number of mosquitoes that died before being detected, so the results may be smaller than the actual condition.

Increasing the application of the integrated SBTVC-SAMT model will have a positive impact, namely having an impact on improving better environmental management, as well as on awareness and community participation in DHF control. To see this, further research is needed. The use of used goods to make this model makes it possible to increase the price value of these used goods and benefit the local community, such as used plastic glasses and all kinds of used goods that can hold water. This also helps government programs, especially in waste management using the 4R principle; Reduce (reduce), Reuse (reuse), Recycle (recycle), and Replace (replace). This CBTVC-SAMT integrated model is very appropriate as a local-based vector control solution in dengue endemic areas in urban areas in developing countries such as Indonesia.²⁸

The integrated use model of CBTVC-SAMT in the long term can also be one of the ways to control the dengue vector in an integrated manner with other vector control programs. The CBTVC-SAMT utilization model that is integrated in the long term can

also be a way of controlling the dengue vector in an integrated manner with other vector control programs. In the future, innovative programs are needed, so that allows fast detection of cases and proper clinical management can reduce mortality from severe dengue fever.²⁶

This model is the most complete modification, compared to the ovitrap designed by several previous researchers. This model can function 3 in one, namely functioning first as a killer for adult benthic mosquitoes and new young mosquitoes that hatch from Pupa, this second model as an alternative in monitoring trapped mosquito species, the third as a trigger for increased community participation in prevention and control. DHF that is easy and cheap takes advantage of local wisdom in the region. Hopefully in the future government policies, in this case, the Ministry of Health of the Republic of Indonesia, in an integrated *Aedes aegypti* vector control activity with the application of this the Integrated CBTVC-SAMT model and Dengue Hemorrhagic Fever vector surveillance activities are not only focused on entomological indicators such as Larva Free Rate (LFR), but are further enhanced on virus surveillance at the vector, as an effort of the Early Warning System (EWS) to prevent Dengue Hemorrhagic Fever Outbreak.

CONCLUSION

The application of the BCTVC-SAMT integrated model, although statistically showed no significant influence on either the DENV infection index or transovarial transmission index, nevertheless there was a tendency for a decrease in the DENV infection index and transovarial transmission index in the intervention group compared to the control group. Examination using the Polymerase Chain Reaction Transcription Reaction (RT-PCR) method succeeded in identifying the DENV-3 virus type as the main cause of Dengue Hemorrhagic Fever cases in endemic areas.

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CONFLICT OF INTEREST

All of us researchers hereby declare that there is no conflict of interest in writing this manuscript, either for any individual or company.

REFERENCES

1. Ministry of Health of the Republic of Indonesia. Dengue Hemorrhagic Fever (DHF) Situation Data Center. *J Vector Ecol.* 2018;31(1):71-78.
2. Andi Jap. Health profile of West Borneo Province. *Heal profile West Borneo Prov Year 2017.* 2017;(7):56-60.
3. Arfan I, Taufik M. Analysis of the Dengue Hemorrhagic Fever (DHF) Epidemiological Survey at the Pontianak City Health Center in 2016. *J Kesmas (Kesehatan Masyarakat) Khatulistiwa.* 2017;4:264. doi:10.29406/jkkm.v4i3.902
4. Dwi Rivyantati R, Fitriana Arifin N, Rahardjo M, Hanani Darundiati Y. Application of Spatial Analysis Of Dengue Hemorrhagic Fever Risk Favtors In Taman District Madiun. *J Kesehat Masy.* 2016;15(2):112-120.
5. Astari S AI. Insecticide Resistance and Effect of Piperonyl Butoxide as a Synergist in Three Strain of *Aedes aegypti* (Linn) (Diptera: Culicidae) on Insecticide Permethrin, Sypermethrin, and d-Allethrin. *Bul Penel Kesehat.* 2005;33 (2):73-79.
6. World Health Organisation. Dengue and severe dengue. *WHO Fact Sheet.* 2014;117(March):1-4.
7. Saepudin M. The Difference of Modification Ability of Autosidal Sticky of Mosquito Trap and Standard Ovitrap In Reducing *Aedes Aegypti* Larva Index And Transovarial Transmission In Pontianak City, West

- Kalimantan. In: *Book of Abstracts 5 Th International Conference on Public Health*. Vol 94. ; 2019:160.
8. Nuryunarsih D. Sociodemographic Factors to Dengue Hemorrhagic Fever Case in Indonesia. *Kesmas Natl Public Heal J*. 2015;10(1):10. doi:10.21109/kesmas.v10i1.813
9. Campbell D., Cook T. *Quasi-Experimental Designs and Analysis Issue for Field Siting*. Houghton Mifflin Company; 1997.
10. Saepudin M. *Public Health Methodology*. TIM; 2011.
11. Dewi R, Tumbelaka AR, Sjarif DR. Clinical features of dengue hemorrhagic fever and risk factors of shock event. *Paediatr Indones*. 2016;46(3):144. doi:10.14238/pi46.3.2006.144-8
12. Tuiskunen Bäck A, Lundkvist Å. Dengue viruses – an overview. *Infect Ecol Epidemiol*. 2013;3(1):19839. doi:10.3402/iee.v3i0.19839
13. Umniyati SR. :Standardization of Immunocytochemical method for the diagnosis of Dengue Viral Infection in *Aedes aegypti* Linn Mosquitoes (Diptera Culicidae). *Berkala Ilmu Kedokteran*. 2009;XLI (1).
14. Sucipto CD. Dengue transovaria virus transmission detection in the *Aedes aegypti* mosquito. *J Heal Sci*. 2012;XII:121.
15. N. James MacLachlan EJD, Fenner's Veterinary Virology (Fourth Edition). Chapter 3 - Pathogenesis of Viral Infections and Diseases Author links open overlay panel. In: *Fourth Edition*. Academic Press; 2011:43-74. doi:https://doi.org/10.1016/B978-0-12-375158-4.00003-1. (<http://www.sciencedirect.com/science/article/pii/B9780123751584000031>)
16. Brackney DE, Correa MA, Cozens DW. The impact of autophagy on arbovirus infection of mosquito cells. *PLoS Negl Trop Dis*. 2020;14(5):1-18. doi:10.1371/journal.pntd.0007754
17. WHO. *Comprehensive Guidelines for Prevention and Control of Dengue and Dengue Haemorrhagic Fever*. (SEARO Technical Publication, ed.); 2011.
18. Brackney DE. Implications of autophagy on arbovirus infection of mosquitoes. *Curr Opin Insect Sci*. 2017;22:1-6. doi:10.1016/j.cois.2017.05.001
19. Mardihusodo SJ, Satoto TBT, Umniyati SR, Ernarningsih. Evidence of Transovarial Dengue Virus Transmission to *Aedes aegypti* Mosquitoes in Yogyakarta City. In: *Symposium Nasional Aspek Biologi Molekuler, Patogenesis, Manajemen Dan Pencegahan KLB*. Pusat Studi Bioteknologi UGM; 2007.
20. Ratnawulan A, Rustiana ER, Sudana IM. Society Efforts in Preventing Dengue Fever in Bergaslor, Bergas, Semarang. *Public Heal Perspect J*. 2019;4(1):54-60.
21. Susanto AN, Maryana, Khasanah TFN. Dengue Hemorrhagic Fever (DHF) educative game to improve knowledge and skill of elementary school children in DHF prevention. 2019;(4):2-7.
22. Wong LP, Shakir SMM, Atefi N, AbuBakar S. Factors affecting dengue prevention practices: Nationwide survey of the Malaysian public. *PLoS One*. 2015;10(4):1-16. doi:10.1371/journal.pone.0122890
23. Pontianak City Health Office. *Pontianak City Health Profile*.; 2015.
24. Jorge AFL, René SL, Susana RP, et al. Analysis of spatial mobility in subjects from a dengue endemic urban locality in Morelos State, Mexico. *PLoS One*. 2017;12(2):1-19. doi:10.1371/journal.pone.0172313
25. Massaro E, Kondor D, Ratti C. Assessing the interplay between human mobility and mosquito borne diseases in urban environments. *Sci Rep*. 2019;9(1):1-13. doi:10.1038/s41598-019-53127-z
26. Murray NEA, Quam MB, Wilder-Smith A. Epidemiology of dengue: Past, present and future prospects. *Clin Epidemiol*. 2013;5(1):299-309. doi:10.2147/CLEP.S34440
27. Achmadi U. *Regional-Based Dengue Fever Management, Epidemiology Window Bulletin, Center for Ecology and Health Statistics*. Kementerian Kesehatan RI; 2010.

28. Luluk Kusminah I. 4R counseling (Reduce, Reuse, recycle, replace) and use of a waste bank as a step to create a clean and economical environment in Mojowuku village, Gresik district. 2018;03(01):22-28.

Article Review

Provision of Peanuts as Additional Food in Stunting Prevention for Pregnant Women During the COVID-19 Pandemic: A Systematic Review

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ABSTRACT

During pregnancy, meeting the needs of nutritious food and drinks is very much needed. The development and growth of the fetus including length and weight at birth is an illustration of one of the factors of the mother's nutritional status. To analyze and identify scientific evidence related to peanut as supplementary feeding in preventing stunting babies in pregnant women during the Covid-19 pandemic. This article is a systematic review. The PRISMA diagram was used based on a checklist to determine the articles to be analyzed. PICOT (P: pregnant women, I: peanut, C: -, O: stunting prevention, T: 2017 - 2022) and MESH. The databases used in the search for articles include Willey Online Library, Garuda, ProQuest, Science Direct, Google Scholar, and PubMed. There were 21,937 articles obtained from the search process from the database. There are 5 articles that were reviewed, from the result of the critical assesment RCT CASP & JBI CASP check list for Quasi-Experimental. In the CASP RCT there are 11 questions, the initial 2 questions about research focus and sampling, if you have 2 answers Yes the article can be used. The JBI Critical Appraisal Checklist contains 9 questions, while the determination of the grade and level of each article uses Johns Hopkins Nursing Evidence-Based Practice. To assess the risk of bias, the authors used the Cochrane Risk Of Bias Assessment Tool which consists of 7 domains. Giving peanuts to pregnant women has a very significant effect in preventing stunting during the Covid-19 pandemic. This is because giving peanuts as additional food to pregnant women and toddlers can increase body weight and upper arm circumference of pregnant women, improve nutritional status, increase protein and energy intake, increase milk production in pregnant women, and increase the duration of pregnancy. The limitations of some articles obtained are some articles do not do blind in on giving treatment to participants, sample size some articles found little sample.

Keywords: *Arachis Hypogaea, Pregnant Women, Peanuts, PMT, Stunting.*

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INTRODUCTION

During pregnancy, meeting the needs of nutritious food and drinks is very much needed. The development and growth of the fetus including length and weight at birth is an illustration of one of the factors of the mother's nutritional status. The high level of poverty in Indonesia results in high rates of malnutrition which can affect the growth of the baby's brain, stunted fetal growth, the risk of infant death, increased morbidity, low birth

weight, and can lead to stunting¹. Stunting is a condition where there is chronic malnutrition due to insufficient nutritional intake from the fetus to the toddler's growth period².

As an effort to overcome the occurrence of malnutrition, the Indonesian government has created a program for providing supplementary food to pregnant women³. One of the food ingredients for supplementary feeding is peanuts, processed peanut foods can be in the form of porridge, formula drinks, supplements, biscuits and

processed food products in various forms ^{3,1,4,5}. Provision of additional food is very significant in fulfilling the nutritional needs and adequacy of pregnant women in reducing the prevalence of malnutrition in pregnant women and also stunting.

The prevalence of stunting in the world according to WHO data shows that in 2019 it was 22.4% and in 2020 it was 22% ⁶. Whereas in data from the Central Statistics Agency the number of toddlers experiencing stunting in Indonesia in 2016 (14,43%), 2017 (14%), and 2018 (13,80%). In the province of South Sulawesi the prevalence of stunting was recorded in 2016 (20,2%), 2017 (17,90%) and 2018 (18,40%) ⁷.

Inadequate nutritional intake in pregnant women can result in babies with low birth weight (LBW) so that growth becomes stunted. Toddlers with low birth weight have a risk of leading to stunting by 1.7 times when compared to toddlers with normal birth weight. In a study conducted by Sukmawati et al., 2018 ⁸, shows that the nutritional status of the mother during pregnancy affects the incidence of stunting and there is a relationship between the baby's birth weight and stunting in toddlers ⁸. The same thing was also reported through literature reviews and systematic reviews that for efforts to combat stunting toddlers by administering nutrients either singly or in combinations of 2-3 nutrients in multi-micro-nutrients have been carried out a lot and have had an inconclusive impact, preventing toddlers from becoming stunting ⁹. Factors that can cause stunting are antenatal nutritional status during pregnancy in the form of insufficient protein, energy and iron. One of the countermeasures that can be done is to conduct health education for pregnant women so that they are more focused on paying attention to the nutritional intake during pregnancy ¹⁰. Base on that phenomena, this review was conducted with the aim of analyzing and identifying scientific evidence related to peanut supplementary feeding in preventing stunting babies in pregnant women during the Covid-19 pandemic.

METHOD

Study Design

This study used a systematic review

research design which was compiled based on the PRISMA checklist ¹¹.

Article Criteria

The questions used to review articles in journals are in accordance with PICOT (**P**: patient is pregnant mother, **I**: arachis hypogaea / peanut, **C**: control, placebo, or any intervention, **O**: stunting prevention, **T**: 2017 – 2022) and MESH : pregnant mother* OR pregnant AND peanut OR peanuts OR arachis hypogaea AND stunting. The research question in this systematic review is whether giving peanuts as an additional food can prevent stunting in pregnant women during a pandemic ?

Description of PICOT

P	Pregnant women
I	Peanut OR arachis hypogaea
C	-
O	Stunting prevention
T	2017 - 2022

Study Identification

We searched for articles using the Willey online library database, Garuda, Proquest, Science Direct, Google Scholar, and PubMed.

Eligibility Criteria

The number of articles obtained from the search process was 21,937. Then the articles were filtered in the form of articles that were full-text & open access, articles for the last 5 years, English and Indonesian so that there were 5.009 articles. Furthermore, articles are screened, namely the type of document must be in the form of research articles & associated data so that 20 articles are obtained. In the final process, duplicate articles were excluded and the type of article was not in the form of RCT, experimental, quasi-experimental, intervention so that the total number of articles included was 5 articles (Figure 1).

Data Extraction

In this study, the data extracted in each included article are title, author, country, research design, intervention, instruments, results, and conclusions (Table 6). Methods in each article are identified, summarized, categorized by theme, and systematically synthesized.

Article Quality Assessment

To assess the feasibility of the articles that have been included, they were screened through the RCT Critical Appraisal Skills Program (CASP) and the JBI Critical Appraisal Checklist. In the CASP RCT there are 11 questions, the initial 3 questions about research focus and sampling, if you have 2 answers Yes the article can be used, and the next 8 questions assess the quality of the article in the blinding segment of the sample, effect size, precision, and applicability of the research results to the population local (Table 1)¹². The JBI Critical Appraisal Checklist contains 9 questions, three questions concerning sampling and research focus, if you have two responses Indeed, you can use the article (Table 2)¹³. While the determination of the grade and level of each article uses Johns Hopkins Nursing Evidence-Based Practice (Table 3)¹⁴. Systematic review of randomized controlled trials (RCTs), with or without meta-analysis (Level 1), consistent, generalizable results, sufficient sample size for the study design, adequate control, definitive conclusions, and consistent recommendations based on comprehensive literature review that includes thorough reference to scientific evidence (High Quality). Quasi-experimental study—systematic review of a combination of RCTs and quasi-experimental studies, or quasi-experimental studies only, with or without meta-analysis (Level 2), reasonably consistent results; sufficient sample size for the study design; some control; and reasonably

definitive conclusions (Good Quality). Insufficient sample size for the study design; little evidence with contradictory outcomes; unable to make conclusions (poor quality or significant quality) additionally study that is not experimental, combined RCTs, quasi-experimental and non-experimental research, or only non-experimental studies, in a systematic manner, with or without meta-analysis a meta-synthesis or a qualitative investigation combined with or without a systematic review (Level 3).

To assess the risk of bias, the authors used the Cochrane Risk Of Bias Assessment Tool which consists of 7 domains (Table 4)¹⁵. Random sequence is provide enough information about the allocation sequence generation process to enable an evaluation of whether or not comparable groups should be produced. Allocation concealment is if intervention assignments might have been predicted before or during enrollment, explain the strategy utilized to hide the allocation process in enough detail. Blinding of participants and personnel is describe all the steps taken, if any, to prevent researchers and trial participants from learning which intervention a participant got. Provide any details about the effectiveness of the planned blinding. Blinding of outcome assessment is describe all the methods (if any) utilized to keep the outcome assessment blind to the participant's intervention. Provide any details about the effectiveness of the planned blinding. Incomplete outcome data is enumerate each primary result's completeness in terms of outcome data, taking into account attrition and analysis exclusions. Indicate if attrition and exclusions were disclosed, the total number of participants in each intervention group (in comparison to the total number of randomly assigned participants), any reported exclusions or attrition causes, and any reinclusions in the review's analysis. Selective reporting is describe the investigation of selective result reporting and the findings. Anything else, ideally prespecified is indicate any significant worries you have regarding bias that aren't addressed in the tool's other domains.

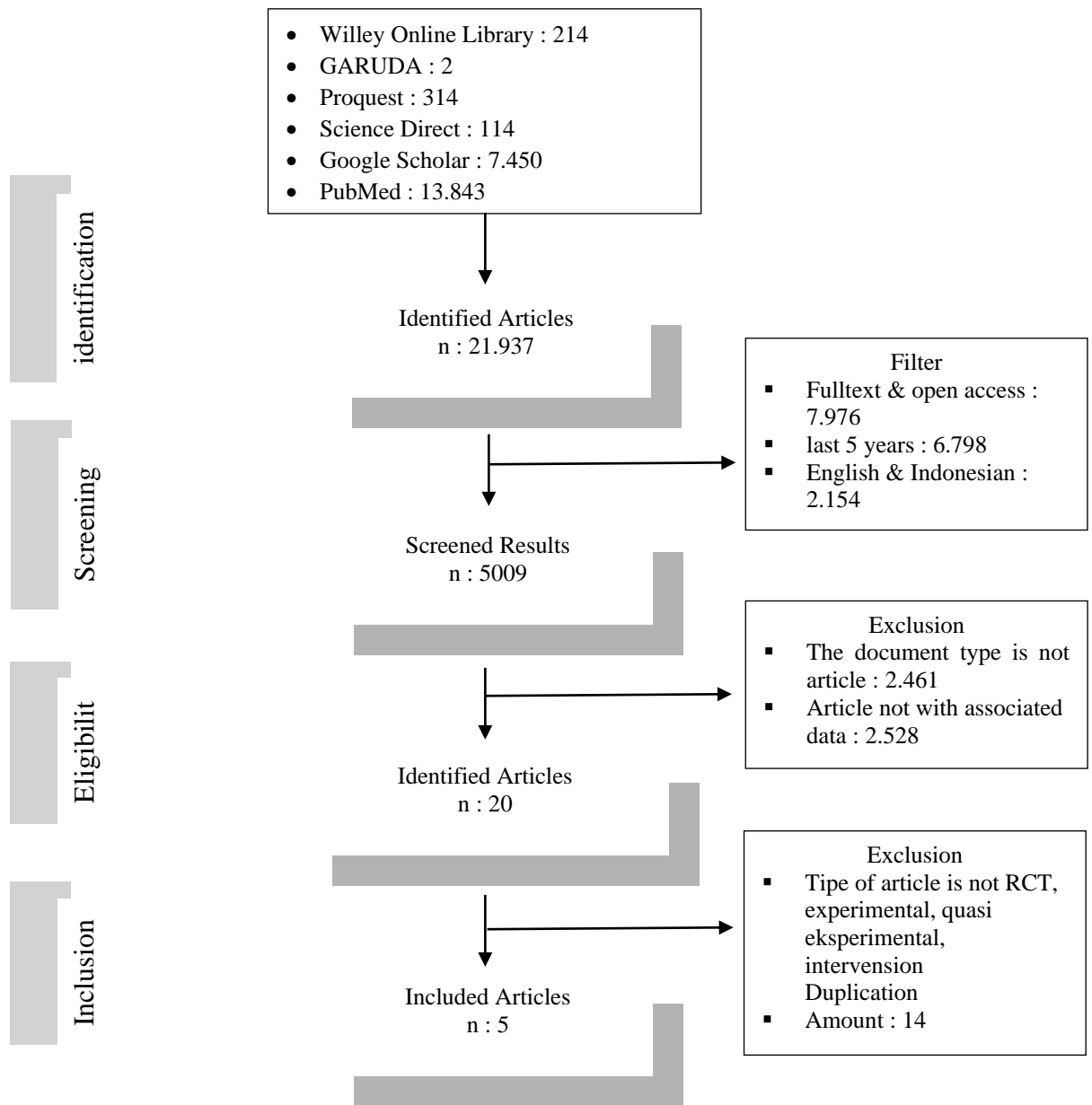


Figure 1. Article Selection and Exclusion Flowchart

Table 1. CASP RCT

Question of Critical Appraisal	Feeney et al, 2017	Utami et al, 2017	Susiloretni et al, 2021	Kok et al 2022
Did the study address a clearly focused research question ?	Yes	Yes	Yes	Yes
Was the assignment of patients to treatments randomised?	Yes	Yes	Yes	Yes
Were all of the patients who entered the trial properly accounted for at its conclusion?	Yes	Yes	Yes	Yes
Were patients, health workers and study personnel 'blind' to treatment?	Can't Tell	Can't Tell	Can't Tell	No
Were the groups similar at the start of the trial (characteristics baseline) ?	Yes	Yes	Yes	Yes
Aside from the experimental intervention, were the groups treated equally?	Yes	Yes	Yes	Yes
How large was the treatment effect? (p-value)	Yes	Yes	Yes	No
How precise was the estimate of the treatment effect? (MD & CI)	Yes	Yes	Yes	Yes
Can the results be applied to the local population, or in your context?	Yes	Yes	Yes	Yes
Were all clinically important outcomes considered?	Yes	Yes	Yes	Yes
Are the benefits worth the harms and costs?	Yes	Yes	Yes	Yes

Table 2. JBI CASP Checklist for Quasi-Experimental

Question of Critical Appraisal	Batubara & Siregar, 2021
Is it clear in the study what is the "cause" and what is the "effect" (i.e. there is no confusion about which variable comes first) ?	Yes
Were the participants included in any comparisons similar ?	Yes
Were the participants included in any comparisons receiving similar treatment / care, other than the exposure or intervention of interest ?	Yes
Was there a control group ?	No
Were there multiple measurements of the outcome both pre and post the intervention / exposure ?	Yes
Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed ?	Yes
Were the outcomes of participants included in any comparisons measured in the same way ?	Yes
Were outcomes measured in a reliable way ?	Yes
Was appropriate statistical analysis used ?	Yes

Table 3. Level Evidence and Quality Guides (Johns Hopkins Nursing Evidence-Based Practice)

(Author, Year)	Evidence Levels	Quality Guides
(Feeney et al, 2017), I/A (Utami et al, 2017), I/A (Susiloretni et al, 2021), I/A (Kok et al 2022), I/A	Level I Experimental study, randomized controlled trial (RCT). Systematic review of RCTs, with or without meta-analysis.	A High quality: Consistent, generalizable results; sufficient sample size for the study design; adequate control; definitive conclusions; consistent recommendations based on comprehensive literature review that includes thorough reference to scientific evidence.
(Batubara & Siregar, 2021), II/B	Level II Quasi-experimental study Systematic review of a combination of RCTs and quasi-experimental, or quasi-experimental studies only, with	B Good quality: Reasonably consistent results; sufficient sample size for the study design; some control, fairly definitive

or without meta-analysis.	conclusions; reasonably consistent recommendations based on fairly comprehensive literature review that includes some reference to scientific evidence.
Level III Non-experimental study Systematic review of a combination of RCTs, quasi-experimental and non-experimental studies, or non-experimental studies only, with or without meta-analysis Qualitative study or systematic review with or without a meta-synthesis.	C Low quality or major flaws: Little evidence with inconsistent results; insufficient sample size for the study design; conclusions cannot be drawn.

Table 4. Biased Risk Assessment

(Author, Year)	Random sequence generation (Selection bias)	Allocation concealment (Selection bias)	Blinding of participants and personel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other sources of bias (other bias)
(16) ¹⁶	+	+	?	?	+	+	+
(3) ³	+	+	+	+	+	+	+
(1) ¹	+	?	-	-	+	?	?
(17) ¹⁷	+	+	?	+	+	+	+
(18) ¹⁸	+	?	+	+	+	+	+

Noted : (+) Low biased risk, (-) High biased risk, (?) Unclear risk of bias

RESULTS

Characteristics Study

In this systematic study, there were 5 articles obtained where the type of research was randomized control trial (RCT) and quasy experimental. All of the articles obtained, they were published

from 2017 to 2022. The research was conducted in the United Kingdom, Indonesia and Belgium. All respondents in this study were pregnant women, breastfeeding mothers and infants/toddlers with a total sample of 15-909 samples.

Table 5. Characteristics of The Study

Author / Year	Country	Research Design	Mean (SD) of Age	Participant		
				<i>Intervensi</i>	<i>Control</i>	<i>Placebo</i>
Feeney et al, 2017	London (United Kingdom)	RCT	7.8 (5.8)	319	321	N/A
Utami et al, 2017	Indonesia	RCT	27	20	22	42
Batubara & Siregar, 2021	Indonesia	Quasi Experimental	20.5	15	N/A	N/A
Susiloretni et al, 2021	Indonesia	RCT	24.8±3.7	30	17	N/A
Kok et al 2022	Belgia	RCT	33.4±9.33	879	909	N/A

Noted : N/A = not avilable

Article Quality Assessment

In the study conducted, in assessing the feasibility of an included article, the authors used the RCT Critical Appraisal Skills Program (CASP) and the JBI Critical Appraisal Checklist. There were 5 articles assessed with the type of RCT and quasi experimental research designs. From the research, most of the articles have explained the randomization of the sample, the purpose of the study, the homogeneity of the sample and its applicability to the local population (Tables 1 & 2). In addition, to assess the feasibility of an article from this study using the level of evidence and quality guides (Johns Hopkins Nursing Evidence-Based Practice). There were 5 articles assessed in this study, where the research conducted by Feeney et al. (2017), Utami et al. (2017), Susiloretni et al. (2021), Kok et al. (2022) are at level I/A quality (high quality). Whereas in the Coal & Siregar research. (2021) it is at level II/B quality (good quality) (Table 3).

Effects of Giving Peanuts in Stunting Prevention for Pregnant Women and Babies/Toddlers

Several studies have shown that giving peanuts as an additional food to pregnant women and toddlers shows very

significant and good results in preventing stunting. There was an increase in body weight and upper arm circumference between groups of pregnant women and the increase in the treatment group was higher than the control ($p < 0.005$). The peanut formula group had a higher increase in nutritional status than the other groups. The peanut formula group also showed an increase in protein and energy intake above the adequacy rate compared to other groups¹, then the average consumption of peanuts per week (grams) FFQ in the first month where the consumer group is 298 (93.4%), median 7, while in the avoiders group 313 (97.5%), median 0.0 and p value of both group in the first month of intervention was < 0.01 . Then the intervention in the first 6 months, consumers 319 (100%), median 7.9, avoiders 321 (100%), median 0.0 and p value for both groups is < 0.01 ¹⁶. The effect of giving peanut extract to increase milk production in pregnant women with p value: 0.001 in 11 people (73.4%) of the total sample³¹, increased the duration of pregnancy (+0.20 weeks, 95% CI 0.05 to 0.36, $p : 0.010$), birth weight (50.1 g, 8.11 to 92.0, $p = 0.019$), birth length (0.20 cm, 0.01 to 0.40, $p = 0.044$), chest circumference (0.20 cm, 0.04 to 0.37, $p = 0.016$), arm circumference (0.86 mm, 0.11 to 1.62, $p = 0.025$)¹⁸.

Table 6. Synthesis Grid

No.	Title	Researcher & Country	Study Design	Interventioni	Sample Size	Instrument	Result
1.	Impact of peanut consumption in The LAP Study : feasibility, growth, and nutrition.	Feeney, et al. ¹⁶ , United Kingdom	RCT	Infants aged 4 to <11 months with severe eczema and/or egg allergy were randomly assigned to eat or avoid peanuts until 60 months of age. Participants randomized to peanut consumption (except those with a diagnosed peanut allergy) were advised to eat at least 6 grams of peanut protein per week distributed over three or more meals per week until age 60 months.	The consumers group had 319 participants, while the avoiders group had 321 participants with a total of 640 participants.	Anthropometry, monitoring the consumption of peanuts is the Food Frequency Questionnaire (FFQ).	There were no differences in anthropometric measurements or energy intake between groups at each visit. Regular consumption of peanuts causes differences in food intake. Consumers have a higher intake of fat and avoiders have a higher intake of carbohydrates; the difference was greatest in the upper quartile of peanut consumption. Protein intake remained consistent between groups. The average consumption of peanuts per week (grams) FFQ in the first month where the consumer group is 298 (93.4%), the median is 7, while in the avoiders group there are 313 (97.5%), the median is 0.0 and the p value of the two groups in the first month of intervention was <0.01 . Then the intervention in the first 6 months, consumers 319 (100%), median 7.9, avoiders 321 (100%), median 0.0 and the p value of the two groups is <0.01 .
2.	Provision of red bean, peanut, and soybean formula drinks on the nutritional status of chronic energy deficient pregnant women.	Utami, et al. ³ , Indonesia	RCT	The intervention was carried out for 30 days by giving 300 ml of drink which was divided into 4 treatment groups which were given the formula of red beans (A), peanuts (B), and soybeans (C). while the control group (D) was given formula milk for pregnant women according to what was given by the puskesmas.	The subjects in the study group were 20 peanuts, 22 soybeans, 22 red beans, and 20 pregnant women's milk. So the total sample was 84 people.	Subject characteristic questionnaire and food frequency questionnaire (FFQ), nutrition survey.	There was no difference between experimental and control group in BMI wether before and after the intervention. There was an increase in body weight and upper arm circumference of pregnant women between groups and the increase in the treatment group was higher than that of the control group ($p<0.005$). The peanut formula group had a higher increase in nutritional status than the other groups. In addition, the peanut formula group also showed an increase in protein and energy intake above the adequacy rate compared to the other groups. The study conclude that the nutritional status of pregnant women who received peanut formula was higher than those who were given red bean, soybean, and formula milk for pregnant women. Moreover, energy and protein intake were higher in pregnant women who received peanut formula.

3.	The effect of giving peanut extract to increasing milk production in breastfeeding mothers in the village of Padang Baruas, North Padang Lawas Regency in 2020.	Batubara, et al. ¹ , Indonesia	Quasi Experimental	The intervention group was divided into two parts, namely pre-intervention and post-intervention with pregnant women as subjects.	The number of samples in this study were 15 people.	Questionnaire developed by researchers.	The results showed that giving peanut extract to pregnant women has a significant effect on increasing milk production with p value: 0.001 as many as 11 people (73.4%) of the total sample.
4.	Low-cost local food supplements could improve maternal and birth outcomes in Indonesia: A pilot randomised controlled trial	Susiloretni, et al. ¹⁷ Indonesia	RCT	The intervention group received LFS (local food supplements) and MMS (multiple micronutrient supplements). LFS is an energy balanced protein food supplement made from peanuts, chickpeas and fish. The control group received GFS (government food supplements) & iron and folic acid (IFA) supplements.	The intervention group was 30 people and the control group was 17 people.	Indonesian food nutrition survey software and structured interviews with questionnaires.	After 60 days of treatment, adherence to food and micronutrient supplements in the LFS group was 78.1% and 62.6% compared to 29.1% and 12.8% in the GFS group, respectively. After adjusting for baseline and main covariates, mothers in the LFS group were more likely to have increased MUAC (mean difference 0.60 cm; 95% CI 0.27, 0.92) and to increase gestational weight (mean difference 1.02 kg; 95% CI 0.08, 1.97) compared to mothers in the GFS group. For birth outcomes, the LFS group had a reduced risk of birth weight <3000 g (adjusted odds ratio [AOR] 0.15; 95% CI 0.02, 0.98), caesarean delivery (AOR 0.11; 95% CI 0.002, 0.60) and short birth length (AOR 0.07; 95% CI 0.01, 0.93) compared to the GFS group. Local food and MMS supplementation can improve maternal and child health at birth. Therefore, LFS administration may result in better adherence and better outcomes compared to centrally distributed GFS supplements.

5.	Prenatal fortified balanced energy-protein supplementation and birth outcomes in rural Burkina Faso : A randomized controlled efficacy trial.	Kok ¹⁸ , Belgia	RCT	Women in the intervention group aged 15 to 40 years with gestational age <21 weeks and received daily BEP supplements and IFA tablets for the duration of their pregnancy. BEP supplementation was LNS in the form of energy-dense peanut paste fortified with MMN. 393 kcal and consists of 36% lipid, 20% protein, and 32% carbohydrates. Protein comes from soybeans (61%), milk (25%), and peanuts (15%).	The intervention group (BEP and IFA) totaled 879 participants and the control group (IFA) amounted to 909.	Anthropometry, Body Mass Index (BMI), and Mid Upper Arm Circumference (MUAC).	The intervention significantly increased gestational duration (+0.20 weeks, 95%CI 0.05 to 0.36, p : 0.010), birth weight (50.1 g, 8.11 to 92.0, P = 0.019), birth length (0.20 cm, 0.01 to 0.40, P = 0.044), chest circumference (0.20 cm, 0.04 to 0.37, P = 0.016), arm circumference (0.86 mm, 0.11–1.62, P = 0.025), and decreased prevalence of LBW (–3.95 pp, –6.83 to –1.06, P = 0.007) as secondary outcome measures.
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From the interpretation of the results in table 6 the synthesis of the grid above demonstrates excellent effectiveness in the feeding of the main ingredients of beans along with other derivative products in various processes. Where it is mentioned and shown can increase body weight and upper arm circumference of pregnant women, improve nutritional status, show increased intake of protein and energy, increasing milk production in pregnant woman, and increasing the duration of pregnancy

For measurements or instruments in several studies conducted systematically using anthropometry, for monitoring the consumption of peanuts are the Food Frequency Quistionnaire (FFQ), subject characteristic questionnaires, nutrition surveys, Indonesian food nutrition survey software and structured interviews with questionnaires, Body Mass Index (BMI), and Mid Upper Arm Circumference (MUAC).

DISCUSSION

This systematic review aims to analyze and identify scientific evidence related to peanut supplementary feeding in preventing stunting babies in pregnant women during a Covid-19 pandemic. There are 5 articles reviewed which are intervention research where the research design is RCT and quasy experimental. All of the articles obtained, they were published from 2017 to 2022. The research was conducted in the United Kingdom, Indonesia and Belgium. All respondents in this study were pregnant women, breastfeeding mothers and infants/toddlers with a total sample of 15-909 samples.

Giving peanuts as additional food to pregnant women and toddlers in the context of preventing stunting can increase body weight and upper arm circumference of pregnant women, improve nutritional status, show increased protein and energy intake ^{3, 19,20}, increase milk production in pregnant women ¹, and increase the duration of pregnancy ¹⁸. However, giving peanuts should pay attention to allergic reactions in participants because this can create new problems for participants who will be intervened both in the community, family and health services ²¹.

From the source of the results of the research conducted a systematic review, it as

found that the measurement tool or instrument used was in the form of anthropometry ^{16, 5}, Food Frequency Quistionnaire (FFQ) ^{16, 3}, Body Mass Index (BMI)¹⁸, dan Mid Upper Arm Circumference (MUAC) ¹⁸.

In addition, in the assessment of articles using CASP, some investigators did not apply the method of blinding to some respondents, researchers, and members of the study. In research, the process of blinding is very important to prevent bias in the results of the study. In addition, in the assessment of articles using CASP, some researchers do not apply the method of blinding to some respondents, researchers, and members of the study. In research, the process of blinding is very important to prevent bias on the results of the research. By doing double blinding or single blinding this can affect the attitude of respondents or researchers in giving treatment to more objective respondents In addition, in the assessment of articles using CASP, some investigators did not apply the method of blinding to some respondents, researchers, and members of the study. In research, the process of blinding is very important to prevent bias in the results of the study. In addition, in the assessment of articles using CASP, some researchers do not apply the method of blinding to some respondents, researchers, and members of the study likes Feeney et al. (2017), Utami et al. (2017), Susiloretni et al. (2021). In research, the process of blinding is very important to prevent bias on the results of the research. By doing double blinding or single blinding this can affect the attitude of respondents or researchers in giving treatment to more objective respondents²¹.

The application of nutritious feeding to pregnant women and toddlers in the context of preventing stunting can increase body weight and upper arm circumference of pregnancy women, improve nutritional status, show increased intake of protein and energy, increasing milk production in pregnant females, and increasing the duration of gestation and can be applied to local populations.

.There are limitations to several articles being reviewed, namely not explaining how much/dose of peanuts is given, how to process peanuts, and how many times peanut consumption should be consumed to avoid

allergies when pregnant women and toddlers consume these additional foods.

CONCLUSION

Giving peanuts (*arachis hypogaea*) to pregnant women has a very significant effect in preventing stunting during the Covid-19 pandemic. This is because giving peanuts as additional food to pregnant women and toddlers in the context of preventing stunting can increase body weight and upper arm circumference of pregnant women, improve nutritional status, show increased intake of protein and energy, increasing milk production in pregnant women, and increasing the duration of pregnancy. However, the limitations of some articles obtained are some articles do not do blind in on giving treatment to participants, sample size some articles found little sample and group control in one of the articles is not done only group intervention alone. As well as the lack of information about the mother's pregnancy age, the age of the baby and young and the length of the intervention of each article.

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CONFLICT OF INTEREST

The authors declare that this article has no financial or personal relationship or interest that significantly influences the results of this research. All authors contribute to the extraction and categorization of data. Methods in each article are identified, categorized to themes, summarized and systematically synthesized.

REFERENCES

1. Batubara NS, Siregar RA. Pengaruh Pemberian Sari Kacang tanah Terhadap Peningkatan Produksi ASI pada Ibu Menyusui di Desa Padang Baruas Kabupaten Padang Lawas Utara Tahun 2020. *J Kesehat Ilm Indones*. 2021;6(1):115–20.
2. Rahmadhita K. Permasalahan Stunting dan Pencegahannya. *J Ilm Kesehat Sandi Husada*. 2020;11(1):225–9.
3. Utami NW, Majid TH, Herawati DMD. Pemberian minuman formula kacang merah, kacang tanah, dan kacang kedelai terhadap status gizi ibu hamil kurang energi kronis (KEK). *J Gizi Klin Indones*. 2017;14(1):1.
4. Lama TP, Moore K, Isanaka S, Jones L, Bedford J, de Pee S. Compliance with and acceptability of two fortified balanced energy protein supplements among pregnant women in rural Nepal. *Matern Child Nutr*. 2022;18(2).
5. Kok B De, Moore K, Jones L, Vanslambrouck K, Toe LC, Ganaba R, et al. Home consumption of two fortified balanced energy protein supplements by pregnant women in Burkina Faso. 2021;(December 2020):1–13.
6. WHO. Prevalence of stunting, height for age (modeled estimate, % of children under 5) [Internet]. 2020. Available from: <https://data.worldbank.org/indicator/SH.STA.STNT.ME.ZS>
7. Kementerian Kesehatan RI. Prevalensi balita gizi kurang menurut Provinsi di Indonesia (PSG) [Internet]. Indonesia; 2022. Available from: <https://www.bps.go.id/indicator/30/1773/1/prevalensi-balita-gizi-kurang->
8. Sukmawati, Hendrayati, Chaerunimah, Nurhumairah. Status Gizi Ibu Saat Hamil, Berat Badan Lahir Bayi Dengan Stunting Pada Balita. *Media Gizi Pangan*. 2018;25:19.
9. Rosmalina Y, Luciasari E, Aditianti, Emawati F. Upaya pencegahan dan penanggulangan balita stunting : systematic review. *J Indones Nutr Assoc*. 2018;41(1):1–14.
10. Pristya TYR, Fitri AM, Wahyuningtyas W. Literature Review : Gizi Antenatal terhadap Kejadian Stunting. *Kesehatan*. 2021;12:314–21.
11. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020

- statement: An updated guideline for reporting systematic reviews. *Int J Surg*. 2021;88(March).
12. CASP - RCT. Critical Appraisal Skills Programme - RCT. 2020;(September 2020):4–7.
 13. Joanna Briggs Institute. Critical Appraisal tools for Quasi-Experimental in JBI Systematic Reviews. *JBI Rev Man*. 2019;
 14. Johns Hopkins. Johns Hopkins Nursing Evidence-Based Practice Appendix C: Evidence Level and Quality Guide. 2017;1–3. Available from:
[https://www.mghpcs.org/EED/EBP/Assets/documents/pdf/2017_Appendix D_Evidence Level and Quality Guide.pdf](https://www.mghpcs.org/EED/EBP/Assets/documents/pdf/2017_Appendix_D_Evidence_Level_and_Quality_Guide.pdf)
 15. Higgins JPT, Altman DG, Gøtzsche PC, Jüni P, Moher D, Oxman AD. The Cochrane Collaboration 's tool for assessing risk of bias in randomised trials. 2011;1–9.
 16. Feeney M, Toit G Du, Roberts G, Sayre PH, Laswson K, Bahnson HT, et al. Impact of peanut consumption in the LEAP study : feasibility, growth and nutrition. *Physiol Behav* [Internet]. 2017;176(5):498–503. Available from:
<https://journals.lww.com/00006479-201842050-00005%0Ahttp://files/16/Wurdeman>
et al. - 2018 - Mobility Analysis of Amputees (MAAT I) Quality of.pdf
 17. Susiloretni KA, Nur D, Elisa S, Sunarto S, Astuti T, Rose E. Low-cost local food supplements could improve maternal and birth outcomes in Indonesia: A pilot randomised controlled trial. 2021;(July):321–31.
 18. Kok B de, Celine L, Id T, Id GH, Vanslambrouck K, Dailey-chwalibo T. Prenatal fortified balanced energy-protein supplementation and birth outcomes in rural Burkina Faso : A randomized controlled efficacy trial. 2022;(December 2020):1–21.
 19. Elisanti AD. Pemetaan Status Gizi Balita di Indonesia. *Indones J Heal Sci*. 2017;1(1):37.
 20. Palmer DJ, Sullivan TR, Campbell DE, Nanan R, Gold MS, Hsu PS, et al. PrEggNut Study : protocol for a randomised controlled trial investigating the effect of a maternal diet rich in eggs and peanuts from < 23 weeks ' gestation during pregnancy to 4 months ' lactation on infant IgE- mediated egg and peanut allergy outcomes. 2022;1–8.
 21. Kabisch M, Ruckes C, Seibert-Grafe M, Blettner M. Randomisierte kontrollierte studien: Teil 17 der serie zur bewertung wissenschaftlicher publikationen. *Dtsch Arztebl*. 2011;108(39):663–8.

Determinant Analysis of Hand Hygiene Compliance and Its Relation to HAIs in Hospitals: Systematic Literature Review

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ABSTRACT

Hand hygiene is one of the practical steps that healthcare providers can take to reduce the incidence of HAIs or nosocomial infections. The percentage of hand hygiene compliance is still low, between 35-55.3%. Several previous studies showed that many factors cause hand hygiene adherence. However, the results are still varied, so this study aimed to determine the factors of hand hygiene, determine the factors that most influence hand hygiene adherence, and the link between hand hygiene and the incidence of HAIs in hospitals. This systematic literature review follows the PRISMA protocol guidelines in three electronic databases (PubMed, Science Direct, and Google Scholar). Article quality was assessed using the JBI assessment tool and analyzed using meta-synthesis. The inclusion criteria are articles discussing hand hygiene compliance among hospital nurses and articles published in 2021-2023, so 15 selected papers. The determinants of hand hygiene compliance include knowledge, attitude, motivation, supervision from superiors or related parties, facilities, age, gender, years of service, and feedback. An electronic monitoring system also has significantly affected hand hygiene compliance. Several articles stated that the multimodal approach initiated by WHO positively impacted hand hygiene compliance. The most dominant factor is the knowledge variable. Hand hygiene compliance is closely related to the incidence of HAIs, when hand hygiene compliance is high, it can reduce the incidence of HAIs in health services.

Keywords: Hand Hygiene, HAIs, Nosocomial, Compliance.

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INTRODUCTION

Hand hygiene is an effective way to reduce the incidence of nosocomial infections. The prevalence of nosocomial infections is still high in both developed and developing countries. The results of several studies indicated that implementing good hand washing is one of the keys to reducing nosocomial infections in health services^{1,2,3}. However, based on the Global Report Infection

Prevention and Control 2021 - 2022, it is stated that the implementation of hand hygiene by health workers in health facilities is still below average with a compliance level of only 54.7%³. Compliance with the implementation of hand hygiene in Indonesia is still not in accordance with the standards set by the Indonesian Ministry of Health, namely 85%⁴. The previous studies showed that the average implementation of hand hygiene among health workers in hospitals ranges from 35% - 55.3%^{5,6}.

Health workers are obliged to carry out correct hand hygiene practices, especially when in contact with patients. The health workers who most often come into contact with patients are nurses⁷. Nurses in providing nursing services, of course, have intense contact with patients and the patient's family. Nurses, in providing nursing care, often carry out nursing procedures and actions that may come into contact with the patient's body fluids. This contact certainly creates a greater risk of HAI transmission.⁸ The results of the previous studies showed that the implementation of hand hygiene not in accordance with the guidelines.

Several literature studies stated that low hand hygiene compliance is caused by several causal factors among health workers. It also explains how hand hygiene is related to the incidence of HAIs, but the results are still varied. This literature review aims to provide information about what hand hygiene compliance has to do with the incidence of HAIs in health services, what determinants influence compliance with hand hygiene implementation among health workers, especially nurses, in implementing hand hygiene and what factors most influence hand hygiene compliance.

METHOD

The study was systematic literature Review. PRISMA protocol was used to select appropriate articles from three electronic databases (PubMed, Science Direct and Google Scholar/Google Scholar). The keywords used are adjusted to Medical Subject Headings (MeSH) and Boolean operators. The article was published in English and Indonesian from January 2021 – March 2023 with the keywords (Determinant) AND (Compliance) OR (Adherence) OR (Policy Compliance) OR (Protocol Compliance)) AND (Hand hygiene) OR (Hand Disinfection) AND (Nurse) AND (Hospital) AND (Healthcare Associated Infections). Search results for articles on PubMed found 68 articles, Science Direct 313 articles and Google Scholar 180 articles (Figure 1). Screening articles using the PICOS method as inclusion criteria: (1) the articles used by researchers are articles discussing the

determinants or factors causing hand hygiene compliance related to HAIs; (2) the population and sample are nurses in hospitals; (3) the results measured are determinants or factors causing hand hygiene compliance; (4) full text available. There were two screenings carried out, namely title screening which found 69 suitable articles and then abstract screening with 15 relevant articles. Article eligibility assessment was carried out using The JBI Critical Appraisal Tools. All articles had assessment results above 50% (Figure 1).

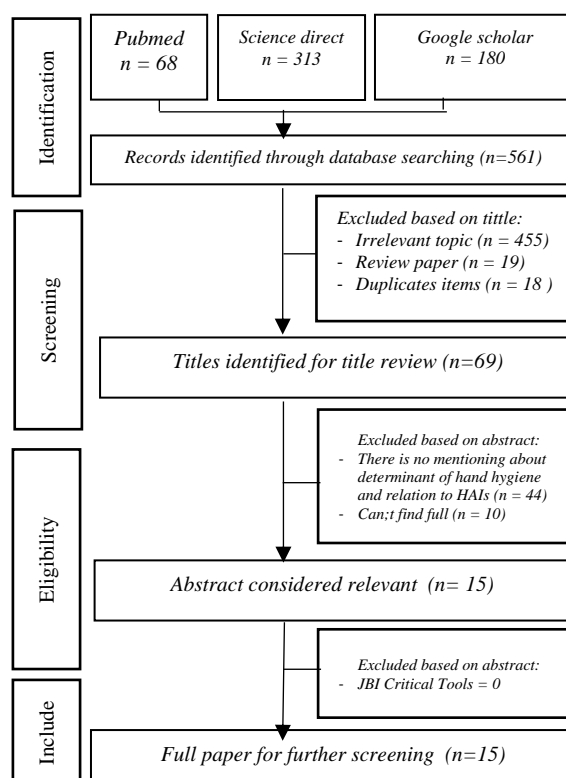


Figure 1. PRISMA Research Protocol

Data analysis used meta-synthesis because homogeneity analysis showed that the articles were not homogeneous. Researchers look for similarities (compare), differences (contrast) in each article, and criticize them according to theory and previous research. Then the researcher synthesized the results of the review articles in narrative form.

RESULTS

Table 1. Characteristics of respondents from articles included in the review

Author (s), year, country	Age (years)	Gender		Education Level
		Male	Female	
Rahim <i>et al.</i> , 2021 (Malaysia) ⁹	38	30	408	Diploma
Dewi <i>et al.</i> , 2022 (Indonesia) ¹⁰	≥25	38	52	Diploma
Umar <i>et al.</i> , 2022 (Ethiopia timur) ¹¹	18 - 35	298	137	Bachelor
Ayu <i>et al.</i> , 2022 (Indonesia) ¹²	30 - 41	19	73	Diploma
Gurning <i>et al.</i> , 2022 (Indonesia) ⁴⁰	17-45	46	23	Diploma

The average age of the nurses who were respondents was 38 years. Most respondents were dominated by women with a nursing diploma level of education. Three articles discuss the role of leadership, three articles discuss perceptions of hand hygiene and knowledge in which there is also a discussion of monitoring factors, five articles discuss acceptance of electronic hand hygiene systems and performance feedback, two articles discuss the influence of respondent characteristics on compliance. hand hygiene, two other articles discuss motivation, facilities and human resources which influence hand hygiene compliance. The research results of each article are explained in detail in Table 2.

Table 2. Research Description and Main Results of the studies reviewed

Author (s), year, country	Study methods (design, subjects, variables, instruments and analysis)	Main findings	Article quality
Rahim <i>et al.</i> , 2021 (Malaysia) ⁹	D <i>Cross-sectional</i>	Factors that influence hand hygiene behavior were perceived hand hygiene ($\beta = 0.260$; 95% CI: 0.020, 0.417; $p < 0.001$), pediatric department ($\beta = -0.014$; 95% CI: -9.335, -2.467; $p < 0.001$), orthopedic beta ($\beta = -5.957$; 95% CI: -9.539, -0.720; $p < 0.023$). Compared with pediatric and orthopedic departments, surgical departments have better hand hygiene compliance.	75%
	S 438 nurses		
	V Perceived of hand hygiene, sociodemographic characteristics, hospital departments		
	I Questionnaires		
	A Simple and multiple linear regression		
Dewi <i>et al.</i> , 2022 (Indonesia) ¹⁰	D <i>Cross-sectional</i>	The description of the interpersonal role of the head of the room in implementing hand hygiene compliance is good 52 (57.8%), the role of the head of the room in implementing hand hygiene compliance is good 65 (72.2%) and the role of the head of the room in making decisions regarding the implementation of hand hygiene is less than 50 (55.6%).	75%
	S 90 inpatient nurses		
	V Overview of leadership roles, implementation of hand hygiene		
	I Questionnaires		
	A Univariate analysis (mean, median, standard deviation, CI, maximum value, (frequency distribution and proportions)		
Knudsen <i>et al.</i> , 2021 (Denmark) ¹³	D <i>Quasi-experimental</i>	Hand hygiene compliance among doctors and nurses increased significantly during the intervention phase and received follow-up group and individual feedback from electronic hand hygiene monitoring systems (EHHMs) with a p value > 0.001 for doctors and nurses. The incidence rate per 10,000 patient days in the first control (July 2018) was 14.7, the second control was 19.1 after receiving intervention with an incidence rate of 0.	100%
	S 99 inpatient nurses in the nephrology department		
	V Electronic-based hand hygiene monitoring, incident rates, patients treated and hand hygiene compliance		
	I <i>Elektronik hand hygiene monitoring system (EHHMSs)</i>		
	A <i>Log rank test</i>		

Hastuti et al., 2021 (Indonesia) ³⁰	D	Cross-sectional	The factor related to hand hygiene compliance is knowledge $p = 0.005$. Factors that are not related to hand hygiene behavior were attitude ($p=0.619$), motivation ($p=1.000$), and work experience ($p = 1.000$).	87,5%
	S	87 nurses		
	V	Knowledge, attitude, motivation and work experience, hand hygiene		
	I	Questionnaire and observation guide		
Umar et al., 2022 (Ethiopia timur) ¹¹	A	Chi square test	Overall hand hygiene compliance was 37.4% [95% CI (0.33, 0.42)]. The mean knowledge score was 21.6% (SD: 2.08). In addition, there was a statistically significant relationship between hand hygiene compliance and gender, work experience, hand hygiene training, availability of running water, and knowledge of hand hygiene.	100%
	D	Cross-sectional		
	S	436 nurses		
	V	Sociodemographic characteristics, work experience, training, availability of running water, knowledge and compliance with hand hygiene		
Ayu et al., 2022 (Indonesia) ¹²	I	Questionnaire and observation guide	There is a relationship between motivation and compliance with five moments hand hygiene ($p=0.009$), and there is no relationship between the level of knowledge and compliance with five moments hand hygiene ($p=0.158$)	100%
	A	Binary logistic regression model and Hosmer-Lemeshow test		
	D	Cross-sectional		
	S	92 nurses		
Gurning et al., 2022 (Indonesia) ⁴⁰	V	Sociodemographic characteristics, knowledge, motivation and five moments hand hygiene compliance	There is a relationship between knowledge and supervision of hand hygiene compliance ($p=0.001$; $p=0.003$).	75%
	I	Questionnaire and observation guide		
	A	Spearman rho correlation test		
	D	Cross-sectional		
Budianto et al., 2021 (Indonesia) ⁴²	S	69 nurses in the inpatient room	There is a significant relationship between supervision by the head of the room and hand hygiene compliance ($p=0.001 < 0.05$)	100%
	V	Head of room supervision and hand hygiene compliance		
	I	Questionnaire and observation guide		
	A	Chi square test		
Kibira et al., 2022 (Kenya, Afrika)	D	Correlative descriptive	Hand hygiene indications/moments, location, professional category of health workers (nurse, midwife, doctor, student, other health staff) and department have a significant relationship to hand hygiene compliance. Moments after exposure to body fluids and after patient contact had higher compliance values, namely (aOR 1.43; 95% CI 1.17 -1.74; $p=0.01$) and before aseptic procedures had lower values with values (aOR 0.93; 95% CI 0.08-0.17 ; $p=0.01$) and the internal medicine department had a higher compliance value compared to the surgery department.	100%
	S	56 nurses		
	V	Hand hygiene indication/moment, location, health worker professional category, department, hand hygiene behavior		
	I	Observation guidelines		
Ataiyero et al., 2023 (Nigeria) ¹⁴	A	Mixed effects logistic regression	Barriers and facilitators in implementing hand hygiene consist of individual and institutional factors, namely (1) knowledge, skills and	100%
	D	Interpretative (qualitative) approach		
	S	12 nurses and 4 doctor		

	V	Barriers and facilitators of hand hygiene	education; (2) perception of the risk of infection to oneself and others; (3) influence of other people; (skin disorders). Institutional factors are (1) environment and resources; (2) workload and staffing levels	
	I	<i>In depth interview</i>		
	A	The interview results were transcribed and analyzed in Nvivo (version 12)		
Blomgren <i>et al.</i> , 2021 (Sweden) ¹⁵	D	Qualitative descriptive	There is positive acceptance of the electronic hand hygiene reminder system and it is able to change the behavior of respondents. Regarding knowledge, respondents said that employees received training and education about hand hygiene. Attitudes, subjective norms and behavioral control show positive acceptance of the electronic hand hygiene reminder system.	100%
	S	38 respondents (nurses, assistants and doctors)		
	V	Perception of acceptance of the electronic hand hygiene reminder system, knowledge, attitudes, subjective norms and behavioral control		
	I	Semi-structured interview guide		
	A	Analysis with focus group discussion		
Ojanpera <i>et al.</i> , 2022 (Finlandia) ¹⁶	D	Longitudinal observational study	Direct observation and feedback significantly improved hand hygiene to both doctors and nurses over an eight year period. The level of hand hygiene compliance has increased in both medical wards and surgical wards. The implementation of hand hygiene among nurses is higher than doctors with respective values, namely in medical wards of OR=3.36; 95% CI=2.90.90; p=0.001 while in the surgical ward OR=9.85%; 95% CI=8.9, 10.8; p=0.001	100%
	S	24,614 nurses and 6,396 doctors		
	V	Hand hygiene moments, wards (medical, surgical), direct observation, feedback related to hand hygiene		
	I	Observation guidelines		
	A	Poisson regression model, multivariable logistic regression analysis		
Iversen <i>et al.</i> , 2021 (Denmark) ⁴⁸	D	Prospective observational study	Doctors and nurses have significantly improved hand hygiene in patient rooms and work spaces. The p value = 0.001 for the doctor in the patient's room and the p value = 0.006 in the work room. Meanwhile, nurses in patient rooms have a p value = 0.005 and p value = 0.001 in the work room. Hand hygiene compliance increases significantly with the encouragement of light sensors on the dispenser tube and data-based performance feedback using automatic hand hygiene	100%
	S	26 nurses dan 10 doctor		
	V	Hand hygiene compliance for nurses and doctors, automatic hand hygiene systems		
	I	Automatic hand hygiene monitoring		
	A	T independent test		

DISCUSSION

Respondent characteristics

The average age of respondents in this study was 38 years. In line with other research, the increasing age of a person influences his mindset at work, especially safety for himself¹⁷⁻²⁰. The theory of age maturity states that the maturity of a person's thinking is influenced by age, where someone who is said to be old enough will also have thoughts and behavior that are more rational and can adapt to the surrounding circumstances²¹. Most of the respondents in this review were women. One study conducted in Saudi Arabia stated that

female nurses were more compliant with hand hygiene than male nurses²². Other literature stated that women dominate in providing services²³. Another factor that influences hand hygiene compliance is education. Previous research results show that the higher a person's education, the more likely they are to comply with hand hygiene. The higher a person's level of education, the easier it is to receive material or input from other people and the broader their insight^{18,19}.

Factors influencing hand hygiene compliance

Several literatures convey in their

research results that one of the factors causing hand hygiene compliance is knowledge. The higher the knowledge, the better the behavior displayed by a person, in this case hand hygiene²⁴⁻²⁸. Notoatmodjo (2010) states that a person's knowledge influences behavior.

Nurses who worked more than 2 years had higher compliance than nurses who worked <2 years^{17,29}. Disagreeing with the research above, other research states that a person's work period does not affect hand hygiene compliance³⁰. However, there is a theory which states that a longer working period creates more effective employee performance because they can control various situations according to previous experiences. Candra (2018) stated that length of service influences employee skills at work. Years of work provide experience so that a worker's professionalism increases. Workers who have worked longer have adapted to the environment so they are better able to handle problems and make decisions³².

A person's attitude and motivation can also influence hand hygiene compliance^{27,33,34}. Harlinisari (2018) stated that attitude has a positive and significant influence on behavior, the better the attitude, the better the behavior that appears. A person's attitude is driven by motivation. The higher the nurse's motivation, the higher the chance of compliance with hand hygiene implementation^{12,18,36-38}.

Hand hygiene behavior is not only influenced by internal factors, but also external factors, one of which is the role of the leader which is applied in the form of supervision. Supervision here is intended to provide support and direction so that the implementation of hand hygiene is in accordance with Standard Operating Procedures (SOP) and WHO provisions. The PPIRS leadership and team have an important role in carrying out the supervisory function. Based on the results of the review, it was found that the higher the level of supervision, the better the nurse's performance in implementing hand hygiene. Supervision that is not carried out routinely provides a 2 times greater chance of not carrying out hand hygiene³⁹⁻⁴². Astuti et al. (2023) stated in their research results that supervision is a strong factor that influences nurses' compliance performance. The success of a work program depends on how the organization's functions can be carried out⁴⁴.

Based on several review articles, facilities are one of the supports that have an

influence on compliance with hand hygiene implementation. Handrub bottles are often empty in health care facilities, the distance between sinks and services is an obstacle to hand hygiene compliance, thus providing an opportunity 2 times greater than the availability of supporting facilities^{39,45,46}. WHO states that to increase the implementation of hand hygiene, a multimodal strategy is needed. One of the approaches taken is changing the system by providing alcohol-based hand rub on a regular basis in addition to providing wash basins and antiseptic soap. This approach has been empirically proven to be able to increase hand hygiene compliance⁴⁷.

Apart from that, performance feedback is needed by employees or staff to evaluate their activities while working. Several research findings stated that hand hygiene compliance increases after direct monitoring and feedback. Hand hygiene compliance increased 10.8% (86.2% to 95.5%) in medical wards. Surgical wards also experienced an increase of 32.7% (67.6% to 89.7%). Overall the implementation of hand hygiene increased significantly for nurses by 17.8%.¹⁶ Other research stated that feedback strategies are effective in improving nurses' performance in implementing hand hygiene. The feedback strategy is one of the approaches initiated by WHO which is combined into a multimodal strategy. This strategy includes (1) system change; (2) training & education; (3) evaluation & feedback; (4) reminders in the workplace; (5) institutional safety climate^{48,49}.

The selected articles in this study were dissimilar to the respondents' intake and intervention. Some articles use total sampling while others only focus on nurses in several wards. This can be explained that all nurses have the same obligation to carry out hand hygiene⁵⁰. Several articles convey research limitations related to research instruments. Researchers used self-assessed questionnaires so there was a possibility of bias. Validity and reliability testing needs to be carried out to ensure that the questionnaire items can measure what they are supposed to measure and ensure that the instrument can be used on the same object to produce the same data⁵¹.

Compliance with hand hygiene and its relationship with the incidence of HAIs in hospitals

Compliance with hand hygiene or washing hands is still low. The percentage of hand hygiene compliance is still at 59%, not reaching the predetermined standard, namely 85%. The implementation of the five moments in hand hygiene is still not implemented optimally. The percentage before contact with patients was 66.7%, before asepsis measures 73.4%, after contact with body fluids 100%, after patient contact 100% and after environmental contact 86%. It is known that the implementation of hand hygiene moments is lowest before patient contact, while the highest percentage is after contact with body fluids and after patient contact⁵².

The incidence of HAIs or nosocomial infections is closely related to compliance with hand hygiene or hand washing, where hands are the main medium of contact between health workers and patients or the environment around the health service area. Low compliance with hand hygiene is certainly one of the triggers for high levels of nosocomial infections. Compliance with the five moments and six steps of hand hygiene is very important in preventing the occurrence of HAIs⁵³.

Increased hand hygiene compliance is in line with a decrease in the incidence of nosocomial infections or HAIs. The higher the level of hand hygiene compliance can reduce the incidence of HAIs in health services. Based on literature studies, increasing hand hygiene by 10.8% can reduce the incidence of HAIs by 15.9% in medical wards. The percentage of hand hygiene in surgical wards increased by 32.7% and reduced the incidence of HAIs from 13.7% to 12.0 per 1000 patients¹⁶.

Windyastuti, et al. (2020) stated that the incidence of nosocomial infections is closely related to hand washing compliance. Not only health workers, but hand washing compliance also has an impact on patients. Based on the 30 respondents studied, only 1 person (3.3%) complied with the implementation of the five moments and six steps of hand hygiene, which did not result in nosocomial infections or HAIs, while 7 (23.3%) other respondents did not carry out hand hygiene according to the procedure, resulting in 22 (73.3%) people exposed to nosocomial infections.

CONCLUSIONS

Based on the results of the literature review, it can be concluded that the factors

causing hand hygiene compliance are knowledge, attitude, motivation, supervision from superiors and the hospital infection control team, facilities, age, gender, length of service and feedback. The most dominant variable is the knowledge factor. Hand hygiene compliance is closely related to the incidence of HAIs, where when hand hygiene compliance is high it can reduce the incidence of HAIs in health services. Future research can consider factors that influence and do not influence hand hygiene compliance as an intervention. We recommend further research regarding the implementation of multimodal strategies that have been designed to determine their effectiveness and impact on hand hygiene compliance. The use of in-depth methodology and direct research can be carried out, for example group discussions with related parties, knowing the perceptions of hospital managers regarding hand hygiene can be explored more deeply so that it is related to the commitment to providing adequate hand hygiene facilities.

REFERENCES

1. Windyastuti, Widyastuti NKA, Kustriyani M. Hubungan kepatuhan cuci tangan enam langkah lima momen dengan kejadian infeksi nosokomial di ruang dosen program studi nursing widya husada Semarang Dosen Program Studi Nursing Widya Husada Semarang Email. Proceeding Widya Husada Nurs Conf [Internet]. 2019;118–28. Available from: <http://journal.uwhs.ac.id/index.php/whnc/article/view/291/296>
2. Tumiwa FF. Hubungan pengetahuan dan sikap tentang pencegahan infeksi nosokomial dengan kepatuhan perawat dalam mencuci tangan di IGD RSUP. Prof. Dr. R.D. Kandou Manado. Gastron ecuatoriana y Tur local. 2019;2(2):5–24.
3. World Health Organisation. Global report on infection prevention and control [Internet]. 2022. 1–182 p. Available from: <http://apps.who.int/bookorders>.
4. Kementerian Kesehatan Republik Indonesia. Panduan cuci tangan pakai sabun [Internet]. 1st ed. Kesehatan Lingkungan. Jakarta; 2020. p. 1–34. Available from: 1212

- https://kesmas.kemkes.go.id/assets/upload/dir_519d41d8cd98f00/files/Panduan_CTPS2020_1636.pdf
5. Ferdinah R. Gambaran Perilaku Hand Hygiene Dan Determinannya Pada Perawat Di Ruang Rawat Inap Gedung X Rumah Sakit Y Jakarta Tahun 2017. UIN Syarif Hidayatullah Jakarta; 2017.
 6. Caesarino RI, Wahjono H, Lestari ES. Tingkat kepatuhan perawat rumah sakit x di Semarang Terhadap Pelaksanaan Cuci Tangan. *Diponegoro Med J (Jurnal Kedokt Diponegoro)* [Internet]. 2019;8(2):852–9. Available from: <https://ejournal3.undip.ac.id/index.php/medico/article/view/23834>
 7. Henderson J, Willis E, Roderick A, Bail K, Brideson G. Why do nurses miss infection control activities? A qualitative study. *Collegian* [Internet]. 2020 Feb;27(1):11–7. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S1322769619300885>
 8. English KM, Langley JM, McGeer A, Hupert N, Tellier R, Henry B, et al. Contact among healthcare workers in the hospital setting: developing the evidence base for innovative approaches to infection control. *BMC Infect Dis* [Internet]. 2018 Dec 17;18(1):184. Available from: <https://bmcinfectdis.biomedcentral.com/articles/10.1186/s12879-018-3093-x>
 9. Abd Rahim MH, Ibrahim MI, Md Noor SS, Fadzil NM. Predictors of self-reported hand hygiene performance among nurses at tertiary care hospitals in east coast Malaysia. *Int J Environ Res Public Health*. 2021;18(2):1–10.
 10. Dewi F, Hayati M, Yusrawati Y. Determinan peran kepemimpinan kepala ruang terhadap kepatuhan perawat dalam melaksanakan hand hygiene di RSUD Cut Meutia Aceh Utara. 2022;1(6):945–53.
 11. Umar H, Geremew A, Worku Kassie T, Dirirsa G, Bayu K, Mengistu DA, et al. Hand hygiene compliance and associated factor among nurses working in public hospitals of Hararghe zones, Oromia region, eastern Ethiopia. *Front Public Heal*. 2022;10.
 12. Ayu, SD, Dewi TK, Juhana C. Hubungan pengetahuan dan motivasi perawat terhadap kepatuhan melakukan five moment hand hygiene di RSUD Sayang Kab. Cianjur. *Malahayati Nurs J*. 2020;4(3):537–55.
 13. Knudsen AR, Kolle S, Hansen MB, Møller JK. Effectiveness of an electronic hand hygiene monitoring system in increasing compliance and reducing healthcare-associated infections. *J Hosp Infect* [Internet]. 2021;115:71–4. Available from: <https://doi.org/10.1016/j.jhin.2021.05.011>
 14. Ataiyero Y, Dyson J, Graham M. The barriers and facilitators to hand hygiene practices in Nigeria: A qualitative study: “There are so many barriers the barriers are limitless.” *Am J Infect Control* [Internet]. 2023;51(3):295–303. Available from: <https://doi.org/10.1016/j.ajic.2022.10.013>
 15. Blomgren PO, Lytsy B, Hjelm K, Swenne CL. Healthcare workers’ perceptions and acceptance of an electronic reminder system for hand hygiene. *J Hosp Infect* [Internet]. 2021;108:197–204. Available from: <https://doi.org/10.1016/j.jhin.2020.12.005>
 16. Ojanperä H, Ohtonen P, Kanste O, Syrjälä H. Impact of direct hand hygiene observations and feedback on hand hygiene compliance among nurses and doctors in medical and surgical wards: an eight-year observational study. *J Hosp Infect*. 2022;127:83–90.
 17. Rozi AN. Hubungan antara karakteristik dengan kepatuhan perawat dalam melaksanakan hand hygiene di rumah sakit islam sultan agung Semarang. Vol. 14, Universitas Sultan Agung Semarang. Universitas Sultan Agung Semarang; 2021.
 18. Handayani NLP, Suarjana IK, Listiyowati R. Hubungan Karakteristik, Pengetahuan dan motivasi perawat dengan kepatuhan cuci tangan di ruang rawat inap RSU Surya Husadha Denpasar. *Arch Community Heal*. 2019;6(1):9.
 19. Iriandoko OW, Chalidyanto D. The relationship between characteristics of health workers on handwashing behavior. *J Medicoeticolegal dan Manaj Rumah Sakit*. 2020;9(2).

20. Octaviani E, Fauzi R. Analisis faktor yang berhubungan dengan kepatuhan mencuci tangan pada tenaga kesehatan di RS Hermina Galaxy Bekasi. *J Kedokt dan Kesehat*. 2020;16(1):12–9.
21. Jalinus N, Verawardina U, Krismadinata. Buku Model Flipped Blended LearninG [Internet]. 1st ed. Jawa Tengah: VC. Sarnu Untung; 2020. Available from: https://www.google.co.id/books/editio n/PERBEDAAN_PEMBERIAN_ASI_EKSLUSIF_DAN_NON/w_uZEAAAQBAJ?hl=id&gbpv=1&dq=teori+tenta ng+usia+berpengaruh+pada+kematang an+berfikir&pg=PA63&printsec=front cover
22. Mohaithef M AL. Assessing hand hygiene practices among nurses in the Kingdom of Saudi Arabia. *Open Public Health J* [Internet]. 2020 May 23;13(1):220–6. Available from: <https://openpublichealthjournal.com/V OLUME/13/PAGE/220/>
23. Indiyani, Saparwati M, Susilo E. Persepsi perawat terhadap fungsi pengarahannya kepala ruang tentang kepatuhan dalam menjalankan hand hygiene di ruang rawat inap. *Indones J Nurs Res*. 2020;3.
24. Kurnia S, Hastuti W, Fadilla AI, Apriansyah S, Kurniawidi Hastuti i k mu ad acid CP. Faktor-faktor yang berhubungan dengan kepatuhan perawat dalam pelaksanaan hand hygiene di ruang rawat inap salah satu rumah sakit swasta di Yogyakarta perkenalan kewaspadaan universal merupakan upaya pencegahan infeksi nosokomial (inos) yang wajib dilak. 2021;10(2):177–88.
25. Anugrahwati R, Hakim N. Faktor-faktor yang mempengaruhi kepatuhan perawat dalam melakukan hand hygiene five moments di Rs. Hermina Jatinegara. *J Ilm Keperawatan Altruistik*. 2019;2(1):41–8.
26. Kurniasari E, Ilham MIA. Hubungan pengetahuan dan pengalaman kerja tenaga kesehatan terhadap kepatuhan 5 moments hand hygiene di ruang maternitas Rsud I Lagaligo Wotu Tahun 2021 Relationship of Knowledge and Work Experience of Health Workers to Compliance with 5 Moments of Hand H. 2023;6(1):20–31.
27. Chairani, Riza S, Putra Y. Hubungan pengetahuan dan sikap pencegahan infeksi nosokomial dengan kepatuhan perawat dalam mencuci tangan di ruang rawat inap terpadu rumah sakit umum daerah Aceh Besar tahun 2022 Knowledge and Attitudes about Prevention of Nosocomial Infections with Nur. *J Healthc Technol Med* [Internet]. 2022;8(2):1293–302. Available from: <https://jurnal.uui.ac.id/index.php/JHT M/article/download/2397/1239>
28. Sembiring R, Rahayu P, Todingbua CLT. Hubungan pengetahuan perawat dengan kepatuhan mencuci tangan berdasarkan standar operasional prosedur di ruang ICU dan ruang HCU saraf rumah sakit umum Jayapura. *Sentani Nurs J*. 2021;3(2):36–43.
29. Nia A., Mahfud, Admanto P. Hubungan lama kerja dengan kepatuhan perawat dalam melaksanakan sop hand hygiene di ruang dahlia dan anggrek RSUD Panembahan Senopati. Universitas Alma Ata Yogyakarta; 2020.
30. Hastuti SKW, Fadilla AI, Apriansyah S. Factors related to nurse compliance in the implementation of universal precaution in the inpatient room one of private hospital in Yogyakarta. *JMMR (Jurnal Medicoeticolegal dan Manaj Rumah Sakit)*. 2021;10(2):177–88.
31. Rohman R. PMIK Berani Bertransformasi [Internet]. Nasrudin M, editor. Jawa Tengah: Penerbit NEM; 2023. Available from: https://www.google.co.id/books/editio n/PMIK_Berani_Bertransformasi/Xo W9EAAAQBAJ?hl=id&gbpv=1
32. Muhdar. Manajemen SDM: Teori dan aplikasi pada bank umum syariah - rajawali pers [Internet]. 1st ed. Hidayati, editor. Depok: PT. RajaGrafindo Persada; 2020. Available from: https://www.google.co.id/books/editio n/Manajemen_SDM_Teori_dan_Aplik asi_Pada_Ba/ykwaEAAAQBAJ?hl=id &gbpv=0
33. Bambang Sumardi, Omega Dr Tahun, Angel Berta Fau. Hubungan Pengetahuan Dan Sikap Dengan

- Kepatuhan perawat dalam melakukan penerapan standar cuci tangan. *J Antara Keperawatan*. 2020;3(2):42–9.
34. Iskandar R. Correlation between behavior and nurse's compliance in hand hygiene five movement at inpatient ward in Sleman general hospital. *J Kesehat Bakti Tunas Husada J Ilmu-ilmu Keperawatan, Anal Kesehat dan Farm*. 2019;19(1):124–32.
 35. Harlinisari R. Hubungan faktor individu dan organisasi terhadap kepatuhan bidan menerapkan standar prosedur operasional cuci tangan. *J Adm Kesehat Indones [Internet]*. 2018 Dec 7;6(2):103. Available from: <https://e-journal.unair.ac.id/JAKI/article/view/7439>
 36. Dwi RA, Suryani D. Factors influencing nurses' compliance level in the application of hand hygiene in inpatient wards of muntlan general hospital. *J Medicoeticolegal dan Manaj Rumah Sakit*. 2019;8(1):40–7.
 37. Laila SA, Zainaro MA. The Correlations of Motivation and Attitude To Obedience of Nurse. *MALAHAYATI Nurs J*. 2020;2(1):68–82.
 38. Surya DP. Hubungan motivasi dengan tingkat kepatuhan tenaga kesehatan dalam melakukan five moments hand hygiene pada era pandemi di klinik rawat inap dr. M. Suherman Universitas Muhammadiyah Jember. *J Pengabdian Kpd Masy [Internet]*. 2021;4(1):1–8. Available from: <http://ejournal.bsi.ac.id/ejurnal/index.php/abdimas>
 39. Mariani P. Faktor - faktor yang berhubungan dengan kepatuhan perawat dalam melakukan hand hygiene di RSUD Lahat tahun 2021. *Sekol Tinggi Ilmu Kesehat Bina Husada*. 2021;
 40. Gurning M, PH WM, Rahayu NLPD. Hubungan pengetahuan dan pengawasan dengan perilaku hand hygiene untuk pencegahan infeksi nosokomial pada perawat di ruang rawat inap. 2022;15(September):74–7.
 41. Komala Dewi RR. Faktor determinan kepatuhan perawat dalam melakukan praktik cuci tangan Di RSUD Ade Muhammad Djoen Sintang. *J Kesmas (Kesehatan Masyarakat) Khatulistiwa*. 2019;4(4):232.
 42. Budianto A, Setyaningrum I, Prastiani DB. Hubungan Supervisi oleh Kepala Ruang dengan Kebiasaan Cuci Tangan Perawat Pelaksana di Rumah Sakit Mitra Keluarga Tegal. *JITK Bhamada*. 2021;12(1):60–5.
 43. Astuti W, Pujiyanto TI, Nurhayati S. The supervision and transformational leadership styles on nurses' compliance in prevention and control of infection risks at a hospital in Kotamobagu, Indonesia. *GHMJ (Global Heal Manag Journal) [Internet]*. 2023 Feb 8;6(1):11–7. Available from: <https://publications.inschool.id/index.php/ghmj/article/view/928>
 44. Gunawan, Yendra, Sudirman A, Naningsih N, Suyatno A, Muhammad S, et al. dasar-dasar manajemen (konsep, prinsip, dan teori) [Internet]. Hartini, editor. Jawa Barat: Media Sains Indonesia; 2023. Available from: <https://www.google.co.id/books/editio> n/Dasar_Dasar_Manajemen_Konsep_Prinsip_dan/qcileAAAQBAJ?hl=id&gbpv=0
 45. Aidi S, Ni Made Utami D, Desak P. Y K. Evaluasi program dan hambatan pelaksanaan hand hygiene di RS “X” BALI. *J Penelit dan Kaji Ilm Kesehat [Internet]*. 2020;6(1):31–41. Available from: www.lppm-mfh.com
 46. Sulisno M, Nurmalia D, Warsito BE, Jannah AM, Ulliya S, Santoso A, et al. Hubungan peran tim pencegahan dan pengendalian infeksi (tim ppi) dan fasilitas cuci tangan dengan kepatuhan cuci tangan perawat. *Holist Nurs Heal Sci*. 2022;5(1):23–33.
 47. Shen L, Wang X, An J, An J, Zhou N, Sun L, et al. Implementation of who multimodal strategy for improvement of hand hygiene: a quasi-experimental study in a traditional chinese medicine hospital in Xi'an, China. *Antimicrob Resist Infect Control [Internet]*. 2017 Dec 20;6(1):98. Available from: <http://aricjournal.biomedcentral.com/articles/10.1186/s13756-017-0254-4>
 48. Iversen AM, Stangerup M, From-Hansen M, Hansen R, Sode LP, Kostadinov K, et al. Light-guided

- nudging and data-driven performance feedback improve hand hygiene compliance among nurses and doctors. *Am J Infect Control*. 2021;49(6):733–9.
49. Sakihama T, Kayauchi N, Kamiya T, Saint S, Fowler KE, Ratz D, et al. Assessing sustainability of hand hygiene adherence 5 years after a contest-based intervention in 3 Japanese hospitals. *Am J Infect Control*. 2020;48(1):77–81.
 50. Menteri Kesehatan Republik Indonesia. Peraturan Menteri Kesehatan Republik Indonesia Nomor 27 Tahun 2017 [Internet]. 27 Indonesia; 2017 p. 2–20. Available from: http://hukor.kemkes.go.id/uploads/produk_hukum/PMK_No._27_ttg_Pedoman_Pencegahan_dan_Pengendalian_Infeksi_di_FASYANKES_.pdf
 51. Sugiyono. Metode penelitian kuantitatif kualitatif dan R&D. kedua. Sutopo, editor. Bandung: Penerbit Alfabeta; 2019. 144–147
 52. Marfu'ah S, Sofiana L. Analisis tingkat kepatuhan hand hygiene perawat dalam pencegahan infeksi nosokomial. *Kes Mas J Fak Kesehat Masy* [Internet]. 2018;12(1):29–37. Available from: <https://core.ac.uk/download/pdf/295186766.pdf>
 53. Nzanga M, Panulo M, Morse T. Kepatuhan terhadap kebersihan tangan di antara perawat dan dokter di rumah sakit Distrik Chiradzulu , Malawi Selatan. 2022.

Implementation of A QR-Coded Model for Stakeholders and Managers of Traditional People's Markets

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ABSTRACT

Health education for market residents to change behavior to create a healthy market can be done using pocketbooks, videos, and posters as the model chosen to create a healthy people's market. Socialization to stakeholders in each market is essential in making this happen. This research aims to determine the delivery mechanism, media either through barcode scans, so that stakeholders can easily convey the source of healthy market messages to traders and buyers to change the habits of market residents which originates from pocketbooks, videos, and posters, to stakeholders, including market managers, to be passed on to traders and buyers or visitors. This research used a qualitative descriptive method focusing on media delivery via QR Barcodes (pocketbooks, videos, and posters). The population in this study are stakeholders related to market management and cleanliness. The sample in this study used a quota sampling technique of 22 people, data collection used focus group discussion (FGD), and qualitative data analysis. The message delivery mechanism by implementing QR Barcodes can make it easier for stakeholders to convey healthy market messages to market residents. Traders want to create a healthy market by participating in spreading information about healthy markets through QR Barcodes. Respondents' most preferred medium for disseminating information is via WhatsApp social media, although suggestion boxes are still one way to channel complaints regarding obstacles in accessing healthy market information.

Keywords: *Implementation, QR Model, Stakeholders, Healthy Market.*

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INTRODUCTION

People's Markets in Indonesia from 28 provinces analyzed by the Ministry of Health in 2017, especially the environmental health conditions of markets 448 People's Markets; it is known that of the total markets analyzed, only 10.94% met the requirements, the remaining 89.06% did not meet the requirements¹. This condition is very concerning because it can increase the risk of transmission and spread of disease, both directly and indirectly, as well as other health problems². The impact is that

people can shop at modern markets; the conditions are cleaner and feel more comfortable compared to traditional markets or people's markets, especially in cities, which are currently felt³. The Healthy Market Approach is an effort that is integrative and synergistic with various other efforts that can guarantee clean, safe, comfortable, and healthy market conditions so that all activities in the market can run by their objectives and designation⁴. Socialization to stakeholders in each market is an essential factor in realizing healthy public market management. Therefore, commitment

and active participation of stakeholders are needed to develop a healthy market⁵.

The facts show that the perception of research market residents in 2021 (buyers, traders, and market managers) was that the majority said that the cleanliness of the aisles, tidiness, and availability of rubbish disposal sites in the panorama market was adequate, d) Meanwhile, the same perception was conveyed with a poor assessment of this aspect, separation of clean and dry waste, e) the manager's role in the socialization of healthy markets and the slogan of healthy people's markets.

Health education for market residents to change behavior to create a healthy market can be done using pocketbooks, videos, and posters as the model chosen to form a healthy people's market⁶. The media that has been perfected according to the plan will be applied next year, to increase knowledge of the attitudes and actions of market residents to participate in keeping people's markets clean and healthy to create a healthy people's market model:



Figures 1 and 2 QR-Code of a healthy market

As mobile technology becomes more prominent in our daily lives, mobile tagging with QR Barcode (Quick Response) in the business sector is prevalent worldwide. However, the movement to use QR Barcodes in education is still in its infancy. Apart from our research in this area, this paper explores the possibilities beyond the simple use of code and offers some suggestions on how the technology can be used to its full potential⁷.

The method for delivering health messages offered by researchers to managers, traders, and buyers at people's markets uses QR Barcodes, especially to convey health messages. The integration of QR Barcodes has been carried out in several studies. As has been done on aspects of listening and speaking skills in Malaysia on the periodic aspects of elements at the secondary school level and as an alternative media for scanning learning resources at the kindergarten level. The use of

QR Barcodes in the context of delivering healthy market materials using pocketbooks, videos, and posters in combination with delivering them on Google Drive to market people in Indonesia, exceptionally healthy people's market materials has never been done. Based on these opportunities, researchers tried implementing QR Barcodes and Google Drive to provide healthy people's market materials.

This research aims to determine the delivery mechanism, media either through barcode scans or other means, so that it is easy to understand the source of the message to change the behavior of market residents, which originates from pocketbooks, videos, and posters, to stakeholders including market managers, to be passed on to traders and buyers or visitors.

METHOD

This research used a qualitative descriptive approach to data collection using the FGD method, which previously prepared general and specific questions/guidelines regarding efforts to change behavior using the QR Barcode method, processing and analyzing using the reduction method, display data, conclusion drawing Miles, and Huberman (2018), focuses on delivering healthy people's market media through (pocketbooks, videos and posters) as a healthy people's market model which is contained in labels displayed on healthy people's market banners, and can be shared via the WhatsApp application with stakeholders, intended as a media delivery mechanism between buyers and market visitors and mechanisms to buyers and market visitors.

The population in this research are stakeholders related to market management and cleanliness in public markets, such as the Health Service, Trade and Industry Service, Market Service, city planning and environmental services, health centers, health policy lecturers, and market managers. The research was carried out at Panorama. Bengkulu City. The sample in this study used a *quota sampling technique* of 22 people, this number represents all elements of stakeholders who play a role in creating a healthy people's market, data collection using FGD, and qualitative data analysis according to stakeholder opinions and quantitatively in the form of percentage answers.

RESULTS

The FGD was held at the Panorama Market office on the second floor in the middle of the market on October 4 at 13.00 WIB until it was finished. The FGD was attended by 22 participants: the Head of the Market, the market manager, two Poltekkes lecturers from the D3 Sanitation Study Program, and the Applied Bachelor of Health Promotion Study Program in Healthy People's Markets.

Market residents, in this case (traders, buyers, and visitors), can participate in creating a healthy market according to the respondents' answers. Nine people answered yes, four answered yes, and three answered yes, as explained below.

"This is possible because traders, after selling, throw away rubbish in a designated place (JA), they can participate in making the market healthy (SR), yes, because it is essential for market progress, such as primary cleanliness."

Next, the FGD participants were asked whether they agreed with using media, pocketbooks, videos, and posters to create a healthy people's market, Agree, strongly agree, and can be 68.75%, 18.75%, and 12.%, respectively, such as the answers of FGD participants as follows:

"Agree because it can create awareness of the meaning of healthy living in a market environment (JA). Agree with the mass media so that traders and visitors know (AW) Yes, very much agree; for the sake of the continuity of a healthy market itself, traders/buyers understand what a healthy market is (EV) Can be a supporter of creating a healthy market (HK)."

Regarding the question of choosing the most appropriate media to socialize a healthy market, half of the respondents chose posters (50%), almost half chose videos (43.75%), and a small portion chose pocketbooks (6.26).

"Posters because they are easier to follow and implement (JA) Posters, because they can be seen immediately when installed around the market environment (SR) Posters because they are easier for the

public to see and read directly, Posters because easy to understand (D) Posters because they will be seen more often (AT) Posters are easier to understand and comprehend (S)."

"videos are easy to understand and more interesting (LJ) videos because they are easy to understand directly with pictures and clear explanations (R) videos because they are more interesting and do not get bored watching them (W) Videos because they are more interesting than posters or pocketbooks and easier to understand (EV) Video because it is more interesting and easier to understand (Y), video because it can be easily imitated directly (HK)."

"Pocketbook, so it is easy to re-read and understand it better (AT)."

"It is delivered directly to traders when they go to the field (Y) so that it is easier to understand and can discuss (SR); all market managers must create a WA group of market traders to convey it (JA) so that it is more practical to find out information about the healthy market itself (AW)."

The advantage of direct delivery is that it can be received through the sense of sight and hearing and several types of reception senses at once. This group approach is in line with what states that the group approach provides many opportunities for interaction and obtaining feedback. However, this method only reaches the target group and only reaches other farmers who join the farmer group. Respondents were asked how to evaluate to ensure whether traders accessed healthy market information. Respondents answered as follows:

"...by creating a WA group of traders who have been exposed to the media so that they can be evaluated (JA), ...conveying it directly to traders when they go to the field (Y), ...seeing changes in behavior by maintaining cleanliness (S), ...seeing the implementation of traders and market visitors maintaining cleanliness around the trading environment (SR)."

Barcode installation location for easy access. Scans by visitors, stakeholders, and FGD participants with opinions are posted in...

"..... it is placed for visitors at market entrances (ER), in busy and strategic places visited by traders, on stall walls and market entrances, gates entering the market because it is easier for everyone to see when entering the market (JA) Placed in strategic locations, for example in the culinary market and morning market and which is most visited by buyers (EV), at the main entrance to the Pamorama market, at the morning market, at the market office itself (HK)"

How do we disseminate information to traders and visitors about bar codes containing healthy market pocketbooks, healthy market videos, and healthy market posters other than through the WA Group?

".... Communicate directly to traders and visitors when entering the market (W), Can provide verbal understanding of the location of the poster containing the healthy market barcode (HK), Make announcements in the market using loudspeakers (TOA) so that traders can hear them directly market (SR), Put up posters in strategic locations (AW)...."

Next, stakeholders were asked how we are getting visitors interested and willing to know the Healthy People's market by scanning the Healthy People's market barcode.

"....By socializing directly with traders or visitors (HK) Explaining how to use barcodes (LJ) By introducing examples of healthy markets from other cities or regions (W), (EV), (Y) Disseminating through print & electronic media (AT), Creating barcodes that are attractive and do not fade easily, are easy to access (D).."

How do you evaluate whether healthy market media has been read and understood or implemented?

".... .By asking directly to traders and visitors (LJ) and by asking market visitors

(Y)(AT), It is clear that the environment is clean and neatly arranged (S)(W) (EV) (D)(SR), By looking at the increasingly neat and clean market conditions (R)...'

How do I discover the obstacles and suggestions for improving information delivery to traders, buyers, and visitors to the healthy people's market? Stakeholders have the following opinions.

"... through the WA group which has created a Poster (LJ), by creating a suggestion box at least 5 points at each market entrance (SR)(JA), by accepting input from the WA group or setting up a suggestion box (W) (AT) (D)(R) Conducting interviews with traders and visitors (AW) (D)..."

When asked which media, between pocketbooks, videos, and posters, can we improve together shortly? Most stakeholders think of posters, followed by videos. Like the following answer.

"... Poster (D)(HK)(Y)(S) (AW)(W)(LJ), Video (SR) (AT)Video and poster (R)(EV), Book (JA).. ."

Is there a mechanism or other way to change the behavior of market residents to create a healthy people's market? Apart from using Barcode scans as offered, stakeholder suggestions and input are varied.

".... By making rubbish dumps everywhere and making clean hand washing places (R)(W) (SR) If you can provide cleaning equipment such as rubbish bins, etc. (LJ) By applying the discipline of throwing rubbish in its place and living net (EV) reward and punishment system if traders and merchants violate cleanliness (AW) (D) Controlling traders who sell on the roadside (D D)(S), by going directly to the field to provide socialization and even providing rubbish bins so that there can be a healthy market (HK)(Y)"

DISCUSSION

Traders are willing to participate in creating a healthy traditional market. Responses regarding the question indicate whether traders

are willing to participate in creating a traditional market. Social participation is participation in which the community gets involved in social activities for the common good. Community participation in social forms in Ngadiprono Hamlet has gone better since the existence of the Papringan Market. Community participation in the social form carried out by the people of Ngadiprono Hamlet is cooperation. This was done because public awareness about cleanliness and a healthy environment exists⁸. Community participation is essential in achieving success and sustainability of development programs. Participation means the conscious participation of a person or group in an activity⁹.

Furthermore, stakeholders agreed to use educational media, such as pocketbooks, videos, and posters, to create and change the behavior of traders to create healthy traditional markets. Most market managers, stakeholders from the Market Service, Health Department, representatives of health polytechnic lecturers, and sword coordinators use media to create a healthy people's market, using pocketbooks, videos, and posters. Like previous research on PHBS health education using video media, most respondents were in a good category. This is because there is an influence before and after health education using video media on the level of knowledge regarding PHBS¹⁰. Posters are effectively used as a health communication medium because their physical appearance is attractive, made using color, and the content of the message is helpful for the reader¹¹.

When market traders were asked which media was most accessible to understand, including pocketbooks, videos, and posters, the reason was that half of the respondents chose posters mostly (50%), almost half chose videos (43.75%), and a small portion chose pocketbooks (6.26). Based on the research results, it is known that visitors can see the posters at the installation site because the place is quite spacious. Apart from the size of the place where the poster is installed, the poster place is a unique attraction when visitors are around the place of installation. Visitors are interested in reading hypertension posters because the poster's position is appropriate to the eye's view, so it is easy to read¹².

Respondents chose posters and video media more because posters and booklets have advantages, namely: (1) Clients can adapt from independent learning; (2) Users can view the

contents at leisure; (3) Information can be shared with family and friends, (4) Easy to create, reproduce and correct and easy to adapt; (5) Reduces the need for note-taking; (6) Can be made simply at relatively low cost; (7) Durable; (8) Wider capacity; (9) Can be directed at specific segments. The advantages of video media are that it makes it easier for teachers to present information, has appeal, and is interactive. Video media can also be used repeatedly¹⁰.

Panorama market managers (eight people) and five representatives of traders from 35 blocks deliver video and poster booklets to all traders. What mechanism should they use? Hearing and several kinds of reception senses at once. This group approach is in line with what states that the group approach provides many opportunities for interaction and obtaining feedback. However, this method only reaches the target group and does not reach other farmers who do not join the farmer group¹³.

Market traders want education through social media, compared to print media. WhatsApp social media is used to disseminate health information to people who use this media; for example, cadres convey information about vaccine implementation. Information was sent via WhatsApp as a reminder to RT, RW, and Subdistrict Head. This party can convey it directly to residents in each hamlet¹⁴. Health education using posters and videos can change people's behavior in a healthier direction when facing COVID-19¹⁵.

Market traders agree to use QR barcode media placed in strategic locations. According to previous research, this media banner is installed in front of the entrance to the health center, in front of the village office, in front of the posyandu, and in other affordable public places¹⁵.

Stakeholders suggest that swords should always be reminded to read electronic education continuously so that healthy behavior changes occur. There has been much input from stakeholders to attract visitor interest. In line with QR Barcode-based digital literacy in Bonto Jai Village, Bissappu District, Bantaeng Regency, it has made it easier for village communities to access information related to education and various other information needed by the community.

Then, to evaluate whether traders access the QR barcode or not, stakeholders suggest continuous evaluation. Most

stakeholders think that after socializing healthy markets by scanning QR barcodes and observing changes in the behavior of market residents, especially by implementing clean and healthy markets, which are reflected in the environment, the better the management of traditional markets that are competitive, healthy, clean, safely and orderly can be implemented¹⁶.

Suppose there are obstacles in accessing healthy market information. In that case, most stakeholders believe that a suggestion box is still needed, and some ask directly to traders and visitors and other opinions via the WA group. The continuation of healthy market education can be followed up with other efforts to create a healthy market. In connection with this, a healthy market approach is needed to create conditions for people's markets that are comfortable and free from health problems and disease transmission. The healthy market approach is a business that is integrated and synergizes with various other businesses that can create clean, safe, comfortable, and healthy market conditions so that the market can run by its goals and functions⁴.

CONCLUSION

The conclusion is the message delivery mechanism to change trader behavior can be done by implementing QR Barcodes. Traders wish to create a healthy market by participating in disseminating information about a healthy market through QR Barcodes. The media that respondents most want to disseminate information is WhatsApp. One way to channel complaints regarding obstacles to accessing healthy market information is to use WhatsApp, although the suggestion box can still be used.

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CONFLICT OF INTEREST

At this moment, the author declares that there are no personal or institutional conflicts of interest that might be deemed to inappropriately influence the representation or interpretation of the reported research results.

REFERENCES

1. Thohira MC, Rahman F. Tata Kelola Sanitasi Lingkungan Pasar Rakyat Menuju Pasar Sehat Era New Normal di Kota Yogyakarta. *Hiegene*, 2021; 7(3), 110-18. Retrieved from https://www.researchgate.net/publication/370914822_Tata_Kelola_Sanitasi_Lingkungan_Pasar_Rakyat_Menuju_Pasar_Sehat_Era_New_Normal_di_Kota_Yogyakarta
2. Marinda D., Ardillah Y. Implementasi Penerapan Sanitasi Tempat-tempat Umum Pada Rekreasi Benteng Kuto Besak Kota Palembang. *Jurnal Kesehatan Lingkungan Indonesia*, 2019; 18(2): 89-97.
3. Rufaidah P. Peran Teknologi Komunikasi Dalam Rantai Nilai Pedagang Di Pasar Tradisional. *Jurnal Sosioteknologi*, 2008; 7(14), 399-414.
4. Kementerian Kesehatan Republik Indonesia. *Peraturan Menteri Kesehatan Nomor 17 Tahun 2020 tentang Pasar Sehat*. Kementerian Kesehatan Republik Indonesia; 2020.
5. Sulistyio H., Cahyono, B. Model Pengembangan Pasar Tradisional Menuju Pasar Sehat di Kota Semarang. *Jurnal Ekonomi dan Bisnis*, 2010; 11(2): 516-26.
6. Roby A., Apriyanto R. Menciptakan Model Pasar Tradisional Sehat Di Bengkulu Ditinjau dari Persepsi Pedagang Pembeli dan Pengelola Pasar. *Dunia keperawatan: Jurnal Keperawatan dan Kesehatan*, 2022; 10(3): 349-362.
7. Agustang A., Suardi S., Putra ADM., Oruh S. Pemberdayaan Guru Mata Pelajaran Sosiologi Melalui Literasi Digital Berbasis Quick Response Code di Kecamatan Bissappu Kabupaten Bantaeng. *Abdi: Jurnal Pengabdian Dan Pemberdayaan Masyarakat*, 2021; 3(2), 175-188.

8. Putro BW. Partisipasi Masyarakat dalam Mengembangkan Pasar Papringan Ngadiprono Ngadimulyo Kedu Temanggung Jawa Tengah. *Journal of Society and Continuing Education*, 2023; 4(3): 568-578.
9. Ndraha T. *Pembangunan Masyarakat: Mempersiapkan Masyarakat Tinggal Landas*. Jakarta: Rineka Cipta; 1990.
10. Mulyadi MI, Warjiman W, Chrisnawati C. Efektivitas Pendidikan Kesehatan Dengan Media Video Terhadap Tingkat Pengetahuan Perilaku Hidup Bersih Dan Sehat. *Jksi*, 2018;3(2). Available from: <http://journal.stikessuakainsan.ac.id/index.php/jksi/article/view/111>
11. Sumartono S., Astuti H. Penggunaan poster sebagai media komunikasi kesehatan. *Komunikologi: Jurnal Ilmiah Ilmu Komunikasi*, 2018; 15(1), 8-14
<https://komunikologi.esaunggul.ac.id/index.php/KM/article/view/187>
12. Amelia, N. *Prinsip etika keperawatan*. Yogyakarta: D-Medika; 2013.
13. Van den Ban, AW., Hawkins HS. *Agricultural extension* (No. 2. ed.). Blackwell Science; 1996.
14. Prasanti D., Fuady I. Pemanfaatan Media Komunikasi Dalam Penyebaran Informasi Kesehatan Kepada Masyarakat (Studi Kualitatif tentang Pemanfaatan Media Komunikasi dalam Penyebaran Informasi Kesehatan di Desa Cimanggu, Kab. Bandung Barat). *Reformasi*, 2018; 8(1), 8-14.
15. Rahmatina LA., Erawati M. Evaluasi program edukasi dengan video dan poster terhadap perilaku masyarakat dalam menghadapi Covid-19 (preliminary study). *Holistic Nursing and Health Science*, 2020; 3(1), 9-16.
16. Darmawan D. Faktor Komunikasi Kebijakan Dalam Pengelolaan Pasar Tradisional (Suatu Studi di Kota Pontianak). *Proyeksi: Jurnal Ilmu-Ilmu Sosial dan Humaniora*, 2015; 20(2), 1-6.

Evaluation of Toxoplasmosis in Female College Students

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ABSTRACT

Female students are a group of women of childbearing age who can become pregnant and have risk factors for toxoplasmosis which can cause pregnancy disorders, birth defects, and death. Seroepidemiological studies of toxoplasmosis in women are essential to determine whether infection occurs in the early stages of fertilization or earlier. The research aimed to determine the incidence of toxoplasmosis in female college students. This research was carried out in June 2023 and has received ethical recommendations from KEPK Poltekkes Kemenkes Semarang. The type of research used was analytical descriptive. Sampling used purposive sampling. The inclusion criteria were 87 students who were willing to have their blood taken. Blood is taken using the venipuncture method, then the whole blood is separated from the plasma. Plasma samples were collected and analyzed for the presence of anti-Toxoplasma gondii using the ELISA method. Then the data was analyzed using SPSS software, univariate analysis to determine the frequency distribution and percentage of each variable. The results showed that 31 students were positive for IgG anti-Toxoplasma gondii. Of these, the majority aged 20 years (n = 20, 16.1%) were positive for anti-Toxoplasma gondii IgG. Toxoplasmosis infection of 9.2% occurred in female college students who owned cats, 3.4% occurred in female college students who consumed undercooked meat, and 29.8% of female college students who consumed raw vegetables. Female college students have risk factors for Toxoplasma gondii infection so it is important to carry out screening so that Toxoplasma gondii can be detected and treated immediately.

Keywords: ELISA, Female Student, IgG, Toxoplasma gondii.

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INTRODUCTION

Toxoplasmosis is one of the zoonotic diseases caused by *Toxoplasma gondii*¹. Toxoplasmosis cases are also common in humans. Humans can be infected with this disease by acquired or congenital. Human infection is acquired through several means including consumption of undercooked meat from infected animals, consumption of unpasteurized milk, direct or indirect contact with oocysts from the environment, vertical transmission during pregnancy, blood transfusions, and organ transplantation².

Toxoplasma gondii infection is

generally asymptomatic in immunologically healthy adults. Only 10-20% of toxoplasmosis cases in children and adults show symptoms. Mild symptoms of primary infection include localized, painless cervical or occipital lymphadenopathy, usually lasting for 4-6 weeks, or nonspecific symptoms including myalgia, headache, rash, or sore throat that persist for a month or more. However, it can cause a variety of clinical complications in immunocompromised patients. In immunocompromised patients it develops eye problems, mental retardation and congenital infections in children born to infected mothers, and abortions in pregnant women. If this

infection occurs during the first and second trimesters of pregnancy, it can manifest severe symptoms, such as low birth weight, hydrocephalus, intracranial calcification, and ectinocoroiditis that can be recognized at birth. Infection in the third trimester of pregnancy can result in hearing loss, visual impairment, and developmental delays^{2,3,4}.

The incidence of toxoplasmosis varies greatly by country and age. The prevalence rate of this parasite in the world ranges from 10% - 90% depending on social habits, climatic conditions, geographical region, socioeconomic level of society, eating habits, prevalence of contact with cats, environment, hygiene and sanitary conditions, age, sex, ethnicity, medical history, and immunogenetic characteristics affect the seropositive rate. In Indonesia, cases of toxoplasmosis in animals range from 6–70%, while in humans between 43–88%^{5,6}. Based on research by Darmawan (2018) and Humaryanto (2019) on women of childbearing age in Jambi, 34% and 60% of positive IgG were found^{7,8}. Another study in Central Java on male and female populations (covering Purworejo, Kebumen, Cilacap, Banyumas, Purbalingga, Banjarnegara and Wonosobo) showed a positive IgG of 90%⁹.

The diagnosis of toxoplasmosis is still based on the detection of different types of antibodies, each of which is interpreted differently. Toxoplasmosis is usually diagnosed by serologic tests of *Toxoplasma gondii*-specific IgG and IgM antibodies. These tests are generally enzyme-based immunoassay or immunofluorescence tests. *Toxoplasma gondii* immunoglobulin M (IgM) antibodies are used to determine the presence of a new infection. *Toxoplasma gondii* immunoglobulin G (IgG) antibodies to see whether there is a chronic infection caused by the *Toxoplasma gondii* parasite^{10,11}.

People who may be at high risk of contracting this parasite include pregnant women and people with weakened immune systems. Women of childbearing age are a group that has the potential to become pregnant. This population group has risk factors for toxoplasma infection that result in abnormalities during pregnancy, disability and fetal death¹². Seroepidemiological studies of toxoplasmosis in women of childbearing age are essential to determine whether the infection occurs in the early stages of conception or

earlier. Female students of childbearing age group will potentially have risk factors to get adverse effects on the occurrence of toxoplasma infection. Therefore, it is very necessary to screen for toxoplasma in the childbearing age group, to detect toxoplasma so that it can be treated immediately. The purpose of the study was to evaluate the incidence of toxoplasmosis in college students.

METHOD

This study is a type of analytical descriptive research, where research was conducted to evaluate toxoplasmosis in female students. The research was conducted at the Laboratory of the Department of Health Analysts, Poltekkes Kemenkes Semarang on May 25 - June 7, 2023. The research population was 101 female students aged 18-23 years in semester 2 and semester 4. Samples were taken using purposive sampling. The inclusion criteria are that students are willing to have their blood taken and then tested for anti-toxoplasma IgG. Based on informed consent, 87 students were willing to have their blood taken. This research does not use controls.

The material used in the study was a whole blood sample with EDTA anticoagulant. The tools used are ELISA washer, ELISA reader, incubator, centrifuge, micropipette, yellow-tip, beker glas, vacutainer, syringe, tourniquet, cotton alcohol 70%. This research received ethical recommendations from the Health Research Ethics Committee of the Health Polytechnic, Ministry of Health, Semarang Number 0480/EA/KEPK/2023.

After consent was obtained, study participants were interviewed to obtain information regarding sociodemographic status as well as epidemiological risk factors. Habits associated with *Toxoplasma gondii* infection in this study include age, place of residence, cat ownership, consumption of undercooked meat, and consumption of raw vegetables (lalapan). A 3 cc blood sample was collected from the participant by venipuncture method. Blood samples are stored overnight in the fridge at 400C. The plasma was separated from the whole blood sample by centrifugation for 10 minutes at a rate of 3000 rpm at room temperature. The plasma is separated from the red blood cells and transferred to an eppendorf tube to measure IgG. Plasma is stored in a

freezer with a temperature of -200C until use. Plasma samples were tested for *Toxoplasma gondii* using indirect ELISA.

All samples were tested in the laboratory of the Department of Health Analyst Poltekkes Kemenkes Semarang. After collecting samples, frozen plasma was thawed at room temperature and evaluated for *Toxoplasma gondii* IgG antibodies using the BIOENZYME Enzyme-Linked Associated Commercial Assay Immunosorbent Test Kit (ELISA). Based on the manufacturer's instructions, a positive or negative control is added 50 µl to the plate. Add 10 µl of sample and 40 µl of sample diluent, mix, incubate for 30 minutes at 37⁰ C. Next wash 5 times and add solution of substrate A and substrate B, incubating in the dark for 10 minutes at a temperature of 37⁰ C. Add 50 µl stop solution. Read OD values within 15 minutes at 450 nm using an ELISA reader. Samples with OD samples < cut off values are considered negative for anti-IgG *Toxoplasma gondii* and OD samples ≥ positive cut off values.

Data analysis was performed with the SPSS 25 software program. Data analysis uses univariate analysis, to find out the frequency and percentage distribution of each variable. The collected research data is presented in tabular form and narrated briefly.

RESULTS

The results of the study are presented in Table 1 and Table 2. Plasma samples were taken from 87 female students from semesters 2 and 4 of the D3 Medical Laboratory Technology Study Program. Of these, 12 (13.8%) participants were 18 years old, 38 (43.7%) were 19 years old, 35 (40.2%) were 20 years old, 1 (1.1%) was 22 years old and 1 (1.1%) was 23 years old. The majority of students live in boarding houses (n=75, 84.3%) and only (n=12, 13.5%) live in parental homes as shown in Table 1.

Table 1. Characteristics of Respondents

	Positive IgG	Negative IgG	Total
Age (years)			
18	4 (4.6%)	8 (9.2%)	12 (13.8%)
19	12 (13.9%)	26 (29.8%)	38 (43.7%)
20	14	21	35

	(16.1%)	(24.1%)	(40.2%)
22	1 (1.1%)	0	1 (1.1%)
23	0	1 (1.1%)	1 (1.1%)
Semester			
2	12 (13.7%)	27 (31%)	39 (44.7%)
4	19 (21.8%)	29 (32.5%)	48 (54.3%)
Status of residence			
Kos	27 (31%)	48 (55.2%)	75 (86.2%)
Parents' house	4 (4.6%)	8 (9.2%)	12 (13.8%)

Plasma samples were examined for the presence of anti-*Toxoplasma gondii* IgG antibodies using the ELISA method. Among the 87 samples collected, 31 (35.6%) samples were positive for anti-*Toxoplasma gondii* IgG which means they had anti-*Toxoplasma gondii* IgG and 56 (64.4%) negative anti-*Toxoplasma gondii* IgG, as shown in Table 2. Table 2 shows Habits associated with *Toxoplasma gondii* infection. The habit associated with the incidence of *Toxoplasma gondii* infection was seen in cat ownership (9.2%), while the consumption of cooked stega meat was the least (3.2%). Twenty-six people consume raw vegetables (29.8%).

Table 2. Habits associated with *Toxoplasma gondii* infection.

Variable	IgG positive (n=31; 35.6%)	IgG negative (n=56; 64.4%)
Cat ownership		
Yes	8 (9.2%)	9 (10.3%)
No	23 (26.4%)	47 (54%)
Consumption of undercooked meat		
Yes	3 (3.4%)	38 (43.6%)
No	28 (32.2%)	18 (20.6%)
Consumption of raw vegetables		
Yes	26 (29.8%)	37 (42.5%)
No	5 (5.7%)	19 (21.8%)

DISCUSSION

Toxoplasmosis is an infection caused by an intracellular protozoan called *Toxoplasma gondii*. Transmission of this disease is more prevalent in warm and humid areas and is caused by intracellular obligate protozoan parasites. High humidity and warm

climate, which can affect the survival of *Toxoplasma gondii* oocysts in the environment, can provide favorable conditions for the development of *Toxoplasma gondii*. Individuals can become infected by eating raw or undercooked meat, or by ingesting eggs released by cats in contaminated soil, water or food, or transplacental transmission of tachyzoites. Although most cases of this infection in immunocompetent individuals are asymptomatic but if this infection occurs in pregnant women it can lead to congenital toxoplasmosis with severe pathological effects on the fetus such as retinochoroiditis, mental disability and abortion, stillbirth, and fetal death¹³.

The immune system plays an important role in the prevention of toxoplasmosis through innate immune mechanisms and adaptive immune responses. Toxoplasmosis stimulates two types of immune responses; humoral and cellular immune responses, the first of which is associated with the formation of extracellular and invasive active tachyzoites in the circulation. Antibodies are produced by stimulating B lymphocytes (B cells); known as IgM, IgG, IgA and IgE. These antibodies functionally work on eradicating infection and eliminating parasites found free in body fluids by activating supplement pathways and the catalytic activity of the immune system¹⁴.

One way to prevent congenital toxoplasmosis is to detect IgG in women of childbearing age before marriage. Women of childbearing age are the best group to evaluate immunity to toxoplasmosis^{12,15}. Early diagnosis of toxoplasmosis, especially in women of childbearing age, is recommended because the disease can cause miscarriage, stillbirth or congenital toxoplasmosis in their babies while they are pregnant¹⁶.

In this study we found that 35.6% of college students aged 18-23 years had seropositive for the IgG antibody *Toxoplasma gondii*. These results are in line with research findings from Al Zaheb (2017) and Al-Kadassy et al (2018) using the ELISA method in women of childbearing age who found toxoplasma IgG antibodies were also found at the age of 18-23 years^{12,17}. The seropositive value in this study was significantly higher than the prevalence reported in women of childbearing age from Yogyakarta, seropositive IgG *Toxoplasma* in premarital women aged 20-25 years by 32.2%,

20% seropositive IgG *Toxoplasma* aged 26-30 years and 3.3% seropositive IgG *Toxoplasma* aged 31-35 years¹⁸.

Measurement of anti-*Toxoplasma gondii* IgG in serum/plasma/other body caian using ELISA method. The parasite antigen is superimposed on the hole of the ELISA plate. After incubation with serum/plasma assay, species-specific anti-immunoglobulin antibodies labeled with enzymes or antibody-binding proteins conjugated to the enzyme (e.g., to peroxidase or alkaline phosphatase) are applied to report antigen-specific reactions, i.e. the extent to which antibodies bind to parasitic antigens. In the last step, a substrate is added that is converted by the enzyme into colored reaction products. Absorbance or optical density (OD) is measured with a spectrophotometer¹⁹.

ELISA is mainly used for routine screening of *Toxoplasma gondii* infection because it is very sensitive (allows quantitative and semi-quantitative antibody measurement), can be easily used to test large populations in a short time, with the ability to detect IgG and IgM²⁰. With 97% specificity and 100% sensitivity, serological tests such as ELISA are considered one of the best laboratory methods for determining serum toxoplasmosis antibody levels¹⁵.

Toxoplasma gondii antibodies are indicative of *Toxoplasma gondii* infection, and the infection lasts a long time (generally lifelong). Significant levels of IgM antibodies to viruses, bacteria, or other infectious agents are interpreted as a sign of acute infection, whereas high specific IgG levels are consistent with persistence of immunity in the convalescent phase after prior infection²¹.

IgM anti-*Toxoplasma gondii* is known as a marker of acute infection that appears earlier and declines faster than IgG antibodies. IgM antibodies are often first detected after primary infection. The diagnosis of newly acquired *Toxoplasma gondii* infection is generally based on detection of specific IgM antibodies, followed by detection of specific IgG antibodies 1-3 weeks later.¹¹ IgG antibodies to *Toxoplasma gondii* can be detected 1-2 weeks after infection. It usually peaks in 1-2 months and decreases at different rates. Because it can last a lifetime at residual titers, these antibodies are an indicator of previous infection. These antibodies are used as

diagnostic markers for chronic infection²⁰.

A positive IgG result indicates past infection, but cannot provide information on when the infection occurred. Serological results may vary depending on the individual, his immune background, and the serological techniques used. In the clinic, serologic detection of IgM and IgG antibody levels is the basis for identifying infections and the most commonly used methods^{22,23,24}.

Several female collage students who participated in this study owned cats and tested positive for *Toxoplasma gondii* IgG antibodies. The results obtained from this study are different from Enitan's research (2020), where respondents kept cats as pets and none of these categories tested positive for *Toxoplasma gondii* IgG antibodies²⁵. Stray cats defecating in parks and sandboxes can put some people at risk of contracting *Toxoplasma gondii*, whether they own cats or not²⁶. Cats that do not receive routine toxoplasmosis vaccinations may be at higher risk of infection with *Toxoplasma gondii*. Cats are the definitive host for *Toxoplasma gondii*. The *Toxoplasma gondii* parasite reproduces in the cat's body until it reaches the oocyst stage which the cat excretes in its feces. To prevent your cat from contracting Toxoplasma, bathe your cat frequently, pay attention to the type of cat food you give it, and vaccinate your cat against *Toxoplasma gondii*²⁷. Humans can also contract *Toxoplasma gondii* infection when they swallow raw meat containing tissue cysts²⁸.

Many female collage students who consume raw vegetables still test positive for *Toxoplasma gondii* anti-IgG. Transmission of *Toxoplasma gondii* by consumption can occur when oocysts containing sporozoites are orally contaminated with contaminated food. Although packaged and ready-to-eat fresh vegetables pose a low risk, these products have been shown to be contaminated with pathogenic microorganisms and could theoretically pose a risk of toxoplasmosis²⁸.

Our study has some limitations. First, we did not use an IgM test that could help determine if a woman-acquired *Toxoplasma* infection was recent. Secondly, it would be ideal to include more samples, but this is not possible due to financial constraints. This study provides information that female students are at risk of *Toxoplasma* infection. Hence the need to raise awareness about toxoplasmosis, especially

the mode of transmission, so that women can take steps to protect themselves and avoid contracting this parasite.

CONCLUSION

Anti-IgG *Toxoplasma gondii* was found in female students. The most positive results of toxoplasmosis are found at the age of 19 years. This study provides new epidemiological data on the seroprevalence of *Toxoplasma gondii* infection in women of childbearing age from college students. The serological status of women of childbearing age provides information about immunity, which can help to prevent congenital infections by identifying women at risk. This research can be useful information for health policymakers for counseling and screening programs. Early diagnosis of toxoplasmosis, especially in women of childbearing age, is recommended as premarital preparation. For further researchers, they can increase the number of examination samples and add anti-*Toxoplasma gondii* IgM examination.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest. We conducted this research with full transparency and free from any outside influence that could harm this research, including any personal or professional relationships that could be construed as a conflict of interest.

REFERENCES

1. Türkmen Albayrak H. Evaluation of *Toxoplasma gondii*, Rubella virus and Cytomegalovirus Infections in Pregnant Women. *Anatol J Fam Med*

- [Internet]. 2020;3(2):136. Available from: <http://dx.doi.org/10.5505/anatoljfm.2020.22932>
2. Nayeri T, Sarvi S, Moosazadeh M, Amouei A, Hosseini Z, Daryani A. The Global Seroprevalence of Anti-Toxoplasma gondii Antibodies in women who had Spontaneous Abortion: A Systematic Review and Meta-analysis. *PLoS Negl Trop Dis* [Internet]. 2020;14(3):1–27. Available from: <http://dx.doi.org/10.1371/journal.pntd.0008103>
 3. Seran VJT, Kepel BJ, . F. Seroepidemiologi Toksoplasmosis pada Masyarakat di Desa Kumu Kabupaten Minahasa Tahun 2015. *J e-Biomedik* [Internet]. 2016 Jan 27;4(1):1–5. Available from: <http://dx.doi.org/10.35790/ebm.4.1.2016.10841>
 4. Thái TL, Jun H, Park SH, Lê HG, Lee J, Ahn SK, et al. Seroprevalence of Toxoplasma gondii among School Children in Pyin Oo Lwin and Naung Cho, upper Myanmar. *Korean J Parasitol* [Internet]. 2019;57(3):303–8. Available from: doi: 10.3347/kjp.2019.57.3.303
 5. Direktorat Kesehatan Hewan. Manual Penyakit Hewan Mamalia [Internet]. 2nd ed. Manual Penyakit Hewan Mamalia. Jakarta: Subdit Pengamatan Penyakit Hewan, Dirjen Peternakan dan Kesehatan Hewan; 2014. 1–479 p. Available from: <https://repository.pertanian.go.id/items/a8331c3c-dfa3-449d-9b1c-4c2eef3e83a2>
 6. Colak M, Asin N. Evaluation Of Toxoplasma gondii Seroprevalence and IgG Avidity Test Results Among Childbearing-Age Women In Karabuk Province. *Gevher Nesibe J IESDR* [Internet]. 2021;6(12):98–103. Available from: <http://dx.doi.org/10.46648/gnj.204>
 7. Darmawan A, Karolina ME, Aurora WID. Skrining Toksoplasmosis Dengan Rapid Test IgG Di Puskesmas Simpang Kawat Jambi. *Medic* [Internet]. 2018;2(1):106–9. Available from: <https://doi.org/10.22437/medicaldedication.v3i1.8579>
 8. Humaryanto, Hanina, Tarawifa S. Identifikasi Kasus Toksoplasmosis Dengan Uji Aglutinasi Latek Di Puskesmas Tahtul Yaman. *Medic* [Internet]. 2019;2(1):37–40. Available from: <https://doi.org/10.22437/medicaldedication.v3i1.8579>
 9. Retmanasari A, Widartono BS, Wijayanti MA, Artama WT. Prevalence and Risk Factors for Toxoplasmosis in Middle Java, Indonesia. *Ecohealth* [Internet]. 2017;14(1):162–70. Available from: <http://dx.doi.org/10.1007/s10393-016-1198-5>
 10. Bakır A, Guney M. Evaluation of Toxoplasma gondii IgM and IgG Seropositivities in Serum Samples Sent from Pediatric and Adult Hematology/Oncology Outpatient Clinics. *Med Lab Technol J* [Internet]. 2020;6(2):163. Available from: <https://doi.org/10.31964/mltj.v6i2.342>
 11. Olarinde O, Sowemimo OA, Chuang TW, Chou CM, Olanmi SO, Ikotun K, et al. Toxoplasma gondii Infection: Seroprevalence and Associated Risk factors for Women of Childbearing age in Osun State, Nigeria. *Pathog Glob Health* [Internet]. 2022;116(1):59–65. Available from: <https://doi.org/10.1080/20477724.2021.1949193>
 12. Al-Kadassy AM, Baraheem OH, Bashanfer SA, Ahmed Al-Kadassy CM. Prevalence of Toxoplasma gondii Infection in Women of Child-bearing age in faculty of Medicine and Health Sciences Hodeida City, Yemen. *Pharma Innov J* [Internet]. 2018;7(9):256–61. Available from: www.thepharmajournal.com
 13. AL-Sadoon MA, Nasir MAH, Yasir ET, Khalaf AO, Kadim SJ. Toxoplasmosis & Risk Factors among Female Students of Medical Colleges. *Biomed Pharmacol J* [Internet]. 2018;11(4):2117–22. Available from: doi 10.13005/bpj/1591
 14. Barzinij AKRA. Seroprevalence and Risk Factors of Toxoplasmosis among

- University of Kirkuk Female Students. *Ann Parasitol* [Internet]. 2021;67(2):175–86. Available from: doi 10.17420/ap6702.327
15. Kalantari M, Asgari Q, Rostami K, Naderi S, Mohammadpour I, Yousefi M, et al. Molecular and Serological Evaluation of *Toxoplasma gondii* among Female University Students in Mamasani District, Fars Province, Southern Iran. *J Heal Sci Surveill Syst* [Internet]. 2020;8(2):75–80. Available from: doi 10.30476/jhsss.2020.86265.1087
16. Mustafa M, Fathy F, Mirghani A, Mohamed MA, Muneer MS, Ahmed AE, et al. Prevalence and Risk Factors Profile of Seropositive *Toxoplasmosis gondii* Infection among Apparently Immunocompetent Sudanese Women. *BMC Res Notes* [Internet]. 2019;12(1):1–6. Available from: <https://doi.org/10.1186/s13104-019-4314-0>
17. Alzaheb RA, Al-Amer O. The Seroprevalence and Risk Factors of *Toxoplasmosis* among Female Undergraduate University Students in Saudi Arabia. *Oman Med J* [Internet]. 2017;32(6):486–91. Available from: DOI 10.5001/omj.2017.93
18. Sari BRY, Gugun AM. Prevalensi Seropositif IgM/IgG Toksoplasma pada Wanita Pranikah dan Tinjauan Faktor Risiko Kepemilikan Kucing. *Mutiara Med* [Internet]. 2017;14(1):1–7. Available from: doi: <https://doi.org/10.18196/mmjkk.v14i1.2379>
19. J.P. Dubey. *Toxoplasmosis of Animals and Humans* [Internet]. Third. USA: CRC Press; 2022. 1–565 p. Available from: <https://doi.org/10.1201/9781003199373>
20. Ybañez RHD, Ybañez AP, Nishikawa Y. Review on the Current Trends of *Toxoplasmosis* Serodiagnosis in Humans. *Front Cell Infect Microbiol* [Internet]. 2020;10(May):1–18. Available from: doi: 10.3389/fcimb.2020.00204
21. Nurdin, Julianti AT. Deteksi Imunoglobulin Miu (IgM) Dan Imunoglobulin Gamma (IgG) Pada Penderita Demam Tifoid. *J Media Anal Kesehatan* [Internet]. 2018;9(2):107. Available from: <https://doi.org/10.32382/mak.v9i2.688>
22. Liu Q, Wang ZD, Huang SY, Zhu XQ. Diagnosis of *Toxoplasmosis* and Typing of *Toxoplasma gondii*. *Parasites and Vectors* [Internet]. 2015;8(1):1–14. Available from: doi 10.1186/s13071-015-0902-6
23. Zhang K, Lin G, Han Y, Li J. Serological Diagnosis of *Toxoplasmosis* and Standardization. *Clin Chim Acta* [Internet]. 2016;461:83–9. Available from: <http://dx.doi.org/10.1016/j.cca.2016.07.018>
24. Sharifi K, Hosseini Farash BR, Tara F, Khaledi A, Sharifi K, Shamsian SAA. Diagnosis of Acute *Toxoplasmosis* by IgG and IgM Antibodies and IgG Avidity in Pregnant Women from Mashhad, Eastern Iran. *Iran J Parasitol* [Internet]. 2019;14(4):639–45. Available from: doi 10.18502/ijpa.v14i4.2107
25. Enitan S, Adejumo O, Adeolu O, Ileoma E, Adejumo E, Enitan C. Sero-Prevalence of Anti-*Toxoplasma Gondii* IgM and IgG Antibodies among Young Adults with History of Ocular Infection in South-Western Nigeria. *EAS J Parasitol Infect Dis* [Internet]. 2020;1(6):133–43. Available from: doi 10.36349/easjpid.2019.v01i06.001
26. Mihu AG, Balta C, Marti DT, Paduraru AA, Lupu MA, Olariu TR. Seroprevalence of *Toxoplasma gondii* Infection among Women of Childbearing age in an Endemic Region of Romania, 2016-2018. *Parasite* [Internet]. 2020;27(59):1–4. Available from: <https://doi.org/10.1051/parasite/2020057>
27. Marthalia W, Sulistyorini L. Chronic *Toxoplasmosis* Infection in Members of Cat Breeding Organization in Surabaya. *J Kesehatan Lingkungan* [Internet]. 2020;12(1):48–58. Available from: <https://doi.org/10.20473/jkl.v12i1.2020.48-58>

28. Obaidat MM, Al-Sheyab NA, Bani Salman AE, Lafi SQ. Seroepidemiology and Risk Factors of *Toxoplasma gondii* Infection in Undergraduate University Female Students in Jordan. *Epidemiol Infect* [Internet]. 2015;143(9):1898–903. Available from: doi 10.1017/S0950268814003604

Original Article

The Effect of Aerobic Exercise and Vinyasa Yoga on Body Fat Reduction among Women Gym Members at G Sports Center in Padang City

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ABSTRACT

Adult female exercise members who take part in activities at the G Sports Center still do not know the exercises that are effective in reducing fat in their bodies. The purpose of this study is to determine the significant difference in influence between the aerobic mix impact exercise method and whether vinyasa yoga has a significant effect on reducing body fat in female exercise members at the G Sports Center. This research is a quasi-experimental study. With a study design of two pretest-posttest groups. The population in this study was female exercise members with an age range of 19 to 45 years with a total of 30 women while the sampling technique in this study used a saturated census/sampling technique. So that the entire population was involved in this study. Data were obtained using an observation sheet by measuring fat using the Omron HBF 375 BIA Tool. This tool can be used in a flat place, resulting in accurate data. Data were analyzed descriptively using a t-test with a significant level of $\alpha = 0.05$. The results showed that there was an effect of mixed-impact aerobic exercise on body fat reduction ($p = 0.000$) and there was an effect of vinyasa yoga practice on body fat reduction ($p = 0.000$). There was a significant difference between mixed-impact aerobic exercise and vinyasa yoga practice on fat reduction ($p = 0.041$). From both treatments, mixed-impact aerobic exercise had a greater effect on fat reduction with an average body fat pretest of 31,727 and posttest 27,653 with a difference in average scores. -The average was 4,074. So aerobic mix impact exercise is recommended for someone, especially in women if you want to reduce body fat.

Keywords: Aerobic Exercise, Vinyasa Yoga, Gym, Body Fat.

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INTRODUCTION

Hypokinetic conditions or lack of physical activity^{1,2}. Increased access to modern technology and transportation without adequate physical activity has led to overweight problems³⁻⁵. Body health and weight control are no longer options, but rather a necessity in this modern era to maintain optimal performance in daily activities^{6,7,8}. Overweight, as a result of an imbalance between food intake and energy used by the body, becomes a serious problem^{9,10,11}. Data from WHO and the West Sumatra Health Office indicate an increase in overweight prevalence in Indonesia, including in West Sumatra¹². Excessive body fat not only

leads to overweight but also increases the risk of diseases such as heart disease, cancer, asthma, and diabetes^{13,14}. Especially in women over 40, aging can worsen fat distribution, making it difficult to maintain body shape and avoid fat accumulation, especially in the waist and abdomen area^{15,16}. Therefore, it is important to maintain a balance of body fat through the intake of healthy foods and regular physical activity.

Aerobic exercises, especially with low impact and high impact intensity, has been shown to be effective in lowering body fat percentage^{15,16}. Yoga, specifically Vinyasa Yoga, offers an interesting alternative with a focus on core strengthening and hormonal

regulation without the need for special equipment¹⁷. Aerobic exercises is a sports activity that involves energetic and creative movements with a fast rhythm, aimed at improving heart health and body stamina^{18,19}. Aerobic exercises is divided into three main types, namely low impact, high impact, and mix impact²⁰. Low impact aerobic exercises involves slow movements without jumps, suitable for all fitness levels²¹. On the other hand, high impact aerobic exercises involves jumping movements that require high strength and endurance, more suitable for those who are already trained²². While aerobic mix impact exercises is a combination of low and high impact movements, providing benefits to improve endurance, blood circulation, and heart condition²³. The focus of this study is aerobic mix impact exercises, which is a combination of low and high impact movements to get optimal benefits. Aerobic Mix Impact exercises, which are a combination of low impact and high impact aerobic exercises, offer a variety of movements with different intensities²⁴. This exercises activity also has advantages and disadvantages. Pros include improved heart health, increased stamina, and an interesting variety of movements^{25,26}. On the other hand, its deficiency involves the risk of injury, specifically to the joints, and can be inappropriate for individuals with certain health conditions²⁷.

Furthermore, Yoga Exercises, which combines breathing techniques, relaxation, meditation, and stretching exercises, has a number of types, such as Bikram Yoga, Prenatal Yoga, Vinyasa, Hatha Yoga, and others²⁸. Benefits include improved endocrine gland function, blood circulation, intelligence, and a more well-built posture^{29,30}. With the diversity of these types of exercises, individuals can choose according to their needs and comfort to improve overall health and fitness. Vinyasa Yoga is a Yoga technique that combines mental exercise with ancient Indian medicinal traditions³¹⁻³³. Benefits include improved physical fitness, comprehension, mental fitness, physical relaxation, body awareness development, and reduced muscle pain and tension³⁴. Some Vinyasa Yoga poses involve intense movements to train and strengthen the muscles of the stomach³⁵. The advantages of

Vinyasa Yoga include increased flexibility, strength, endurance, body awareness, breathing, and stress reduction³⁶. However, there are drawbacks such as the risk of injury, not suitable for beginners, requiring good physical condition, high intensity, and lack of emphasis on meditation³⁷. Therefore, before starting Vinyasa Yoga, it is important for individuals to understand their physical abilities and health and get proper guidance to prevent injuries and maximize their benefits. G Sports Center in Kota Padang provides a variety of fitness programs, including aerobic exercises and yoga, with the aim of helping adult women lose weight, gain health, and lose excess fat. By understanding the different effects of Mix Impact exercises and Vinyasa Yoga on body fat loss, it is hoped that it can provide a holistic view of the health and well-being of adult women who participate in these activities.

METHOD

This study aimed to assess the impact of two distinct exercise methods, namely aerobic mix impact and Vinyasa Yoga, on reducing body fat among female exercise members aged 19 to 45 years at G Sports Center Kota Padang. The quasi-experimental design involved two groups, each undergoing 16 sessions over 6 weeks, with three weekly training sessions. The BIA Omron HBF 375 body fat measuring device was utilized for pretest and posttest measurements. This tool must be used on a flat place so as to produce accurate data. The population of 30 healthy women with a body fat percentage exceeding 26% was sampled using the census method. Criteria included good health, absence of chronic injuries, and willingness to participate. Data analysis incorporated descriptive statistics, normality and homogeneity tests, paired sample t-test, and independent t-test. The BIA Omron HBF 375 device provided information on body weight, body fat percentage, subcutaneous fat percentage, visceral fat level, and body muscle mass. The results, analyzed through statistical techniques like mean, standard deviation, and t-tests, aimed to determine the effectiveness and comparative impact of the two exercise methods on body fat reduction.

RESULTS

Table 1. Aerobic Mix Impact Exercise

Aerobic Mix Impact Exercise	Treatment		n
	Pretest	Posttest	
Body Fat	31.727	27.653	15
SD	2.7175	2.2048	
Minimal	28.1	24.8	
Maximum	37.6	32.1	
Average	31.727	27.653	
Sum	15	15	

Based on the table 1 above, it can be seen that in the aerobic mix impact exercise group, the average before (pretest) doing aerobic mix impact exercises was 31.727 with a standard deviation of 2.7175. Before doing aerobic mix impact exercises, the lowest body fat was 28.1 and the highest body fat was 37.6 in female exercises members at G Sport Center Padang. While the average after (posttest) doing aerobic mix impact exercises was 27.653 with a standard deviation of 2.2048. After doing aerobic mix impact exercises, the lowest body fat was 24.8 and the highest body fat was 32.1 in female exercises members at G Sport Center Padang. The results showed that there was an average difference before and after doing aerobic mix impact exercises on female exercises members at G-Sport Center Padang with an average difference of 4.074.

Table 2. Vinyasa Yoga Exercise Group

Vinyasa Yoga Exercise	Treatment		n
	Pretest	Posttest	
Body Fat	31.780	29.387	15
SD	2.0446	2.2229	
Minimal	29.2	26.6	
Maximum	37.1		
Average	31.780	35.4	
Sum	29.387		

Based on table 2 above, it can be seen that in the vinyasa yoga exercise group, the average before (pretest) doing vinyasa yoga exercises is 31.780 with a standard deviation of 2.0446. Before doing vinyasa yoga exercises, the lowest body fat was obtained at 29.2 and the highest body fat at 37.1 in female exercises members at G Sport Center Padang. While the average after (posttest) doing vinyasa yoga exercises was 29.387 with a standard deviation of 2.2229. After doing vinyasa yoga exercises, the lowest body fat was obtained at 26.6 and the

highest body fat at 35.4 in female exercises members at G Sport Center Padang. The results showed that there was an average difference before and after doing vinyasa yoga in female exercises members at G-Sport Center Padang with an average difference of 2.393.

Table 3. Aerobic Mix Impact group normality test

	Shapiro-Wilk		
	Statistic	df	Sig.
Body Fat Before Aerobic Exercise Mix Impact	0.954	15	0.588
Body Fat After Aerobic Exercise Mix Impact	0.928	15	0.251

Based on the table 3 above, it can be seen that based on the results of the Shapiro-Wilk normality test in the aerobic mix impact exercises group with a total of 15 samples obtained, namely pretest 0.588>0.05 and posttest 0.251>0.05, it can be concluded that the normality test results show normal distributed data in the aerobic mix impact group of female exercises members at G Sport Center Padang.

Table 4. Vinyasa Yoga group normality test

	Shapiro-Wilk		
	Statistic	df	Sig.
Body Fat Before Vinyasa Yoga	0.895	15	0.081
Body Fat After Vinyasa Yoga	0.888	15	0.062

Based on the table 4 above, it can be seen that based on the results of the Shapiro-Wilk normality test in the vinyasa yoga exercises group with a total of 15 samples obtained, namely pretest 0.081>0.05 and posttest 0.062>0.05, it can be concluded that the normality test results show normal distributed data in the vinyasa yoga group of female exercises members at G Sport Center Padang.

Table 5. Homogeneity Test on Aerobic Mix Impact group

Levene Statistic	df1	df2	Sig.
0.730	1	28	0.400

Based on the table 5 above, it can be seen that the results of the homogeneity test in the aerobic mix impact exercises group found that a significant value of 0.400>0.05, so it can be concluded that the data has a homogeneous variant.

Table 6. Homogeneity Test on Aerobix Mix Impact group

Levene Statistic	df1	df2	Sig.
0.011	1	28	0.917

Based on the table 6 above, it can be seen that the results of the homogeneity test in the vinyasa yoga exercises group found that a significant value of $0.917 > 0.05$, so it can be concluded that the data has homogeneous variants.

Table 7. The Effect of Aerobic Mix Impact on Fat Loss

Aerobic Mix Impact	Mean	SD	95% confidence interval of the difference	
			Lower	Upper
Pretest	31.727	2.7175		
Posttest	27.653	2.2048	3.6743	4.4724

Based on the table above, it can be seen that the average value of body fat pretest is 31.727 and posttest is 27.653 with a difference in average value of 4.074. Based on the results of the paired sample t-test obtained t-count $21.893 > t\text{-table } 1.761$ and it was also found that the significance value (p-value) $0.000 < 0.05$, it can be concluded that there is an effect of aerobic mix impact on reducing body fat in female exercises members at G-Sports Center Padang.

Table 8. The Effect of Vinyasa Yoga on Fat Loss

Yoga Vinyasa	Mean	SD	95% confidence interval of the difference	
			Lower	Upper
Pretest	31,780	2,0446	1,9471	2,8395
Posttest	29,387	2,2229		

Based on table 8 above, it can be seen that the average value of body fat pretest is 31.780 and posttest is 29.987 with a difference in average value of 2.393. Based on the results of the paired sample t-test obtained t-count $11.504 > t\text{-table } 1.761$ and it was also found that the significance value (p-value) $0.000 < 0.05$, it can be concluded that there is an influence of vinyasa yoga on body fat reduction in female exercises members at G-Sports Center Padang.

Table 9. The difference in the effect of low impact aerobic exercise and Vinyasa yoga on body fat loss

Variable	Mean	Difference Mean	t	Sig
Aerobic Mix impact	27.653	-1.734	-2.144	0.041
Yoga Vinyasa	29.387			

Based on the table 9 above, it can be seen that based on the results of the independent t-test it was found that the average value of aerobic mix impact exercises was 27,653 and the average vinyasa yoga exercise was 29,387 with an average difference of -1,734. Based on the results of the independent t-test obtained t-count -2.144 with t-table 1.701. While the results of the study found that the significance (p-value) was $0.041 < 0.05$, it can be concluded that there is a significant difference between aerobic mix impact exercises and vinyasa yoga exercises on fat loss in female exercises members at G-Sports Center Padang.

DISCUSSION

With a regular frequency of exercise, both of these sports activities are proven to have a significant impact in reducing body fat levels, having a positive effect on endurance, and maintaining overall physical shape. This is in line with previous research that in addition to reducing body fat levels, aerobic mix impact exercise also has an impact on increasing a person's cardiovascular endurance³⁸. In addition, mix-impact aerobic gymnastics also involves a combination of low-impact and high-impact movements, providing a variety that keeps the workout interesting and effective. This corroborates previous research that aerobic mix impact gymnastics with varied movements is very significant in affecting a person's physical fitness²³.

Then, Yoga vinyasa, with its combination of movement, breathing, and meditation, not only helps to lose body fat, but also has a positive impact on body strength and mind balance. This statement is evidenced by previous research that calmness is very significant in influencing one's well-being³⁶. With a focus on flexibility and core strength, vinyasa yoga is an attractive option for those

looking for a combination of physical and spiritual exercise. In this study proves the comparison between the impact of aerobic mixed impact gymnastics and vinyasa yoga shows a real difference. Mixed impact aerobic exercise focuses more on burning calories and reducing fat through high-intensity dynamic movements³⁹. While vinyasa yoga offers a more holistic approach by combining body movements, breathing, and mind focus¹⁷. The difference in concepts and objectives of the two can give an idea that each type of exercise has its own unique benefits, depending on the goals and personal preferences of the trainee.

CONCLUSION

This study emphasizes the significant impact of mixed aerobic and vinyasa yoga exercises on body fat reduction among female sports members at G-Sports Center Padang. While the observed reduction in body fat wasn't very high, it confirmed the effectiveness of these two exercise methods as alternatives. Practical implications extend to developing more focused exercise programs for G-Sports Center and similar institutions, offering valuable insights into the diverse health benefits. By explicitly stating these implications, we aim to guide exercise participants and instructors in making choices aligned with their health goals, fostering a healthier and more informed community. G-Sports Center and similar institutions can leverage these findings to enhance existing fitness programs, reinforcing the importance of combining diverse exercise methods. Scientific support from this research encourages the incorporation of varied exercises for more people to enjoy proven health benefits. Overall, our research envisions inspiring a wider audience to embrace different types of exercise, contributing to the ongoing improvement of exercise programs and fostering a healthier community.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest and that this research used only personal funds.

REFERENCES

1. Rahayu NI, Suherman A, Muktiarni M. The Use of Information Technology and Lifestyle: An Evaluation of Digital Technology Intervention for Improving Physical Activity and Eating Behavior. *J Adv Res Appl Sci Eng Technol*. 2023;32(1):303–14.
2. Olufemi AC, Mji A, Mukhola MS. Potential Health Risks of Lead Exposure from Early Life through Later Life: Implications for Public Health Education. *Int J Environ Res Public Health*. 2022;19(23).
3. Vandoni M, Codella R, Pippi R, Pellino VC, Lovecchio N, Marin L, et al. Combatting sedentary behaviors by delivering remote physical exercise in children and adolescents with obesity in the covid-19 era: A narrative review. *Nutrients*. 2021;13(12).
4. Pyšná J, Pyšný L, Cihlár D, Petrů D, Müllerová LH, Čtvrtečka L, et al. Physical Activity and BMI before and after the Situation Caused by COVID-19 in Upper Primary School Pupils in the Czech Republic. *Int J Environ Res Public Health*. 2022;19(5).
5. Calcaterra V, Verduci E, Vandoni M, Rossi V, Di Profio E, Pellino VC, et al. Telehealth: A useful tool for the management of nutrition and exercise programs in pediatric obesity in the covid-19 era. *Nutrients*. 2021;13(11):1–24.
6. Kirwan R, McCullough D, Butler T, Perez de Heredia F, Davies IG, Stewart C. Sarcopenia during COVID-19 lockdown restrictions: long-term health effects of short-term muscle loss. *GeroScience*. 2020;42(6):1547–78.
7. Nightingale S, Spiby H, Sheen K, Slade P. LJMUResearchOnline m. Tour Recreat Res [Internet]. 2018;19. Available from:

- <http://researchonline.ljmu.ac.uk/id/eprint/8705/>
8. Syah MNH. The Relationship between Obesity and Anemia among Adolescent Girls. *Poltekita J Ilmu Kesehat*. 2022;15(4):355–9.
 9. Jehan S, Zizi F, Pandi-Perumal SR, McFarlane SI, Jean-Louis G, K Myers A. Energy imbalance: obesity, associated comorbidities, prevention, management and public health implications. *Adv Obesity, Weight Manag Control*. 2020;10(5):146–61.
 10. Monnier L, Schlienger JL, Colette C, Bonnet F. The obesity treatment dilemma: Why dieting is both the answer and the problem? A mechanistic overview. *Diabetes Metab*. 2021;47(3).
 11. Reny Rahmawati, Ida Nurwati BW. Association Between Eating Habit , Sedentary Lifestyle , and Place of Living with Nutritional Status Among College Students at Sebelas Maret University Department of Nutrition Science , Postgraduate Program , Universitas Sebelas Maret , Surakarta City , C. *Poltekita J Ilmu Kesehat*. 2023;17(2):273–8.
 12. Dinkes Sumbar. Riset Kesehatan Dasar Provinsi Sumatera Barat Tahun 2018. Laporan Riskesdas Nasional 2018. 2018. 1–478 p.
 13. De Lorenzo A, Romano L, Di Renzo L, Di Lorenzo N, Cennamo G, Gualtieri P. Obesity: A preventable, treatable, but relapsing disease. *Nutrition*. 2020;71.
 14. Boubertakh B, Silvestri C, Di Marzo V. Obesity: The Fat Tissue Disease Version of Cancer. *Cells*. 2022;11(12):1–16.
 15. Ni S, Jia M, Wang X, Hong Y, Zhao X, Zhang L, et al. Associations of eating speed with fat distribution and body shape vary in different age groups and obesity status. *Nutr Metab [Internet]*. 2022;19(1):1–11. Available from: <https://doi.org/10.1186/s12986-022-00698-w>
 16. Ponti F, Santoro A, Mercatelli D, Gasperini C, Conte M, Martucci M, et al. Aging and Imaging Assessment of Body Composition: From Fat to Facts. *Front Endocrinol (Lausanne)*. 2020;10(January).
 17. Dybvik H, Steinert M. Real-world fNIRS brain activity measurements during Ashtanga Vinyasa Yoga. *Brain Sci*. 2021;11(6).
 18. Muscella A, Stefàno E, Lunetti P, Capobianco L, Marsigliante S. The regulation of fat metabolism during aerobic exercise. *Biomolecules*. 2020;10(12):1–29.
 19. Broskey NT, Martin CK, Burton JH, Church TS, Ravussin E, Redman LM. Effect of Aerobic Exercise-induced Weight Loss on the Components of Daily Energy Expenditure. *Med Sci Sports Exerc*. 2021;53(10):2164–72.
 20. Nopianto W, El Cintami Lanos M. the Effect of Mixed Impact Aerobic Gymnastics on the Improvement of Physical Fitness for High School Students Palembang. *J Indones Phys Educ Sport P [Internet]*. 2020;6(2):2020. Available from: <https://doi.org/10.21009/JIPES.061.03>
 21. Rismayanthi C, Zein MI, Mulyawan R, Nurfadhila R, Prasetyawan RR, Antoni MS. The effect of low impact aerobic exercise on increasing physical fitness for the elderly. *J Keolahragaan*. 2022;10(1):137–46.
 22. Waldo K, Indra Bayu W, Sriwijaya U. the Effect of Aerobic General and Sex on Physical Fitness. *J Ilmu Keolahragaan [Internet]*. 2023;6(1):89–98. Available from: <http://dx.doi.org/10.31851/hon.v6i1.8178>
 23. Anik Maryani, Fahmy Fachrezzy, Ramdan Pelana. The Effectiveness of Mix Impact Aerobic Gymnastics Exercises With SKJ 2000 On Improvement of Physical Freshness. *Gladi J Ilmu Keolahragaan*. 2021;12(03):39–44.
 24. Latuheru RV, Arfanda PE. Aerobic Dance: Facilities for the Development of Physical Education and Recreational Sports. *J Phys Educ Sport Heal Recreat*. 2023;12(1):83–7.
 25. Arfanda PE, Wiriawan O, Setijono H, Kusnanik NW, Muhammad HN, Puspodari, et al. the Effect of Low-Impact Aerobic Dance Exercise Video on Cardiovascular Endurance, Flexibility, and Concentration in Females With Sedentary Lifestyle. *Phys Educ Theory Methodol*.

- 2022;22(3):303–8.
26. Tamilselvan G, Nandagopal D, Giridharaprasath RG. Effect of aerobic and anaerobic exercise programme on selected physical fitness components among college women. *Int J Phys Educ Sport Heal*. 2021;8(2):157–63.
27. Li Y. Scenario of Joint Injury in Aerobic Exercise and Recovery Strategies. *Rev Bras Med do Esporte*. 2023;29:2–5.
28. Brinsley J, Girard D, Smout M, Davison K. Is yoga considered exercise within systematic reviews of exercise interventions? A scoping review. *Complement Ther Med* [Internet]. 2021;56:102618. Available from: <https://doi.org/10.1016/j.ctim.2020.102618>
29. Pal R, Adhikari D, Heyat MB Bin, Ullah I, You Z. Yoga Meets Intelligent Internet of Things: Recent Challenges and Future Directions. *Bioengineering*. 2023;10(4):1–25.
30. Mergiyaw W, Rani S, Deyou M. Effect of moderate intensity aerobic exercises combined with yoga on cardiorespiratory capacity and self-concepts of Haramaya University sedentary female undergraduate students. *Int J Yogic, Hum Mov Sport* [Internet]. 2018;3(2):6–10. Available from: www.theyogicjournal.com
31. Patel R, Veidlinger D. Exploring the Benefits of Yoga for Mental and Physical Health during the COVID-19 Pandemic. *Religions*. 2023;14(4):1–18.
32. Ansori ANM. Health Impacts of Yoga: A Brief Review. *Genbinesia J Biol*. 2023;2(2):73–80.
33. Shaw A, Kaytaz ES. Yoga bodies, yoga minds: contextualising the health discourses and practices of modern postural yoga. *Anthropol Med* [Internet]. 2021;28(3):279–96. Available from: <https://doi.org/10.1080/13648470.2021.1949943>
34. Singh V, Acharya J, Bhutia TN. Effect of 6 weeks of online vinyasa training on explosive leg strength of school children during covid-19 – a pilot study. *J Phys Educ Sport*. 2021;21(4):2276–82.
35. Ni M, Mooney K, Harriell K, Balachandran A, Signorile J. Core muscle function during specific yoga poses. *Complement Ther Med* [Internet]. 2014;22(2):235–43. Available from: <http://dx.doi.org/10.1016/j.ctim.2014.01.007>
36. Zok A, Matecka M, Zapala J, Izycki D, Baum E. The Effect of Vinyasa Yoga Practice on the Well-Being of Breast-Cancer Patients during COVID-19 Pandemic. *Int J Environ Res Public Health*. 2023;20(4).
37. Dai CL, Chen CC, Sharma M. Exploring Yoga Behaviors among College Students Based on the Multi-Theory Model (MTM) of Health Behavior Change. *Int J Environ Res Public Health*. 2023;20(14).
38. Sukendro, Yeni Kurniawati, Yusra Dinafi, Turino Adi Irawan, Yonifia Anjanika, Putri Ayu Lestari. The Effect of Mix Impact Aerobic Exercise on Cardiovascular Improvement at Penggemar Senam Pagi Sungai Kambang Ceria (PSPSKC) Community. *Kinestetik J Ilm Pendidik Jasm*. 2022;6(3):606–14.
39. Said M, Lamya N, Olfa N, Hamda M. Effects of high-impact aerobics vs. low-impact aerobics and strength training in overweight and obese women. *J Sports Med Phys Fitness*. 2017;57(3):278–88.

Knowledge, Attitude, and Practice toward COVID-19 Infections among Preclinical Medical Students in a Public University in Depok, Indonesia

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ABSTRACT

Preclinical medical students have a big role as agents of change to raise awareness of the pandemic caused by Coronavirus Disease 2019 (COVID-19) infection in family, friends, and society. This study aims to determine the final stage of preclinical medical students' knowledge, attitudes, and practices (KAP) toward COVID-19 infection. This study used a cross-sectional method that was conducted on 213 final-stage preclinical medical students in a public university in Depok, Indonesia using an online validated KAP Questionnaire that measures age, gender, domicile, class, and level of KAP toward COVID-19 infection. Data were analyzed using SPSS 21. The p-value <0.05 indicates statistical significance. The result KAP of students toward COVID-19 infection showed a good level of knowledge (73.7%), positive attitude (96.2%), and positive Practice (83.6. %). There was no relationship between the level of knowledge and attitudes toward COVID-19 infection because a p-value of 0.211 ($p > 0.05$) was obtained. Meanwhile, there was a relationship between the level of knowledge and practice toward COVID-19 infection with a p-value = 0.044 ($p < 0.05$). The results revealed that the majority of preclinical medical students had favorable attitudes, had adequate knowledge of COVID-19, and used effective practices to stop the transmission of the disease.

Keywords: Attitude, COVID-19, Knowledge, Medical Student, Practices.

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INTRODUCTION

Since the first infection was discovered by a lab in Wuhan City, Hubei Province, China, the coronavirus pandemic has restricted global travel and social interaction for over two years.¹ Starting with the observations of the personnel at the Huanan seafood wholesale market in Wuhan City, who suffered from a puzzling pneumonia outbreak accompanied by signs of acute respiratory infection, exhaustion, and digestive system issues.² The infection was discovered to be a new beta-coronavirus after investigation, and it was given the name 2019 novel

coronavirus, which is what causes coronavirus disease (COVID-19) in the world today.³ This virus is related to the Severe Acute Respiratory Syndrome Coronavirus 2 (SAR-CoV-2) and the Middle East Respiratory Syndrome Coronavirus (MERS-CoV) since it has been linked to outbreaks in multiple nations over the past few years, the same clinical signs, but not necessarily specific.² In just two weeks, COVID-19 has spread to several nations outside of China, and more people are becoming infected with the virus. COVID-19 can be distributed by people either directly or indirectly through things. Because SARS-CoV-2 can spread through

droplets created by coughing, sneezing, or talking, transmission through direct contact is possible.⁴ According to reports, 118 countries were affected by this outbreak at the time. Therefore, COVID-19 was deemed a pandemic by the World Health Organization (WHO) on March 11, 2020.⁵ On March 2, 2020, the President of the Republic of Indonesia Joko Widodo (Jokowi) held a news conference at the Presidential Palace to officially announce the first incidence of COVID-19 in Indonesia.⁶ Since the initial case, only the subsequent three months have seen a sharp rise in COVID-19 cases in Indonesia. President Jokowi declared non-natural disasters brought on by the widespread spread of COVID-19 to be national disasters in the same year. The government has implemented several strategies to stop the spread of COVID-19, one of which is Large-Scale Social Restrictions (LSSR)/*Pembatasan Sosial Berskala Besar* (PSBB). Starting with PSBB, PSBB Java-Bali, Enforcement of Community Activity Restrictions (ECAR)/*Pemberlakuan Pembatasan Kegiatan Masyarakat* (PPKM), emergency PPKM, and PPKM levels 1-4, where the policy was adjusted to the circumstances of COVID-19 at that time, the nomenclature and content of this policy altered multiple times. All parties working under the local government's coordination are subject to this policy.⁷

Unfortunately, despite the sharp rise in COVID-19 cases, it appears that several Indonesians lack enough information about the disease. This is related to how widely COVID-19 information is disseminated online and on social media, whether the material is correct, false, true, or false, which leads to disinformation.⁸ The WHO later labeled this phenomenon as an infodemic. Infodemics develop as a result of an abundance of information sources, including incorrect and misleading information, in the physical and digital environment during disease epidemics. Of course, this results in errors in society and encourages risk-taking practices toward COVID-19. Because of widespread mistrust of health officials and the weakened public health response, the WHO believes that the existence of this infodemic is more harmful than a pandemic.⁹ Therefore the importance of health literacy related to COVID-19 is increased.¹⁰ Currently, wearing masks, frequently washing hands, and keeping a safe distance are the best practices for preventing the COVID-19 pandemic.^{11,12} These initiatives also need to be supported by

knowledge, attitudes, and practices (KAP) that will influence society's healthy preventive.¹³ Having a role model has a big impact on society. Someone having a background in health, such as a health worker or a medical student, can serve as a good role model. Particularly in light of the present pandemic, health professionals must spread awareness and carry out disease prevention initiatives.¹⁴ Medical students must be evaluated to ascertain their level of KAP-related COVID-19.¹⁵ A crucial survey that must be conducted during a pandemic is the KAP survey. This survey can reveal respondents' fundamental knowledge, misperceptions, beliefs, practices, and attitudes toward disease.¹⁶

Medical students who have KAP in a good category will have a positive impact on dealing with a pandemic as agents of change in the COVID-19 pandemic. Thus, they can exert a positive influence and change the perceptions of their friends and family because medical students are considered reliable sources of health information.¹⁷ This was further supported by other investigations, including one by Linawati et al.¹⁸ According to KAP COVID-19, there is a correlation between students' positive attitudes and excellent practices in connection to COVID-19 prevention and their moderate-high awareness of the disease. KAP has been investigated by researchers from several nations with a variety of participants, such as the studies by Masoud et al,¹⁹ Sujarwoto et al,²⁰ but very few medical students,^{13,21} particularly among those at the final stage of preclinical medical students, nearly none. This study focused on the final stage of preclinical medical students because they are preparing to enter the clinical phase and they must have good KAP because it will have an impact on the standard of medical care they will give their patients, to protect medical students who might be exposed to COVID 19. Therefore, based on the background information provided above, the purpose of this study is to determine whether there is a correlation between the level of KAP and COVID-19 infection among the final stage of preclinical medical students at the Faculty of Medicine, Public University in Depok, Indonesia.

METHOD

Research Design and Participant

In February 2022, during the third wave of the COVID-19 pandemic, and in August 2021, during the second wave, the final stage of

preclinical medical students at the Faculty of Medicine, Public University in Depok, were recruited for the study using a cross-sectional methodology and the KAP online questionnaire. 213 preclinical medical students in their final year of study answered the survey.

Measurement Tools

This study makes use of the valid and trustworthy KAP questionnaire, which was developed by Rasyid,²² and is a reliable and valid tool. According to the results of the instrument analysis, every item has a Content Validity Index (CVI) greater than 0.80, making every item necessary for measuring KAP. The three domains had high item reliability scores (0.89 for attitudes, 0.81 for knowledge, and 0.84 for practice domains). The four key sections of this questionnaire are as follows: (1) The respondent's sociodemographic information, which includes their name, gender, level, age, semester, class, and address or city of residence; (2) The knowledge category consists of 15 questions covering the definition, epidemiology, pathophysiology, clinical manifestations, diagnosis, and management of COVID-19 disease. (3) The attitude and (4) practice categories also contain 15 questions about COVID-19. The respondent is required to select either "right" or "wrong" for each item in the knowledge domain. In contrast, each of the attitude and practice tests had 15 items on a four-point Likert scale. Regarding the attitude domain's items, respondents were asked to indicate their level of agreement with each statement by choosing one of four options: (1) strongly disagree, (2) disagree, (3) agree, or (4) strongly agree. In terms of practice, respondents were asked to select one of four options that best represented their routines during a pandemic, including (1) never, (2) sometimes, (3) often, and (4) always.

Data Processing and Analysis

Before being processed, survey data were downloaded in.csv format and verified by the authors. For data analysis, Microsoft Excel and Statistical Program for Social Science (SPSS) software were used. According to the normality of the data distribution assessed by the Kolmogorov-Smirnov test, categorical data are shown as frequencies and percentages, while numerical data are displayed as the mean or median. The Chi-Square Test was applied while bivariate analysis was utilized to compare the

two variables, specifically the link between knowledge and attitude and the association with practices. However, Fisher's test or Kolmogorov-Smirnov test are used as alternatives if it doesn't match the parameters of the Chi-square test.

According to Bloom's cut-off ($\geq 80\%$), outcomes on KAP were dichotomized, Where the total knowledge score $\geq 80\%$ indicates a good level of knowledge, and conversely if the knowledge score $< 80\%$ indicates a poor level of knowledge. As well as the level of knowledge, from the sum of the attitude and practice scores $\geq 80\%$ indicates a positive value and $< 80\%$ indicates a negative value for each variable.²³

This study uses a significance limit of 0.05, therefore the data can be interpreted if the p-value < 0.05 then the results of statistical calculations have a significant value, and if the p-value ≥ 0.05 then the results of statistical calculations are considered not significant.

Ethical Approval

The Health Research Ethics Committee of the Faculty of Medicine, University of Indonesia, and Cipto Mangunkusumo Hospital gave their approval to all of the procedures used in this study, and these organizations were given the following license numbers for their approval: 1129/UN2.F1/ETIK/PPM.00.02/2022

RESULTS

Respondent's Characteristics

According to the characteristics of the respondents in this survey, the respondents are in the 20–25 age range, with a median age of 22. Approximately 65.7% of responders were female. As many as 94.4% of the respondents in this study are from the island of Java. Respondents from the Regular Class made up 73.7% of the sample and those from the International Class made up 26.3%. The distribution of the respondents' sociodemographic details is shown in Table 1.

Table 1. Characteristics of respondents involved in this study

Variable	Median (Min-Max)	n=213	%
Age	22(20-25)		
Gender			
Male		73	34.3
Female		140	65.7
Domicile			

Java	201	94.4
Outside Java	12	5.6
Class		
Regular	157	73.7
International	56	26.3

Knowledge, Attitude, and Practice toward COVID-19

According to the findings of this study, in Table 2 respondents have a high level of knowledge about the COVID-19 infection (73.7%), a positive attitude toward it (96.2%), and positive practice (83.6%).

Table 2. The Distribution of respondents' knowledge, attitudes, and practice levels toward COVID-19 Infection

Variable	Category	n=213	%
Knowledge	Good	157	73.7
	Poor	56	26.3
Attitude	Positive	205	96.2
	Negative	8	3.8
Practice	Positive	178	83.6
	Negative	35	16.4

The COVID-19 knowledge of medical students

Based on Table 3, it can be seen that respondents who know the definition category of COVID-19 with the question item which stands for Coronavirus Disease-2019, all respondents answered correctly. However, in the question items, which are a group of related viruses that cause disease in mammals and birds, only 55.9% answered correctly. In the question of knowledge of the COVID-19 epidemiology category with question items since March 2020 the Government of the Republic of Indonesia has established a PSBB, Most of the respondents answered correctly as many as 186 respondents (87.3%). In the COVID-19 pathophysiology category with the question items infection is faster and more severe for people with a weak immune system (elderly/progressive disease) all respondents answered correctly. Likewise regarding the category of clinical manifestations of COVID-19 with the question item Infection can cause mild, moderate, or severe symptoms, all respondents answered correctly. Meanwhile, in the symptom question item, most of the COVID-19 patients had a good prognosis, a small number of critical conditions, and died as many as 88.7% answered correctly. In the knowledge question in the COVID-19 diagnosis

category with question items *Pasien Dalam Pengawasan* (PDP) characteristics: fever > 38°C, cough/runny nose, sore throat mild to severe pneumonia based on clinical radiological picture having a history of travel to China/infected country, the majority of respondents (94. 8%) answered correctly. Likewise for questions in the COVID-19 management category with the question item confirmed (+) patients without symptoms and mild symptoms, isolated at home for 14 days, almost all respondents (99.5%) answered correctly.

Table 3. Detailed responses of respondents' correct answers toward knowledge of COVID-19

Knowledge items	n=213	%
Definition of COVID-19		
It stands for Coronavirus Disease-2019	213*	100
It is an infectious disease that was discovered in Wuhan in late 2019	213*	100
It is a viral respiratory infection that can kill humans	204	95.8
Is a group of related viruses that cause disease in mammals and birds	119	55.9
Epidemiology of COVID-19		
Since March 2020 the Government of Indonesia has established PSBB	186	87.3
The spread of infection often occurs in winter, and spring, and is related to climatic factors and travel or movement	122**	57.3
Pathophysiology of COVID-19		
Infection is more rapid and more severe in people with weak immune systems (elderly/progressive disease)	213	100
COVID-19 Clinical Manifestations		

Infection can cause mild, moderate, or severe symptoms	213	100
The main clinical symptoms are fever (temperature > 38°C), cough, difficulty breathing, accompanied by severe shortness of breath	205	96.2
Symptoms that appear in some COVID-19 patients are mild, not even accompanied by fever	195	91.5
Most of the symptoms of COVID-19 patients have a good prognosis, a small number are in critical condition and have died	189	88.7
Diagnosis of COVID-19		
Characteristics of <i>Pasien dalam Pengawasan</i> (PDP) (B): fever > 38°C, cough/runny nose, sore throat mild to severe pneumonia based on clinical radiological picture has a history of travel to China/infected countries	202	94.8
<i>Orang Dalam Pemantauan</i> (ODP) characteristics (B): has fever symptoms or a history of fever without pneumonia, has a history of travel to China or infected regions/countries	187	87.8
Management of COVID-19		
The patient was confirmed positive with no symptoms and mild symptoms, isolated at home for 14 days	212	99.5
Patients confirmed positive for moderate and severe symptoms were isolated at the Referral Hospital	208	97.7

Notes: *Question with the most correct answers,

**Question with the least correct answers

The attitudes of medical students toward COVID-19

According to the results of the study in

Table 4, of the 15 questions presented, most of the respondents answered with positive answers on several question items to prevent COVID-19 infection. In the question item for preventing COVID-19 infection, all respondents are required to keep their distance (social distancing) with an answer in the positive category, as well as The question item to improve the body's immune system should carry out activities required to wash hands with antiseptic soap and running water every people who have just finished carrying out activities, as well as the question items to avoid COVID-19 infection should clean and disinfect regularly, almost all answered in the positive category, namely as much as 92%.

Table 4. The positive attitude of respondents about COVID-19

Attitude items	n=213	%
To prevent COVID-19 infection, social distancing is required	213*	100
To improve the body's immune system, regular exercise should be done	213*	100
To prevent COVID-19 infection, it is mandatory to wear a mask when leaving the house	212	99.5
To prevent COVID-19 infection, it is mandatory to wash hands with antiseptic soap and running water for everyone who has just finished carrying out activities	212	99.5
When you are unwell or have mild flu symptoms, you should wear a mask and stay at home while taking medicine	212	99.5
To avoid humidity in every room in the house, you should improve air circulation and light	212	99.5
When outside the home, you should avoid public places with dense populations and poor air circulation	212	99.5
To avoid being infected with COVID-19, when carrying out activities as much as possible avoid touching your eyes, nose, and mouth	211	99
To avoid being infected with COVID-19, it is mandatory to avoid contact with people who are sick	211	99
When coughing, or sneezing, you must cover your mouth and nose with a tissue or your shoulder	210	98.5
To improve the body's immune system you should consume fruits rich in vitamin C every day	210	98.5

To improve the body's immune system should bask in the morning sun every day	201	94.3
When traveling by Bus, Train, or Aircraft, you are required to first do a Rapid Test or Polymerase Chain Reaction (PCR) swab	201	94.3
To avoid COVID-19 infection, you should clean and disinfect regularly surfaces and objects that are frequently touched at home	200	93.8
While at the animal market, avoid contact with livestock or wild animals without protection	196**	92

Notes: *Statements with the most positive attitude,

**Statements with the least positive attitude

Medical students' practices toward COVID-19

Based on Table 5, it can be seen from the 15 question items toward practices in preventing COVID-19 infection, in the question items when traveling using private vehicle facilities or using public transportation facilities, always using a mask and social distancing, all respondents answered in the positive category. In contrast to the question items related to carrying out regular sports activities to improve the immune system, only 61.9% answered in the positive category.

Table 5. The positive practice of respondents toward COVID-19

Practice items	n=213	%
When traveling using private vehicle facilities or using public transportation facilities, I always use a mask and social distancing	213*	100
I always obey and implement health protocols every time I leave the house	212	99.5
I maintain cleanliness in myself, my family, and the house where I live	211	99
When I cough or sneeze, I always cover my mouth with a tissue or my shoulder	207	97.1
Every time I'm outside the house, I always avoid public places with dense populations and bad air circulation	205	96.2
If the mask I use starts to feel damp and smells bad, I immediately replace it with a new mask	202	94.8
I always avoid contact and social distancing	201	94.3

When my body feels unwell, I stay at home while taking the medicine	200	93.8
When I shop at the market, I always avoid direct contact with farm animals without protection	192	90.1
I reduce going to crowded places unless it is mandatory to attend.	189	88.7
When using a mask, I always avoid touching the front of the mask.	189	88.7
To avoid humidity, every day I always pay attention to air circulation and sufficient light in every room in the house	182	85.4
I take vitamin C tablets and eat vitamin C-rich fruits regularly	160	75.1
I clean and disinfect frequently touched surfaces and objects in the house	153	71.8
I do sports activities regularly to improve my immune system	132**	61.9

Notes: *The statement with the most positive practice,

**Statements with the least positive practice

Related KAP toward COVID-19

Table 6 in this study's findings shows that, of the 157 respondents with a good degree of knowledge, 97.5% of them had a positive attitude about infection with COVID-19 infection. 92.9% of respondents had a positive attitude in addition to the 56 respondents with inadequate knowledge. The Fisher's Exact Test was used in statistical calculations after it was determined from the Chi-square test results that 1 cell (> 25%) had an expected count of less than 5. The Fisher's Exact Test results showed a p-value of 0.211 ($p \geq 0.05$), indicating that there was no statistically significant correlation between knowledge and attitude toward the COVID-19 infection. In addition, the odds ratio value is 2.942 (95% CI, 0.710-12.187).

Meanwhile, Table 4 shows that, of respondents with a good level of knowledge, 86.6% of respondents had positive practice, and the rest had negative practice. Of the respondents who have a poor level of knowledge, 75% of respondents have a positive practice level. Chi-square test findings showed a p-value of 0.044 ($p < 0.05$). This indicates that there is a substantial correlation between knowledge and practice about COVID-19 infection, with an odds ratio of 2.159 (95% CI, 1.010-4.614)

Table 6. Relationship between Knowledge, Attitudes, and Practice Respondents toward COVID-19 Infection

Variable	Category	Knowledge			p-value	OR	95% CI
		Poor (n = 56)	Good (n = 157)	Total (n = 213)			
		n (%)	n (%)	n (%)			
Attitude	Negative	4 (7.1)	4 (2.5)	8 (3.8)	0.211	2.942	(0.710-12.187)
	Positive	52 (92.9)	153 (97.5)	205 (96.2)			
Practice	Negative	14 (25)	21 (13.4)	35 (16.4)	0.044	2.159	(10.10-4.614)
	Positive	42 (75)	136 (86.6)	178 (83.6)			

Notes: OR = Odds Ratio, CI = Confidence Interval

DISCUSSION

Health workers have an important role in efforts to improve public health status. In addition to providing care and treatment, health workers must also be able to provide adequate education to the public. Medical students are one of the health workers who will participate in a line of health facilities. They play an important role in providing education to increase awareness of disease prevention, reduce risks, and support disease prevention measures in the community.²⁴ Medical students can become agents of change in the COVID-19 pandemic. Thus they can exert a good influence and change the perceptions of their friends and family because medical students are considered a reliable source of health information.¹⁷ This study showed that most students had a good level of knowledge (73.3%), positive attitude (96.2%), and positive practice (83.6%). This study is comparable to earlier studies conducted in Ethiopia.²⁵ In the knowledge level category, most of the respondents had good knowledge about COVID-19 infection. Shown by The respondents answered correctly in several categories of questions, namely regarding definition (100%), pathophysiology (100%), clinical manifestations (100%), and aspects of management (99.5%). This can illustrate that with a good level of knowledge about COVID-19, effective health education has been delivered properly through formal education, and informal education.²⁶

Regarding attitudes towards COVID-19, the results showed that the majority of respondents (96.2%) had a positive attitude towards COVID-19 infection. In line with

research conducted on medical students in East Java, the majority of respondents (81%) had a good attitude towards COVID-19 infection. Attitudes are formed from experience gained through the learning process to increase individual knowledge. Besides that one's attitude is obtained from interactions with personal experience, influence from other people who are considered important, social culture, mass media, education, and emotional influences. Attitudes related to the prevention of COVID-19 are about how a person has awareness of situations, emergencies, and education regarding the transmission of COVID-19 because attitudes are one of the important aspects that need attention in efforts to prevent and handle cases of infection with COVID-19.²⁷

Regarding practice toward COVID-19 infection, the majority (83.6%) of respondents have shown positive practice in preventing COVID-19 infection, namely by using masks, practicing social distancing, washing hands with soap, and following other health protocols, following other studies.²⁸ More than half (61.9%) of respondents do sports activities regularly to improve the immune system. Even though according to studies, exercise has been proven to increase the body's immunity to prevent COVID-19.²⁹

This study also analyzed the relationship between the level of knowledge and attitudes of students toward COVID-19 infection. Based on the Fisher's Exact Test statistical test, it was found that the significance of p-value = 0.211 ($p > 0.05$) which was considered statistically insignificant. Therefore it can be concluded that there is no significant relationship between the level of knowledge and attitudes of respondents

toward COVID-19 infection. In the statistical test, it was also found that students who had a poor level of knowledge were 2.942 times at risk of having a negative attitude in preventing COVID-19 infection compared to respondents who had a good level of knowledge. The results of this study were strengthened by KAP research in Ecuador explaining that the majority of respondents believe that greater knowledge about COVID-19 is not enough to change individual attitudes towards COVID-19 prevention.³⁰ However, these results contradict various studies in Malaysia, which report that adequate knowledge is needed for more positive attitudes and practices in preventing COVID-19 infection.³¹ The differences in these findings indicate that attitudes are also related to individual beliefs apart from the education that has been obtained. That is, when someone believes that doing something will have an impact as expected, they tend to take that action.³²

Likewise, the relationship between the level of KAP is proven by using the Chi-Square Test statistic. From the statistical test, the results obtained were $p \text{ value} = 0.044$ ($p < 0.05$), meaning that the results of statistical calculations were considered significant. If it is concluded that there is a significant relationship between the level of knowledge and the level of respondent practice toward COVID-19 infection. In addition, according to the statistical test, $OR = 2.159$ (95% CI, 1.010-4.614) which means that students with a poor level of knowledge are 2.159 times more likely to have a risk of negative practice in terms of preventing COVID-19 infection compared to students who have good knowledge. In line with KAP research on COVID-19 infection in the Palestinian community, stated that the majority of respondents (81%) had preventive practices against the spread of COVID-19 infection this was associated with adequate knowledge of how COVID-19 is transmitted.³³ Knowledge about COVID-19 infection is one of the important things in efforts to prevent COVID-19 in the current pandemic. Based on the theory put forward by Lawrence Green,³⁴ knowledge is one of the three factors that can influence a person's practice. Someone who already has a certain knowledge usually tends to have more ability to determine and make the right decision. It is hoped that if someone has good knowledge about COVID-19 infection, it is also directly proportional to good practices to prevent

COVID-19.¹⁸ Medical students are students who have gone through various studies in medical science, one of which has learned about COVID-19. With the knowledge that has been obtained and owned by students, of course, they can provide education to the public toward the prevention of COVID-19.

There are various limitations to this study. First of all, as it is only a cross-sectional study, no causal relationship between factors can be drawn, and the Likert scale used for attitude and practice questions may lack granularity, limiting the depth of understanding of respondents' attitudes and behaviors. Furthermore, utilizing self-reported questionnaires to gather data can lead to recall bias and reporting bias, and some questions may be dishonestly answered out of social desirability. In addition, this study did not analyze factors that could influence students' knowledge, attitudes, and behavior towards COVID-19 infection of students who had been infected with COVID-19. Therefore it is hoped that future research can consider confounding variables such as students who have been infected with COVID-19, and factors such as socioeconomic status, prior exposure to health education, and personal experiences with the virus could impact students' KAP, so that they can provide results that can be useful in the future. Last but not least, the sample cannot be generalized; only gathers data from one university. It can't be generalized to include all students.

CONCLUSION

This study concludes that there are most medical students have a good level of knowledge and positive attitudes and behaviors toward COVID-19 infection. There is no significant relationship between the knowledge and attitudes toward COVID-19 infection and there is a significant relationship between the knowledge and practice toward COVID-19 infection. Thus the existence of a KAP study is important to find out the extent of KAP in medical students. Medical students can become agents of change in dealing with the current COVID-19 pandemic by having a good influence and changing the perceptions of their friends and family because medical students are considered reliable sources of health information. In addition, students need to have a good KAP related to COVID-19 to prevent being

infected with COVID-19.

The present outbreak teaches medical institutions a valuable lesson about the importance of creating curricula that equip students to respond favorably to pandemics. A lot of people are losing faith in science as a result of this pandemic, which is a blow to all involved. As a result, the government should create a curriculum for schools that fosters scientific mindsets beginning in elementary school.

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CONFLICTS OF INTEREST

The author declares that the performance or presentation of the work described in this manuscript was not influenced by any substantial conflicting financial, professional, or personal interests.

REFERENCES

- Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet*. 2020;395(10223):497–506.
- Wu D, Wu T, Liu Q, Yang Z. The SARS-CoV-2 outbreak: What we know. *Int J Infect Dis IJID Off Publ Int Soc Infect Dis*. 2020 May;94:44–8.
- Wu YC, Chen CS, Chan YJ. The outbreak of COVID-19: An overview. *J Chinese Med Assoc*. 2020;83(3):217–20.
- Guo ZD, Wang ZY, Zhang SF, Li X, Li L, Li C, et al. Aerosol and surface distribution of severe acute respiratory syndrome coronavirus 2 in Hospital Wards, Wuhan, China, 2020. *Emerg Infect Dis*. 2020;26(7):1586–91.
- WHO. WHO director-general's opening remarks at the media briefing on COVID-19 - 11 March 2020 [Internet]. <https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020>. 2020. Available from: <https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020>
- Ihsanuddin. Breaking News: Jokowi umumkan dua orang di Indonesia positif corona [Internet]. <https://nasional.kompas.com/read/2020/03/02/11265921/breaking-news-jokowi-umumkan-dua-orang-di-indonesia-positif-corona>. 2020. Available from: <https://nasional.kompas.com/read/2020/03/02/11265921/breaking-news-jokowi-umumkan-dua-orang-di-indonesia-positif-corona>
- Budiono A, Ngestiningrum AH, Nurani S, Rizka R, Nurhayati N, Sari SD, et al. Large-scale social restrictions and public community activity restriction legal policy to decrease COVID-19 infections effectivity to handling COVID-19 pandemic. *Open Access Maced J Med Sci*. 2022;10(A):176–80.
- Gabarron E, Oyeyemi SO, Wynn R. COVID-19-related misinformation on social media: a systematic review. *Bull World Health Organ*. 2021 Jun;99(6):455–463A.
- Rubinelli S, Purnat TD, Wihelm E, Traicoff D, Namageyo-Funa A, Thomson A, et al. WHO competency framework for health authorities and institutions to manage infodemics: its development and features. *Hum Resour Health*. 2022;20(1):1–14.
- Herdayati M, Besral, Karniastuti J. Knowledge, attitude, and practice regarding covid-19 among residents of pesantren. *Kesmas*. 2021;16(1):29–35.
- Agus Sugiharto, Damar P. Susilaradeya, Reza Haryo Yudanto, Rasyad Khalifah, Anastasia Asmoro, Dian Aris Priyanti, et al. Community Diagnosis of Knowledge, attitudes, and practices towards COVID-19 prevention in Koja, DKI Jakarta Province, Indonesia. *Indones J Community Occup Med*. 2022;2(1):3–10.
- Ariyanti F, Mustakim, Al Ayubi MTA, Marlisman DP. How risky people of getting COVID-19 based on their daily activities? *Kesmas*. 2021;16(4):298–306.

13. Alzoubi HM, Alnawaiseh N, Al-Mnayyis AM, Aqel A. COVID-19 - Knowledge, attitude and practice among medical and non-medical university students in Jordan. *Artic J Pure Appl Microbiol* [Internet]. 2020;14(March):17–24. Available from: <https://microbiologyjournal.org/covid-19-knowledge-attitude-and-practice-among-medical-and-non-medical-university-students-in-jordan/>
14. Trause D, Peterson S, Doty N, Liguori A, Holmes K, Kanzleiter L, et al. The diverse roles of community health workers: cues for technology innovations. *Procedia Eng* [Internet]. 2014;78(October):208–17. Available from: <http://dx.doi.org/10.1016/j.proeng.2014.07.058>
15. Sondakh JJS, Warastuti W, Susatia B, Wildan M, Sunindya BR, Budiyanto MAK, et al. Indonesian medical students' knowledge, attitudes, and practices toward COVID-19. *Heliyon*. 2022 Jan;8(1):e08686.
16. Andrade C, Menon V, Ameen S, Kumar Praharaj S. Designing and conducting knowledge, attitude, and practice surveys in psychiatry: practical guidance. *Indian J Psychol Med*. 2020 Sep;42(5):478–81.
17. Gohel KH, Patel PB, Shah PM, Patel JR, Pandit N. Knowledge and perceptions about COVID-19 among the medical and allied health science students in India : An online cross-sectional survey. 2020;(January). Available from: <https://pubmed.ncbi.nlm.nih.gov/32838066/>
18. Linawati H, Helmina SN, Intan VA, Oktavia WS, Rahmah HF, Nisa H. Pengetahuan, sikap, dan perilaku pencegahan COVID-19 mahasiswa. *Media Penelit dan Pengemb Kesehat*. 2021;31(2):125–32.
19. Masoud AT, Zaazouee MS, Elsayed SM, Ragab KM, Kamal EM, Alnasser YT, et al. KAP-COVID Global: A multinational survey of the levels and determinants of public knowledge, attitudes and practices towards COVID-19. *BMJ Open*. 2021;11(2):1–9.
20. Sujarwoto S, Holipah H, Maharani A. A Cross-sectional study of knowledge, attitudes, and practices concerning COVID-19 outbreaks in the general population in Malang District, Indonesia. *Int J Environ Res Public Health*. 2022;19(7).
21. Maheshwari S, Gupta PK, Sinha R, Rawat P. Knowledge, attitude, and practice towards coronavirus disease 2019 (COVID-19) among medical students: A cross-sectional study. *J Acute Dis*. 2020;9(3):100–4.
22. Rasyid RM. Tingkat pengetahuan, sikap dan perilaku mahasiswa fakultas kedokteran Universitas Sumatera Utara angkatan 2020 terhadap infeksi COVID-19 [Internet]. Universitas Sumatera Utara; 2021. Available from: <http://repositori.usu.ac.id/handle/123456789/32839>
23. Adli I, Widyahening IS, Lazarus G, Phowira J, Baihaqi LA, Ariffandi B, et al. Knowledge, attitude, and practice related to the COVID-19 pandemic among undergraduate medical students in Indonesia: A nationwide cross-sectional study. *PLoS One* [Internet]. 2022;17(1 January):1–16. Available from: <http://dx.doi.org/10.1371/journal.pone.0262827>
24. Anil S, Zawahir MS, Al-Naggar RA. Effectiveness of preventive medicine education and its determinants among medical students in Malaysia. *Front Med*. 2016;10(1):91–100.
25. Yesuf M, Abdu M. Knowledge, attitude, prevention practice, and associated factors toward COVID-19 among preparatory school students in Southwest Ethiopia, 2021. *PLoS One* [Internet]. 2022;17(1 January):1–12. Available from: <http://dx.doi.org/10.1371/journal.pone.0262907>
26. Wang H, Liao R, Chen X, Yu J, Zhu T, Liao Q, et al. How to improve the COVID-19 health education strategy in impoverished regions: a pilot study. *Infect Dis Poverty* [Internet]. 2022;11(1):1–14. Available from: <https://doi.org/10.1186/s40249-022-00963-3>
27. Agusti TLP, Arkhaesi N, Riansari A, Hapsari R. Knowledge, Attitudes, and Practices of Indonesian medical and

- non-medical undergraduate students toward COVID-19. *Int J Public Heal Sci*. 2022;11(1):185–94.
28. Dwipayanti NMU, Lubis DS, Harjana NPA. Public perception and hand hygiene behavior during the COVID-19 pandemic in Indonesia. *Front Public Heal*. 2021;9(May):1–12.
 29. Xu Z, Chen Y, Yu D, Mao D, Wang T, Feng D, et al. The effects of exercise on COVID-19 therapeutics A protocol for systematic review and meta-analysis. 2020;0(August).
 30. Bates BR, Moncayo AL, Costales JA, Herrera-Céspedes CA, Grijalva MJ. Knowledge, attitudes, and practices towards COVID-19 among Ecuadorians during the outbreak: An online cross-sectional survey. *J Community Health [Internet]*. 2020;45(6):1158–67. Available from: <https://doi.org/10.1007/s10900-020-00916-7>
 31. Azlan AA, Hamzah MR, Sern TJ, Ayub SH, Mohamad E. Public knowledge, attitudes and practices towards COVID-19: A cross-sectional study in Malaysia. *PLoS One [Internet]*. 2020;15(5):1–15. Available from: <http://dx.doi.org/10.1371/journal.pone.0233668>
 32. Sheeran P, Maki A, Montanaro E, Avishai-Yitshak A, Bryan A, Klein WMP, et al. The impact of changing attitudes, norms, and self-efficacy on health-related intentions and behavior: A meta-analysis. *Heal Psychol Off J Div Heal Psychol Am Psychol Assoc*. 2016 Nov;35(11):1178–88.
 33. Qutob N, Awartani F. Knowledge, attitudes and practices (KAP) towards COVID-19 among Palestinians during the COVID-19 outbreak: A cross-sectional survey. *PLoS One [Internet]*. 2021;16(1 January):1–11. Available from: <http://dx.doi.org/10.1371/journal.pone.0244925>
 34. Green L, Kreuter M. Health program planning: An educational and ecological approach. 4th Edition. New York: McGraw-Hill; 2005.

Original Article

Detection of Dengue Virus in Female Aedes aegypti Mosquito using Reverse Transcription-polymerase Chain Reaction (RT-PCR) in West Jakarta

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ABSTRACT

Dengue hemorrhagic fever (DHF) is an acute disease caused by dengue virus infection which is a clinical manifestation of bleeding, transmitted through the bite of a female mosquito *Aedes aegypti*. The incidence of dengue fever is still a health problem in developing countries, including Indonesia. There are several ways to detect the presence of dengue virus, namely by Reverse Transcription-Polymerase Chain Reaction (RT-PCR). The purpose of this study was to detect Dengue virus in adult female *Aedes aegypti* mosquitoes using RT-PCR. The type of research is a descriptive survey to determine the number of dengue virus transmission in *Aedes aegypti* mosquitoes in Kembangan Village, West Jakarta, especially in RW02 RT 1-10. There are 62 *Aedes aegypti* found in 100 houses that were selected by simple random sampling. Totally 23 female *Aedes aegypti* were identified from a total of 62. Moreover, the result showed that all *Aedes aegypti* mosquitoes caught in were negative for dengue virus. There are several reasons for the limitation of RT-PCR that caused zero findings, including potential false negatives, sensitivity, low quality control measures. Moreover, the small sample size and seasonal reason also played a role in impacting the zero result.

Keywords: *Aedes aegypti*, Dengue, RT-PCR.

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INTRODUCTION

The dengue virus, which is a member of the Flaviridae family and the genus Flavivirus, is what causes dengue hemorrhagic fever (DHF), an infectious disease that spreads to people when the *Aedes aegypti* mosquito bites them¹. DHF is still one of the biggest health problems in Asia and the world. DHF can appear throughout the year and attack all ages, both children and the elderly².

Transmission of the dengue virus occurs through the bite of the *Aedes aegypti* mosquito, which will bite people if the mosquito is infected with the dengue virus and transmit through bites to people who are not infected with the dengue virus³. However, there are also dengue cases that arise when there are

no previous dengue cases. This is thought to be due to the transovarial transmission of the dengue virus in dengue hemorrhagic fever vectors⁴.

The detection of the dengue virus in female *Aedes aegypti* mosquitoes using reverse transcription-polymerase chain reaction (RT-PCR) is crucial for understanding the transmission dynamics of dengue fever. RT-PCR has been widely used for the detection and serotyping of dengue virus in mosquitoes⁵. While virus isolation and RT-PCR are highly sensitive and definitive for diagnosing dengue fever, they are time-consuming and require trained staff and sophisticated equipment⁶. Studies have utilized rapid diagnostic RT-PCR for the detection and typing of dengue viruses in adult female *Aedes aegypti* mosquitoes in

field populations⁷. Additionally, the effectiveness of dengue vector control has been assessed through the analysis of dengue serotypes using RT-PCR⁸. Furthermore, RT-PCR has been used for the detection of dengue virus in *Aedes aegypti* mosquitoes in various geographical locations, such as Ternate City in Indonesia and Taman Connaught in Cheras^{9,10}. The importance of direct detection of dengue virus using RT-PCR has been emphasized in different regions, including Sokaraja in Indonesia¹¹. Moreover, the specificity of virus detection using conventional RT-PCR followed by sequencing has been highlighted in the context of proactive preparedness for orthobunyaviruses in India¹².

In Kembangan District, West Jakarta has 6 Kelurahan, and IR figures for August 2022 were recorded in each Kelurahan, namely South Kembangan which is 378.3/100,000 residents, South Meruya which is 196/100,000 residents, North Kembangan which is 194.7/100,000 residents, Joglo which is 186.6/100,000 residents, North Meruya which is 140.2/100,000 residents, and in Srengseng sub-districts which is 115.3/100,000 residents¹³. In September 2022, the incidence of dengue fever was recorded at 136 cases in North Kembangan Village, South Kembangan Village with 133 cases, Joglo Village with 97 cases, North Meruya Village with 81 cases, South Meruya Village with 80 cases, and in Srengseng Village, there were 66 cases¹³.

Efforts to overcome dengue cases have been implemented through various programs, the most effective is to break the chain of larvae breeding, such as, mosquito larvae examination, fogging implementation, 3M plus movement (draining, closing and utilizing/recycling) and socialization about dengue fever to the community¹⁴.

Based on the background of problems that occur in the field, the purpose of this study is to detect the *Dengue Virus* in Female *Aedes aegypti* Mosquitoes using Polymerase Chain Reaction (PCR) in Kembangan District, North Kembangan Village, West Jakarta.

METHOD

The type of research used in this study is descriptive survey using molecular laboratory test conducted by catching female *Aedes aegypti* mosquitoes from perch in North

Kembangan Village. This research will be carried out in June-August 2023 in Kembangan District, North Kembangan Village, West Jakarta. The sample selection technique in this study was carried out by Random sampling technique. The samples used in this study were 100 houses located in RW 02 RT 01-10, then traps were installed in each house. Virus detection dengue using RT-PCR.

The RT-PCR process for dengue virus detection in this study was carried out in two stages. The first is the conversion of viral RNA into cDNA as well as the amplification of the Dengue virus in general. The second stage is an amplification of viral cDNA with specific primers for all four serotypes of the dengue virus.

RT-PCR (Reverse Transcriptase Polymerase Chain Reaction) has been widely used for the detection of dengue virus in *Aedes aegypti* mosquitoes. Several studies have employed RT-PCR to identify and characterize the presence of dengue virus in field-caught adult *Aedes aegypti* mosquitoes^{15,16}. This method has been effective in detecting the virus in mosquitoes, including transovarial transmission, where the virus is passed on to the next generation¹⁷. Additionally, RT-PCR has been used to confirm the presence of dengue virus in mosquito samples, contributing to the understanding of the epidemiological persistence of dengue in various regions¹⁸.

However, despite its widespread use, RT-PCR has limitations when it comes to detecting dengue virus in mosquitoes. One of the challenges is that while RT-PCR can provide evidence of the presence of the virus, it does not confirm active infection or circulation of the virus among the mosquito population¹⁹. Furthermore, the use of RT-PCR for routine surveillance of dengue virus in mosquitoes presents challenges for public health professionals. Additionally, the limitations of RT-PCR for dengue virus detection in mosquitoes are evident in the context of extreme temperatures that may prevent the mosquito from surviving long enough to allow dengue virus transmission, thus affecting the accuracy of RT-PCR results²⁰. In conclusion, while RT-PCR has been a valuable tool for detecting dengue virus in *Aedes aegypti* mosquitoes, it is important to consider its limitations, particularly in confirming active infection and in the context of environmental factors that may affect the accuracy of results.

This research was conducted after obtaining ethics from the Health Research Ethics Committee, Faculty of Public Health Diponegoro University with registration number: 19/EA/KEPK/-FKM/2024.

RESULTS

Based on the results of the study showed that mosquitoes caught from as many as 100 houses in RW 02 RT 01-10 were carried out in the morning and evening to get *Aedes aegypti* mosquitoes. The number of house mosquitoes per location is as follows (Table 1). Table 1 shows the of the many houses inspected in RW 02 RT 01-10, the most *Aedes aegypti* mosquitoes were caught in RW 02 RT 01 where the catch in the morning was 12 *Aedes aegypti* mosquitoes and in the afternoon 4 *Aedes aegypti* mosquitoes were caught. The total from the capture in RT 01 was 16 *Aedes aegypti* mosquitoes. Then followed by RT 07 as many as 8 *Aedes aegypti* mosquitoes caught in the morning and as many as 5 *Aedes aegypti* mosquitoes caught in the afternoon. The total number of mosquitoes caught in RT 07 was 13 *Aedes aegypti* mosquitoes.

Table 1. Catching of *Aedes aegypti* mosquitoes in North Kembangan Village, Kembangan District, West Jakarta

Location	Houses		Catch		Total
	Inspected	Morning	Afternoon		
Rt 1	10	12	4		16
Rt 2	10	4	2		6
Rt 3	10	6	2		8
Rt 4	10	3	0		3
Rt 5	10	2	0		2
Rt 6	10	5	2		7
Rt 7	10	8	5		13
Rt 8	10	2	0		2
Rt 9	10	0	0		0
Rt 10	10	3	2		5

Based on table 2 in the below, the results of the study showed that the results of dengue virus identification showed the number of female *Aedes aegypti* mosquitoes caught in North Kembangan Village in each house examined as many as 100 houses per RT, it was found that in RT 01 out of 10 houses that had been inspected, 5 female *Aedes argypti* mosquitoes were obtained in the morning and 1 female *Aedes aegypti* mosquito in the afternoon. RT 03 of the 10 houses that have been inspected found 3 female *Aedes aegypti* mosquitoes in the morning, RT 04 and RT 05

obtained as many as 2 female *Aedes aegypti* mosquitoes in the morning, RT 06 as many as 5 female *Aedes argypti* mosquitoes in the morning and 1 female *Aedes aegypti* mosquito in the afternoon, RT 07 obtained 3 *Aedes aegypti* mosquitoes in the morning and RT 10 obtained 1 *Aedes aegypti* mosquito in the afternoon. From the results of examinations that have been carried out using RT PCR detection, it is obtained that all mosquitoes caught and have been examined all show negative results of the dengue virus.

Table 2. Results of dengue virus identification in *Aedes aegypti*

Location	Female Mosquitoes Catch		Detection Results RT-PCR
	Morning	Afternoon	
Rt 1	5	1	Negative
Rt 2	0	0	-
Rt 3	3	0	Negative
Rt 4	2	0	Negative
Rt 5	2	0	Negative
Rt 6	5	1	Negative
Rt 7	3	0	Negative
Rt 8	0	0	-
Rt 9	0	0	-
Rt 10	0	1	Negative

DISCUSSION

From the results of catching mosquitoes that have been done, it can be seen that the mosquitoes obtained are few (table 1). This is because at the time of capture was and dry season and the temperature at the location is 25°C in the morning and in the afternoon the ambient temperature still ranges 31°C. temperature is one of the environmental factors that can affect the breeding of *Aedes aegypti* mosquitoes. The average optimum temperature for mosquito breeding is 25-30°C and the average mosquito breeding takes 12 days²¹. If the optimum temperature is above the average, the mosquito life cycle may be short, on average only 7 days²². If at extreme temperatures that are around 10°C or more than 40°C, then the development of mosquitoes stops, so mosquitoes die. Tolerance to temperature depends on mosquito species²³.

Aedes aegypti mosquitoes today are a living place for various microorganisms that play a vital role in growth, lambing, immune system, and mosquito efficiency as a spreader of diseases such as dengue. The composition of

microbes in the body of adult *Aedes aegypti* mosquitoes is strongly influenced by environmental factors, especially in the environment of mosquito larvae that are in the water²⁴.

The detection of the dengue virus was obtained from the results of capture in Kembangan Village Rw 02 Rt 1–10, and mosquitoes caught only a few. According to data from the Kembangan Health Center, this is possible because, when conducting research during the long dry season, which spans September–October 2023, temperature and humidity do not support the growth and breeding of mosquitoes. Similar studies have been conducted before, where climatic conditions favourable to the development of *Aedes aegypti* mosquitoes make the area they studied vulnerable to the entry and endemicity of dengue disease^{25,26}. However, the results of the examination of dengue virus infection in *Aedes aegypti* mosquitoes using the reverse transcriptase-polymerase chain reaction assay in, southern Iran, did not indicate any dengue virus infection in this species²⁷.

By using the RT-PCR method to detect Dengue virus in adult mosquitoes, it can predict outbreaks with a period of up to 6 weeks before the first case appears in humans²⁸. In addition, PCR-based screening makes it possible to map an area with varying levels of endemicity. PCR testing can be a practical tool in vector control, which helps to identify high-risk areas. All of this also enhances the capabilities of epidemiological surveillance systems in anticipating outbreaks and detecting viruses that may go undetected.

Studies have detected the presence of dengue virus serotypes, such as DENV4, in adult female mosquitoes reared from wild-captured eggs, indicating transovarial transmission in local *A. aegypti* populations²⁹. Furthermore, research has aimed to detect dengue virus transovarial transmission in *A. aegypti* collected from dengue haemorrhagic fever patients' residences, highlighting the importance of understanding the potential for vertical transmission of the virus³⁰.

Additionally, investigations have utilized immunohistochemistry to examine the transovarial transmission of dengue virus in *Aedes* spp., providing insights into the mechanisms and prevalence of this mode of transmission³¹. Moreover, the transovarial infection of dengue virus in both *Aedes aegypti*

and *Aedes albopictus* has been studied, emphasizing the significance of understanding the potential involvement of multiple mosquito species in the vertical transmission of the virus³². These studies collectively contribute to our understanding of the transovarial transmission of dengue virus in *Aedes aegypti* mosquitoes, shedding light on the potential mechanisms, prevalence, and implications of this mode of virus transmission.

Environmental factors, particularly temperature, play a crucial role in the breeding and population dynamics of mosquitoes. Studies have consistently highlighted the influence of temperature on mosquito survival, development, and population dynamics^{33–35}. For instance, the temperature at breeding and resting locations has been identified as a significant factor in the organismal development and abundance of mosquitoes³⁶. Additionally, temperature, along with other environmental factors, has been shown to influence the selection of breeding sites for various mosquito species^{37,38}. Furthermore, the impact of temperature on the metabolism, growth, development, and population of mosquitoes has been emphasized, with temperature variations affecting the water temperature in breeding sites according to seasonal and circadian weather patterns³⁹. Moreover, temperature has been found to provide favorable breeding conditions for mosquitoes, contributing to their infestation and proliferation⁴⁰.

Comparatively, studies have also investigated the impact of transovarial transmission on the spread of dengue virus in various endemic areas. Furthermore, the detection of transovarial transmission in *Aedes aegypti* in endemic areas has been associated with the role of this mechanism in the spread of dengue hemorrhagic fever⁴¹. Additionally, the prevalence of dengue virus transovarial transmission in Grogol Sub-district has been linked to the maintenance and improvement of the dengue epidemic⁴².

The findings of this study cannot be generalized to the broader population and different time settings. Moreover, this study is limited to descriptive so there is no more advanced analysis used. Future research is recommended to use a larger sample size, multiple seasons timing, and examine the multivariate analysis.

CONCLUSION

Based on the results of the study, the results of identification of the Dengue virus by RT-PCR and the number of samples used in 10 RTs in North Kembangan Village that had been examined by female *Aedes aegypti* mosquitoes were all negative results on 23 samples of *Aedes aegypti* mosquitoes.

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CONFLICTS OF INTEREST

All authors declared no conflict of interest in this study.

REFERENCES

1. Qi R, Yu H, Yu XJ. Chapter 121 - Hemorrhagic fever viruses. In: Tang YW, Hindiyeh MY, Liu D, Sails A, Spearman P, Zhang JR, editors. *Molecular Medical Microbiology* (Third Edition) [Internet]. Academic Press; 2024. p.2479–93. Available from: <https://www.sciencedirect.com/science/article/pii/B9780128186190000654>
2. Parveen S, Riaz Z, Saeed S, Ishaque U, Sultana M, Faiz Z, et al. Dengue hemorrhagic fever: a growing global menace. *J Water Health*. 2023 Nov 1;21(11):1632–50.
3. Li HH, Su MP, Wu SC, Tsou HH, Chang MC, Cheng YC, et al. Mechanical transmission of dengue virus by *Aedes aegypti* may influence disease transmission dynamics during outbreaks. *EBioMedicine*. 2023 Aug;94:104723.
4. Golding MAJ, Noble SAA, Khouri NK, Layne-Yarde RNA, Ali I, Sandiford SL. Natural vertical transmission of dengue virus in Latin America and the Caribbean: highlighting its detection limitations and potential significance. *Parasit Vectors*. 2023 Nov 28;16(1):442.
5. Balingit JC, Carvajal TM, Saito-Obata M, Gamboa M, Nicolasora AD, Sy AK, et al. Surveillance of Dengue Virus in Individual *Aedes Aegypti* Mosquitoes Collected Concurrently With Suspected Human Cases in Tarlac City, Philippines. *Parasit Vectors*. 2020.
6. Gaber M, Ahmad AA, El-Kady AM, Tolba MEM, Suzuki Y, Mohammed S, et al. Dengue Fever as a Reemerging Disease in Upper Egypt: Diagnosis, Vector Surveillance and Genetic Diversity Using RT-LAMP Assay. *PLoS One*. 2022.
7. Rahayu A, Saraswati U, Supriyati E, Kumalawati DA, Hermantara R, Rovik A, et al. Prevalence and Distribution of Dengue Virus in *Aedes Aegypti* in Yogyakarta City Before Deployment of Wolbachia Infected *Aedes Aegypti*. *Int J Environ Res Public Health*. 2019.
8. Kurniawan W, Suwandono A, Widjanarko B, Suwondo A, Artama WT, Shaluhiah Z, et al. The Effectiveness of the One Health SMART Approach on Dengue Vector Control in Majalengka, Indonesia. *J Health Res*. 2020.
9. Tomia A, Tuharea R. Dengue Virus Detection Using Rt-PCR Method in Ternate City, North Maluku, Indonesia. *International Journal of Health and Pharmaceutical (IJHP)*; 2022: 2(4), 622-626.
10. Heng WL, Chia KY, Nashwaan I, Chee HY, Lim CSY. Dengue Virus Surveillance: Circulation of DENV-1, DENV-2, DENV-3 and DENV-4 in Mosquitoes Around Taman Connaught, Cheras. *Asia Pac J Mol Biol Biotechnol*. 2019.
11. Annisa DR, Kusmintarsih ES, Ambarningrum TB. Reverse Transcriptase PCR (Rt-Pcr) for Detection of Dengue and Chikungunya Virus of Mosquito *Aedes Aegypti* in Sokaraja. *Bioeksakta Jurnal Ilmiah Biologi Unsoed*. 2020.
12. Shete AM, Yadav PD, Gokhale MD, Jain R, Pardeshi P, Majumdar T, et al. Proactive Preparedness for Cat Que Virus: An Orthobunyavirus Existing in India. *Indian J Med Res*. 2020.
13. PKC Kembangan. *Buku Register Demam Berdarah Dengue*. 2022.
14. Pramestuti N, Widiastuti D, Raharjo J. Transmisi Trans-Ovari Virus Dengue Pada Nyamuk *Aedes Aegypti* Dan

- Aedes Albopictus Di Kabupaten Banjarnegara. 2013.
15. Ngingo BL, Mboera LEG, Chengula AA, Machelo I, Makange M, Msolla MM,...& Misinzo, G. Aedes Aegypti Abundance, Larval Indices and Risk for Dengue Virus Transmission in Kinondoni District, Tanzania. Trop Med Health. 2022; 50(1), 1-8.
16. Muller, DA, Depelsenaire, AC, Young. (2017). Clinical and laboratory diagnosis of dengue virus infection. *The Journal of infectious diseases*, 215(suppl_2), S89-S95.
17. Tatontos EY, Fahiruddin F, Inayati N. Accurate Detection of Viral Serotype Dengue Hemorrhagic Fever Through Aedes Sp Mosquitoes Using Reverse Transcriptase Polymerase Chain Reaction (Rt-Pcr). Jurnal Riset Kesehatan. 2021;
18. Danis-Lozano R, Díaz-González EE, Malo-García IR, Rodríguez MH, Ramos-Castañeda J, Juárez-Palma L, et al. Vertical Transmission of Dengue Virus in *Aedes Aegypti* and Its Role in the Epidemiological Persistence of Dengue in Central and Southern Mexico. Tropical Medicine & International Health. 2019;
19. Gwee SXW, John ALS, Gray GC, Pang J. Animals as Potential Reservoirs for Dengue Transmission: A Systematic Review. One Health. 2021;
20. Messina JP, Brady OJ, Golding N, Kraemer MUG, Wint W, Ray SE, et al. The Current and Future Global Distribution and Population at Risk of Dengue. Nat Microbiol. 2019;
21. Pliego Pliego E, Velázquez-Castro J, Fraguera Collar A. Seasonality on the life cycle of Aedes aegypti mosquito and its statistical relation with dengue outbreaks. Appl Math Model. 2017 Oct;50:484–96.
22. Marinho RA, Beserra EB, Bezerra-Gusmão MA, Porto V de S, Olinda RA, dos Santos CAC. Effects of temperature on the life cycle, expansion, and dispersion of *Aedes aegypti* (Diptera: Culicidae) in three cities in Paraíba, Brazil. Journal of Vector Ecology. 2016 Jun;41(1):1–10.
23. Evans M V., Drake JM, Jones L, Murdock CC. Assessing temperature-dependent competition between two invasive mosquito species. Ecological Applications. 2021 Jul 27;31(5).
24. Leandro AS, de Castro WAC, Lopes RD, Delai RM, Villela DAM, de-Freitas RM. Citywide Integrated *Aedes aegypti* Mosquito Surveillance as Early Warning System for Arbovirus Transmission, Brazil. Emerg Infect Dis. 2022 Apr;28(4):701–6.
25. Nakase T, Giovanetti M, Obolski U, Lourenço J. Global transmission suitability maps for dengue virus transmitted by Aedes aegypti from 1981 to 2019. Sci Data. 2023 May 12;10(1):275.
26. Gómez M, Martínez D, Páez-Triana L, Luna N, Ramírez A, Medina J, et al. Influence of dengue virus serotypes on the abundance of *Aedes aegypti* insect-specific viruses (ISVs). J Virol. 2023 Dec 14;
27. Azizi K, Dorzaban H, Soltani A, Alipour H, Jaberhashemi SA, Salehi-Vaziri M, et al. Monitoring of Dengue Virus in Field-caught Aedes Species (Diptera: Culicidae) by Molecular Method, from 2016 to 2017 in Southern Iran. J Health Sci Surveill Syst [Internet]. 2023;11(1):77–83. Available from: https://jhss.sums.ac.ir/article_48965.html
28. Ali EOM, Babalghith AO, Bahathig AOS, Dafalla OM, Al-Maghamsi IW, Mustafa NEAG, et al. Detection of Dengue Virus From Aedes aegypti (Diptera, Culicidae) in Field-Caught Samples From Makkah Al-Mokarramah, Kingdom of Saudi Arabia, Using RT-PCR. Front Public Health. 2022 Jun 9;10.
29. Boyles SM, Mavian C, Finol E, Ukhanova M, Stephenson CJ, Hamerlinck G, et al. Under-the-Radar Dengue Virus Infections in Natural Populations of Aedes Aegypti Mosquitoes. mSphere. 2020.
30. Sudarmaja IM, Swastika IK, Diarthini LPE, Prasetya IPD, Wirawan IMA. Dengue Virus Transovarial Transmission Detection in Aedes Aegypti From Dengue Hemorrhagic Fever Patients' Residences in Denpasar, Bali. Vet World. 2022.

31. Kurnia N, Kaitana Y, Salaki CL, Mandey LC, Tuda JSB, Tallei TE. Study of Dengue Virus Transovarial Transmission in *Aedes* spp. In Ternate City Using Streptavidin-Biotin-Peroxidase Complex Immunohistochemistry. *Infect Dis Rep*. 2022.
32. Wanti W, Isnawati I, Respati T. Transovarial Infection of Dengue Virus in *Aedes Aegypti* and *Aedes Albopictus*. *Jurnal Kesehatan Masyarakat*, 2022; 17(4), 606-613.
33. Mbanzulu KM, Mboera LEG, Wumba R, Engbu D, Bojabwa MM, Zanga J, et al. Physicochemical Characteristics of *Aedes* Mosquito Breeding Habitats in Suburban and Urban Areas of Kinshasa, Democratic Republic of the Congo. *Frontiers in Tropical Diseases*. 2022.
34. Xia I, Singirikonda N, Hellman L, Watson J, Hanna M. Using Machine Learning Models for Predicting *Culex* Mosquito Habitats and Breeding Patterns in Washington D.C. 2023;
35. Vallasamy SK. The Impact of the Climate on Dengue Fever Cases in Johor. 2023.
36. Erraguntla M, Dave D, Zapletal J, Myles KM, Adelman ZN, Pohlenz TD, et al. Predictive Model for Microclimatic Temperature and Its Use in Mosquito Population Modeling. *Sci Rep*. 2021.
37. Chaturanga WGD, Weeraratne TC, Abeysundara S, Karunaratne SHPP, Silva WAPP de. Breeding Site Selection and Co-existing Patterns of Tropical Mosquitoes. *Med Vet Entomol*. 2023.
38. Graziosi I, Aranda C, Balestrino F, Bellini R, Busquets N, Coulibaly MB, et al. A Litmus Test for Harmonized Mosquito Monitoring Across Europe and Africa. 2020.
39. Muniz ER, Catão AML, Rueda-Páramo ME, Rodrigues NJ, Lastra CCL, García JJ. Impact of Short-Term Temperature Challenges on the Larvicidal Activities of the Entomopathogenic Watermold *Leptolegnia Chapmanii* Against *Aedes Aegypti*, and Development on Infected Dead Larvae. *Fungal Biol*. 2018.
40. Lorenz C, Castro MC, Trindade PMP, Nogueira ML, Lage M d. O, Quintanilha JA, et al. Predicting *Aedes Aegypti* Infestation Using Landscape and Thermal Features. *Sci Rep*. 2020.
41. Suparmin, Widyanto A, Rajiani I. Detection of Dengue Transovarial Virus for *Aedes Aegypti* Mosquitoes in Endemic Areas of Dengue Hemorrhagic Fever. *Int J Med Biomed Stud*. 2019;
42. Sunardi P, Kusnanto H, Satoto TBT, Lazuardi L. Prevalence of Dengue Virus Transovarial Transmission and DHF Incidence Rate in Grogol Sub-District of Sukoharjo District. *Jurnal Medicoeticolegal Dan Manajemen Rumah Sakit*. 2018.

Original Article

Screening for the Detection of IgG anti-Toxoplasma gondii Antibodies in Female Donors at Semarang Regency

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ABSTRACT

Toxoplasmosis is a widespread zoonotic disease caused by Toxoplasma gondii (T.gondii). Blood and blood products are possible routes of transmission of T. gondii, especially in patients who have undergone multiple transfusions. The aim of this study is to determine the seroprevalence of toxoplasmosis in female donors using blood serum which is analyzed serologically to detect ImmunoglobulinG (IgG) using the Enzyme-Linked Fluorescent Assay (ELFA) method, as well as the relationship between risk factors for toxoplasmosis, such as keeping cats, receiving blood transfusions, eating undercooked meat and eating raw vegetables. This research is an analytic observational study using a cross-sectional study design. The sample taken is female donor candidates who are willing to participate during the study period, from March to September 2023, and have met the inclusion criteria to become research subjects by explaining the purpose and procedure of the study and the consent letter signed by each research subject before blood samples were taken and filling out the research questionnaire. 177 blood serum samples of female donors were collected from blood donor candidates using consecutive sampling method and a questionnaire to obtain risk factor data that influence the incidence of toxoplasmosis. The results showed that the seroprevalence of toxoplasmosis in the blood of female donor at Indonesian Red Cross Blood Donor Unit (UDD PMI) Semarang Regency, Central Java Province was 26.6%. In this study the risk factors that influence the incidence of toxoplasmosis are consuming raw vegetables with 5.835 times more risk than women who do not consume raw vegetables, while other factors such as keeping cats, receiving blood transfusions, and eating undercooked meat, have no significant effect. The seroprevalence of toxoplasmosis in female donors at UDD PMI of Semarang Regency is quite high due to the habit of eating raw vegetables or fresh vegetables with a very high transmission potential.

Keywords: Anti-Toxoplasma gondii, Female Donors, IgG Screening.

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INTRODUCTION

Toxoplasmosis is one of the most widespread diseases and is a zoonotic disease in humans and animals worldwide caused by single cell obligate intracellular opportunistic

protozoa belonging to the phylum Apicomplexa¹.

Epidemiological surveys show that toxoplasmosis has a global distribution with a highly variable prevalence from 1% to 90% in different regions of the country. It is estimated

that about 25% to 30% of the world's population is chronically infected with *Toxoplasma gondii*^{2,3}. Toxoplasmosis affects one third of the world's population with prevalence rates in developing countries varying between 30-60%⁴. At the global level, the seroprevalence is 40-70% in South American and Caribbean countries. El Salvador, Germany, and France show 75% seropositive Indonesia and Ivory Coast have a prevalence of 60%⁵. There are few reports of voluntary blood donors with positive *T. gondii* antibodies. In Africa, prevalence varying from 7-80% is observed which drops to 6.4% in South Africa. Namibia recorded a low positivity of 0.96, New Zealand reported 42.9% seroprevalence, China, prevalence ranged from 0.4 to 20.2%, and prevalence of 63.9% in Balinese women (Indonesia)⁵. High seroprevalence in some countries, positive serological tests can be used as an effective method for donor screening⁴.

Human toxoplasmosis occurs after birth, through ingestion or appropriate handling of tissue cysts from undercooked or raw meat, consumption of contaminated food (unwashed raw fruit and vegetables), and drinking water contaminated with sporulated oocysts or unpasteurized milk containing decent tachyzoites. Moreover, tachyzoites in the blood can be crossed to the fetus via the placenta when an uninfected woman acquires the infection during pregnancy^{2,6}.

T. gondii requires two hosts to complete its life cycle: the *Felidae* family as the definitive host and vertebrates such as birds and mammals as the intermediate host⁴. *Toxoplasma* infection can also be transmitted through blood transfusions and organ transplants⁴.

T. gondii which is transmitted from blood donors to recipient patients becomes our concern⁷. Toxoplasmosis in healthy adults is a chronic disease without clinical symptoms or with self-limited symptoms. Although the safety of the blood supply is always under strict control and supervision, toxoplasmosis transmitted by transfusion from asymptomatic donors remains a concern for patients receiving blood transfusions, especially donor recipients with low immunity. *T. gondii* infection lasts a lifetime and most people who are infected are asymptomatic, testing is necessary to identify toxoplasmosis in potential female blood donors⁴. The aim of this study is to determine the seroprevalence of toxoplasmosis in female

donors using blood serum.

METHOD

This research is an analytic observational study using a *cross-sectional* study design. The sample taken is female donor candidates who are willing to participate during the study period, from March to September 2023 by explaining the purpose and procedure of the study and the consent letter signed by each research subject before blood samples were taken and filling out the research questionnaire.

The questionnaire given to respondents had been tested for validity and reliability on 30 respondents because the test results were close to a normal curve. The instrument is said to be valid if it has a correlation significance value of 95% or $\alpha=0.05$. This research has received ethical approval from the Health Research Ethics Committee of the Health Polytechnic of the Ministry of Health, Semarang.

A total sampling of 177 female donor serum samples were collected and aged 18-60 years old. Sample collection was carried out at UDD PMI, Semarang Regency, Central Java Province. The sample examination was carried out at the Health Analyst Department Laboratory of Poltekkes Kemenkes Semarang.

The primary data collection was collected directly by the researcher by carrying out a serological blood serum examination to detect Immunoglobulin G (IgG) using the *Enzyme Linked Fluorescent Assay* (ELFA) method, with a standard assessment of the anti-toxoplasmosis immunoglobulin G (IgG) reaction consisting of 3 (three) conditions, namely, nonreactive (< 4 IU/mL), equivocal (≥ 4 and < 8 IU/mL), and reactive (≥ 8 IU/mL)⁸. Respondents were asked to fill out a questionnaire whose results were used as data on risk factors that influence the incidence of toxoplasmosis.

RESULTS

The total sample in the study were 177 blood serum of female donors, with a donor age range of 18-60 years old, examination of IgG Anti-Toxoplasma using the ELISA method. The results in table 1 showed that 47 people (26.6%) were positive for IgG toxoplasma and 130 people (73.4%) were negative for IgG toxoplasma.

Table 1. Examination results of IgG Toxo ELISA method

Female donors	Frequency	Percent
Positive	47	26.6%
Negative	130	73.4%
Total	177	100%

Statistical analysis was performed using the *Chi-square test*, using categorical data to find out the relationships between variables and risk factors that are significantly related to toxoplasmosis. Then, it was analyzed multivariate, and the level of significance (p) was set at a value limit of 0.05 and a confidence interval of 95%. All statistical analysis was done by software.

Table 2. Test Results for the Relationship Between Risk Factors and Toxoplasmosis Seroprevalence Using the *Chi-Square Test*

Risk factor	Female Donors	
	<i>p-value</i>	OR (Meaningful)
Keeping cats	0.184 (No)	1,648
Receiving Blood Transfusions	0.344 (No)	0.725
Eating Undercooked Meat	0.078 (No)	2.008
Eating Raw Vegetables	0.002 (Yes)	5,835

Description: *p-value* = significance at $\alpha < 0.05$, OR = Odds ratio

Based on table 2, it can be seen that cat owners, a history of blood transfusions and eating undercooked meat are not significantly associated with positive *T.gondii* IgG incidence.

The risk factor that has a significant relationship with toxoplasmosis seroprevalence in female donors (the largest OR) is only in eating raw vegetables with OR=5.835. It can be interpreted that eating raw vegetables is significantly associated with positive IgG *T.gondii* incidence so women who consume raw vegetables increase the risk of positive IgG toxo on average as much as 5.835 times greater than women who do not consume raw vegetables with an increased susceptibility from 1.706 times to 19.963 times.

DISCUSSION

Based on research results, the prevalence of toxoplasma infection in Indonesia ranges from 40-60%, compared to Malaysia which is 42.5%. This prevalence rate is also

greater compared to countries in Africa (61.4%), Oceania (38.5%), South America (31.2%) and European countries (29.6%)⁹.

The tropical climate of Indonesia which becomes the main breeding ground for the *Toxoplasma* parasite, which is more commonly found in subtropical and tropical regions, is the reason for this high prevalence. This is because the parasite reproduces sexually in the cat's host, and the oocysts are then excreted from the body along with the feces. Oocysts can survive up to a year in warm, moist soil when fully developed and not exposed to sunlight. Intermediate hosts such as rats, birds, pigs, goats, and humans can be infected with this disease by consuming contaminated adult oocysts¹⁰. The temperature in Indonesia is considered ideal because toxoplasma oocysts need temperatures between 4 and 37 degrees Celsius to survive¹⁰.

According to the Regulation of the Minister of Health Number 91 of 2015, blood transfusions are only performed on blood that has passed the infectious disease screening test. However, the detection of positive *Toxoplasma* samples in donor blood indicates the need for additional testing with Anti-*Toxoplasma* characteristics. In particular, the use of whole blood which must be limited or reduced for donor blood recipients with certain conditions and replaced with leucoreduced blood products to prevent the transmission of toxoplasmosis through opportunistic infections, can be used as a preventive action for the transmission of *Toxoplasma gondii* through blood transfusions. Immunosuppressed patients, particularly those with HIV, cancer, or organ transplant recipients, are considered particularly susceptible to *Toxoplasma gondii*^{11,12}. However, the risk factors for receiving blood transfusions in this study did not significantly influence positive IgG toxo incidence.

The prevalence of mammals that act as a source of transmission, such as cattle and pets, as well as the tendency to eat undercooked meat and raw vegetables are risk factors for this disease. Environmental hygiene and sanitation issues are also incriminating factors. Pregnant women and those with low immune systems are among the groups of people most at risk of infecting this disease¹³. The risk factors for eating undercooked meat in this study also did not have a significant effect on positive IgG toxo incidence, but a high-risk factor that has a significant effect is eating raw vegetables on the

positive incidence of IgG toxo, so women who consume raw vegetables are 5.8 times more likely to be infected with toxoplasma than women who don't consume it.

Foods that are often consumed in Indonesia that have the potential to carry this dangerous parasite include satay, grilled/grilled chicken, and steak. This food is an example of processed meat that should not be eaten raw. About 33.9% of Indonesia's population consumes grilled food 1-6 times per week. Based on information, it is known that this parasite will die if cooked at 74°C for chicken meat and 71°C for ground beef¹⁰.

Transmission of *Toxoplasma gondii* through food has traditionally referred to the ingestion of cystic tissue in raw form or undercooked meat¹⁴. The toxoplasmosis epidemic associated with the consumption of fresh produce or juice describes an acute toxoplasmosis epidemic in an industrial plant in Brazil, which was associated with the consumption of green vegetables¹⁵, identifying 73 cases of acute toxoplasmosis associated with acai juice consumption¹⁶. It is concluded that the reported cases of toxoplasmosis associated with consumption of salad vegetables may be due to many potential routes of infection for this parasite and the fact that infection is often asymptomatic¹³.

Research based on samples collected from donors who were treated at the blood center of the university hospital in Ankara, Turkey in 790 male donors (90.0%), 89 female donors (10.0%), with an age range of 18-65 years old and mean age 34 years. Number of donors with Toxo IgG. (+) as many as 213 (24.2%)¹⁷. In line with this study, where donor subjects were only women at UDD PMI, Semarang Regency, Central Java Province, out of 177 samples, 47 (26.6%) samples were positive for IgG Toxo.

The seroprevalence rate in healthy blood donors is very high such as in Egypt (59.6%), Kenya (54%), Saudi Arabia (52.1%), North India (51.8%), Czech Republic (32%), Iraq (30%), South India (20.3%), Turkey (19.5%), Southern Iran (12.3%), Taiwan (9.3%), Mexico (7.4%) and Northeastern Thailand (4.1%)¹⁸.

The results of the study reported that the cities with the highest prevalence of toxoplasmosis in Indonesian women were Jambi (60%), Bantul (55.6%), Minahasa (50%)

Samarinda (43.5%), and Makassar (40%)¹⁰. Compared with the results of the prevalence of toxoplasmosis in UDD PMI Semarang Regency (26.6%), it is still below the prevalence of the city mentioned earlier. The seroprevalence of *T. gondii* in Central Java is 20%¹⁹.

According to the highest risk factors for toxoplasmosis in Indonesian women are the presence of feral cats (OR=14.153), occupation (OR=7.97), habit of eating raw or undercooked meat (OR=5.667), parity status (OR=5.33), not wearing shoes in outdoors (OR=4.684), and raise birds (OR= 0.177)(10). In contrast to the risk factors assessed in this study were keeping cats (OR=1.648), receiving blood transfusions (OR=0.725), eating undercooked meat (OR=2.008), and eating raw vegetables (OR=5.835), indicating risk factors that a significant effect on donor subjects at UDD PMI Semarang Regency is eating raw vegetables. Promotive and preventive measures are needed to fight toxoplasma infection, especially in women who have the habit of eating raw vegetables, environmental sanitation, and poor personal hygiene habits²⁰.

CONCLUSION

Seroprevalence of toxoplasmosis in female donors in Semarang Regency is quite high (26.6%) this is related to the dietary habit of consuming raw vegetables (fresh vegetables). Possible transmission of infection happens through blood transfusion, while screening tests are not performed to detect toxoplasma in UDD PMI Semarang Regency.

The detection of *Toxoplasma* samples in donor blood that is positive indicates the need for additional testing with Anti-*Toxoplasma* characteristics to prevent the transmission of *T. gondii* to people at risk, especially multi-transfusion patients can be used as a preventive measure for the transmission of *T. gondii* through blood transfusions.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES

1. Rahimi MT, Daryani A, Sarvi S, Shokri A, Ahmadpour E, Teshnizi SH, et al. Cats and Toxoplasma gondii: A systematic review and meta-analysis in Iran. *Onderstepoort Journal of Veterinary Research*. 2015;82(1).
2. Naeini KM, Soureshjani EH, Jafari M, Parchami S, Karimi G, Abdizadeh R. Prevalence of Toxoplasma gondii infection in healthy volunteer blood donors using serological and molecular methods from chaharmahal and Bakhtiari Province, Southwest Iran. *Jundishapur J Microbiol*. 2019;12(5).
3. Daryani A, Sarvi S, Aarabi M, Mizani A, Ahmadpour E, Shokri A, et al. Seroprevalence of Toxoplasma gondii in the Iranian general population: A systematic review and meta-analysis. *Acta tropica*, 2014; 137, 185-194.
4. Foroutan-Rad M, Majidiani H, Dalvand S, Daryani A, Kooti W, Saki J, et al. Toxoplasmosis in Blood Donors: A Systematic Review and Meta-Analysis. *Transfusion medicine reviews*, 2016; 30(3), 116-122.
5. Stephen S, Pradeep J, Anitharaj V, Janarthanam V. Seroprevalence of toxoplasmosis in voluntary blood donors of Puducherry and surrounding districts of Tamil Nadu. *Journal of Parasitic Diseases*. 2017 Dec 1;41(4):1158–61.
6. Belluco S, Mancin M, Conficoni D, Simonato G, Pietrobelli M, Ricci A. Investigating the determinants of Toxoplasma gondii prevalence in meat: A systematic review and meta-regression. *PLoS One*. 2016 Apr 1;11(4).
7. Mansouri A, Adhami Mojarad MR, Badfar G, Abasian L, Rahmati S, Kooti W, et al. Epidemiology of Toxoplasma gondii among blood donors in Iran: A systematic review and meta-analysis. *Transfusion and Apheresis Science*, 2017; 56(3), 404-409.
8. Marthalia W. Chronic Toxoplasmosis Infection in Members of Cat Breeding Organization in Surabaya. *Jurnal Kesehatan Lingkungan*. 2020 Jan 30;12(1):48.
9. Wana MN, Moklas MAM, Watanabe M, Nordin N, Unyah NZ, Abdullahi SA, et al. A review on the prevalence of toxoplasma gondii in humans and animals reported in Malaysia from 2008–2018. *International journal of environmental research and public health*, 17(13), 4809.
10. Pramardika DD., Kasaluhe MD, & Sambeka Y. Studi Literatur: Analisis Faktor Risiko Toksoplasmosis Pada Wanita Indonesia. *Prosiding Seminar Nasional Penelitian Poltekkes Kemenkes Tasikmalaya*, 2022; 1(1),15-25.
11. Siransy L, Dasse SR, Dou Gonat SP, Legbedji A, N'Guessan K, Kouacou PA, et al. Immunity Status of Blood Donors Regarding Toxoplasma gondii Infection in a Low-Income District of Abidjan, Côte d'Ivoire, West Africa. *J Immunol Res*. 2016;2016.
12. Izadi M, Jafari NJ, Poornaki AM, Sadraei J, Rezavand B, Mirzaei HR, et al. Detection of Toxoplasma gondii from Clinical Specimens of Patients Receiving Renal Transplant Using ELISA and PCR. *Nephro Urol Mon*. 2013;5(5):983–90.
13. Shapiro K, Bahia-Oliveira L, Dixon B, Dumètre A, de Wit LA, VanWormer E, et al. Environmental transmission of Toxoplasma gondii: Oocysts in water, soil and food. *Food and waterborne parasitology*, 2019;15, e00049.
14. Guo M, Dubey JP, Hill D, Buchanan RL, Ray Gamble H, Jones JL, et al. Prevalence and risk factors for toxoplasma gondii infection in meat animals and meat products destined for human consumption. *Journal of food protection*, 2015; 78(2), 457-476.
15. Ekman CCJ, Chiossi MF do V, Meireles LR, de Andrade HF, Figueiredo WM, Marciano MAM, et al. Case-control study of an outbreak of acute toxoplasmosis in an industrial plant in the state of São Paulo, Brazil. *Rev Inst Med Trop Sao Paulo*, 2012 Sep;54(5):239–44.
16. Morais R dos APB, Freire ABC, Barbosa DRL, Silva L de CT da,

- Pinheiro AF, Costa SS da, et al. Surto de toxoplasmose aguda no Município de Ponta de Pedras, Arquipélago do Marajó, Estado do Pará, Brasil: características clínicas, laboratoriais e epidemiológicas. *Rev Panamazonica Saude*. 2016 Dec;7(esp):143–52.
17. Yılmaz A, Yazıcı E, Turk C. Assessment of seroprevalence of *Toxoplasma gondii* in blood donors applied to the blood center of Gazi university hospital [Internet]. *Iranian Journal of Microbiology*, 2021; 13(2), 243.
 18. Hosseini SA, Golchin E, Sharif M, Sarvi S, Ahmadpour E, Rostamian A, et al. A serological investigation and genotyping of *Toxoplasma gondii* among Iranian blood donors indicates threat to health of blood recipients. *Transfusion and Apheresis Science*. 2020 Jun 1;59(3).
 19. Afrianti D. The Incidence of Toxoplasmosis Disease on Pregnant Women Raise Cats and Not Raise Cats in Tlogosari Wetan Health Center Semarang City. *Jaringan Laboratorium Medis*, 2023; 5(1), 49-52.
 20. Laksemi DAAS., Artama WT., Wijayanti MA. (2013). Seroprevalensi yang tinggi dan faktor-faktor risiko toksoplasmosis pada darah donor dan wanita di bali. *Jurnal Veteriner*, 2013; 14(2), 204-212.

Original Article

Effect of Lycopene Administration on the Antioxidant Status of Hypercholesterolemic Wistar Rats (*Rattus Norvegicus*)

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ABSTRACT

An imbalance between oxidants and antioxidants causes oxidative stress. Antioxidants such as vitamins C and E, known to prevent various diseases, can help reduce oxidative stress. The antioxidant lycopene in fruits can prevent carcinogenesis and atherogenesis. The objective of this study is to assess the impact of administering lycopene at doses of 0.36, 0.72, and 1.08 mg/day from tomato (*Lycopersicum esculentum*) fruit extract on the antioxidant levels (Vitamin C, E, and GPx) in hypercholesterolemic Wistar rats (*Rattus norvegicus*). The research methods of this study employ true experiment designs, LSD post hoc, control, and treatment groups. Experimentally, 28 rats with the Wistar strain were assigned to control and treatment groups. Hypercholesterolemic rats were fed high-fat, high-cholesterol with 0.35 ml/day cholesterol crystals. Vitamin C, vitamin E, and GPx levels were measured. The result of this study shows lycopene increased both vitamin C and E ($P_3 > P_2 > P_1 > P_0$). A post hoc LSDV statistical test of vitamin C, vitamin E, and GPx levels shows a significant difference ($p = 0.00$). The conclusion of this study found that administering a dosage of 0.36 mg/head/day of lycopene to those with high cholesterol levels benefits the body's antioxidant status, thereby improving the overall ability to counteract oxidative stress.

Keywords: Lycopene, Free Radicals, Antioxidant.

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INTRODUCTION

The National Household Health Survey reveals that high LDL cholesterol levels are atherogenic, while high HDL cholesterol levels protect against CHD. The National Household Health Survey shows that Cardiovascular Disease (CVD) is the most common degenerative disease and leading killer in industrialized countries, ranking first as the cause of death for people over 40 years old¹. CHD, closely related to atherosclerosis, is the leading cardiovascular disease in productive age². Understanding cholesterol levels prevents

deadly diseases like CHD³.

Oxidative stress, a disease trigger factor, increases the number of free radicals and Reactive Oxygen Species (ROS) essential for cell damage⁴. Enzymatic antioxidants like superoxide dismutase, catalase, and glutathione peroxidase, while non-enzymatic antioxidants like alpha-tocopherol and ascorbic acid, play a crucial role in controlling ROS⁵⁻⁹. Exogenous sources of antioxidants, such as vitamins like vitamin C and β -carotene, are also needed to minimize oxidative stress¹⁰. Vitamin C, found in Lycopene, works with vitamin E to inhibit oxidation reactions, protecting important cell

biomolecules, including lipids, proteins, and DNA. These antioxidants, combined with vitamins like β -carotene and β -tocopherol, are believed to prevent carcinogenesis and atherogenesis.

Free radicals cause cell damage through peroxidation of lipid components, DNA damage, and protein modification¹¹⁻¹⁶. This damage is linked to various diseases, including heart disease, pain, inflammation, cancer, diabetes, Alzheimer's disease, liver damage, and glaucoma¹⁷. Antioxidants, such as lycopene in fruits, protect important cell biomolecules and prevent carcinogenesis and atherogenesis¹⁸. Long-term exposure to synthetic antioxidants can cause side effects and increase the risk of carcinogenesis¹⁹. Consuming natural antioxidants from fruits, vegetables, and flowers can help prevent degenerative diseases^{14-16,20}.

The effect of lycopene, vitamin C, and vitamin E on hypercholesterolemia in rats is investigated in this study. We picked these rats for their hypercholesterolemia-causing abilities because of their omnivorous diet and treatment resistance. This research aimed to discover how lycopene affected lipid profiles, antioxidant status, and the protection of LDL cholesterol from oxidation, foam cell formation, and atherosclerotic lesions.

METHOD

The experiment conducted at the experimental research base involved dividing rats into control and treatment groups using simple randomization^{21,22}. The rats were administered a diet rich in high fat and high cholesterol and lycopene treatment to enhance their antioxidant levels. The data analysis involved using descriptive and inferential statistical tests; specifically, ANOVA and LSD tests were employed for comparison purposes. The study employed SPSS 25 for Windows for data processing and presentation²³.

The Federer formula calculates the sample size for each treatment group using the inequality $(n-1)(t-1) > 15$ (n = sample size, t = sample group size)²⁴. According to the calculation, each treatment group had at least 6 participants. This study had four treatment

groups of 7 mice each. Therefore, a total of 28 mice were sampled. The lycopene administration doses 0.36 mg/day, 0.72 mg/day, and 1.08 mg/day served as the independent variable. At the same time, the antioxidant status, vitamin C, vitamin E, and glutathione peroxidase levels were the dependent variables. Each dependent variable is associated with an independent variable that either has an influence on it or is a consequence of it²⁵.

The extract technique is used to administer lycopene from tomato (*Lycopersicon esculentum*) fruit extract to rats^{26,27}. The dosages varied between control and treatment groups, being 0.72 mg/head/day, 1.08 mg/head/day, and 1.44 mg/head/day due to conversion from human doses. Hypercholesterolemic rats, aged 12 weeks, have total cholesterol levels above 120 mg/dl, which are measured based on serum cholesterol levels after high fat, high cholesterol feed.

Procedure research includes animal preparation experiments, dose calculation, and feed preparation.

RESULTS

The rats' mean body weight was 180-200 grams, with 185.8 grams meeting the inclusion criteria. Normal rats' baseline cholesterol averages 111.45 mg/dl. The high-fat, high-cholesterol diet raised blood serum cholesterol to the inclusion criteria (>120 mg/dl) with a mean value of 221.8 mg/dl before lycopene. The mean cholesterol dropped to 151.9 mg/dl after lycopene administration. Twenty-eight rats consumed isocaloric food before and after lycopene administration.

Plasma lycopene levels increased in most treatment groups for mg/head/day ($P_1 = 0.72$, $P_2 = 1.08$, $P_3 = 1.44$) from 54 UI/L to 67, 76, and 97, except in group P_0 (control group), which decreased from 54 to 53. P_3 had almost twice the plasma lycopene increase of the control. Plasma lycopene levels rise with dose.

The study results on antioxidant status in the form of measurement results of vitamin C, vitamin E, and glutathione peroxidase levels measured enzymatically are described and included in Table 1.

Table 1. Mean and Standard Deviation of Vitamin C, E, And GPx Levels

Variable	Control (P ₀)		Treatment 1 (P ₁)		Treatment 2 (P ₂)		Treatment 3 (P ₃)		Σ		<i>p</i>
	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	
Vit. C Content	0,5	0,09	0,81	0,08	1,16	0,69	1,46	0,73	0,99	0,38	0,00**
Vit. E Level	7,45	0,49	12,45	0,33	16,16	0,33	19,41	0,33	13,87	4,543	0,00**
GPx Level	93,38	1,53	80,77	1,83	54,93	1,52	31,74	1,53	65,36	24,45	0,00**

Differences between the two treatment groups on vitamin C, vitamin E, and GPx levels

can be seen in Table 2.

Table 2. LSD Post Holc Test in Vitamin C, E, And GPx Levels Between Two Treatment Groups

Variable	Treatment Groups					
	K-P ₁	P ₁ -P ₂	P ₂ -P ₃	K-P ₂	K-P ₃	P ₁ -P ₃
Vit. C Content (<i>p</i>)	0,00**	0,00**	0,00**	0,00**	0,00**	0,00**
Vit. E Level (<i>p</i>)	0,00**	0,00**	0,00**	0,00**	0,00**	0,00**
GPx Level (<i>p</i>)	0,00**	0,00**	0,00**	0,00**	0,00**	0,00**

** *LSD is highly significant.*

Data from Table 2 shows that the mean vitamin C levels in the treatment groups (P₁, P₂, and P₃) were higher than the mean vitamin C levels in the control group (P₀). Anova test results showed a significant difference between the four treatment groups with *p*=0.00. LSDV post hoc statistical test indicated that there was also a substantial difference between the two groups in all treatments with *p*=0.00.

The mean vitamin E levels in the treatment groups (P₁, P₂, and P₃) were higher than the mean vitamin C levels in the control group (P₀). The ANOVA test results show a significant difference between the four treatment groups with *p*=0.00. LSD post hoc

statistical test indicated that there was also a substantial difference between the two groups in all treatments with *p*=0.00.

The data shows that the mean levels of glutathione peroxidase were the opposite; in the control group (P₀), the mean levels of glutathione peroxidase were higher than the mean levels of glutathione peroxidase in the treatment groups (P₁, P₂, and P₃). The ANOVA test results showed a significant difference between the four treatment groups with *p*=0.00. LSD post hoc statistical test indicated that there was also a substantial difference between the two groups in all treatments with *p*=0.00.

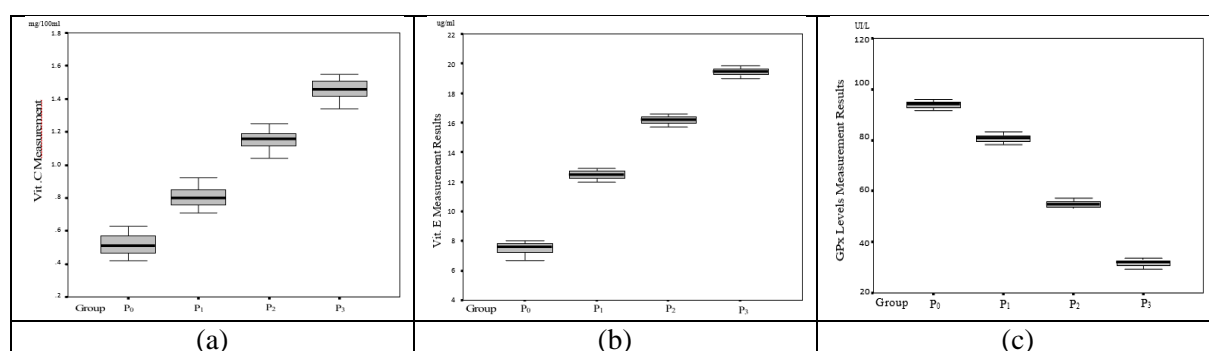


Figure 1. (a) Boxplot of vitamin C measurement results; (b) Boxplot of vitamin E measurement results; (c) Boxplot of the GPx levels measurement results of GPx levels.

The boxplot in Figure 1. (a) shows that the median vitamin C in the treatment group (P₁, P₂, and P₃) is higher than the median vitamin C

in the control group (P₀). Figure 1. (b) shows that the median vitamin E in the treatment group (P₁, P₂, and P₃) is higher than the median in the

control group (P_0). Figure 1. (c) shows that the median glutathione peroxidase decreased, with the control group (P_0) having the highest median glutathione peroxidase compared to the treatment group.

DISCUSSION

In this study, male rats (*Rattus Norvegicus* Wistar strain) were grouped into four treatment groups; each group consisted of 7 rats, so the total sample was 28. With an average rat body weight of 180-200 grams at 12 weeks and cholesterol levels < 120 mg/dl. Experimental animals were kept in individual cages and cleaned every day. The cage temperature was $28-32^{\circ}\text{C}$, and there was adequate air circulation and light.

This study used 1% crystalline cholesterol in feed as much as 18 gr/head/day for 20 days in rats to change the cholesterol levels of rats from 85.8 mg/dl \pm 12.9 to 112.2 mg/dl \pm 21.2²⁸. Feeding high-fat, high cholesterol in the form of 10% lard and pure cholesterol as much as 10 gr/kg in this study was shown to increase cholesterol levels within 14 days. Furthermore, the treatment will be given lycopene doses of 0.36 mg/day, 0.72 mg/day, and 1.08 mg/day in each group so that changes in antioxidant status can be known, which include levels of vitamin C, vitamin E, and glutathione peroxidase (GPx).

Research shows the mechanism of lycopene in protecting native LDL from oxidation and suppressing cholesterol synthesis²⁹. If its protective ability is reduced, native LDL will develop into LDL-ox, which has the characteristics of containing lipid peroxides and other degradation products, apoprotein B, which is degraded through scavenger receptors, causing lipid accumulation in macrophages, low levels of fat-soluble antioxidant vitamins and has immunogenic and biologically active properties³⁰.

According to epidemiological studies, consuming plenty of tomatoes (*Lycopersicon esculentum*) and their processed derivatives can increase plasma levels of lycopene³¹. Lycopene levels decreased in the control group, suggesting that lycopene does not raise plasma levels. A diet rich in fat and cholesterol continuously causes oxidative damage so that the antioxidant effect of lycopene may be reduced. Different doses of lycopene increased plasma levels, suggesting an increase in

antioxidant ability. Consumption cannot determine circulatory lycopene levels. Bloodstream plasma and adipose tissue lycopene levels are better indicators of disease prevention than dietary consumption.

The levels of various doses of lycopene on vitamin C, E, and GPx in this study show that lycopene interacts directly with other antioxidants through oxidative mechanisms. The more lycopene is given, the higher the levels of vitamin C and E compared to the control ($P_3 > P_2 > P_1 > P_0$) seen in the results of this study. GPx levels have been reduced, with the lowest being 0.36 mg/day (P_1).

Vitamin C is a water-soluble vitamin that can only eliminate free radicals in liquid media. Vitamin C can suppress free radicals that will attack lipids³². This vitamin reacts with superoxide, hydroxyl anion, and lipid hydroperoxides as a free radical scavenger. Vitamin C, a chain-breaking antioxidant, regenerates reduced vitamin E. Vitamin C acts as a secondary antioxidant by maintaining reduced glutathione. Chain reactions in lipid peroxidation can be stopped by vitamin E by giving a single electron to two consecutive responses to form a stable oxidized compound³³. Giving lycopene in this study is expected to increase vitamin E levels so that its ability as an antioxidant is even greater. If lycopene, vitamin C, and vitamin E levels rise, the decrease in GPx levels may be positive (feedback mechanism). Excess lycopene can become pro-oxidants in an antioxidant balance mechanism, so GPx is needed to bind them³⁴.

CONCLUSION

The study results indicate that vitamins C and E, especially at 0.36 mg, possess antioxidant characteristics, which help maintain and improve the body's antioxidant capacity. Vitamin C is a secondary antioxidant that helps maintain lowered glutathione levels. In contrast, a higher intake of lycopene leads to increased levels of vitamin E, indicating a mutually beneficial connection between antioxidants. Although there was a drop in GPx levels due to the dosage effects, this reduction could be helpful if there is a significant improvement in other antioxidant statuses.

This improvement may reduce the reliance on GPx to counteract pro-oxidants. In hypercholesterolemic situations, injecting 0.36 mg/head/day of lycopene favors antioxidant

status, improving the body's ability to counteract oxidative stress. The study emphasizes the complex interaction between different antioxidants and their ability to work together to enhance the body's antioxidant defense mechanisms. This is especially important in situations of oxidative stress, such as hypercholesterolemia.

REFERENCES

1. Jousilahti P, Laatikainen T, Salomaa V, Pietilä A, Vartiainen E, Puska P. 40-Year CHD Mortality Trends and the Role of Risk Factors in Mortality Decline: The North Karelia Project Experience. *Glob Heart*. 2016 Jun 1;11(2):207–12.
2. Rodgers JL, Jones J, Bolleddu SI, Vanthenapalli S, Rodgers LE, Shah K, et al. Cardiovascular Risks Associated with Gender and Aging. *Journal of Cardiovascular Development and Disease* 2019, Vol 6, Page 19 [Internet]. 2019 Apr 27 [cited 2024 Feb 3];6(2):19. Available from: <https://www.mdpi.com/2308-3425/6/2/19/htm>
3. Zhang Q, Ai Y, Dong H, Wang J, Xu L. Circulating Oxidized Low-Density Lipoprotein is a Strong Risk Factor for the Early Stage of Coronary Heart Disease. *IUBMB Life* [Internet]. 2019 Feb 1 [cited 2024 Feb 2];71(2):277–82. Available from: <https://onlinelibrary.wiley.com/doi/full/10.1002/iub.1966>
4. Bhattacharya S. Reactive oxygen species and cellular defense system. *Free Radicals in Human Health and Disease* [Internet]. 2015 Jan 1 [cited 2024 Jan 30];17–29. Available from: https://link.springer.com/chapter/10.1007/978-81-322-2035-0_2
5. Voronkova EANI; S, Voronkova YS, Gorban OS, Holoborodko VA. Oxidative stress, reactive oxygen species, antioxidants: a review. *Ecology and Noospherology* [Internet]. 2018 May 9 [cited 2024 Feb 3];29(1):52–5. Available from: <https://en.dp.ua/index.php/en/article/view/118>
6. Tauffenberger A, Magistretti PJ. Reactive Oxygen Species: Beyond Their Reactive Behavior. *Neurochem Res*. 2021 Jan 13;46(1):77–87.
7. Checa J, Aran JM. Reactive oxygen species: Drivers of physiological and pathological processes. *J Inflamm Res*. 2020;13:1057–73.
8. Nakamura H, Takada K. Reactive oxygen species in cancer: Current findings and future directions. *Cancer Sci* [Internet]. 2021 Oct 1 [cited 2024 Feb 8];112(10):3945–52. Available from: <https://onlinelibrary.wiley.com/doi/full/10.1111/cas.15068>
9. Jomova K, Raptova R, Alomar SY, Alwasel SH, Nepovimova E, Kuca K, et al. Reactive oxygen species, toxicity, oxidative stress, and antioxidants: chronic diseases and aging. *Archives of Toxicology* 2023 97:10 [Internet]. 2023 Aug 19 [cited 2024 Feb 8];97(10):2499–574. Available from: <https://link.springer.com/article/10.1007/s00204-023-03562-9>
10. Marreiro D do N, Cruz KJC, Morais JBS, Beserra JB, Severo JS, Soares de Oliveira AR. Zinc and Oxidative Stress: Current Mechanisms. *Antioxidants (Basel)* [Internet]. 2017 Jun 1 [cited 2024 Jan 27];6(2). Available from: <https://pubmed.ncbi.nlm.nih.gov/28353636/>
11. Recknagel RO, Glende EA, Britton RS. Free Radical Damage and Lipid Peroxidation. *Hepatotoxicology* [Internet]. 2020 Jan 16 [cited 2024 Feb 3];401–36. Available from: <https://www.taylorfrancis.com/chapters/edit/10.1201/9780367812041-9/free-radical-damage-lipid-peroxidation-richard-recknagel-eric-glende-robert-britton>
12. Nakai K, Tsuruta D. What Are Reactive Oxygen Species, Free Radicals, and Oxidative Stress in Skin Diseases? *International Journal of Molecular Sciences* 2021, Vol 22, Page 10799 [Internet]. 2021 Oct 6 [cited 2024 Feb 8];22(19):10799. Available from: <https://www.mdpi.com/1422-0067/22/19/10799/htm>
13. Engwa GA. Free radicals and the role

- of plant phytochemicals as antioxidants against oxidative stress-related diseases. *Phytochemicals: source of antioxidants and role in disease prevention BoD–Books on Demand*. 2018;7:49–74.
14. Duke JA, Bogenschutz-Godwin MJ, DuCellier J, Duke PAK, Kumar R. *Handbook of Medicinal Herbs Second Edition* (Kindle Edi, Vol. 5, Issue 1). Florida: CRC Press. 2022.
15. Yaman SO, Ayhanci A, Yaman SO, Ayhanci A. Lipid Peroxidation. *Eur J Clin Nutr* [Internet]. 2021 Feb 12 [cited 2024 Jan 27];47(11):759–64. Available from: <https://www.intechopen.com/chapters/75229>
16. Chaudhari PM, Paithankar A V. Herbal Nanogel Formulation: A Novel Approach. *Journal of Science and Technology* [Internet]. [cited 2024 Feb 8];5(5):149–53. Available from: www.jst.org.inDOI:https://doi.org/10.46243/jst.2020.v5.i5.pp149-153
17. Qazi MA, Molvi KI. Free Radicals and their Management. *Am J Pharm Health Res* [Internet]. 2018;6(04). Available from: www.ajphr.com
18. Mirahmadi M, Azimi-Hashemi S, Saburi E, Kamali H, Pishbin M, Hadizadeh F. Potential inhibitory effect of lycopene on prostate cancer. *Biomedicine & Pharmacotherapy*. 2020 Sep 1;129:110459.
19. Liu R, Mabury SA. Synthetic Phenolic Antioxidants: A Review of Environmental Occurrence, Fate, Human Exposure, and Toxicity. *Environ Sci Technol* [Internet]. 2020 Oct 6 [cited 2024 Feb 3];54(19):11706–19. Available from: <https://pubs.acs.org/doi/abs/10.1021/acs.est.0c05077>
20. Moradi B, Abbaszadeh S, Shahsavari S, Alizadeh M, Beyranvand F. The most useful medicinal herbs to treat diabetes. *Biomedical Research and Therapy*. 2018;5(8):2538–51.
21. Notoatmodjo S. *Metodologi Penelitian Kesehatan*. 3rd ed. Jakarta: Rineka Cipta; 2022. 268 p.
22. Weichbrod RH, Thompson GA (Heidbrink), Norton JN. *Management of Animal Care and Use Programs in Research, Education, and Testing*. 2nd ed. Boca Raton: CRC Press Taylor & Francis Group; 2018. 902 p.
23. Ghozali I. *Aplikasi Analisis Multivariate dengan Program IBM SPSS 25*. Badan Penerbit Universitas Diponegoro. Semarang; 2018.
24. Federer WT. Randomization and Sample Size In Experimentation. *Cornell University Biometrics Unit Technical* [Internet]. 1966 Sep [cited 2024 Feb 7];Number BU-236-M:1–15. Available from: <https://hdl.handle.net/1813/32334>
25. Suwarno B, Nugroho A. *Kumpulan Variabel-Variabel Penelitian Manajemen Pemasaran (Definisi & Artikel Publikasi)*. 1st ed. Bogor: Halaman Moeka Publishing; 2023. 207 p.
26. Ligor M, Buszewski B. Thin Layer Chromatographic Techniques (TLC, OP TLC) for Determination of Biological Activated Compounds from Herb Extracts. *J Liq Chromatogr Relat Technol* [Internet]. 2007 Jan [cited 2024 Feb 6];30(17):2617–28. Available from: <https://www.tandfonline.com/doi/abs/10.1080/10826070701540639>
27. Šegan S, Opsenica D, Milojković-Opsenica D. Thin-layer chromatography in medicinal chemistry. *J Liq Chromatogr Relat Technol* [Internet]. 2019 Jun 15 [cited 2024 Feb 3];42(9–10):238–48. Available from: <https://www.tandfonline.com/doi/abs/10.1080/10826076.2019.1585615>
28. Rosnah R, Taslim NA, Aman AM, Idris I, As'ad S, Buchari A, et al. The Formulation and Evaluation of High-Fat Pellet on Lipid Profiles and Body Mass Index of Male Wistar Rats. *Iraqi Journal of Pharmaceutical Sciences* (P-ISSN 1683 - 3597 E-ISSN 2521 - 3512) [Internet]. 2022 Jun 23 [cited 2024 Feb 8];31(1):285–92. Available from: <https://www.bijps.uobaghdad.edu.iq/index.php/bijps/article/view/1555>
29. Arballo J, Amengual J, Erdman JW. Lycopene: A Critical Review of Digestion, Absorption, Metabolism, and Excretion. *Antioxidants* 2021, Vol

- 10, Page 342 [Internet]. 2021 Feb 25 [cited 2024 Feb 8];10(3):342. Available from: <https://www.mdpi.com/2076-3921/10/3/342/htm>
30. Narasimhulu CA, Parthasarathy S. Preparation of LDL, Oxidation, Methods of Detection, and Applications in Atherosclerosis Research. *Methods Protoc.* 2022;213.
 31. Przybylska S. Lycopene – a bioactive carotenoid offering multiple health benefits: a review. *Int J Food Sci Technol* [Internet]. 2020 Jan 1 [cited 2024 Feb 3];55(1):11–32. Available from: <https://onlinelibrary.wiley.com/doi/full/10.1111/ijfs.14260>
 32. Szarka A, Kapuy O, Lorincz T, Bánhegyi G. Vitamin C and Cell Death. *Antioxid Redox Signal* [Internet]. 2021 Apr 10 [cited 2024 Feb 8];34(11):831–44. Available from: <https://www.liebertpub.com/doi/10.1089/ars.2019.7897>
 33. Bayram I, Decker EA. Underlying mechanisms of synergistic antioxidant interactions during lipid oxidation. *Trends Food Sci Technol.* 2023 Mar 1;133:219–30.
 34. Averill-Bates DA. The antioxidant glutathione. *Vitam Horm.* 2023 Jan 1;121:109–41.

Original Article

Substitution Effect of Purple Sweet Potato Flour (*Ipomea batatas*) and Green Oca (*Abelmoschus esculentus*) As a High Dietary Fiber Snack Bar for Obese Adolescent Girls

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ABSTRACT

The trend of obesity among adolescent girls aged 10 – 19 years increased from 4.2% in 2014, 4.5% in 2015, and 4.7% in 2016. Followed by southeast asia in 2014 increased from 1.9% to 2.1% in 2015, and 2.3% in 2016. Riskesdas reported prevalence of obesity in adolescent girls was higher than adolescent boys, which was 1.5% in 2010, 1.9% in 2013, and 4.5 % in 2018. This study aims to analyze the effect of purple sweet potato and green oca as a substitutes for snack bars by considering chemical quality, nutritional quality, and organoleptic quality for obese adolescent girls. The study was carried out by using 4 levels of treatment with proportion wheat flour: purple sweet potato flour: green oca that is P0 (100: 0: 0), P1 (20: 40: 40), P2 (20: 30: 50), and P3 (20: 20: 60). The results of the study showed that purple sweet potato flour and green oca had a significant effect ($p < 0.05$) on water content, ash, protein, fat, carbohydrates, energy value, dietary fiber, color, taste, and texture but did not have a significant effect ($p > 0.05$) on aroma snack bars. Furthermore, the best level treatment is P2 (20: 30: 50), with the highest panelist acceptance and high in dietary fiber that is $6,99 \pm 0,035$ g/100 g in which good for obese adolescent girls. Serving size of snack bar P2 (20: 30: 50) is 55 grams according to Recommended Dietary Allowance for adolescent girls aged 16 – 18 years and 10% of the daily requirement for snacks.

Keywords: Obesity, Substitution, Snack Bar, Purple Sweet Potato Flour, Green Oca.

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INTRODUCTION

Obesity is a health problem for all people in the world, especially among young women because the differences in fat metabolism processes and body fat are greater than in men, so the accumulation of fat in adipose tissue is also greater¹. WHO (2022) reports that the obesity trend in adolescent girls

aged 10 - 19 years in the world continues to increase from 4.2% in 2014, 4.5% in 2015, and 4.7% in 2016². Followed by Southeast Asia in 2014 it was 1.9%, in 2015 it was 2.1%, and in 2016 it was 2.3%. Data from Riskesdas reports that the prevalence of obesity in adolescent girls is higher than in adolescent boys, in which 1.5% in 2010, 1.9% in 2013, and 4.5% in 2018.

Ratna (2021) showed there is a relationship between dietary fiber intake and the incidence of obesity in students at SMAN 2 Banda Aceh and low dietary fiber intake can increase the risk of obesity by 6 times greater than teenagers with good dietary fiber intake³. The average dietary fiber consumption in Indonesia generally tends to be low, that is around 10.5 grams per day⁴. There is a relationship between dietary fiber and preventing obesity, soluble dietary fiber such as pectin and some hemicelluloses have the ability to retain water and form a thick liquid in digestive tract. So that, it takes more longer to digest foods that contain high dietary fiber. Hull et al., (2020) showed a significant relationship between dietary fiber intake and the incidence of obesity where there was a reduction in body weight in women of 3.8 kg and a reduction in fat mass of 2.8 kg after consuming high dietary fiber foods for 6 weeks⁵.

Interventions that can be carried out to reduce the incidence of obesity from dietary habit are paying attention to food intake, that is dietary fiber intake and develop processed food products that contain nutrient dense and high in dietary fiber that is *snack bars*. Because it is quite practical, easily accepted by the public especially teenagers, and can fill the stomach when hungry. Local food ingredients that can be used as high dietary fiber foods are purple sweet potato flour and green ocra. Because contain high levels of dietary fiber that good for consumption by teenagers who are at risk of obesity. Purple sweet potato flour and green ocra are native Indonesian commodities that need to be developed, especially green ocra is still limited to savoury dish and only a few processed green ocra are used as snacks.

The dietary fiber content in purple sweet potato flour is 4.7% per 100 grams of flour⁶. Yolanda et al., (2018) showed that there was an increase in dietary fiber content and decrease in fat content as the proportion of purple sweet potato flour increased in dried noodle⁷. Furthermore, Anggarawati et al., (2019) showed that higher proportion of purple sweet potato flour, the dietary fiber content in waffle products increased⁸. Dietary fiber content in every 100 grams of green ocra is 3.2 grams. The highest dietary fiber content in pinch cake is 17.7% with the addition 35% of green ocra. In line with Agustiana et al., (2020) the highest level of dietary fiber in wet noodle products is 9.92% with the addition 20% of green ocra⁹.

Therefore, the development of a snack product in the form of a *snack bar* was carried out using substitution of purple sweet potato flour and green ocra as an intervention for high dietary fiber product for obese teenage girls by paying attention to chemical quality, nutritional quality, and organoleptic quality.

METHOD

The study was conducted from August 2022 – May 2023. The type of study is an Experiment with a Completely Randomized Treatment Design (CRD) with 4 levels of treatment and 3 proportions of wheat flour: purple sweet potato flour: green ocra that is P₀ (100: 0 : 0), P₁ (20 : 40: 40), P₂ (20: 30: 50), and P₃ (20 : 20: 60). The calculation of nutritional needs according to RDA for adolescent girls aged 16 – 18 years and 10% of the daily requirement of snack. So that energy requirement is 210 Kcal, 6,5 grams of protein, 7 grams of fat, and 30 grams of carbohydrates. Dietary fiber needs according to regulatory from BPOM No. 1, 2022 to dietary fiber content > 6 grams/100 grams product so that it can be said high dietary fiber food.

RESULTS

Nutritional Quality

Research results showed the average of water content for snack bar ranges from 9.91 – 12.88%. The highest water content in the level treatment is P₃ (12.88%) while the lowest level treatment P₀ (9.91%).

Table 1. Snack Bar Water Content for Every 100 Grams of Product

Treatment Level Percentage (%) (Wheat Flour: Purple Sweet Potato Flour: Green Ocra)	Water content (%)
P ₀ (100: 0: 0)	9.91 ± 0.062 ^a
P ₁ (20: 40: 40)	11.08 ± 0.040 ^b
P ₂ (20: 30: 50)	12.36 ± 0.036 ^c
P ₃ (20: 20: 60)	12.88 ± 0.025 ^d

Research results showed the average of ash for snack bar ranges from 3.11 – 3.93. The highest ash content in the level treatment P₃ (3.93%) while the lowest level treatment P₀ (3.11%).

Table 2. Snack Bar Ash Content for Every 100 Grams of Product

Treatment Level Percentage (%) (Wheat Flour: Purple Sweet Potato Flour: Green Ocra)	Ash Content (%)
P ₀ (100: 0: 0)	3.11 ± 0.030 ^a
P ₁ (20: 40: 40)	3.66 ± 0.045 ^b
P ₂ (20: 30: 50)	3.77 ± 0.040 ^c
P ₃ (20: 20: 60)	3.93 ± 0.020 ^d

Research result showed the average of protein content for snack bars ranges from 13.48 – 15.64%. The highest protein content in level treatment P₀ (15.64%) while the lowest level treatment P₃ namely 13.48%.

Table 31. Snack Bar Protein Content for Every 100 Grams of Product

Treatment Level Percentage (%) (Wheat Flour: Purple Sweet Potato Flour: Green Ocra)	Protein Content (%)
P ₀ (100: 0: 0)	15.64 ± 0.050 ^a
P ₁ (20: 40: 40)	14.35 ± 0.060 ^b
P ₂ (20: 30: 50)	13.59 ± 0.040 ^c
P ₃ (20: 20: 60)	3.93 ± 0.020 ^d

Research result showed the average of fat content for snack bars ranges from 8.38 – 9.08. The highest fat content in level treatment P₁ (9.08%) while the lowest level treatment P₀ (8.38%).

Table 4. Fat Content Per 100 Grams of Product

Treatment Level Percentage (%) (Wheat Flour: Purple Sweet Potato Flour: Green Ocra)	Fat level (%)
P ₀ (100: 0: 0)	8.38 ± 0.045 ^a
P ₁ (20: 40: 40)	9.08 ± 0.040 ^b
P ₂ (20: 30: 50)	9.05 ± 0.045 ^c
P ₃ (20: 20: 60)	8.39 ± 0.020 ^a

Research result showed the average of carbohydrate content for snack bars ranges from 60.31 – 62.95%. The highest fat content in level treatment P₀ (62.95%) while the lowest level treatment P₃ (60.31%).

Table 2. Carbohydrate Levels Every 100 Grams of Product

Treatment Level Percentage (%) (Wheat Flour: Purple Sweet Potato Flour: Green Ocra)	Carbohydrate Content (%)
P ₀ (100: 0: 0)	62.95 ± 0.072 ^a
P ₁ (20: 40: 40)	61.82 ± 0.176 ^b
P ₂ (20: 30: 50)	60.62 ± 0.513 ^c
P ₃ (20: 20: 60)	60.31 ± 0.070 ^d

Research result showed the average of energy value from snack bars ranges from 374.64 – 389.79%. The highest energy value at level treatment P₀ (389.79 Kcal) while the lowest level treatment P₃ (374.64 Kcal).

Table 3. Energy Value Every 100 Grams of Product

Treatment Level Percentage (%) (Wheat Flour: Purple Sweet Potato Flour: Green Ocra)	Energy Value (%)
P ₀ (100: 0: 0)	389.79 ± 0.015 ^a
P ₁ (20: 40: 40)	386.44 ± 0.155 ^b
P ₂ (20: 30: 50)	383.76 ± 0.345 ^c
P ₃ (20: 20: 60)	374.64 ± 0.041 ^d

Research result showed the average of dietary fiber for snack bars around 3.98% – 8.08%. The highest dietary fiber at level treatment P₁ (8.08%) while the lowest level treatment P₀ (3.98%).

Table 7. Dietary fiber Content Per 100 Grams of Product

Treatment Level Percentage (%) (Wheat Flour: Purple Sweet Potato Flour: Green Ocra)	Dietary fiber Content (%)
P ₀ (100: 0: 0)	3.98 ± 0.075 ^a
P ₁ (20: 40: 40)	8.08 ± 0.020 ^b
P ₂ (20: 30: 50)	6.99 ± 0.035 ^c
P ₃ (20: 20: 60)	6.16 ± 0.020 ^d

Organoleptic Quality

Research result showed the average of level favorite panelist for color is 2.33 (dislikes) – 3.27 (likes). The highest score on level treatment P₁ that is 3.27 and the lowest level treatment P₀ that is 2.33.

Table 8. Distribution of Panelists based on Level of Likeness for Snack Bar Colors

Level of Treatment Percentage (%) (Flour Wheat: Purple Sweet Potato Flour: Green Ocra)	Amount Panelists		Average		
	Strongly Dislike	Like – Really Like			
	n	%	n	%	
P ₀ (100: 0: 0)	19	63	11	36	2.33 ± 0.661 ^a
P ₁ (20: 40: 40)	5	16	25	83	3.27 ± 0.828 ^b
P ₂ (20: 30: 50)	4	13	26	86	3.13 ± 0.629 ^b
P ₃ (20: 20: 60)	13	43	17	56	2.80 ± 0.887 ^c

Research result showed the average level favorite panelist for aroma is 2.90 (dislikes) – 3.07 (likes). The highest score on level treatment P₀ is 3.07 and the lowest level treatment P₃ is 2.90.

Table 4. Distribution Panelists based on Likeability Level towards Aroma Snack Bar

Level of Treatment Percentage (%) (Flour Wheat: Purple Sweet Potato Flour: Green Ocra)	Amount Panelists				Average
	Strongly Dislike		Like – Really Like		
	n	%	n	%	
P ₀ (100: 0: 0)	7	23	23	76	3.07 ± 0.828 ^a
P ₁ (20: 40: 40)	7	23	23	76	2.93 ± 0.828 ^a
P ₂ (20: 30: 50)	9	30	21	70	2.97 ± 0.850 ^a
P ₃ (20: 20: 60)	20	66	10	33	2.90 ± 0.845 ^a

Research result showed the average of level favorite panelist for taste is 2.33 (dislikes) – 3.30 (likes). The highest score on level treatment P₂ is 3.30 and the lowest level treatment P₃ is 2.33.

Table 5. Distribution Panelists based on Likeability Level on the taste of the snack bar

Level of Treatment Percentage (%) (Flour Wheat: Purple Sweet Potato Flour: Green Ocra)	Amount Panelists				Average
	Strongly Dislike		Like – Really Like		
	–				
	Dislike				
	n	%	n	%	
P ₀ (100: 0: 0)	18	60	12	40	2.40 ± 0.724 ^a
P ₁ (20: 40: 40)	9	30	21	70	2.87 ± 0.776 ^a
P ₂ (20: 30: 50)	3	10	27	90	3.30 ± 0.651 ^b
P ₃ (20: 20: 60)	14	46	16	53	2.33 ± 0.884 ^c

Research result showed the average of level favorite panelist for texture is 1.90 (dislikes) – 3.13 (likes). The highest score on level treatment P₂ is 3.13 and the lowest level treatment P₃ is 1.90.

Table 6. Distribution Panelists based on Likeability Level to Snack Bar Texture

Level of Treatment Percentage (%) (Flour Wheat: Purple Sweet Potato Flour: Green Ocra)	Amount Panelists				Average
	Strongly Dislike		Like – Really Like		
	–				
	Dislike				
	n	%	n	%	
P ₀ (100: 0: 0)	14	46	16	53	2.40 ± 1.037 ^a

P ₁ (20: 40: 40)	6	20	24	80	3.00 ± 0.743 ^b
P ₂ (20: 30: 50)	6	20	24	80	3.13 ± 0.730 ^b
P ₃ (20: 20: 60)	24	80	6	20	1.90 ± 0.803 ^c

Level of The Best Treatment

Analysis results for the best level treatment using de Garmo method of 11 variables obtained results that rate dietary fiber occupy order the first as variable most importantly at the snack bar for obese adolescent girls.

Table 12. Average Ranking of Variables in Determining Treatment Levels Best

Quality Variables	Average	Rank
Water content	4.2	10
Ash content	4	11
Protein content	6,8	6
Fat level	6	7
Carbohydrate levels	7.4	4
Energy Value	8.3	2
Dietary fiber content	9.2	1
Color	5.8	9
Aroma	5.9	8
Flavor	8	3
Texture	7.1	5

DISCUSSION

Enhancement of the water content of the snack bar caused by green ocra is vegetables classified that have high water content that is 89.58%¹⁰. While purple sweet potato flour classified as processed from tubers that have lower of water content that is 9.4%¹¹. In line with study Janice (2022), showed that the more high proportions of green ocra that 4%, 5%, 6%, and 7% then more high of water content of jelly candy¹². More carry on study Giyatmi et al., (2022) showed that the highest proportions of green ocra (50%) is the highest water content (84.3%)¹³. Water content matters for protein content in food, where the more high water content then protein levels decreased¹⁴. This matter caused by myogen that water soluble protein in water. In line with study Murdiati et al., (2015) showed the level treatment with the highest water content (31.85%) has lowest protein content (0.68%)¹⁵.

Enhancement of the ash content of snack bars caused by purple sweet potato flour has rate ash content higher than flour wheat that is 2.8 grams every 100 grams¹¹. In line with study

Montolalu et al., (2019) the more high proportion of purple sweet potato flour that 10%, 30%, 50%, 70%, and 90% then ash content also increased because mineral content such as phosphorus 74 mg, astringent iron 0.70 mg, and calcium 29 mg per 100 grams of purple sweet potato flour¹⁶. Other research showed that higher proportion of purple sweet potato flour that 70%, 80%, 90%, and 100% at the snack bar then ash content also increased¹⁷. While ash content on green oca is 0.86 grams every 100 grams¹⁰. Study Xavier et al., (2022) showed that green oca with proportions of 5%, 10%, and 15% provide influence to enhancement rate ash in cookie products¹⁸. The more high proportion of green oca (50%) then ash content is increased (3.89%). So, purple sweet potato flour and green oca can influence enhancement of ash content on snack bar. Ash content is substance organic from remainder results burning something material organic. Ash content of the product food influential to internal mineral content product food. The higher ash content so existing mineral content in product food is also getting high¹⁹. Decreasing protein levels of snack bar caused by materials used in substitution classified tubers and vegetables with low relative protein content. Purple sweet potato flour including in group tubers with protein content 2.8 grams every 100 grams¹¹. Meanwhile, green oca including in group vegetables with protein content 2 grams every 100 grams¹⁰. In line with study Montolalu et al., (2019) showed that the highest substitution of purple sweet potato flour (90%) have lowest protein content (7.45%)¹⁶. More further, research Putri et al., (2020) showed that decreasing protein content in biscuits along with enhancement proportion of purple sweet potato flour 70% and 100%²⁰. While study Xavier et al., (2022) showed that increasing proportions of green oca that 5%, 10%, and 15% then protein content in *cookies* the more decreased¹⁸.

The fat content of the snack bar decreased because of purple sweet potato flour classified at tubers with low relative fat content than flour wheat that is 0.6 grams every 100 grams¹¹. In line with Yolanda's research (2018) showed that dry noodles with the highest proportion of purple sweet potato flour (40%) have lowest fat content (0.23%)⁷. Decreasing fat content with enhancement proportion purple sweet potato flour. Meanwhile, green oca owns low relative fat content because classified in vegetables with fat content 0.2 grams every 100

grams¹⁰. Decreasing fat content (3.15%) along with with enhancement portion of green oca (50%). Apart from that, the baking process can influence fat content depends on the temperature and time used, where temperature 160°C for 60 minutes can lower fat content of 3.88%²¹. Decreased fat content can occurs due to susceptible fat to temperature high so the fat will melt and evaporates (volatile).

Decreasing carbohydrate content caused by green oca classified as vegetables with low relative carbohydrates that is 7.45 grams every 100 grams¹⁰. In line with study Xavier et al., (2022) showed that the more high proportions of green oca so rate of carbohydrate *cookies* are more low¹⁸. Proportions of green oca the highest (50%) have rate lowest carbohydrates (66.07%). Purple sweet potato flour own rate carbohydrate enough high that 84.4 grams every 100 grams¹¹ because purple sweet potato flour is processed from purple sweet potatoes which belongs to food source carbohydrate²². In line with study Karo et al., (2022) the more high proportion purple sweet potato flour used (10%, 20%, 30%, 40%, 50%, and 60%) then rate carbohydrates content in the product chip experience decreased²³. The more high proportion purple sweet potato flouris used so rate more carbohydrates too low.

Energy value influenced by protein content, fat content, and fat content carbohydrates. Every 1 gram Carbohydrates and protein each contain 4 calories energy, while 1 gram of fat contains 9 calories. Additionally, value _ energy in each material compiler give influence to mark energy from the snack bar. Energy value purple sweet potato flouris amounting to 354 Kcal / 100 grams¹¹. Whereas mark green oca energy is 33 Kcal / 100 grams¹⁰. Study Xavier et al., (2022) showed that proportions of green oca the highest (15%) have mark energy lowest (451.23 Kcal)¹⁸. The higher proportion of green oca (50%) then mark energy the lower (364.55%).

Decreasing rate dietary fiber caused by green oca own more low than purple sweet potato flour that is 3.2 grams every 100 grams¹⁰. Whereas rate dietary fiber purple sweet potato flour own rate dietary fiber 12.9 grams every 100 grams¹¹. In line with study Anggarawati et al., (2019) showed the more high proportion purple sweet potato flour that 20%, 40%, 60%, and 80% then rate the dietary fiber in the waffle is increasing high⁸. More further, research Suladra (2020) showed that the more high proportion of

purple sweet potato flour is used, then rate dietary fiber of cake yangko is also increasing²⁴. Green ocra has dietary fiber content classified more high than other vegetables²⁵. Is known that rate green ocra dietary fiber higher than come on that is as big as 1.3 grams every 100 grams¹¹.

Organoleptic Quality

Decreasing level favorite panelist to color is caused by green ocra give influence color towards the snack bar. Color pigments in green ocra caused the presence of color pigments chlorophyll. The more big proportions of green ocra so the resulting color the more green. More carry on study Giyatmi et al., (2022) showed color pudding with addition of green ocra is white greenish¹³. Purple sweet potato flour contains color pigments anthocyanins that can give color purple until purple concentrated in a way experience. In line with study Montolalu et al., (2019) the more high proportion purple sweet potato flour so the result of color the more thick¹⁶. Other research says that addition of purple sweet potato flour as much as 20% on each level treatment give difference in a way significant to change color⁸. Influence more colors in snack bar products dominated by purple sweet potato flour. So, snack bar with level treatment P₁, P₂, and P₃ own color dominant increasing purple faded along with decreased proportion of purple sweet potato flour and increasing green ocra proportions. Study Pehulisa (2016) showed substitution flakes color purple sweet potato flour and skin peanut powder dominated by color purple²⁶.

Decreasing level favorite panelist to the aroma caused by the aroma that produced by the snack bar is langu. Delicious aroma typical green ocra originate from content fatty acids do not fed up especially linoleate catalyzed by lipoxigenase enzymes²⁷. The more high proportions of green ocra then the smell is pleasant the more strong. Other research showed that the more increase proportion of green ocra in the product wet noodles then the aroma increases not enough liked by the panelists⁹. The pleasant aroma produced by green ocra minimized moment *pre-treatment* that is use method *blanching*. *Blanching* is a heating process that requires temperature aim range is 75 - 95°C for deactivate possible enzymes for happen change color, taste, texture, and aroma of material food²⁸. Study Larasati & Muarif (2020) showed best blanching duration is for 3 minutes²⁹. Study the mention that the blanching

process takes 15 minutes can reduces the unpleasant aroma of green ocra.

Enhancement level favorite panelist to the taste of snack bar development caused by material substitution classified tubers with rate enough carbohydrates high. A sweet taste is produced from sugar arrangement like monosaccharides and disaccharides contained in purple sweet potato flour. In line with study Anggarawati et al., (2019) waffle with highest proportion of purple sweet potato flour has a sweet taste⁸. More carry on study Syafitri & Mandasari (2021) showed shrimp crisp with highest substitution of purple sweet potato flour has a slightly sweet taste³⁰. Decreasing level favorite panelist to taste at level treatment P₃ caused by enhancement proportion of green ocra and decreasing proportion sweet potato flour purple. Panelists mention the level P₃ treatment has a tending taste originating language of green ocra because there is diosgenin compounds included saponin group so can give rise to unpleasant *aftertaste* typical green ocra. Saponins are type lots of glycosides found in plants and forms colloid Water soluble, when the saponin is shaken and foams can gives rise to a bitter taste³¹. In line with Pratiwi et al., (2021), increasingly high proportion of green ocra used then the feeling that arises dominant unpleasant typical green ocra³². Proportion green ocra (50%) had the highest level favorite lowest (5.3).

Enhancement level favorite panelist to texture caused Because the texture produced by the snack bar tends to be congested. There is connection between texture with water content, where the more low water content then the resulting texture the more hard³³. along with decreased proportion purple sweet potato flour and increased proportion of green ocra on level P₃ treatment then the texture of the resulting snack bar soft with the surface of the snack bar is inclined sticky. This matter because mucilage produced by green ocra cause the texture of the snack bar is getting better wet. Texture own connection with protein, where the lower protein levels then Gluten protein levels also increase low. Gluten proteins consist of gliadin and glutenin, where gliadin plays a role as adhesive so that dough become elastic and glutenin has function make dough still sturdy and expanding.

Dietary fiber content occupy order as first as the most important variable in snack bars for obese adolescent girls. Intake recommendations dietary fiber daily for adolescent girl aged 16 – 18 years according to

the RDA 2019 is as big as 37 grams in a day, and recommendations intake dietary fiber daily in food Intermezzo is 10% of total requirements or the same with 3.7 grams. Content dietary fiber food in product can written in two ways, such as claims and information mark nutrition. At the substitute snack bar purple sweet potato flour and green ocra give claim high dietary fiber. According to BPOM Regulation No. 1 of 2022 written that something product food can give claim high dietary fiber if in 100 grams product food contains 6 grams of dietary fiber or more. Variable most important second is mark energy. Intake recommendations energy consumed adolescent girl with range aged 16 – 18 years based on the 2019 AKG is of 2100 Kcal in a day³⁴. Intake energy for food Intermezzo by 10% of need energy in a day, which is 210 Kcal for adolescent girl. Variable most important third is taste quality. Taste is factor important in evaluation to quality product food. In substitute snack bar products purple sweet potato flour and green ocra, the resulting flavors dominantly sweet originating from use sweet potato flour purple. Level of treatment best furthermore determined with use calculation index effectiveness and level treatment P2 has a total value highest yield (NH) that is 0.594.

CONCLUSION

The study results indicate that vitamins C Substitute snack bar purple sweet potato flour and green ocra give significant influence to quality chemistry covers water content and grade ash. Substitute snack bar purple sweet potato flour and green ocra give significant influence to quality nutrition covers protein content, fat content, content carbohydrates, value energy, and levels dietary fiber. Substitution of purple sweet potato flour and green ocra give significant influence to quality organoleptic covers quality color, taste, and texture. While purple sweet potato flour and green ocra give significant influence to aroma quality. Treatment level P₂ with proportion flour flour, sweet potato flour purple, and green ocra (20: 30: 50) are level treatment best with a Result Value (NH) of 0.594.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES

1. Septiyanti, S. Obesity and Central Obesity in Adult Communities in Urban Areas in Indonesia. *J Health Science*, 2020; 2 (3), 118–127.
2. WHO. Obesity and overweight. WHO; 2022.
3. Ratna M., Arifin VN, Ramadhaniah R. Determinants of Obesity in Students of SMA Negeri 2 Banda Aceh City. *AN-NUR: Journal of Public Health Studies and Development*, 2021; 1 (2), 147–160.
4. Hanifah NID, Dieny FF. The relationship between total dietary fiber intake, soluble dietary fiber and insoluble dietary fiber intake with the incidence of metabolic syndrome in obese adolescents. *College Journal of Nutrition*, 2016; 5 (3), 148–155.
5. Hull HR, Herman A, Gibbs H, Gajewski B., Krase K., Carlson S.E., Sullivan, D.K., & Goetz, J. The effect of high dietary dietary fiber intake on gestational weight gain, fat accrual, and postpartum weight retention: A randomized clinical trial. *BMC Pregnancy and Childbirth*, 2020; 20 (1), 1–10.
6. Gionte, F., Limonu, M., & Liputo, S. A. Characteristics and acceptability of flakes made from purple sweet potato flour formulated with rice bran flour. *Jambura Journal of Food Technology*, 2022; 4 (1), 34–44.
7. Yolanda, RS, Dewi, DP, Wijanarka, A. Dietary dietary fiber, proximate and energy levels in dry noodles substituted for purple sweet potato flour (*Ipomoea batatas* L. Poir). *Indonesian Nutrition Science*, 2018; 2 (1), 01–06.
8. Anggarawati NKA, Ekawati IGA, Wiadnyani AAIS. Effect of Modified Purple Sweet Potato (*Ipomoea Batatas* Var Ayamurasaki) Flour Substitution on Waffle Characteristics. *Journal of Food Science and Technology (ITEPA)*, 2019; 8 (2), 160–170.
9. Agustiana A., Waluyo W., Widiyanti, FL. Organoleptic Properties and Food

- Dietary fiber Content of Wet Noodles with the Addition of Green Oca (Abelmoschus esculentum L.) Flour. *Journal of Nutrition* , 2020; 9 (1), 131–141.
10. USDA. Agricultural Outlook Forum Program. USDA; 2023.
 11. Data Kemenkes TKPI. *Tabel Komposisi Pangan Indonesia (TKPI)*. Data Kemenkes TKPI; 2019.
 12. Janice FT, Pratiwi ID, Wiadnyani AA. Pengaruh Perbandingan Ekstrak Okra Hijau (Abelmoschus esculentus L.) dan Karagenan Terhadap Karakteristik Permen Jeli. *Itepa: Jurnal Ilmu dan Teknologi Pangan*, 2022;11(2):280-288.
 13. Giyatmi, G., Zakiyah, D., & Hamidatun, H. Pudding Quality Characteristics in Various Comparisons of Agar-Agar Flour and Oca Juice. *Journal of Food Technology and Health*, 2022; 4 (1), 11–19.
 14. Hadi, S. Determination of water content and protein content in biscuits circulating in the Banjarbaru market. *CERATA Journal of Pharmaceutical Sciences*, 2019; 10 (2), 51–55.
 15. Murdiati A., Anggrahini S, Alim A. Increasing the Protein Content of Wet Noodles from Tapioca by Substituting White Sword Koro Flour (Canavalia ensiformis L.). *Agritech* , 2015; 35 (3), 251–260.
 16. Montolalu OS, Langi T, Koapaha T. Uji Organoleptik Dan Sifat Kimia Kue Semprong Campuran Tepung Ubi Jalar Ungu (Ipomoea batatas) Dan Tepung Terigu. *COCOS* 2019,11(1).
 17. Zaddana C, Almasyhuri SN, Oktaviyanti T. Snack Bar Berbahan Dasar Ubi Ungu dan Kacang Merah sebagai Alternatif Selingan untuk Penderita Diabetes Mellitus Snack Bar Based on Purple Sweet Potato and Red Bean as an Alternative Snack for Diabetes Mellitus. *Amerta Nutrition*, 2021; 5(3), 260-275.
 18. Xavier, SN, da Silva, AGF, de Souza, PA, Sales, GNB, da Costa, FB, & Ribeiro, WS. Quality of cookies with partial substitution of wheat flour for oca flour. *Comunicata Scientiae* , 2022; 13 , e3561–e3561.
 19. Wilmulda, A. Testing the Quality of Shredded Beef and Beef Sausages Using the Ashing Method (Ash Content and Acid Insoluble Ash Content). *AMINA*, 2021; 3 (1), 8–12.
 20. Putri Y., Julianti E., Ridwansyah R. Chemical Characteristics of Biscuits from Purple Sweet Potato and Wheat Flour. *Indonesian Journal of Agricultural Technology and Industry*, 2020; 12 (1), 16–20.
 21. Kasim R., Liputo SA, Limonu M, Mohamad FP. The effect of temperature and baking time on the level of preference and nutritional content of snack food bars made from goroho banana flour and tofu dregs flour. *Journal of Technopreneur (JTech)*, 2018; 6 (2), 41–48.
 22. Mustapa. Modification of purple sweet potato flour (ipomea batatas l) using the fermentation method and its application in the making of last bread. *Thesis* , 2020; 1 (651415003).
 23. Karo EB, Suter IK, Putra IN. Pengaruh Penambahan Tepung Ubi Jalar Ungu dengan Campuran Tepung Beras dan Ketan Terhadap Karakteristik Cimpa The Effect of Addition of Purple Sweet Potato Flour with Mixed Rice Flour and Glutinous Rice Flour on the Characteristics of Cimpa. *Itepa: Jurnal Ilmu dan Teknologi Pangan*, 2022; 11(1) 83-91
 24. Suladra M. Effect of adding purple sweet potato (Ipomea batatas L.) on organoleptic properties and antioxidant activity in yangko cake. *Agrotech: Scientific Journal of Agricultural Technology* , 2020; 3 (1).
 25. Syamsuddin, T., Achmadi, NS, Sasmita, AS. Trial of the Use of Oca Puree (Abelmoschus Esculentus L. Moench.) in Making Quick Bread. *Home Journal: Hospitality and Gastronomy Research Journal*, 2021; 3 (2), 136–152.
 26. Pehulisa A., Pato U, Rossi, E. Utilization of purple sweet potato flour and soybean bran flour in making flakes. *Student Online Journal (JOM) in Agriculture* , 2016; 3 (1), 1–10.
 27. Widya, EAD, Rosiana, NM. Making Green Oca and Red Guava Juice Jelly Drinks as an Alternative Source of Dietary fiber. *HARENA: Journal of Nutrition* , 2020; 1 (1), 1–9.
 28. Harun, N, Fitriani S. Utilization of Kepok Banana Flour and Dried Jackfruit

- in Making Snack Bars. *Journal of Food Technology*, 2019; 13 (1), 1–11.
29. Larasati, D., & Muarif, H. (2020). The Effect of Blanching Time on the Physicochemistry and Organoleptics of Ocra Drinks. *Student Journal, Food Technology and Agricultural Products*, 2020.
 30. Syafitri, R., Mandasari, Y. Substitution of Purple Sweet Potato Flour for Mud Cake. *Bunda Tourism Journal*, 2021; 2 (1), 48–60.
 31. Mien DJ, Carolin WA, Firhani PA. Determination of saponin content in mother-in-law's tongue (*Sansevieria trifasciata* Prain variety *S. Laurentii*) leaf extract gravimetrically. *Journal of Health Science and Technology*, 2015; 2 (2), 65–69.
 32. Pratiwi, ND, Wijanarka, A., Widiyanti, FL. Physical Properties, Organoleptic Properties, Food Dietary fiber Content of Pinch Cake with the Mixing of Ocra and Arrowroot: Physical Properties, Organoleptic Properties and Dietary Dietary fiber Contents of Pinch Cake with the Mixing of Ocra and Garut. *ProFood*, 2021; 7 (1), 785–794.
 33. Salsabielia AR, Afgani CA, Dzulfikri MA. The Chemical, Physical and Organoleptic Characteristics of Snack Bars Based on Sorghum (*Sorghum Bicolor* (L.) Moench) and Cashew Nuts (*Anacardium occidentale*). *Food and Agro-Industry Journal*, 2021; 2 (2), 41–52.
 34. AKG. *Recommended Nutritional Adequacy Rates for Indonesian People*. Republic of Indonesia Ministry of Health Regulation Number 28 of 2019; 2019.

The Effect of Acupressure on Increasing Oxygen Saturation in Pneumonia Patients

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ABSTRACT

Pneumonia is one of the top 10 hospital admissions, with a case proportion of 53.95% male and 46.05% female. Pneumonia can cause complications in the oxygenation process that lead to decrease the oxygen saturation value and causes hypoxemia. The purpose of this study was to analyze the effectiveness of acupressure on increasing oxygen saturation in patients with pneumonia. The design used quasi experiment pre test and post test with control group design approach. The sampel of this study was patiens with pneumonia between of 18 to 64 years, which choosing by convenience sampling. Participants in the experimenal group received auricular acupressure at the Shen Men and 5 meridian points, that is LU1, LU2, BL11, BL 12, and BL13. Data collection was done by measuring oxygen saturation using a plus oxymeter. The analysis test to determine the effect of acupressure on oxygen saturation using the Mann-Whitney Test with a significance level of 0.05, and N-Gain. The results showed that average oxygen saturation before acupressure in the intervention group was 74.00% and in the control group 73.15%. After acupressure there was an increase of saturation oxygen 23,8% in the intervention group and 21% in the control, and the effect test showed that there was an effect of acupressure on oxygen saturation (pValue 0.000). The conclusion is acupressure therapy can accelerate increaseing oxygen saturation in pneumonia patients. Therefore, it is recommended that besade addition standard therapy, pneumonia patients can also be given acupressure to accelerate healing.

Keywords : *Acupressure, Breathing Points, Pneumonia, Oxygen Saturation.*

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INTRODUCTION

Pneumonia is an infectious disease concerning the lower respiratory tract with signs and symptoms similar as coughing and briefness of breath caused by the presence of infectious agents, such as viruses, bacteria, mycoplasma (fungi), and/or foreign substances

in the form of exudates (fluid) and consolidations (cloudy spots) on the lungs¹. WHO states, that prevalensi of pneumonia cases are 1.5 and 14 cases per 1000 people/year, with a death rate of 9.2 million people in 1 time worldwide². The prevalence of pneumonia in Indonesia also increased by 0.4% in 2018 compared to 2013³. According to the Indonesian Lung Doctors Association (PDPI),

the *crude fatality rate* (CFR) of pneumonia is 7.6%⁴. One indicator of impaired breathing is the oxygen supply to the body. Organs in the body need an adequate supply of oxygen. Therefore, body functions can work optimally and effectively. If oxygen saturation is low, it can cause hypoxemia which is characterized by shortness of breath, respiratory frequency of 35 breaths/minute, rapid and shallow pulse, and cyanosis⁵. One effort that can be made to accelerate the increase in oxygen saturation in pneumonia patients is by acupressure.

Acupressure is a type of physical therapy that massage and stimulates specific points on the body⁶. Acupressure is a technique for treating disease by massaging and pressing certain points using your fingers to activate the circulation of vital energy^{7,8}. Research by Alipour et al (2022), states that acupuncture can improve the respiratory tract, reduce the development of mechanical ventilation, hypoxemia, tachypnea, dyspnea, cough, sore throat weakness, myalgia, anorexia, and the need for oxygen therapy in COVID-19 patients treated at home sick⁹. Research by Yakout et al (2021) on bronchial asthma patients in the inpatient unit of Alexandria University Hospital by applying pressure and finger massage on five acupuncture points (LU1, LU7, LU9, LI 4, and LI11) showed that there were differences in the degree of dyspnea in these patients. compared with controls¹⁰. Research by Liu et al (2021), on 128 COVID-19 patients who carried out *Qigong Exercise* and *Acupressure Rehabilitation Program (QARP) interventions*, showed a significant increase in vital signs and faster treatment times compared to controls¹¹. Another study conducted by Fan, et.al (2023), said that acupuncture remedy turned into powerful in enhancing lung function , quality of life, and physical capacity, and may be used as an alternative treatment for sufferers with chronic obstructive pulmonary disease (COPD)¹².

Based on the description above, the difference between this research and previous research is that the research subjects suffered from pneumonia and had acupuncture at five respiratory tract points (LU1, LU2, BL11, BL12, and BL13). The purpose of this study

was to analyze the effectiveness of acupressure on increasing oxygen saturation in patients with pneumonia.

METHOD

The study design used a quasi experiment pre test and post test with control group design approach. The research conducted at Dr. Soekardjo Hospital Tasikmalaya, from 17th April to 16th August 2023. The population of this study was all patiens with pneumonia that is not caused by cardiovascular disorder or anemia between of 18 to 64 years. We use convenience sampling, whichis choosing subjects with certain criteria. Inculsion criteria is pneumonia patients who had received antibiotic and oxygen therapy with a nebulaizer, while exclucion criteria are patients who don't decreased consciousness. Experiment were divided into 2 groups. The sample size is 1:1 with each group is 20 participan.

Participants in the experimenal group received auricular acupressure at the Shen Men and 5 meridian points, that is LU1, LU2, BL11, BL 12, and BL13 by using fingers therapist, slowly and rhythmically starting from light, medium to hard pressure, with circular pressure in a clockwise direction to pen on the chest and back area. Pressure was applied for 2 minutes for each point twice for 3 consecutive days. Before and after the intervention, oxygen saturation was measured using *pulse oximetry* and then analyzed using the Man-Whitney test at a confidence level of 95%.

RESULTS

Table 1. Charateristics of responden

Category	Group	
	Intervention	Control
Age (n=20)		
Mean	64.35	65.65
SD	17.092	18.175
Min	27	27
Max	88	85
Sex (n=20)		
Male	5 (25%)	10 (50%)
Female	15 (75%)	10 (50%)

Table 1 shows that the respondents have an age range 27-88 years. Based on sex, the majority of responden in thr intervation

group is female (75%), while the control has the same number between male dan female (50%).

Table 2. Differences of oxygen saturation

Table 2: Differences of Oxygen Saturation					
Category	Before		After		p-values
	Group		Group		
	Intervention	Control	Intervention	Control	
Mean	74,0	73,2	97,9	94,3	0,0001
Median	76,0	71	98	94	
Min	86,0	12	95	92	
Max	61,0	37	99	97	

Based on the table 2, it is known that the oxygen saturation level of intervention group before acupressure therapy was carried out for 2 minutes twice/day for 3 consecutave days was increased by 23,9% with an average oxygen saturation from 74,0 to 97,9. Mean while in the control group, the increase was only 21% with an average osygen saturation from 73,2 to 94.3. The results of the *Man Whitney* test obtained pValue = 0.0001 (≤ 0.05), meaning that acupressure had a significant effect on increasing oxygen saturation in the intervention group.

Table 3. The Effectiveness of Acupressure Therapy

Oxygen Saturation	N-Gain (Min-Max)	Information
Intervention Group (n=20)	91.2 (80-97)	Effective
Control Group (n=20)	76.2 (57.1 – 85)	

As calculated by the N-gain test, the mean N-gain score for the intervention group was 91.2%, the minimum N-gain score was 80.0 and the maximum was 97.0. But, in the control group, it was 76% with a minimum N gain score of 7.1 and a maximum N gain score of 85. Based on the known analytical value of 1.196, we can conclude that acupressure therapy is more effective. Reducing the increase accelerates oxygen saturation in patients with pneumonia.

DISCUSSION

The result showed that acupressure can increasing oxygen saturation in the intervention group compared to control group, with a p-value = 0.0001. This research is in line with Pratama's research that accupreasure and

slow deep breathing have an effect on increasing peak expiratory flow values (p-value=0,003) and oxygen saturation (p-value=0,001)¹³. Likewise Saputra's research shows that accupressure is a complementary therapy for patiens with respiratory disorders¹⁴.

Oxygen saturation is the amount of oxygen bound to red blood cells and reflects the extent to which oxygen is distributed to all body tissues. If the oxygen level in the blood is low, it will affect vital organs and cause hypoxia or even lung dysfunction^{15,16}.

In pneumonia sufferers, oxygen saturation is an important indicator in evaluating the severity of the disease and determining the need for treatment. Pneumonia can cause damage to lung tissue, and inhibit normal ventilation and inflammation in the alveoli area, thereby disrupting oxygen exchange between the lungs and blood (gas diffusion) and causing a decrease in oxygen saturation^{2,15}.

Acupressure therapy is an alternative treatment technique that provides a flow of vital energy (qi) by pressing certain points using the fingers inside the body and stimulating sensory nerve cells around the acupressure points which will stimulate the spinal cord, mesencephalon, and hypothalamus-pituitary complex^{16,17}. Acupressure therapy on the respiratory median is known as a water channel with regional flow resistance and functions to drain nutrients, remove supersession waste, and convey physical and chemical responses. Acupressure stimulation can induce neurotransmission and changes in chemical reactions in the central nervous system, causing the release of the hormones dynorphin, serotonin, noradrenaline, beta-endorphin, and metaenkephalin^{18,6}. Moslehi's et all's research explains that acupressure at P6 point in patients can effect

mechanical ventilation, blood circulation, increase blood pressure and respiratory rate²⁰.

Pressure on the LU1 and LU2 points will provide energy and strength to the lung organs which provides maximum lung diffusion¹⁹. The LU2 point aims to eliminate heat in the lungs; reduce pain in the front of the neck/throat, and reduce anxiety. The LU1 point is the front Mu point of the lung meridian, namely the meeting of the lung meridian and the spleen meridian, which provides tonification of Lung Qi and Yin, regulates the distribution of lung Qi, and relaxation of the chest cavity and respiratory tract^{19,22}. Points BL11, BL12, BL 13 will provide a sense of relief in the breathing process which causes maximum ventilation in the meridians. Points BL11 and 12, are the meeting points of the small intestine median and the BL median, San Jiao median, and gall bladder median. The function of this point is to stimulate blood flow to the lungs, the cough reflex point, and relax and regulate lung Qi. Point BL13, is the Shu point at the back of the lungs which functions to facilitate the distribution of air in the respiratory tract-lungs; opens the airways in the lungs, and soothes and relaxes the airways in the lungs^{10,11,21,23}.

CONCLUSIONS

The conclusion of this study is that acupressure at 5 tonification points including LU1, LU2, BL11, BL 12, and BL13 can accelerate oxygen saturation levels in patients with pneumonia. Based on this, it is necessary to develop acupressure therapy in addition to administering oxygen. As a result, residence time and oxygen saturation can be faster.

REFERENCES

1. Wibowo NA, Priyantini D, Kurnyaantini M, Khotimah K. Buku Ajar Pencegahan Penularan Infeksi Pasien Ventilator Associated Pneumonia di Ruang Perawat Intensif. Surabaya: Universitas Muhammadiyah Surabaya Publishing; 2023.
2. WHO. Global action plan for prevention and control of pneumonia. Geneva Switzerland; 2022.
3. Pusat Data dan Informasi Kementerian Kesehatan RI. Situasi Kesehatan Jiwa Di Indonesia. InfoDATIN. 2019. p. 12.
4. Perhimpunan Dokter Paru Indonesia. Pers Relase Perhimpunan Dokter Paru Indonesia dalam rangka World Pneumonia Day 2018 [Internet]. 2018. Available from: <https://klikpdp.com/>
5. Firdaus S, Ehwan MM, Rachmadi A. Efektivitas Pemberian Oksigen Posisi Semi Fowler dan Fowler Terhadap Perubahan Saturasi pada Pasien Asma Bronkial Persisten Ringan. J Keperawatan. 2019;4(1):576–90.
6. Ikhsan M. Dasar Ilmu Akupresur dan Moksibas. Cimahi: Bhimaristan Press; 2019.
7. Rifiana AJ, Mirantika S, Indrayani T. Pengaruh Akupresur terhadap Dismenore pada Remaja. J Penelit Perawat Prof [Internet]. 2023;5(1):37–42. Available from: <https://jurnal.globalhealthsciencegroup.com/index.php/JPPP/article/view/1272>
8. Bakara MS, Wardani KADF, Mansur L. Efektifitas Terapi Tuina Chuzhen Meditatif , Akupuntur Dan Food Therapy Tcm Terhadap Diabetes Gestasional. J Pengabdian Masyarakat Husada. 2022;4(2):93–9.
9. Alipour R, Jamalimoghadamsiahkali S, Karimi M, Asadi A, Ghaem H, Adel-Mehraban MS, et al. Acupuncture or cupping plus standard care versus standard care in moderate to severe COVID-19 patients: An assessor-blinded, randomized, controlled trial. Integr Med Res [Internet]. 2022;11(4):100898. Available from: <https://doi.org/10.1016/j.imr.2022.100898>
10. Yakout R, Hashem E. Effect of Acupressure Sessions on Dyspnea and Fatigue among Patients with Bronchial Asthma. Assiut Sci Nurs J. 2020 Dec 1;8(23):30-44.
11. Xiong C, Li Y, Li CY, Liu YF, Wei H, Fu JJ. Acupuncture for dyspnea and breathing physiology in chronic respiratory diseases: A protocol of a systematic review and meta-analysis of randomized controlled trials. Med (United States). 2022;101(41):E30909.
12. Fan S, Zhang Z, Wang Q. Efficacy of acupuncture therapy for stable chronic obstructive pulmonary disease: A systematic review and meta-analysis. Med (United States). 2023;102(15):E33537.
13. Pratama F. Efektivitas Akupreureur dan

- Slow Deep Breating (SDB) Terhadap Nilai Arus Puncak Ekspirasi (APE) dan Saturasi Oksigen (SPO2) Pada Penderita Asma. Semarang; 2020.
14. Saputra ramal. Terapi Komplementer Acupressure Untuk Menurunkan Dyspnea Pasien dengan Efusi Pleura. *J Penelit Kesehat Suara Forikes*. 2022;13(April):275–9.
 15. Novita C. Berapa Saturasi Oksigen Normal dan Cara Membaca Oximeter Yang benar. 2022.
 16. Al-Halawani R, Charlton PH, Qassem M, Kyriacou PA. A review of the effect of skin pigmentation on pulse oximeter accuracy. *Physiol Meas*. 2023;44(5).
 17. Sri Wulandari Novianti, Suharjiman, Mulyati R, Safarina L, Ismafiaty, Suryaningsih C, et al. Peningkatan Pengetahuan Pada Perawat Dan Kader Kesehatan Di Puskesmas Wilayah Kota Cimahi Melalui Pelatihan Terapi Pijat Akupresur. *Kaibon Abhinaya J Pengabd Masy*. 2023;5(1):85–90.
 18. Zhang Y, Yang G, Wei J, Chen F, Zhang MZ, Mao S. Prospective comparison of acupuncture with sham acupuncture to determine impact on sedation and analgesia in mechanically ventilated critically ill patients (PASSION study): protocol for a randomised controlled trial. *BMJ Open*. 2022;12(8):1–10.
 19. Centis MCL, Kusmiyati Y, Suwondo A. Peran Akupresur Ki3, SP 6, ST 36, ST 25 Motorik Pada Baduta Stunting. In *Magelang: Pustaka Rumah Cinta*; 2022.
 20. Moslehi A, Yadollahi F, Hasanpour Dehkordi A, Kabiri M, Salehitali S. The effect of acupressure on the level of the blood pressure, respiratory rate, and heart rate in patients with the brain contusion under mechanical ventilation. *J Complement Integr Med*. 2021;18(4):18(4), 835–841.
 21. Revianti ID, Yanto A. Teknik Akupresur Titik Hegu (LI4) Menurunkan Intensitas Nyeri Dismenore Pada Remaja. *Holist Nurs Care Approach*. 2021;1(1):39.
 22. Setyoadi T. Terapi Modalitas Keperawatan dan Klien Psikogeriatik. Jakarta: Salemba Medika; 2015.
 23. Suwarini NM, Sukmandari NMA, Wulandari MRS. Pengaruh Pemberian Terapi Akupresur terhadap Tekanan Darah Lansia di Puskesmas Kediri I Tabanan. *J Surya Med*. 2021;7(1):243–7.

Original Article

Validity and Reliability of Physical Fitness Test of Nusantara Students at SMP Padang City

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ABSTRACT

The validity and reliability of the Nusantara Student Fitness Test instrument remain uncertain, prompting this study to investigate its efficacy. This research aims to assess the validity of various components of the test, including Body Mass Index (BMI), V Sit and Reach, 60-second Sit Up, Squat Thrust, Pacer Test, and overall reliability of the Nusantara Student Fitness Test (TKPN) instrument. A descriptive research method was employed, involving 109 junior high school students from Padang City across 11 districts. The sample comprised 143 students actively participating in extracurricular sports from SMP N 18 Padang City and SMP Adabiah Padang City. Data analysis utilized correlation tests (rxy) at a significance level of 0.05. The findings reveal several key outcomes: (1) BMI provided insights into students' nutritional status, with the majority exhibiting good nutrition; (2) The V Sit and Reach test exhibited validity ($0.314 > 0.163$), albeit not particularly useful; (3) The Sit Up test demonstrated acceptable validity ($0.647 > 0.163$); (4) The Squat Thrust test showed clear relevance ($0.444 > 0.163$); (5) The Pacer Test displayed very good validity ($0.814 > 0.163$); (6) The TKPN instrument exhibited medium reliability (0.676). These findings contribute to a better understanding of the Nusantara Student Fitness Test instrument's effectiveness and underscore the importance of validity and reliability assessments in fitness evaluation tools.

Keywords: Validity, Reliability, Physical Fitness.

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INTRODUCTION

Sport is a physical activity that is beneficial in life and running life ^{1,2}. Sports are one of the fields that play an important role in human life through coaching and development through sports events carried out. By exercising, in addition to seeking body freshness, exercise is one way to get appreciation to improve the dignity and dignity of the nation. Now people have understood and understood the needs of sports to run their lives, this can be seen through the development of sports that occur ^{3,4}. People have full awareness of keeping their bodies healthy and fit, because

physical fitness is an important aspect of human life, with a fit body can make it easier to carry out daily activities ^{5,6}.

Physical fitness is an important aspect of human life, with a fit body can make it easier to carry out daily activities ^{7,8}. Physical fitness is also related to Health ^{9,10}. Physical fitness is one of the most influential elements in human life, with good physical fitness, it is also good in carrying out activities as a human being, both related to physical problems and related to spiritual problems ¹¹. This is in line with opinion ⁵ which states that fitness is also in line with a healthy lifestyle. In addition, physical fitness is a person's physical ability to carry out

daily tasks without feeling excessive fatigue and recover before the same task comes the next day¹². Physical fitness does not merely appear without any effort made, in addition to food that must be maintained, motivation to stay healthy of course also by doing exercises that are in accordance with the purpose^{13,14}.

The activity in question is also not spared for every student, especially in Indonesia, because to achieve it has been assisted in compulsory subjects, namely physical education for the Elementary School (SD), Junior High School (SMP), and High School (SMA) levels. This is a form of government support to achieve physical fitness of students in Indonesia because physical freshness and learning achievement are inseparable^{15,16}. Because basically physical education is the need of every individual to run his life¹⁷. Physical fitness is a very important aspect of overall body fitness that gives students the ability to persevere following the training process that takes place both in practice and outside of practice so as not to get tired quickly to lead a productive life and be able to adjust to the right physical load¹⁸. Through physical education, it is expected to be able to maintain body fitness so that it can improve cognitive^{19,20}. When cognitive increases, it also facilitates decision making²¹. When everything goes well, you are able to achieve one of the goals of the sport, namely achievement. Of course, this also leads to Presidential Regulation (Perpres) No. 86 of 2021 concerning the Grand Design of National Sports (DBON), the other of which aims to increase the capacity, synergy, and productivity of national achievement sports. In its latest direction, it directs to a new type of test instrument in looking at the physical fitness of students in the archipelago.

Every human being in carrying out daily activities requires good physical conditions, as is the case with students with their task of learning²². The physical fitness test instrument is one of the tests used to determine a person's physical fitness level. Many previous test instruments can be used as physical fitness test instruments, such as the Indonesian Physical Fitness Test (TKJI) but over time new instruments have emerged to measure physical fitness. According to^{23,24} The emergence of this instrument as a form of the development of science to increase activities that support

learning. The test in question is the Nusantara Student Fitness Test (TKPN) which consists of 5 test instruments, namely BMI (Body Mass Index), V Sit and Reach, Sit Up 60 seconds, Squat Trust 30 seconds, Pacer Test.

However, currently it is not known about the validity and reliability of the test instrument for the junior high school level in Padang City. Validity is a concept used in research to measure the extent to which a measurement instrument or research method can be considered as an accurate measuring instrument to measure or collect data in accordance with the purpose of the study. Knowing the validity of the test instrument can facilitate the evaluation of physical ability in sports because it is also one of the important components in determining and improving sports achievement in all sports²⁵. Therefore, researchers will examine the level of validity and reliability of the Indonesian Student Fitness Test (TKPN) at SMP Kota Padang.

METHOD

This study used the product moment correlation method. Researchers want to know how valid and reliable the Indonesian Student Fitness Test (TKPN) instrument in Padang City is. The population in this study was junior high school students in Padang City. The sampling technique uses purposive sampling based on the criteria of students who take part in extracurricular sports activities at school, namely at SMPN 18 Kota Padang and SMP Adabiah Kota Padang, so that the number of samples in the study was 143 samples.

This study aims to determine the validity and reliability of the Indonesian Student Fitness Test (TKPN) instrument. Data collection of instrument validity was carried out by conducting tests on 143 samples. The following are the test instruments tested;

a. **Body Mass Index (BMI)**

Body Mass Index (BMI) is a form of measurement with a screening method used for anthropometric measurements of a person's body. Nowadays most people focus more on the taste of the dish than the nutritional intake in the food itself, so that the weight they have is not appropriate, with the aim of knowing the vertical posture from floor to head (vertex)

- b. *V Sit and Reach*
The sit and reach (SR) test is a field test used to measure hamstring and lower back flexibility. This test aims to measure a person's effectiveness in adjusting to all activities by stretching the body on a wide joint plane.
- c. *Sit Up 60 seconds*
Sit ups are one of the physical activities-resistance exercises whose movements train the abdominal muscles to lift the weight of the body until it forms a 90° angle from a lying position.
- d. *Squat Thrust 30 seconds*
Squat thrust is a combination movement of changing the position of the body from a standing position, squatting then a push-up position and returning to standing. This test aims to measure the endurance ability of strength, body control, balance, coordination and agility.
- e. *Pacer Test*
The test run is 20 meters marked with markings with an initial speed of 8.5 km / h and will be increased by 0.5 km / h every minute marked with a signal. The Progressive Aerobic Cardiovascular Endurance Run (PACER) test is a progressive aerobic cardiovascular endurance test using a back-and-forth run at a distance of 20 meters with a stride speed increasing every minute following a predetermined rhythm. This test aims to measure the working ability of the heart and lungs to the maximum.

After the instrument validity data is collected, the next step is to collect instrument reliability data by means of the halving technique. To analyze the data that has been obtained, a simple correlation test will be carried out. If the correlation value is high, then the result will determine the validity of the created instrument. After that, researchers will analyze the level of reliability of the instrument by looking at the correlation between test results in odd and even groups. The statistical analysis used to find out how high the reliability level of this instrument is is correlation using the halving technique (Spearman Brown).

RESULTS

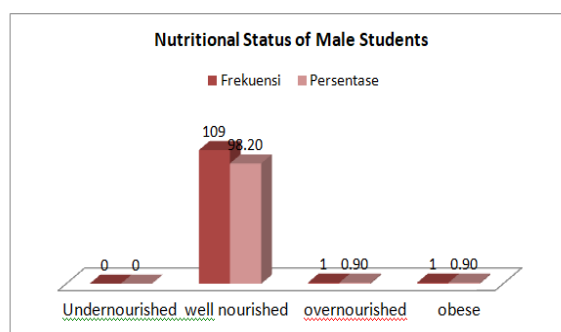


Figure 1. Nutritional Status of Male Students

Body Mass Index data is used to see the nutritional status of students, which is divided into two, namely based on gender, namely 111 men and 32 women. For men, 109 people with good nutrition category (98.20%), 1 person with more nutrition category (0.90%), and 1 person with obesity category (0.90%).

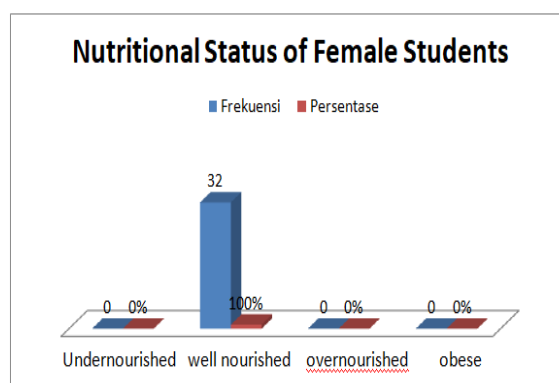


Figure 2. Nutritional Status of Female Students

While for women, 32 people with good nutrition category (100%) were obtained.

Table 1. Validity of V Sit and Reach Instruments

Test Name	R count	R table	Information
V Sit and Reach	0,341	0,163	Valid

V Sit and Reach instrument testing was carried out by correlating the results of student achievement in conducting this test three times, from the three experiments the highest data was taken. After that, an analysis was carried out to see the physical fitness of the students. After both of them were obtained, a correlation test

was carried out between the results of V Sit and Reach on physical fitness, and obtained r count results of $0.341 > 0.163$ (Valid / Acceptable).

Table 2. Validity of Sit Up Instruments

Test Name	R count	R table	Information
Sit Up 60 seconds	0,647	0,163	Valid

Sit Up instrument testing is carried out by correlating the results of student achievement in conducting this test. After obtaining the results, a correlation test was then carried out between the results of Sit Ups on physical fitness, and obtained the results of r count $0.647 > 0.163$ (Valid / Good).

Table 3. Squat Thrust Instrument Validity

Test Name	R count	R table	Information
<i>Squat Thrust</i>	0,444	0,163	Valid

The testing of the Squat Thrust instrument was carried out by correlating the results of student achievement in doing this test for 30 seconds. From the data obtained, a correlation test was carried out between the results of Squat Thrust on physical fitness, and obtained the results of r count $0.444 > 0.163$ (Valid / Clearly Related).

Table 4. Validitas Instrumen Pacer Test

Test Name	R count	R table	Information
<i>Pacer Test</i>	0,814	0,163	Valid

Testing the pacer test instrument is carried out by looking at the results of student achievements in conducting this test. Furthermore, a correlation test was carried out between the results of the pacer test on physical fitness, and obtained the results of r count $0.814 > 0.163$ (Valid / Clearly Related).

Table 5. Reliability of Nusantara Student Fitness Test Instrument (TKPN)

Test Name	R count	R table	Information
TKPN	0,510	0,686	Valid

After conducting the validity test, the next is to conduct a reliability test using the half split test or the halving technique (Spearman Brown). This halving technique is carried out by dividing the sample of 143 people into 2 odd and even groups consisting of 72 people for the first group and 71 people for the second group. Then further testing between odd and even groups was carried out to test its reliability.

After testing, a reliability result of 0.510 was carried out, then further testing was carried out, using the Spearman Brown reliability formula with a result of 0.686 and was in the medium category.

DISCUSSION

The validity and reliability test of the Nusantara Student Fitness Test (TKPN) instrument was carried out to determine whether or not the TKPN test instrument was valid consisting of 5 test instruments consisting of Body Mass Index (BMI), V Sit and Reach, Sit Up, Squat Thrust, and Pacer Test as well as to determine the reliability of the Nusantara Student Fitness Test (TKPN) test instrument. The results of this test are expected to be able to answer and become a reference in the use of this test instrument. Data collection of instrument validity and reliability was carried out by testing 143 samples. To analyze the data that has been obtained, a simple correlation test will be carried out. If the correlation value is high, then the result will determine the validity of the created instrument. After that, researchers will analyze the level of reliability of the instrument by analyzing statistically to find out how high the level of reliability of this instrument with correlation using a correlation test with a split half test (halving technique).

^{26,27}states, "The number that indicates whether or not a test is valid is called a validity coefficient whose magnitude ranges from 0 to +1. The coefficient of statistical validity can range from -1 to +1, the higher the validity of the test, the more precisely the test is used, conversely, the lower the coefficient of validity of the test, the more doubtful the accuracy of the test in measuring. ^{28,29}states By knowing the level of validity and reliability of the instrument, it can be used as a reference in choosing and using a valid fitness test for use.

Statistical testing was carried out on four test instruments, namely v sit and reach, sit up, squat thrust, and pacer test. Meanwhile, the Body Mass Index (BMI) test instrument is analyzed to see the level of nutritional status. The level of nutritional status of students is adjusted based on the Minister of Health Regulation Number 2 of 2020 concerning Anthropometric Standards for Children with male and female genders. The Minister of Health contains categories and thresholds for children's nutritional status. BMI is one of the

things needed to get data on the results of nutritional status, besides that height and weight data are also needed. From the testing carried out will get the results of how the nutritional status of a person.

The results of this nutritional status also refer to physical activity that cannot be separated from the influence of physical fitness, where in every activity carried out regularly and has a stable level of activity will also affect physical fitness^{30,31}. After obtaining nutritional status results based on BMI data, it was continued with testing the validity and reliability of four other test instruments at the crime scene. The results of data analysis showed that the four test instruments were in the valid category. However, with different values and levels, such as in the V Sit and Reach test instrument, measurements are valid but still in the category of useless.

Then on the 60-second sit up test instrument, the measurement is valid and is in the acceptable category. Furthermore, the squat thrust instrument is valid and is in a clearly related category. And finally, the pacer test instrument in measurement is already in the valid category with a very good category and this instrument is the instrument with the highest value of the measurement scale³². So simply based on the four test instruments, all of them are already in the valid category but with different categories and one of them with the useless category. Furthermore, after conducting a validity test, a reliability test was carried out which based on the test stated that the Nusantara Student Fitness Test (TKPN) instrument was reliable with a medium category.

This study discusses the validity and reliability of fitness test instruments used in junior high school students in Padang City. The results showed that the use of Body Mass Index (BMI) as a tool to assess students' nutritional status was reliable, with most students in the good nutrition category. However, the V Sit and Reach test instruments have low validity and are considered useless, while the Sit Up, Squat Thrust, and Pacer Test tests show higher validity, with acceptable to excellent categories. That is, the test can reliably measure certain components of fitness in students^{33,34}.

In the context of test instrument validity, these findings may provide valuable guidance for the assessment of junior high school students' fitness. Especially, Sit Up, Squat Thrust, and Pacer Test test instruments

can be good choices to get an accurate picture of a student's fitness level. In addition, the study also highlights the importance of understanding the limitations of certain instruments, such as V Sit and Reach, which may not provide valid information regarding student fitness. Therefore, the selection of appropriate test instruments is a crucial aspect in accurately assessing student fitness^{35,36}.

The reliability results of the Nusantara Student Fitness test (TKPN) showed a moderate level of reliability. Nevertheless, its fairly good reliability still makes this instrument reliable for consistent measurement of student fitness. This provides a strong foundation for the use of the crime scene test as a tool for evaluating the physical fitness of junior high school students. Thus, this study not only provides insight into the validity of the test instruments, but also strengthens confidence in the reliability of the instruments used in measuring student fitness at the junior high school level in Kota Padang.

CONCLUSION

Overall, this study contributes significantly to the understanding of the validity and reliability of fitness test instruments commonly used in junior high school students in Padang City. First, the results show that Body Mass Index (BMI) can be relied upon as a tool to assess students' nutritional status, providing an in-depth understanding of their health condition. Meanwhile, the finding of low validity on the V Sit and Reach test instrument provides a warning of the need to consider more valid alternatives in measuring student flexibility. This limitation should be a concern in the preparation of school fitness programs to ensure that the data collected provides an accurate and relevant picture of the physical condition of students.

The results corroborate the reliability of the Sit Up, Squat Thrust, and Pacer Test test instruments as valid tools for evaluating the fitness of junior high school students. The validity found in these instruments opens up opportunities for wider application in the context of school physical fitness assessments. Although the reliability of the Nusantara Student Fitness test (TKPN) is categorized as moderate, it still creates a solid basis for its use in measuring student fitness consistency. This conclusion provides a strong foundation for educators and researchers to select and develop

appropriate test instruments, while improving the quality of physical fitness assessments of students at the junior high level.

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CONFLICTS OF INTEREST

All authors declared no conflict of interest in this study.

REFERENCES

1. Han H. Fuzzy clustering algorithm for university students' psychological fitness and performance detection. *Heliyon*. 2023;9(8):e18550. doi:10.1016/j.heliyon.2023.e18550
2. Garst BA, Bowers EP, Stephens LE. A randomized study of CrossFit Kids for fostering fitness and academic outcomes in middle school students. *Eval Program Plann*. 2020;83:101856. doi:10.1016/j.evalprogplan.2020.101856
3. Damayanti MR, Sudira PG, Karmany NPG, Kristianingsih KN. The effectiveness of exercise on the go program to nursing students' physical fitness and quality of life in Bali. *Enfermería Clínica*. 2020;30:90-94. doi:10.1016/j.enfcli.2019.09.029
4. Xu SS, Leung K, Wong TWL, Chung KHK, Chan DKC. Physical activity and health-related fitness among Chinese older women: A test of self-determination theory. *Asian J Sport Exerc Psychol*. 2023;3(2):107-113. doi:10.1016/j.ajsep.2023.08.001
5. Henning L, Dreiskämper D, Tietjens M. The interplay of actual and perceived physical fitness in children: Effects on motivation and physical activity. *Psychol Sport Exerc*. 2022;58:102055. doi:10.1016/j.psychsport.2021.102055
6. Jurić P, Dudley DA, Petocz P. Does incorporating high intensity interval training in physical education classes improve fitness outcomes of students? A cluster randomized controlled trial. *Prev Med Reports*. 2023;32:102127. doi:10.1016/j.pmedr.2023.102127
7. HB B, Wahyuri AS, Zarya F, Sabillah MI, Annasai F. Revitalizing student physical fitness: The vital role of post?pandemic physical activity programs. *Fizjoterapia Pol / Polish J Physiother*. 2023;23(4):226-232. doi:10.56984/8ZG20A4D3
8. Bafirman B, Wahyuri AS, Vellya V, Zarya F, Munir A. Comparison of VO2Max Capacity and Lung Vital Capacity of Junior High School Students: Highlands and Lowlands. *JOSSAE (Journal Sport Sci Educ*. 2023;8(1):69-76. doi:10.26740/jossae.v8n1.p69-76
9. Zhang X, Xu X. Continuous use of fitness apps and shaping factors among college students: A mixed-method investigation. *Int J Nurs Sci*. 2020;7:S80-S87. doi:10.1016/j.ijnss.2020.07.009
10. Thompson HR, Hewawitharana SC, Kao J, et al. SNAP-Ed physical activity interventions in low-income schools are associated with greater cardiovascular fitness among 5th and 7th grade students in California. *Prev Med Reports*. 2020;20:101222. doi:10.1016/j.pmedr.2020.101222
11. Dermiansyah, Razali, Ifwandi. Evaluasi Tingkat Kebugaran Jasmani Siswa Kelas Tinggi Sd Negeri Lambaro Angan Aceh Besar. *J Ilm Mhs Pendidik Jasmani, Kesehat dan Rekreasi Fak Kegur dan Ilmu Pendidik Unsyiah*. 2018;4:82-90.
12. Kurniawati A, Baresi MR, ... Evaluasi Tingkat Kebugaran Jasmani Siswa Kelas VI Di SD IT Bhaskara Garut Tahun 2022. *JPM J Pengabdian* 2022;01(03):124-137.
13. Singh H, Esht V, Shaphe MA, Rathore N, Chahal A, Kashoo FZ. Relationship between body mass index and cardiorespiratory fitness to interpret health risks among sedentary university students from Northern India: A correlation study. *Clin Epidemiol Glob Heal*. 2023;20:101254. doi:10.1016/j.cegh.2023.101254
14. Ludyga S, Hauser C, Köchli S, et al. Influence of physical fitness and retinal microcirculation on the development of cognitive abilities from childhood to preadolescence. *Ment Health Phys Act*.

- 2023;25:100544.
doi:10.1016/j.mhpa.2023.100544
15. Martinko A, Sorić M, Jurak G, Starc G. Physical fitness among children with diverse weight status during and after the COVID-19 pandemic: a population-wide, cohort study based on the Slovenian physical fitness surveillance system (SLOfit). *Lancet Reg Heal - Eur*. 2023;34:100748.
doi:10.1016/j.lanepe.2023.100748
16. Callow DD, Smith JC. Physical fitness, cognition, and structural network efficiency of brain connections across the lifespan. *Neuropsychologia*. 2023;182:108527.
doi:10.1016/j.neuropsychologia.2023.108527
17. Felin Fochesatto C, Brand C, Menezes F, et al. Sedentary time play a moderator role in the relationship between physical fitness and brain-derived neurotrophic factor in children. A pilot study. *J Exerc Sci Fit*. 2023;21(1):119-124.
doi:10.1016/j.jesf.2022.11.004
18. Fachrezzy F, Hermawan I, Maslikah U, Nugroho H, Sudarmanto E. Profile Physical Fitness Athlete of Slalom Number Water Ski. *Int J Educ Res Soc Sci*. 2021;2(1):34-40.
doi:10.51601/ijersc.v2i1.29
19. Haverkamp BF, Oosterlaan J, Königs M, Hartman E. Physical fitness, cognitive functioning and academic achievement in healthy adolescents. *Psychol Sport Exerc*. 2021;57(May).
doi:10.1016/j.psychsport.2021.102060
20. Wang L, Guo F, Zhao C, et al. The effect of aerobic dancing on physical fitness and cognitive function in older adults during the COVID-19 pandemic-a natural experiment. *Sport Med Heal Sci*. 2023;(July).
doi:10.1016/j.smhs.2023.07.005
21. Castillo-Rodríguez A, Alejo-Moya EJ, Figueiredo A, Onetti-Onetti W, González-Fernández FT. Influence of physical fitness on decision-making of soccer referees throughout the match. *Heliyon*. 2023;9(9).
doi:10.1016/j.heliyon.2023.e19702
22. Damsir D, Idris M, Rizhardi R. Survei Tingkat Kebugaran Jasmani Pada Siswa Sekolah Menengah Pertama. *Jolma*. 2021;1(1):41.
doi:10.31851/jolma.v1i1.5369
23. Umar MEW, Zulfikar, Syamsulrizal, Putra S. The Implementation of Physical Fitness Test Instruments for Low Grade Elementary School Students in West Aceh District In 2019. *Iosr*. 2021;8(1):19-22. doi:10.9790/6737-08011922
24. Prayuda AM, Jakarta UM, Mulyanto TY, Education S, Program S, Jakarta UM. GUIDELINES FOR ASSESSMENT OF PHYSICAL FITNESS TESTS FOR ADMISSION OF NEW STUDENTS AT HIGH SCHOOL LEVEL THROUGH. 2023;2(2):93-105.
doi:10.53947/tspj.v2i2.555
25. Boleng LM, Louk MJH, Tajuddin AI, et al. Development of norms of physical ability tests of students aged 13 -18 years. *J Cakrawala Pendidik*. 2023;42(2):415-432.
doi:10.21831/cp.v42i2.55493
26. Zhang M, Wang L, Yang J, et al. Impact of body fat and fitness on human thermal responses under transient neutral-cool indoor conditions. *Build Environ*. 2023;234:110206.
doi:10.1016/j.buildenv.2023.110206
27. Qi F, Soh KG, Nasiruddin NJM, Leong OS, He S, Liu H. Effect of Taichi Chuan on health-related physical fitness in adults: A systematic review with meta-analysis. *Complement Ther Med*. 2023;77:102971.
doi:10.1016/j.ctim.2023.102971
28. López-Sánchez GF, Radziński Ł, Skalska M, et al. Body composition, physical fitness, physical activity and nutrition in Polish and Spanish female students of sports sciences. *Sci Sports*. 2020;35(1):e21-e28.
doi:10.1016/j.scispo.2019.04.002
29. Xu K, Sun Z. Predicting academic performance associated with physical fitness of primary school students using machine learning methods. *Complement Ther Clin Pract*. 2023;51:101736.
doi:10.1016/j.ctcp.2023.101736
30. Guijarro-Romero S, Mayorga-Vega D, Casado-Robles C, Viciano J. Does students' self-determined motivation toward Physical Education influence the effectiveness of a fitness teaching unit? A cluster-randomized controlled trial

- and cluster analysis. *Psychol Sport Exerc.* 2020;51:101768. doi:10.1016/j.psychsport.2020.101768
31. Hewawitharana SC, Woodward-Lopez G, Ohri-Vachaspati P, et al. Latent class analysis identifies a promising combination of Supplemental Nutrition Assistance Program-Education interventions for improving student cardiorespiratory fitness. *Prev Med (Baltim).* 2023;175:107687. doi:10.1016/j.ypmed.2023.107687
 32. Kumar A, Zhang S, Neshteruk CD, et al. The longitudinal association between asthma severity and physical fitness by neighborhood factors among New York City public school youth. *Ann Epidemiol.* 2023;88:37-42. doi:10.1016/j.annepidem.2023.11.003
 33. Zhang D, Shi L, Zhu X, Chen S, Liu Y. Effects of intervention integrating physical literacy into active school recesses on physical fitness and academic achievement in Chinese children. *J Exerc Sci Fit.* 2023;21(4):376-384. doi:10.1016/j.jesf.2023.09.004
 34. Huang Z, Li S, Lu F, Tian K, Peng L. Current situation and factors influencing physical fitness among adolescents aged 12 ~ 15 in Shandong Province, China: A cross-sectional study. *Prev Med Reports.* 2023;36:102460. doi:10.1016/j.pmedr.2023.102460
 35. Shen B, Cui G, Bo J. The growth trajectory of college students' academic amotivation and its association with cardiorespiratory fitness and meaning in life. *Learn Individ Differ.* 2023;106:102329. doi:10.1016/j.lindif.2023.102329
 36. D'Agostino EM, Zhang S, Day SE, et al. The longitudinal association between asthma severity and physical fitness among new York City public school youth. *Prev Med (Baltim).* 2023;170:107486. doi:10.1016/j.ypmed.2023.107486

Original Article

The Effect of Ambient Temperature and Air Humidity on The Body's Hematocrit Levels when Exercising

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ABSTRACT

Sport has a crucial role in improving quality of life and health, but the environment including temperature and humidity can affect athletes' performance and health. This study focused on the impact of environmental temperature and humidity on hematocrit levels during exercise in Padang City. Using an ex-post facto design, the study involved 15 football players with pre-test and post-test hematocrit before and after a 10km jog. The results of the study are the body's hematocrit levels when exercising, evidenced by statistical analysis, namely: a) P value < 0.05 , $0.034 < 0.05$, b) Hematocrit increase that occurs with a difference of 1.25%, c) t calculate $> t$ table which is $2.331 > 1.753$ with $\alpha < 0.05$. The normality test shows normally distributed data, validating the results of the analysis. Increased hematocrit is related to oxygen demand and dehydration, which can be exacerbated by high temperatures and humidity. The research underscores the importance of a holistic understanding of the sports environment and the implementation of preventive measures, such as adequate fluid intake. Elevated hematocrit levels can be an indicator of dehydration risk, which can affect physical performance and heart health. Therefore, education on the body's adaptation to environmental changes and safe sports practices needs to be introduced to maintain the health and quality of life of people in environments with high temperatures and humidity. It can be concluded that there is a significant difference in the body's hematocrit levels when exercising with a P value of < 0.05 .

Keywords : Ambient Temperature, Air Humidity, Hematocrit Levels.

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INTRODUCTION

Sport continues to play a vital role in improving quality of life and health¹⁻³. Sports also provide physical and mental benefits, improve physical fitness, and provide fun and entertainment^{4,5}. Sports can be practiced by anyone, anytime, and anywhere, regardless of gender, ethnicity, or race^{6,7}. Physical fitness, involving the body's adaptation to physical loading, plays a key role in improving the quality of life^{8,9}. The environment, including air temperature and humidity, greatly affects

physical appearance in sports¹⁰. High temperatures and humidity can affect blood flow and loss of body fluids, impairing appearance and health¹¹. In exercise, the body produces heat, and the loss of body fluids and electrolytes is closely related to the surrounding environmental conditions¹². Loss of body fluids can cause dehydration, affect the work of the heart, and can be fatal¹³. Therefore, an understanding of environmental factors and the role of exercise in maintaining health is the key to improving people's quality of life.

Changes in air temperature can affect air humidity, and both have a significant contribution to sports performance ¹⁴. High relative humidity can inhibit the removal of body fluids, while high temperature and humidity can affect blood flow and blood distribution to muscles ¹⁵. High temperatures and humidity can increase blood flow to the skin and blood distribution to muscles, which can affect the body's physiology ¹⁶. The importance of temperature and humidity in exercise is closely related to the risk of dehydration. Dehydration can affect physical performance, increase the heart's workload, and can be fatal ^{17,18}. Excessive loss of body fluids can lead to dehydration, which can be indicated by an increase in hematocrit values ¹⁹. The hematocrit reflects the percentage of red blood cells in the blood, and an increase in the hematocrit value can be an indicator of dehydration ²⁰. Monitoring of ambient temperature, relative humidity, and hematocrit levels is important in maintaining athletes' health and performance, especially in areas with high temperatures and humidity such as Padang City.

Hematocrit is an important parameter in a blood test that measures the volume of erythrocytes in 100ml of blood, expressed in percentage form ²¹. The hematocrit value is useful for knowing the average erythrocyte count and detecting health problems. Normal values of hematocrit in men are 40-48%, while in women it is 37-43% ²². Hematocrit examination can be carried out by macro and micro methods using wintrobe tubes or microcapillaries ²³. Both methods have their own advantages and disadvantages. Factors that affect hematocrit examination results involve in vivo and in vitro conditions, such as erythrocyte count, blood viscosity, and anticoagulant use. Dehydration can increase hematocrit values due to hemoconcentration due to a decrease in fluid volume and an increase in the number of erythrocytes ²⁴. Therefore, an understanding of the factors affecting hematocrit, as well as its relationship with dehydrated conditions, becomes important in the interpretation of blood test results. This study highlights the impact of environmental temperature on health when doing sports activities. High temperatures can cause heat exhaustion, dehydration, and other health problems ²⁵. The variation in air temperature in Padang City reaches 12°C - 30°C, with the highest temperature

concentrated in urban areas. High population density and urban activity can increase local temperatures, affecting people's health and comfort. This study aims to explore the effects of ambient temperature and air humidity on hematocrit levels when exercising in environments with high temperature and humidity conditions.

Based on the background and observations of researchers, there has been no research, especially in Padang City, which has a high enough temperature and humidity in calculating hematocrit levels when exercising as an indicator of someone being dehydrated and there is no one's examination test to be able to determine hematological changes when doing sports activities in hot climates without consuming fluids. And there is still no education on how to maintain hematocrit levels in normal circumstances when doing sports. Researchers are interested in conducting research on the Effects of Environmental Temperature and Air Humidity on Hematocrit Levels in the Body When Doing Exercise, because body fluid loss (dehydration) and hematocrit levels are closely related to environmental conditions, especially air temperature and humidity. The hope is that this study can provide deep insight into the relationship between the environment and athletes' health, as well as become the basis for education on how to maintain hematocrit levels in normal conditions when exercising in challenging environments.

This study aims to fill a crucial gap in the literature by investigating the specific impact of environmental temperature and humidity on hematocrit levels during exercise in Padang City, shedding light on the potential risks of dehydration and oxygen demand for athletes. The research objectives include assessing the magnitude of hematocrit changes, analyzing statistical significance, and emphasizing the need for holistic measures, such as adequate fluid intake, to mitigate these effects and safeguard athletes' health and performance in high-temperature and high-humidity environments.

METHOD

This study uses quantitative research methods with an ex-post facto design, which aims to examine events that have occurred and see the factors that can give rise to these events.

The research design chosen was a pre-test post-test, where the research sample conducted an initial test (pre-test) to check hematocrit levels before jogging 10 km, and a final test (post-test) to check hematocrit levels after jogging. The independent (free) variables in this study were ambient temperature and air humidity, while the dependent variable (bound) was hematocrit levels during exercise. The study population consisted of soccer players in Padang City, with a sample of 15 people who met certain criteria, such as aged 16-25 years, male, able-bodied, not injured, and actively training and playing football.

Research instruments involve tools such as EDTA tubes, hematocrit centrifuges, 3 cc syringes, hematocrit tubes, and digital thermohygrometers. The research procedure includes blood sampling before and after jogging, hematocrit examination using micro (capillary) methods, as well as data collection and analysis. The data obtained will be analyzed using a t-test with a significance level of 5%. Previously, data normality tests were carried out to ensure the data matched with the normal distribution. Population homogeneity is also tested to ensure similarity of variance between groups. The results of data analysis will be presented in the form of tables and graphs to illustrate changes in hematocrit levels before and after jogging. This research is expected to contribute to the understanding of the influence of environmental temperature and air humidity on hematocrit levels when doing sports, especially jogging as far as 10 km.

RESULTS

In accordance with the objectives that have been stated previously and the research hypothesis, the data will be described. Based on the results of measurements carried out, namely

A. Test Analysis Requirements

Paired sample t-Test is a difference test between two paired samples. Paired samples were the same subjects, but subjected to different treatments. This difference test model is used to analyze the research model before and after. The requirements must be met i.e. the data is normally distributed. The Shapiro Wilk test was used to test the normality of the data in this study at the significance level $\alpha = 0.05$ assisted by the SPSS program. Here's the breakdown:

hematocrit levels, preliminary data were obtained pre-test (attachment of own contents) and post-test (attachment of sendri contents). Here's a full description of the data:

Table 1. Description of Research Data

	N	Mean \pm Std. Deviation	Minimum	Maximum
Pre-Test	16	43.38 \pm 2.125	40	47
Post-Test	16	44.63 \pm 2.705		49
Total	16	59.02 \pm 1.687	55.50	60.13

Based on table 1 described above, it can be seen, the average pre-test is 43.38 with the lowest value of 40 and the highest value of 47. The post-test average was 44.63 with a low score of 40 and a high of 49. The average duration of time traveled was 59.02 minutes with the lowest value of 55.50 minutes and the highest value of 60.13 minutes. So that from the pre-test and post-test data, a difference of 1.25 is obtained with the following diagram:

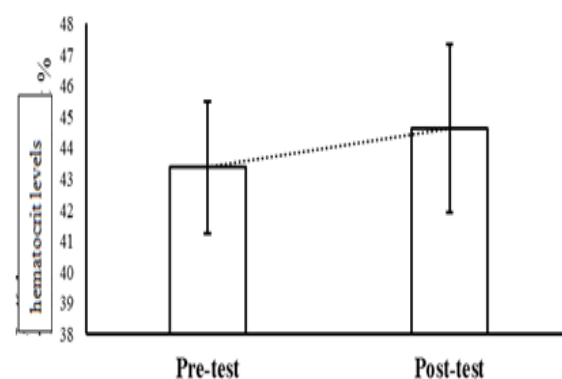


Figure 1. Effects of ambient temperature and humidity on hematocrit levels

Table 2 . Normality Test Results

Tests of Normality (<i>Shapiro Wilk</i>)			
Data	Statistic	Df	Sig
Pre Test Hematocrit	0,947	16	0,451
Post Test Hematocrit	0,958		0,625

Based on the results of the normality test P value > 0.05 , it can be said to be normal in the data group, namely the pre-test research shows, that the significance level is $0.451 > 0.05$ so that it can be concluded that the pre- test data

is normally distributed. In the post-test data, the study showed that the significance level was $0.625 > 0.05$ so that it can also be concluded that the post-test data is normally distributed.

B. Test the Hypothesis

Testing the research hypothesis was carried out based on the results of data analysis and interpretation of t-test analysis using paired sample t test. The sequence of hypothesis testing results adjusted to the hypotheses formulated in the table below, as follows:

Table 3. Pre-test and Post-test T Test Results of ambient temperature and air humidity on hematocrit levels

Source	T	df	Sig. 2 tailed
<i>Pair Pre Test</i>			
Hematokrit - Post Test Hematokrit	-2.331	15	.034

From the paired t test results of Table 4 above, it can be seen that the significance value of p value is 0.034 and t value is 2.331. Because the significance value of p value is $0.034 < 0.05$, it means that there is an influence of environmental temperature and air humidity on the body's hematocrit levels.

Table 4. Pre-test and Post-test T Test Results of ambient temperature and air humidity on hematocrit levels

Source	N	Decrease	Unchanged	Increased
Hematocrit value	16	18,75%	12,5%	68,75%

Table 4 above, there were 3 people (18.75) who experienced a decrease in hematocrit levels, 2 people (12.5%) did not increase or decrease and 11 people (68.75%) experienced an increase.

Based on the results of the analysis, data obtained in Table 2, Figure 1 and Table 4 show the results of the calculated t value $> t$ table so that the difference that occurs from the results of the difference in the average hematocrit value of pre and post which shows 1.25%. Judging from the value of t, calculate with (-) so that in the table t take the value of 1-tailed 0.05 with df 15, which is 1.753. Judging from the absolute value or absolute value of T calculate $> T$ table, $2,331 > 1.753$ which means there is a significant difference in ambient temperature and air humidity to the body's hematocrit levels.

DISCUSSION

Based on hypothesis testing, the results of the data were found by exercising at a temperature of $33, 2^{\circ} \text{C} - 35.1^{\circ} \text{C}$ air humidity at the time of carrying out this study between: 50% - 53% had a significant effect, namely p value of $0.034 < 0.05$. The average pre-test hematocrit value of 43.38% increased the post-test hematocrit value by 44.63% with an average time of 59.02 minutes. Hematocrit is the percentage of total blood volume containing erythrocytes or red blood cells, that is, the volume of all erythrocytes in 100 ml of blood expressed in % (percent)²⁶. When exercising, plasma volume will decrease so that the hematocrit value will increase. Exercising during this time is done only by referring to the signs of changes that appear and are produced by the body, such as differences in pulse levels, the amount of sweat and other signs of fatigue²⁷. In addition to these factors, ambient temperature and air humidity have a significant influence on the body when doing sports²⁸.

Environmental temperature is closely related to the level of air humidity. The higher the ambient temperature, the higher the humidity level of the surrounding air²⁹. An area has different temperatures and relative humidity. Indonesia is a tropical region with temperatures ranging from $29-30^{\circ}\text{C}$ with relative humidity of the air varying depending on various factors such as rainfall, waterlogging, or barren tropics. Environmental temperature is the degree of heat or cold that prevails in the surrounding space³⁰. These environmental factors can be classified in the external environment, namely the environment that affects the performance of athletes who come from outside the body^{31,32}. In addition, there is also the internal environment, namely things that affect physical appearance in sports activities that originate from within the athlete's body. The division of the environment does not only stand alone, but supports each other. The altitude of the place (physical factors) affects chemical factors, namely the partial pressure of O_2 , CO_2 , and CO in the air. Biological environmental factors affect the chemical environment. During the day in arid areas, O_2 levels will be lower than in grassy areas or fields and shady plants. While at night the opposite will happen, namely CO_2 gas will increase in levels. Exercising will lead to a state of oxygen deprivation or hypoxia. If hypoxia occurs, the

body will compensate by increasing the number of oxygen carriers. One of them is by increasing the secretion of the hormone erythropoietin into the blood by the kidneys which will further stimulate the production of erythropoiesis by the red bone marrow to increase the number of red blood cells in the blood, it causes the percentage of hematocrit to increase.

A decrease in hematocrit levels occurs in states of hypovolemia, dehydration, polycythemia vera, severe diarrhea, diabetic acidosis, pulmonary emphysema, cerebral ischemic and eclampsia. A hot environment can increase the flow of blood vessels in the skin, so it can change cardiovascular function ¹¹. Increased blood vessel flow in the skin reduces pressure on the central blood vessels and disrupts blood flow in the muscles. Sweating at increased temperature conditions can exceed fluid intake in the body. When dehydration exceeds 3% of total body water (2% of body mass) then aerobic performance can be consistently impaired. Dehydration adds to hyperthermia and a reduction in plasma volume, which combine to accentuate cardiovascular stress. Changes in high blood plasma volume are also caused due to longer duration of exercise (i.e., time periods longer than one hour). This causes the body to compensate by using blood plasma which is the main source of body fluids. As a result, the plasma volume will decrease resulting in blood clotting or hemoconcentration which causes an increase in hematocrit due to the exit of erythrocytes from the spleen. On examination of plasma hematocrit should also be observed for the presence of hemolysis. Physiological or pathophysiological states in plasma can affect hematocrit examination. This is in line with research Sari et al (2023) Hematocrit deficiency can occur due to physical activity that is beyond the limits of maximum ability. Physical activity can affect the increase or decrease in hematocrit levels in the blood. In general, exercise can change hematocrit acutely or chronically in blood plasma, and changes the availability of hematocrit in red blood cells. Volume in blood plasma can decrease after physical activity, resulting in increased pressure, this can occur due to hormonal changes and sweat ^{34,35}.

Based on the explanation above, there are several factors that affect hematocrit, including oxygen demand and dehydration caused by environmental temperature and air humidity. That the use of oxygen and

dehydration can decrease with the simultaneous increase in temperature and humidity of air in an area. At high room temperature, the body increases, the body temperature is higher and the cardiovascular pressure is higher, resulting in a higher dehydration process as a form of resistance to the increase in temperature. Based on this, it can affect the hematocrit in a person's body.

CONCLUSION

This study highlights the impact of environmental temperature and air humidity on health and hematocrit levels during exercise, especially in Padang City. The results of the analysis showed a significant influence of environmental temperature and air humidity on the increase in hematocrit levels during activity, with an average increase of 1.25%. Factors such as oxygen demand, dehydration, and the body's adaptation to the environment play an important role in changes in hematocrit levels. Therefore, a holistic understanding of the sports environment, including physical, biological, and social aspects, is crucial to maintaining the health and performance of athletes. A significant increase in hematocrit levels may also be associated with a risk of dehydration that can affect the physical performance and workload of the heart. Preventive measures that can be taken, such as adequate fluid intake and adaptation to environmental changes, need to be implemented to maintain the health and quality of life of people who exercise in environments with high temperatures and humidity.

REFERENCES

1. Tjørndal A, Nilssen M. Innovative sport and leisure approaches to quality of life in the smart city. *World Leis J.* 2019;61(3):228-240. doi:10.1080/16078055.2019.1639922
2. Gonçalves Galdino da Costa B, Souto Barreto P, Magno da Silveira P, Aragoni da Silva J, Samara Silva K. The association between practicing sport and non-sport physical activities and health-related quality of life of Brazilian adolescents: A cross-sectional study. *Sci Sport.* 2020;35(4):e109-e119. doi:10.1016/j.scispo.2020.02.003
3. Badru B. The Feasibility of 'BEYB' Attacking Tactic Training in Futsal

- Game. *JPI (Jurnal Pendidik Indones.* 2021;10(3):555. doi:10.23887/jpi-undiksha.v10i3.29359
4. Destriana D, Destriani D, Yusfi H. Service Techniques To Improve Volyball GameS. *JPI (Jurnal Pendidik Indones.* 2020;9(4):597. doi:10.23887/jpi-undiksha.v9i4.21906
5. Hammami A, Harrabi B, Mohr M, Krusturup P. Physical activity and coronavirus disease 2019 (COVID-19): specific recommendations for home-based physical training. *Manag Sport Leis.* 2022;27(1-2):26-31. doi:10.1080/23750472.2020.1757494
6. Nunn C, Spaaij R, Luguetti C. Beyond integration: football as a mobile, transnational sphere of belonging for refugee-background young people. *Leis Stud.* 2022;41(1):42-55. doi:10.1080/02614367.2021.1962393
7. Fox B, Paradies Y. Youth sport and community segregation: a study of kids' participation in Australian rules football and soccer clubs in an Australian community. *Race Ethn Educ.* 2020;23(5):732-746. doi:10.1080/13613324.2019.1679755
8. El Hajj A, Wardy N, Haidar S, et al. Menopausal symptoms, physical activity level and quality of life of women living in the Mediterranean region. *PLoS One.* 2020;15(3):1-16. doi:10.1371/journal.pone.0230515
9. Blegur J, Lumba AJF. Teaching Skills of the Prospective Physical Education Teachers Based on Group Learning Commitment. *JPI (Jurnal Pendidik Indones.* 2022;11(1):107-116. doi:10.23887/jpi-undiksha.v11i1.34739
10. Draper G, Wright MD, Ishida A, Chesterton P, Portas M, Atkinson G. Do environmental temperatures and altitudes affect physical outputs of elite football athletes in match conditions? A systematic review of the 'real world' studies. *Sci Med Footb.* 2023;7(1):81-92. doi:10.1080/24733938.2022.2033823
11. Apriantono T, Herman I, Juniarsyah AD, et al. Pengaruh suhu dan kelembaban terhadap vo2max pada atlet PPLP se-Pulau Jawa, Indonesia. *J Sport J Penelit Pembelajaran.* 2020;6(1):59-68. doi:10.29407/js_unpgri.v6i1.13872
12. McCubbin AJ, Allanson BA, Caldwell Odgers JN, et al. Sports Dietitians Australia position statement: Nutrition for exercise in hot environments. *Int J Sport Nutr Exerc Metab.* 2020;30(1):83-98. doi:10.1123/ijsnem.2019-0300
13. Barley OR, Chapman DW, Abbiss CR. Reviewing the current methods of assessing hydration in athletes. *J Int Soc Sports Nutr.* 2020;17:1-13.
14. Gatterer H, Dünwald T, Turner R, et al. Practicing sport in cold environments: Practical recommendations to improve sport performance and reduce negative health outcomes. *Int J Environ Res Public Health.* 2021;18(18). doi:10.3390/ijerph18189700
15. Zubac D, Stella AB, Morrison SA. Up in the air: Evidence of dehydration risk and long-haul flight on athletic performance. *Nutrients.* 2020;12(9):1-15. doi:10.3390/nu12092574
16. Travers G, Kippelen P, Trangmar SJ, González-Alonso J. Physiological Function during Exercise and Environmental Stress in Humans—An Integrative View of Body Systems and Homeostasis. *Cells.* 2022;11(3). doi:10.3390/cells11030383
17. Nye NS, Grubic T, Kim M, O'Connor F, Deuster PA. Universal Training Precautions: A Review of Evidence and Recommendations for Prevention of Exercise-Related Injury, Illness, and Death in Warfighters and Athletes. *J Athl Train.* 2023;58(3):232-243. doi:10.4085/1062-6050-0400.21
18. Blanchard A. Faktor Determinan Status Hidrasi Atlet Bela Diri Di Pusat Pelatihan Olahraga Pelajar. *Soins Aides - Soignantes.* 2014;11(56):26-27.
19. Alhowikan AM, Al-Hazaa HM. Impact of running race in warm weather on hematological and biochemical parameters. *Eur Rev Med Pharmacol Sci.* 2022;26(7):2288-2291. doi:10.26355/eurrev_202204_28458
20. Li L, Wu W, Yin M. Effect of Hematocrit Injury on the Survival Rate of Advanced Malignant Tumors and Its Clinical Significance. *Comput Math*

- Methods Med.* 2022;2022. doi:10.1155/2022/4968754
21. Quinn JG, Tansey EA, Johnson CD, Roe SM, Montgomery LEA. Blood: Tests used to assess the physiological and immunological properties of blood. *Adv Physiol Educ.* 2016;40(2):165-175. doi:10.1152/advan.00079.2015
 22. Meilanie ADR. Different of Hematocrit Value Microhematocrit Methods and Automatic Methods in Dengue Hemorrhagic Patients With Hemoconcentration. *J Vocat Heal Stud.* 2019;3(2):67. doi:10.20473/jvhs.v3.i2.2019.67-71
 23. Livshits L, Bilu T, Peretz S, et al. Back to the “Gold Standard”: How Precise is Hematocrit Detection Today? *Mediterr J Hematol Infect Dis.* 2022;14(1):1-12. doi:10.4084/MJHID.2022.049
 24. Putri APH. Nilai Hematokrit pada Pasien Diare. *Lab Medis.* 2021;03(02):120-126.
 25. Ebi KL, Capon A, Berry P, et al. Hot weather and heat extremes: health risks. *Lancet.* 2021;398(10301):698-708. doi:10.1016/S0140-6736(21)01208-3
 26. Rashidi Y, Simionato G, Zhou Q, et al. Red blood cell lingering modulates hematocrit distribution in the microcirculation. *Biophys J.* 2023;122(8):1526-1537. doi:10.1016/j.bpj.2023.03.020
 27. Kishimoto S, Maruhashi T, Kajikawa M, et al. Hematocrit, hemoglobin and red blood cells are associated with vascular function and vascular structure in men. *Sci Rep.* 2020;10(1):1-9. doi:10.1038/s41598-020-68319-1
 28. Mintarto E, Fattahilah M. Efek Suhu Lingkungan Terhadap Fisiologi Tubuh pada saat Melakukan Latihan Olahraga. *JSES J Sport Exerc Sci.* 2019;2(1):9. doi:10.26740/jses.v2n1.p9-13
 29. Park JE, Son WS, Ryu Y, Choi SB, Kwon O, Ahn I. Effects of temperature, humidity, and diurnal temperature range on influenza incidence in a temperate region. *Influenza Other Respi Viruses.* 2020;14(1):11-18. doi:10.1111/irv.12682
 30. Sandi IN, Ashadi K, Womsiwor D. Pembagian Lingkungan Olahraga. *J Pendidik Kesehat Rekreasi.* 2021;7(1):174-185.
 31. Bafirman B, Wahyuri AS, Vellya V, Zarya F, Munir A. Comparison of VO2Max Capacity and Lung Vital Capacity of Junior High School Students: Highlands and Lowlands. *JOSSAE (Journal Sport Sci Educ.* 2023;8(1):69-76. doi:10.26740/jossae.v8n1.p69-76
 32. HB B, Wahyuri AS, Zarya F, Sabillah MI, Annasai F. Revitalizing student physical fitness: The vital role of post?pandemic physical activity programs. *Fizjoterapia Pol / Polish J Physiother.* 2023;23(4):226-232. doi:10.56984/8ZG20A4D3
 33. Sari AF, Yuniarti E, Atifah Y, Farma SA. Perbedaan Kadar Hematokrit dan Trombosit Mahasiswa Biologi dengan Mahasiswa Olahraga Universitas Negeri Padang. *Serambi Biol.* 2023;8(1):44-49.
 34. Anjarsari DRP, Hanan A, Widiani E. Perpaduan Isometric Exercise dan Latihan Pernafasan Yoga Terhadap Penurunan Tekanan Darah pada Pasien Hipertensi di Desa Mojojajar Wilayah Kerja Puskesmas Kedungsari Kabupaten Mojokerto. *J Kesehat Andalas.* 2021;10(1):8. doi:10.25077/jka.v10i1.1601
 35. Jesuthasan A, Ali A, Lee JKW, Rutherford-Markwick K. Assessment of Changes in Physiological Markers in Different Body Fluids at Rest and after Exercise. *Nutrients.* 2022;14(21):4685.

Case Study

Behavior Change Based on Local Wisdom

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ABSTRACT

The KB Village Program is an icon of BKKBN that can directly contact and provide benefits to the Indonesian people at all levels of the region. Programs related to stunting prevention have been provided but are not running optimally. Local wisdom is all forms of knowledge, beliefs, understanding, and insights as well as customs or ethics that demand human behavior in life in ecological communities. Various local values or wisdom are expected to be able to reduce stunting cases. This research uses a qualitative method with a case study approach. The population in this study are some of the people who live in Tolango Village, Anggrek Subdistrict, village officials and officials who handle the stunting program. The purpose of this research is expected to be able to provide education to the community, government and families regarding the right information in handling stunting. It is necessary to provide education to the community through appropriate health promotion means to reduce stunting cases in collaboration with religious leaders in conducting socialization to the community based on local wisdom by involving religious, traditional, community and government leaders. The local wisdom of "Bai'at" and "raba-raba puru" is a local wisdom of the Gorontalo community that has been carried out for generations. Cooperation between health practitioners and religious leaders as one of the figures respected by the community is carried out with the aim of making the community to better understand and carry out the information provided.

Keywords: KB Village, Innovation Program, Stunting Program, Local Wisdom.

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INTRODUCTION

Nutrition is still a major concern globally, especially in developing countries. According to the 2018 Basic Health Research (Riskesdas), the prevalence of underweight, stunting and wasting was 17.7 percent, 30.8 percent and 10.2 percent, respectively¹. Indonesia is one of the countries with a high prevalence of stunting compared to other middle-income countries. The Indonesian Nutrition Status Study (SSGI) reported that the national prevalence of stunting from 2019, 2020, and 2021 has decreased, namely 27.7 percent; 26.9 percent; and 10.2 percent².

The nutritional status of children under

five years old is an important health indicator because toddlers are vulnerable to nutrition problems and diseases³. Underweight and wasting indicate acute malnutrition, while stunting is a condition of failure to thrive in children under five years old due to chronic malnutrition, making them too short for their age. The risks caused by malnutrition in the short term include increased morbidity and mortality rates, impaired development (cognitive, motor, language), and increased economic burden for the care and treatment of sick children⁴. In the long term, it causes a decline in reproductive health, learning concentration, and low work productivity⁵.

Undernutrition that occurs in early

childhood has serious consequences. Children who are undernourished tend to become more seriously ill. There is a strong association between child undernutrition and child mortality. Underweight in children under five accounts for 4.7 percent or 2 million deaths of all deaths of children under five in the world. Undernourished children who escape death become shorter adults, have lower IQs, are hampered in their economic productivity, and are at greater risk of having underweight offspring⁴. The government is committed to accelerating stunting. As a form of commitment to accelerate stunting reduction, the government has issued Presidential Regulation (Perpres) number 72 of 2021 concerning Acceleration of Stunting Reduction. This regulation is the legal umbrella for the National Strategy (Stranas) for Accelerating Stunting Reduction, which has been launched and implemented since 2018. This regulation is also to strengthen the framework of interventions that must be carried out and institutions in the implementation of accelerating stunting reduction⁶. The government targets a 14 percent reduction in stunting prevalence by 2024 and sustainable development targets by 2030 based on achievements in 2024. Based on the Five Pillars of Accelerating Stunting Reduction, a National Action Plan (NAP) will be developed to encourage and strengthen convergence between programs through a family approach at the risk of stunting⁷.

Based on Presidential Regulation No. 72 of 2021, the Government has set the acceleration of stunting reduction among children under five as a priority that must be done with various strategic, effective, and efficient steps. BKKBN as the chief executive of the Stunting Reduction Acceleration Team has established the National Action Plan for Accelerating Stunting Reduction (RAN PASTI)⁶.

In integrating all BKKBN programs and activities, including in accelerating stunting reduction, BKKBN has a Quality Family Village (KB Village) program. In KB villages there is integration and convergence of organizing, empowering, and strengthening family institutions. From this KB village, we can see the implementation of various programs to accelerate stunting reduction, both those carried out by BKKBN or programs implemented by other cross-sectors.

Seeing the massive implementation of accelerated stunting reduction in Indonesia through KB villages, creates an opportunity to photograph activities carried out in KB villages related to handling stunting, especially those that have a major impact in reducing or preventing stunting. For this reason, BKKBN through the Directorate of Population Impact Analysis needs to conduct specific case studies that can illustrate how good practices in accelerating stunting reduction interventions are carried out in KB Villages. Good practices that are successfully photographed from KB Villages will be used as intervention models that can be applied in other KB Villages in Indonesia.

North Gorontalo, which is one of the districts in Gorontalo Province, also has a commitment to accelerate stunting reduction. This is evidenced by the issuance of Regent Regulation No. 15 of 2020 concerning Integrated Stunting Reduction Efforts through the Community Movement to Prevent Stunting. In 2021, North Gorontalo District proposed and determined the Stunting Locus. In 2022, North Gorontalo District was designated as a locus by Bappenas RI with KEP Number. 10/M.PPN/HK/02/2021 concerning the Determination of Regency/City Expansion of Integrated Stunting Reduction Intervention Focus Locations in 2022. Furthermore, it was determined that there were 13 stunting Locus Villages. The local government of North Gorontalo District has integrated the issue of stunting into the 2022 RKPD⁸. The government has various ways to overcome stunting, one of which is by providing education through counseling. Study results show that counseling from officers will affect behavior change⁹. Providing health education to the community requires collaboration with related cross-sectors. The target of providing education is people who are far from healthcare facilities. This research is expected to be able to provide education to the community about the right information in overcoming stunting. Various values or local wisdom inherent in the community provide positive value. This study was conducted to provide an overview of the innovative nutrition-sensitive and nutrition-specific stunting intervention program carried out in the KB Village.

The purpose of this study is to describe program interventions and their impact on accelerating stunting reduction carried out on

adolescent girls, pregnant women and under-five children in the KB Village locus.

METHOD

This research uses a qualitative method with a case study approach. The population in this study were some of the people living in Tolango Village, Anggrek Sub-district, village officials and OPD officials who handle stunting programs. Data collection was carried out by in-depth interviews and FGDs with 25 informants consisting of mothers of toddlers who have stunted children, adolescents, village officials and OPD officials.

Data collection was conducted during May-July 2023. The response of the informants was quite good when conducting the research. All informants were willing to provide the information requested during in-depth interviews.

RESULTS AND DISCUSSION

a. Government Innovation Program to Accelerate Stunting Reduction in KB Village

The informants in this study consisted of two groups. The first group is informants who are all female with the status as housewives who have stunting toddlers, and adolescents who are still at school age. While the next group is OPD and village officials.

Stunting in toddlers can be assessed by the TB/U (Height for age) indicator with a z score of -3 standard deviations to less than -2 standard deviations. Some factors that can cause undernutrition and stunting are maternal knowledge, low birth weight, socioeconomic factors and exclusive breastfeeding. The efforts that can be used to overcome malnutrition are to provide nutritional interventions, both macro and macro in infants and toddlers. Providing macro-nutrition interventions can be done by providing knowledge to fulfill toddler nutrition. While micronutrient interventions can be fulfilled by giving formulas or supplements of multi-micronutrients¹⁰.

The results of interviews with officers found that there was an intervention program to accelerate the reduction of stunting in under-five children in the KB Village locus. The One Day One Egg program is a government program through the Puskesmas to tackle the problem of

stunting. Another program is the provision of green beans. Based on information from program officers, it is given to families at risk of stunting that have been determined by BKKBN.

Based on the results of FGDs with mothers of toddlers, it is known that the assistance provided is not on target. Based on the results of interviews with informants, there are families who receive assistance but apparently do not have infants and toddlers who have a history of stunting, BGM, 2T, and Undernutrition. Conversely, there are families with children aged 24-59 months who are detected to have children at risk of stunting and are currently experiencing malnutrition but do not receive assistance. Information from the officer stated that the data was obtained from the village office. So it is necessary to verify the data every year so that the assistance is right on target¹¹.

Based on the results of the interview, it is also known that the assistance provided by the puskesmas through the One Day One Egg program, however, it turns out that the eggs that have been distributed are not consumed by children who are stunted on the grounds that these children do not like to eat eggs. Eggs are instead consumed by their siblings who are not stunted or even consumed by their own mothers. This was also the case with the mung bean distribution program. The green beans that have been given are not consumed by children who are stunted because the children do not like to eat green beans.

Based on the results of interviews with officers, it is known that there is an intervention program to accelerate the reduction of stunting aimed at pregnant women. The program for pregnant women is aimed at preventing the occurrence of SEZ in pregnant women. Chronic Energy Deficiency (CHD) is a condition of poor nutritional status caused by the lack of food consumption that contains nutrients needed by the body³. SEZ usually occurs in pregnant women. This is because the nutritional needs of pregnant women increase. Pregnant women who experience SEZ are in poor health. This is one of the factors that cause impaired growth and development of the fetus that is conceived, causing Low Birth Weight (LBW)¹². Based on several studies, it is known that one of the causes of stunting is the incidence of LBW³.

Based on the FGD results, it is known that the government program for pregnant

women is in the form of the provision of Blood Additive Tablets (TTD) and milk. However, according to the confession, the milk and TTD provided were not consumed by pregnant women because they did not like the smell and taste and experienced nausea after consuming TTD. The officer mentioned that the community still needs information about the importance of consuming TTD. The results showed that health promotion efforts are needed to improve community knowledge⁹.

The results of interviews with officers showed that Posbindu adolescents have been formed in the KB Village of Tolango Village. Various activities include: gymnastics, anthropometric measurements (TB, BW and LILA), measurement of Hemoglobin levels. In addition, there are also activities to provide Blood Addition Tablets (TTD) at school. The officer distributes TTD every two months (once at school on the 15th and once at the village office during adolescent posyandu). Another activity is counseling at school on anemia and other health counseling.

Based on the results of FGDs with adolescents, it is known that adolescents are less enthusiastic about participating in Posbindu remaja activities for various reasons, such as activities being held at three in the afternoon, at which time they have just returned from school. Adolescents also did not all consume the TTD that had been given, citing forgetfulness, bad taste, bitterness and stickiness. Adolescents are vulnerable to nutrition problems¹³. The many activities they have are potentially unable to control food intake. This is due to the imbalance between food consumed and intake needs in adolescents. The growth and development of adolescents is necessary for their nutritional status. Optimal nutritional status will create healthy and productive adolescents¹⁴.

Nutritional status is a measure of a person's body¹⁵. Many factors contribute to nutritional status, both direct and indirect factors. One of the direct causative factors is knowledge¹⁶.

Based on the results of the study, it is known that teenage informants have a junior high school education. According to Kristiana and Juliansyah¹⁷, education affects a person's learning process. The higher the education, the easier it is to absorb the information they get. Education affects knowledge and attitudes in improving nutritional status. The lower the

knowledge, the lower the attitude in improving nutritional status¹⁸.

b. Innovation in stunting reduction programs assisted by universities

The government has prepared several programs in stunting prevention. However, research shows that existing programs are not optimal. Strengthening the program is needed to change people's behavior. It is necessary to strengthen local government such as Perbup and Perda by involving religious leaders, traditional leaders, community leaders and families in order to increase the success of the stunting prevention program.

Various efforts made by the government to overcome stunting are to increase public knowledge and awareness related to stunting. It is necessary to provide education to the community through appropriate health promotion tools to reduce stunting cases.

Overcoming stunting requires collaboration between stakeholders starting from the smallest scope, namely the village. The village is the last bastion of defense by involving all residents by adopting local wisdom values. Local wisdom is something that cannot be separated from society. According to Lestari and Sularso (2021) local wisdom is a hereditary legacy from ancestors that contains elements of norms and values in regulating, developing and maintaining a balance between nature, human integrity and lifestyle¹⁹. As a country with cultural diversity, many Indonesian people use local wisdom to overcome existing problems. Such as research conducted by Rahmawati (2021) on local wisdom in dealing with Covid-19: A study of resilient villages in East Java²⁰. Other research on local wisdom also supports health²¹. Likewise, research by Rizki, et al (2023) wrote about Mappanetta'isi, the local wisdom of the Bugis tribe in maintaining dental health²².

Based on observation, the Gorontalo community conducts an activity carried out on adolescent girls who get their first period called "Bai'at". "Bai'at" is a local wisdom of Gorontalo people that has been done for generations. In this activity, there is usually a religious figure called Pak Imam who will give advice and in the activity of giving this advice the scenario is inserted "the importance of blood add tablets and mandatory consumption of blood add

tablets in adolescent girls" using local language that is easier to understand and understand.

In addition, there is also a seven-month prayer activity for pregnant women called "Raba-Raba Puru". The Raba-Raba Puru activity is one of the customs carried out on all pregnant women whose pregnancy age enters 7 months. In this activity there are also usually religious leaders who will give advice. In this activity, the scenario of "the importance of Blood Addition Tablets and the mandatory consumption of TTD and tiliaya food for pregnant women will be inserted using local languages that are easier to understand and understand" this activity will take place during pregnancy until the mother will experience partus so that the mother's health status can be monitored. Health workers can collaborate with religious leaders in socializing to the community regarding stunting. Cooperation between health practitioners and religious leaders as one of the figures respected by the community is carried out with the aim of making the community better understand and carry out the information provided.

CONCLUSIONS

It can be concluded that there are two local wisdoms that can be used as educational media in the community to overcome stunting. "Bai'at" and "Raba-Raba Puru" are activities that can be used as a means to provide information about the importance of TTD to adolescent girls and pregnant women using local language that is easier to understand and understand. The suggestion is an innovation of the stunting reduction acceleration program in KB Village in the form of Local Wisdom-Based Behavior Change by involving religious, traditional, community, and government leaders in supporting local wisdom including "Bai'at and raba-raba puru" through ratified Perbup and Perda so that it can be implemented by all OPDs that will be directly involved in stunting prevention.

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CONFLICTS OF INTEREST

All authors declared no conflict of interest in this study.

REFERENCES

1. Kemenkes RI. Hasil Riskesdas 2018. Badan Penelitian dan Pengembangan Kesehatan; 2018.
2. Kementerian Kesehatan Republik Indonesia. Buku Saku Hasil Studi Status Gizi Indonesia (SSGI) Tahun 2022. Kemenkes RI [Internet]. 2022;1–14. Available from: <https://www.litbang.kemkes.go.id/buku-saku-hasil-studi-status-gizi-indonesia-ssgi-tahun-2021/>
3. Ramadhani F, Hano YH. Determinan Kejadian Bayi Berat Badan Lahir Rendah (Bblr) di Gorontalo. *J Kesmas Untika Luwuk Public Heal J*. 2020;11(2):37–42.
4. Barbosa MCF, Reis CLB, Lopes CMCF, Madalena IR, Kuchler EC, Baratto-Filho F, et al. Assessing the Association Between Nutritional Status, Caries, and Gingivitis in Schoolchildren: A Cross-Sectional Study. *Glob Pediatr Heal* [Internet]. 2021;8. Available from: <https://doi.org/10.1177/2333794X211001237>
5. Rachmayani SA, Kuswari M, Melani V. Hubungan Asupan Zat Gizi dan Status Gizi Remaja Putri di SMK Ciawi Bogor. *Indones J Hum Nutr*. 2018;5(2):125–30.
6. Perpres. Peraturan Presiden No. 28. 2020;(1).
7. BKKBN . Pedoman Optimalisasi Penyelenggaraan Kampung Keluarga Berkualitas. Jakarta; 2023.
8. Dinas Pengendalian Penduduk Dan Keluarga Berencana. Rekapitulasi Keluarga Berisiko Stunting Tingkat Kecamatan Hasil Pemutakhiran, Verifikasi Dan Validasi. In Kabupaten Gorontalo Utara.; 2022.
9. Firdausi Ramadhani, Ririh Yudhastuti SW. Pelaksanaan PSN 3M Plus untuk Pencegahan Demam Berdarah Dengue (Studi Kasus Masyarakat Desa Kamal). *J Public Health (Bangkok)*. 2019;2(2).
10. Maesarah M, Paramata Y, Dengo MR,

- Junus D, Rahmawati R, Adhayani Z, et al. Pemberdayaan Dasawisma Pada Praktik Pembuatan Olahan Daun Katuk Dalam Peningkatan Produksi ASI Pada Ibu Hamil dan Ibu Nifas Sebagai Upaya Penanggulangan Stunting di Desa Meranti Kabupaten Bonebolango. *SENTRA Dedik J Pengabdian Masy.* 2023;1(3):78–84.
11. S. Roy, N. S. Barman, J. Mondal, and J. Sen. "Prevalence of stunting and thinness among adolescent girls belonging to the rajbanshi population of West Bengal, India,." *J Nepal Paediatr Soc* vol 36, no 2, pp 147–155, 2016. 2016;36(2):147.
 12. Bater, J., Lauer, J. M., Ghosh, S., Webb, P., Agaba, E., Bashaasha, B., Duggan CP. Predictors of low birth weight and preterm birth in rural Uganda: Findings from a birth cohort study. *PLoS One.* 2020;15(7):1–16.
 13. Firdausi Ramadhani, Herman Hatta, Nuryani, Nirmala Yusuf S. Hubungan Asupan Gizi, Pendapatan Keluarga, Dan Tingkat Stres Dengan Obesitas Pada Remaja. *Uwigama J Kesehat Masy.* 2021;7(2).
 14. Dhillon J, Craig BA, Leidy HJ, Amankwaah AF, Osei-Boadi Anguah K, Jacobs A, et al. The Effects of Increased Protein Intake on Fullness: A Meta-Analysis and Its Limitations. *J Acad Nutr Diet* [Internet]. 2016;116(6):968–83. Available from: <http://dx.doi.org/10.1016/j.jand.2016.01.003>
 15. Alivia Norma Yusintha A. Relationship between Eating Behavior and Body Image with Nutritional Status of Adolescent Girl Age 15-18 Years. Open access under CC BY – SA. 2018;
 16. Utami HD, Kamsiah K, Siregar A. Hubungan Pola Makan, Tingkat Kecukupan Energi, dan Protein dengan Status Gizi pada Remaja. *J Kesehat.* 2020;11(2):279.
 17. Kristiana & Juliansyah. Umur, Pendidikan, Pekerjaan dan Pengetahuan dengan kejadian berat badan lahir rendah (BBLR) Age, Education, Work and Knowledge with Lower Heavy Service. *Wawasan Kesehatan*, 4(1). 2017;4(1).
 18. Firdausi Ramadhani YHH. Determinan Kejadian Bayi Berat Badan Lahir Rendah (Bblr) di Gorontalo (Factors Related With Baby Low Birth Weight (Lbw) Incidence of Gorontalo District). *J Kesmas Untika Luwuk Public Heal J.* 2020;11(2).
 19. Lestari, P., & Sularso S. The COVID-19 impact crisis communication model using gending jawa local wisdom. *International 12 J Masy Indones.* 2021;47(1).
 20. Rahmawati Y, Santaufany FFA, Hati EM, Roziqin A. Kearifan Lokal Dalam Menghadapi Covid-19: Studi Kampung Tangguh Di Jawa Timur. *Masy Indones.* 2022;47(1):1–12.
 21. Saleh Al-Omoush, K., Orero-Blat, M., & Ribeiro Soriano D. (2020). The role of sense of community in harnessing the wisdom of crowds and creating collaborative knowledge during the COVID-19 pandemic. *J Bus Res.* 2020;
 22. Muhammad Alif Rizki AA& HHA. Mappanetta'Isi:Kearifan Lokal Suku Bugis Dalam Menjaga Kesehatan Gigi. *J Keperawatan.* 2023;15:1795–808.

The Effectiveness of Olive Oil in Preventing Atherosclerosis: A Literature Review

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ABSTRACT

Olive oil is a rich source of oleic acid and polyphenols. Extra virgin olive oil is rich in phenolic compounds which are known to have anti-inflammatory, anti-cancer, and antioxidant effects. Olive oil has been used for thousands of years as a food source and is reported to have beneficial effects on cardiovascular disease. This review aims to provide a comprehensive overview of the current literature on the use of olive oil in the prevention and treatment of cardiovascular diseases and prevention of atherosclerosis. The methodology is employed by searching the article at Google Scholar, PubMed, Semantic Scholar, teaching materials, and research gate. Studies included the consumption of olive oil, by using qualitative and quantitative methodologies, were published in journals between 2013 and 2024 to obtain the latest information and relevant contents of the articles as well as the empirical data that indicate the effectiveness of olive oil. This research has a varying result, such as the high level of cholesterol and low-density lipoprotein cholesterol (LDL-C). Olive oil polyphenols also increase HDL particle size increase HDL stability by producing a triglyceride-poor core, and improve HDL antioxidant status by increasing the olive oil polyphenol metabolite content of lipoproteins, and it can intake of several foods also positively modulates platelet reactivity and may be the basis for the reduced cardiovascular risk reported in individuals on diets that increase the intake of plant foods, such as the Mediterranean diet. The olive oil which contains MUFA in the form of oleic acid and polyphenols has anti-atherogenic properties to prevent cardiovascular disease.

Keywords: Olive Oil, Atherosclerosis, Antioxidant.

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INTRODUCTION

According to the World Health Organization (WHO) and the World Heart Federation, heart disease is currently the main cause of death in Asian and European countries. Every year an estimated 17.3 million people die from cardiovascular disease. As many as 11.1 million of them occurred due to heart disease and 6.2 million due to stroke. Heart disease and stroke occur due to blockage and hardening of the arteries called atherosclerosis¹.

Atherosclerosis is described as the “stiffening of the arteries” and is a chronic inflammatory process whose pathophysiology involves lipids, thrombosis, vascular walls, and immune cells².

This atherosclerosis process begins to form at a very early age, even while still in the mother's womb. In line with increasing age, and with the presence of risk factors, the process will further develop and give rise to diseases related to atherosclerosis and its complications. Atherosclerosis is a chronic inflammatory

process whose pathophysiology involves inflammation, lipids, thrombosis, and vascular walls including dysfunction of the endothelium and immune cells. The vascular endothelium will regulate vascular homeostasis by producing substances that can cause clotting or anti-clotting. The presence of inflammatory factors and other risk factors will cause the loss of the endothelial protective effect, including hyperlipidemia, hypertension, diabetes and smoking².

The Mediterranean diet is considered one of the mainstream diets and has long been known as one of the most effective ways to prevent and improve cardiovascular disease^{3,4}.

Olive oil is a typical fat source in the Mediterranean diet that has been shown to have important nutritional value and a positive impact on human health due to its bioactive composition^{4,5}. The main component of olive oil which is associated with its anti-atherogenic properties in preventing cardiovascular disease is the MUFA oleic acid which makes up 55-83% of the total fatty acids and minor components of olive oil such as phenolic compounds which amount to 1-2% of the total olive oil content^{4,6}.

The high MUFA content in olive oil significantly reduces the concentration of total cholesterol (TC) and LDL cholesterol (LDL-C), reducing the TC/HDL and LDL/HDL ratios. Phenolic compounds, especially hydroxytyrosol and oleuropein, inhibit the oxidation of LDL and HDL in vitro and in vivo, inhibit superoxide-induced reactions, and interrupt the propagation of lipid peroxides.⁽⁶⁾ Consumption of foods rich in polyphenols has also been shown to increase the bioavailability of nitric oxide (NO) as well as reduce oxidative stress and inflammation⁷.

EVOO's high nutritional value lies largely in its rich and complex chemical profile containing more than 200 compounds. MUFA in the form of oleic acid (OA) is the main component of EVOO which contributes up to 70%–80%. Other minor but nutritious components, such as phenolic compounds, squalene and tocopherol, account for approximately 1%–2% of EVOO content. Although these minor components (such as chlorophyll and carotenoids) also contribute to the beneficial effects of EVOO, the pharmacological effects of EVOO are mainly due to its main components, OA and polyphenols⁴.

This review aims to provide a comprehensive overview of the current literature on the use of olive oil in the prevention and treatment of cardiovascular diseases and prevention of atherosclerosis.

METHOD

A literature search was conducted using the following electronic database such as, Google scholar, PubMed, semantic scholar, teaching materials, research gate to identify the research publications. In addition, we manually search the cited of data and review article for many pertinent studies.

Studies were included the consumption of olive oil, by using qualitative and quantitative methodologies, were published in journal between 2013 and 2024 to obtain the latest information and relevant contents of the articles as well as the empirical data which indicate the effectiveness of olive oil. Each article have a different sources and methodologies to find out the result of the research.

RESULTS AND DISCUSSION

Marta et al conducted a prospective cohort study followed for 24 years, finding an inverse association between olive oil consumption and cardiovascular events. Compared with non-consumers, people who consumed more olive oil had a 14% lower risk of cardiovascular disease and an 18% lower risk of coronary heart disease. In addition, it is estimated that compared with margarine, butter, mayonnaise, and milk fat, olive oil is associated with a lower risk of cardiovascular disease (CVD) and CHD, whereas when compared with other vegetable oils combined, olive oil is not associated with CVD. This research produces new evidence showing that replacing saturated fats, such as butter and margarine, with healthy vegetable fats, such as olive oil, is beneficial for the primary prevention of CVD. Additionally, higher olive oil intake was associated with lower levels of inflammatory biomarkers and better lipid profiles, suggesting that moderate olive oil intake may provide some benefit on surrogate markers of CVD¹³.

Evaluation of the thickness of the intima-media layer of both common carotid arteries or intima-media thickness of both common carotid arteries (IMT-CC) using B-

mode ultrasound is a noninvasive and well-validated clinical method as a surrogate marker of subclinical atherosclerosis and a strong predictor of infarction, new myocardium and stroke. Jose et al's study evaluated the efficacy of two healthy diet patterns (a Mediterranean diet rich in EVOO compared with a diet low in fat and rich in complex carbohydrates) in reducing IMT-CC in patients with coronary heart disease. The Mediterranean diet reduced IMT-CC at 5 years (-0.027 ± 0.008 mm; $P < 0.001$), maintained at 7 years (-0.031 ± 0.008 mm; $P < 0.001$), compared with baseline values. A low-fat diet did not change BMI-CC. IMT-CC and carotid plaque height decreased more after the Mediterranean diet, compared with the low-fat diet during the follow-up period¹⁴.

High levels of total cholesterol and low-density lipoprotein cholesterol (LDL-C) are known risk markers for atherosclerosis. It is considered a major cause of CVD while high-density lipoprotein cholesterol (HDL-C) is thought to be protective¹⁵. Several epidemiological and interventional studies have shown that there is an inverse relationship between plasma HDL levels and CVD¹⁶.

Oxidation of low-density lipoprotein (LDL) is an early event in the development of atherosclerosis, the main cause of CHD. Oxidized LDL is not recognized by the LDL receptor Apo (B/E) but is taken up by macrophages in an unregulated manner via the scavenger-receptor pathway, leading to the formation of foam cells, a characteristic feature of arteriosclerotic lesions. Macrophage-specific reverse cholesterol transport (RCT) is considered one of the most important HDL-mediated cardioprotective mechanisms. RCT is the process by which cholesterol in peripheral cells is removed to circulating HDL and transported back to the liver for excretion in bile and feces. RCT is considered the main antiatherogenic function of HDL. Two major macrophage cholesterol efflux pathways have been described: SR-BI receptor-mediated cholesterol efflux and ABCA1/ABCG1-mediated cholesterol efflux. ABCA1 promotes the efflux of phospholipids and cholesterol to lipid-poor apo-AI through a process involving direct binding of apo-AI to the ABCA1 transporter, whereas ABCG1 and SR-BI are the main mediators of macrophage cholesterol efflux to HDL⁶.

The results of Hicham et al's research showed an increase in LDL and HDL resistance

to lipid peroxidation. This effect may be due to the antioxidant effect of phenolic compounds that can capture reactive oxygen species and thereby inhibit lipoprotein oxidation. Olive oil polyphenols also increase HDL particle size, increase HDL stability by producing a triglyceride-poor core, and improve HDL antioxidant status by increasing the olive oil polyphenol metabolite content of lipoproteins. Thus, EVOO enhances the anti-atherogenic properties of HDL by reducing oxidative modifications and by maintaining the physicochemical properties of HDL, which in turn improves HDL function, especially the capacity to increase cholesterol efflux. EVOO also protects cells from oxidative damage and stimulates the expression of the ABCA1 protein, a key factor in cholesterol efflux and HDL formation⁶.

The results of clinical trials in healthy people as well as individuals at high cardiovascular risk, who followed a traditional Mediterranean diet supplemented with virgin olive oil for a long period showed that olive oil can induce the resistance of HDL to oxidation, and therefore, maintain its vasodilatory capacity (HDL can induce the release of nitric oxide in endothelial cells by activating eNOS). In addition, human studies indicate that phenolic compounds can protect LDL from oxidation, as demonstrated by reducing the oxidizing ability of LDL and modulating the oxidative effects of LDL ox. Polyphenol-rich olive oil has also been shown to reduce the concentration and atherogenicity of circulating LDL¹⁷.

Lipid profiles improved in participants in the EUROLIVE human crossover study, in which 200 European participants consumed olive oil for three weeks. Participants were randomly divided into three groups of olive oils that differed in phenolic content (low, medium and high). HDL-C increased linearly with phenolic content, whereas the TC/HDL-C ratio decreased linearly. The LDL-C/HDL-C ratio and triglycerides decreased in those consuming medium and high phenolic olive oil. Smaller trials in humans confirmed that phenol-rich olive oil improved the lipid profile in terms of circulating HDL-C, lowering LDL-C and to a greater but lesser extent triacylglycerol-rich lipoproteins (TRL)¹⁵.

Research from Katerina et al showed that a non-significant average increase in serum HDL cholesterol efflux capacity was observed in the extra virgin low polyphenol (LPOO) and

high polyphenol (HPOO) treatment groups after consuming both types of OO for 3 weeks respectively. Additionally, significant increases in circulating HDL cholesterol were observed in both treatment groups¹⁸.

The first anti-inflammatory mechanism attributed to olive oil is the ability of the main phenolic compounds to inhibit the adhesion of immune cells (T, B lymphocytes and monocytes) to the endothelium, in response to the inflammatory process. This is achieved by inhibiting the expression of inflammatory mediators, such as cytokines (interleukin (IL)-1, IL-6, IL-8 and tumor necrosis factor- α (TNF- α) signaling pathways), chemokines (monocyte chemotactic protein (MCP-1), adhesion molecules (P and E-selectin, intercellular adhesion molecule-1 (ICAM-1), and leukocyte adhesion molecules, namely vascular cell adhesion molecule-1 (VCAM-1), which are very important in the regulation of innate and adaptive immunoinflammatory responses. A recent study showed that hydroxytyrosol and its metabolites were protective against endothelial dysfunction in human aortic endothelial cells in combination with TNF- α by reducing the secretion of E-selectin, P-selectin, ICAM-1, and VCAM-1. hydroxytyrosol metabolites further reduced MCP-1 levels¹⁷.

Platelets are the first response to vascular injury in the early stages of endothelial disruption, after plaque rupture, and in the late manifestations of disease; at the same time, it promote inflammatory processes that exacerbate atherosclerotic disease. Intake of several foods also positively modulates platelet reactivity and may be the basis for the reduced cardiovascular risk reported in individuals on diets that increase the intake of plant foods, such as the Mediterranean diet. What is interesting about the current trial is the effect of olive oil on platelet function¹⁹.

Blood platelets have been shown to play a role in the development of atherosclerosis. The development of CHD has been associated with high levels of plasma coagulation factors and fibrinolytics such as plasminogen activator inhibitor-1 (PAI-1) and factor VII (FVII). Pure olive oil with a high content of phenolic compounds (400 mg/kg) has been shown to inhibit PAI-1 and FVII¹⁵. VOO exhibits anti-atherogenic effects, especially PL which acts as a Platelet-Activating Factor (PAF) inhibitor, tyrosol and

oleuropein and α T which also exert anti-PAF activity²⁰.

Research from Ruina et al states that more frequent olive oil intake is associated with reduced thrombin-induced platelet activation in people with obesity. Platelet activation is measured by surface markers such as P-selectin. P-selectin is translocated to the platelet surface during activation and mediates platelet interactions with endothelial cells and immune cells. As a direct marker of platelet activation, P-selectin is increased in obesity and is positively associated with carotid intima medial thickness and the development of atherosclerosis and other vascular risk factors. Therefore, increased P-selectin is thought to contribute to the increased risk of CVD in obesity. Thrombin-induced platelet P-selectin expression is increased in severe obesity and normalizes after bariatric surgery²¹.

Thrombin is a potent platelet agonist via proteinase-activated receptors (PAR). Activation of PAR in human platelets increases intracellular calcium, which in turn causes a signaling cascade and translocation of P-selectin from α -granules to the platelet surface. However, olive oil intake did not affect basal P-selectin expression in circulating platelets, affecting only thrombin-induced P-selectin. Polyphenols can block receptor-agonist interactions, such as PAR1-thrombin binding, leading to inhibition of downstream activation signals, reduced degranulation, and suppressed P-selectin translocation to the platelet surface²¹.

A recent observational study showed that obese patients who frequently consumed OO (>4 times/week) showed lower thrombin-induced P-selectin expression on platelet counts compared with less frequent consumers (<1 time/week). This study clearly shows that increased OO consumption correlates with lower platelet activation however the type of OO consumed by the study volunteers was not identified²².

CONCLUSIONS

Based on a review of some articles since 2013-2023, the researcher concluded that the olive oil which contains MUFA in the form of oleic acid and polyphenols, has anti-atherogenic properties to prevent cardiovascular disease such as congenital heart disease (CHD), high density lipoprotein (HDL).

REFERENCES

1. Syamsu RF. Efek Pemberian Minyak Zaitun (Olive oil) Terhadap Perubahan Profil Lipid Pada Tikus putih (*Rattus norvegicus*). *J Ilm As-Syifaa*. 2017;9(1):75–84.
2. Setiati S, Alwi I, Sudoyo AW, Simadibrata M, Setiyohadi B, Syam AF. *Buku Ajar Ilmu Penyakit Dalam*. 6th ed. Jakarta: InternaPublishing; 2014.
3. Report HC, Gaforio JJ, Visioli F, Alarc C. *Nutrients-11-02039-V2(1).Pdf*. 2019;
4. Lu Y, Zhao J, Xin Q, Yuan R, Miao Y, Yang M, et al. Protective effects of oleic acid and polyphenols in extra virgin olive oil on cardiovascular diseases. *Food Sci Hum Wellness*. 2024;13(2):529–40.
5. Covas MI, De La Torre R, Fitó M. Virgin olive oil: A key food for cardiovascular risk protection. *Br J Nutr*. 2015;113(S2):S19–28.
6. Berrougui H, Ikhlef S, Khalil A. Extra Virgin Olive Oil Polyphenols Promote Cholesterol Efflux and Improve HDL Functionality. *Evidence-based Complement Altern Med*. 2015;2015.
7. Widmer RJ, Freund MA, Flammer AJ, Sexton J, Lennon R, Romani A, et al. Beneficial effects of polyphenol-rich olive oil in patients with early atherosclerosis. *Eur J Nutr*. 2013;52(3):1223–31.
8. Mustikyantoro APJ. Potensi Manfaat Kardioprotektif dari Minyak Zaitun. *J Ilm Kesehat Sandi Husada*. 2020;12(2):908–15.
9. Jiménez-Sánchez A, Martínez-Ortega AJ, Remón-Ruiz PJ, Piñar-Gutiérrez A, Pereira-Cunill JL, García-Luna PP. Therapeutic Properties and Use of Extra Virgin Olive Oil in Clinical Nutrition: A Narrative Review and Literature Update. *Nutrients*. 2022;14(7):1–36.
10. De Santis S, Cariello M, Piccinin E, Sabbà C, Moschetta A. Extra virgin olive oil: Lesson from nutrigenomics. *Nutrients*. 2019;11(9):1–17.
11. Frangipane MT, Costantini L, Merendino N, Massantini R. Antioxidant Profile and Sensory Analysis in Olive Oils of Different Quality Grades. *Agric*. 2023;13(5):1–13.
12. Bilal RM, Liu C, Zhao H, Wang Y, Farag MR, Alagawany M, et al. Olive Oil: Nutritional Applications, Beneficial Health Aspects and its Prospective Application in Poultry Production. *Front Pharmacol*. 2021;12(August):1–12.
13. Guasch-Ferré M, Liu G, Li Y, Sampson L, Manson JAE, Salas-Salvadó J, et al. Olive Oil Consumption and Cardiovascular Risk in U.S. Adults. *J Am Coll Cardiol*. 2020;75(15):1729–39.
14. Jiménez-Torres J, Alcalá-Díaz JF, Torres-Peña JD, Gutierrez-Mariscal FM, Leon-Acuña A, Gómez-Luna P, et al. Mediterranean Diet Reduces Atherosclerosis Progression in Coronary Heart Disease: An Analysis of the CORDIOPREV Randomized Controlled Trial. *Stroke*. 2021;52(11):3440–9.
15. Amiot MJ. Olive oil and health effects: From epidemiological studies to the molecular mechanisms of phenolic fraction. *OCL - Oilseeds fats*. 2014;21(5).
16. Loued S, Berrougui H, Componova P, Ikhlef S, Helal O, Khalil A. Extra-virgin olive oil consumption reduces the age-related decrease in HDL and Paraoxonase 1 anti-inflammatory activities. *Br J Nutr*. 2013;110(7):1272–84.
17. Summerhill V, Karagodin V, Grechko A, Myasoedova V, Orekhov A. Vasculoprotective Role of Olive Oil Compounds via Modulation of Oxidative Stress in Atherosclerosis. *Front Cardiovasc Med*. 2018;5(December):1–10.
18. Sarapis K, George ES, Marx W, Mayr HL, Willcox J, Powell KL, et al. Extra virgin olive oil improves HDL lipid fraction but not HDL-mediated cholesterol efflux capacity: A double-blind, randomised, controlled, cross-over study (OLIVAUS). *Br J Nutr*. 2023;130(4):641–50.
19. Agrawal K, Melliou E, Li X, Pedersen TL, Wang SC, Magiatis P, et al. Oleocanthal-rich extra virgin olive oil

- demonstrates acute anti-platelet effects in healthy men in a randomized trial. *J Funct Foods*. 2017;36:84–93.
20. Antonopoulou S, Demopoulos CA. Protective Effect of Olive Oil Microconstituents in Atherosclerosis: Emphasis on PAF Implicated Atherosclerosis Theory. *Biomolecules*. 2023;13(4).
 21. Zhang R, Moscona A, Myndzar K, Luttrell-Williams E, Vanegas S, Jay MR, et al. More frequent olive oil intake is associated with reduced platelet activation in obesity. *Nutr Metab Cardiovasc Dis*. 2021;31(12):3322–5.
 22. Katsa ME, Nomikos T. Olive Oil Phenolics and Platelets—From Molecular Mechanisms to Human Studies. *Rev Cardiovasc Med*. 2022;23(8).

Original Article

The Effect of Interpersonal Communication Skills, Social Support, and Coping Strategy on Resilience in Master of Nursing Students Who Work on Thesis

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ABSTRACT

The majority of Master of Nursing Students are experiencing moderate to high levels of stress. Especially while working on their thesis. High-stress levels in nursing students can make them vulnerable to mental health disorders. One of the interventions to solve this problem is by building their resilience. Several previous studies related to resilience in nursing students focus more on undergraduate students. This study aims to analyze factors related to resilience in a master of nursing students in one of the state universities in East Java who are working on a thesis and see the fit of the resilience model. This study used a cross-sectional design with a total sampling technique. The minimum sample size is 10x the number of exogenous variables studied. There are 6 exogenous variables in this study so the minimum sample size is 60 respondents. The sample in this study amounted to 63 respondents. Univariate analysis in this study was carried out by analyzing numerical data using mean, median, and standard deviation values. Meanwhile, for categorical data, proportion analysis is used. Multivariate analysis was carried out using Partial Least Square (PLS) using SmartPLS 4. The result of this study shows p-values for X3 and Y, X5 and Y, X6 and Y, X1 and X6, X4 and X6 are below 0,05. So it can be concluded that interpersonal communication skills, social support, and coping strategies are positively related to resilience. Spirituality and physical health were not related to resilience but were positively related to coping strategies. Meanwhile, emotional intelligence is not related to either of them. The resilience model is a good fit. Further research by improving the research design is needed to support the results of this study.

Keywords: Resilience, Master of Nursing Students, Resilience Model, Factors Related to Resilience.

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INTRODUCTION

The majority of master of nursing students carry out various roles, namely as students, nurses, and caregivers in their households¹. This situation can cause stress for students. Research shows that levels of stress, anxiety, and depression in students in health disciplines (especially nursing) are higher and show more severe symptoms than students in other disciplines². Meanwhile, nursing students who are completing their final assignments experience moderate levels of stress, moderate anxiety, and moderate depression³.

High levels of stress are also experienced by master of nursing students at One of state university in East Java. Based on preliminary studies, data shows that master of nursing students have moderate to severe levels of stress. Students also revealed that working on their thesis was a stressor during their master's degree in nursing. This problem can cause delays in completing final assignments and extend the student's study period^{4,5,6}. Apart from that, stress can also affect personal well-being, student academic performance, communication with patients during clinical practice, as well as the quality and safety of health services

provided by nursing students².

Based on the results of the preliminary study and literature review above, it can be concluded that nursing students are vulnerable to mental health disorders due to high levels of stress. Therefore, intervention is needed to prevent the occurrence of mental health disorders, one of which is by building resilience in students. Resilience can be seen as resistance to stress⁷. Resilience is generally described as a person's ability to overcome difficulties⁸. Resilience is also defined as the ability to overcome unpleasant events⁹. Thus resilience can be defined as an individual's ability to face situations that cause stress. Resilience can reduce mental health disorders and improve well-being in students, as well as increase professionalism in practice or in the workplace. Resilience building in master of nursing students needs to be carried out to increase their resilience. Before building resilience in students, it is necessary to know the factors related to resilience in master of nursing students.

Based on Kumpfer (1999) resilience model, factors related to resilience are the individual's internal characteristics, the external environment and the interaction process between the individual and the environment¹⁰. Individual internal characteristics consist of spiritual, cognitive, social/behavioral, emotional/affective and physical aspects. The external environment includes the balance and interaction between risk factors and protective factors in the environment around the individual including family, community, school, peers. This includes social support obtained from the individual's social environment. The process of interaction between the individual and the environment, namely how the individual overcomes stressors or challenges that arise, including the coping strategies used by the individual.

This model is in accordance with several previous studies and reviews regarding factors related to resilience in students. Based on the literature review, resilience in students is related to several factors, namely demographic characteristics, spirituality, emotional intelligence, interpersonal communication skills, physical health, social support, and coping strategies. Based on this background, the author wants to study factors related to resilience in master of nursing students in One of state university in East Java who work on

thesis.

METHOD

This study uses a cross sectional research design. The author analyzes the factors related to resilience in master of nursing students in One of state university in East Java who work on thesis.

The author uses the Rule of Thumb for robust PLS SEM estimations to calculate the minimum sample size in this study. Barclay et al (1995) suggest a minimum sample size of 10x the number of exogenous variables studied¹¹. There are 6 exogenous variables in this study so the minimum sample size is 60 respondents. The sample in this study amounted to 63 respondents. This study was conducted in October-November 2023 online using Zoho form.

In this research, the demographic characteristics questionnaire contains questions regarding the respondent's identity including name, age, gender, period of study, GPA, employment status, source of financial during master studies, marital status, and living conditions. The Spirituality Questionnaire used by authors comes from The Daily Spiritual Experience Scale questionnaire¹². This questionnaire measures perceptions of God's presence and His involvement in life. Measurements in this questionnaire use a Likert scale ranging from 1 (never) to 6 (several times a day). According to Davies et al. (2010), the Brief Emotional Intelligence Scale (BEIS) is a 10-item scale questionnaire based on the Emotional Intelligence Scale (SEIS) and the emotional intelligence framework by Salovey and Mayer^{13,14,15}. This questionnaire uses a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

On the other hand, the Interpersonal Communication Competency Scale (ICCS) was used to measure interpersonal communication skills¹⁶. ICCS identifies competencies in 10 interpersonal communication domains. This questionnaire consists of 30 question items with ratings using a Likert scale from "almost always" (5) to "almost never" (1). The physical health questionnaire used by the authors comes from the Physical Health Questionnaire (PHQ) by Schat and Kelloway¹⁷. The PHQ is a short and modification version of the health scale developed by Spence et al.¹⁸. The assessment of this questionnaire uses a Likert scale from 1

to 7. The social support questionnaire used by

the authors comes from The Social Support Inventory (SSI) questionnaire. SSI is a short instrument that measures the satisfaction felt by individuals regarding the social support they receive. This instrument can be applied in a variety of settings. This questionnaire has a rating based on a Likert scale of 1 (receiving very little support from other people) to 5 (receiving very much support from other people).

Coping strategies in this study were measured using the Brief-COPE (B-COPE) questionnaire. Brief-COPE (B-COPE) is a shortened form of Coping Orientation to Problems Experience (COPE). B-COPE contains 14 scales with 2 items in each scale. Rating of each item was carried out on a four-point Likert scale ranging from 0 (never) to 3 (always). The resilience questionnaire used by authors comes from the 10-Item Connor-Davidson Resilience Scale (CD-RISC-10) questionnaire. Initially, the Connor-Davidson Resilience Scale (CD-RISC) consisted of 25

items and five factors. However, the structure of the questionnaire was found to be unstable across different social and cultural groups, so revisions were made to shorten and increase the reliability of the questionnaire. This questionnaire has a score of 0 (not at all) to 4 (always).

Univariate analysis in this study was carried out by analyzing numerical data using mean, median and standard deviation values. Meanwhile, for categorical data, proportion analysis is used. Multivariate analysis was carried out using Partial Least Square (PLS) using SmartPLS Version 4. The author chose to use this type of test because it can test several variables at one time and does not require many assumptions to be met. The PLS model is carried out based on three stages, namely outer model measurement, inner model measurement and goodness of fit test. This research has received ethical approval from the Ethics Committee of the Faculty of Health Sciences, Brawijaya University with ethic approval number No.6080/UN10.F17.10.4TU/2023

RESULTS

Outer Model Testing

Outer model testing was carried out to test the validity and reliability of the research indicators and variables. The following are the results of the outer model testing carried out by the authors. Convergent validity can be tested at the indicator level or variable level. At the indicator level, convergence validity can be seen from the results of the loading factors. The loading factor value is considered sufficient if the justification of an indicator for the latent variable is at least 0.7¹⁹. The loading factor value for each indicator in this study ranged from -0.111 to 0.922. Based on the analysis, the results showed that several indicators had not yet reached 0.7. These indicators are considered invalid and will be removed from further analysis.

Meanwhile, at the variable level, convergent validity can be seen from the internal consistency value or also called composite reliability. Composite reliability is a combination of the overall reliability of indicators and latent variables. A variable is considered reliable if its composite reliability value reaches 0.7¹⁹. The following is the

composite reliability value of each research variable:

Table 1. Composite Reliability for Each Variables.

Variable	Composite reliability (rho_a)	Composite reliability (rho_c)
Spirituality (X1)	0.960	0.957
Emotional Intelligence (X2)	0.749	0.786
Interpersonal Communication Ability (X3)	0.811	0.815
Physical Health (X4)	0.861	0.882
Social Support (X5)	0.884	0.914
Coping Strategies (X6)	0.813	0.854
Resilience (Y)	0.942	0.947

The table above shows that all research variables have a composite reliability value of >0.7, so it can be concluded that all variables have met the reliability criteria.

Similar to convergent validity, discriminant validity can also be tested at the indicator level and latent variable level. The cross loading value can be used to see discriminant validity at the indicator level. The cross loading value illustrates that the loading value of an indicator on its variable must be greater than that on other variables¹⁹. The results of research data analysis show that the cross loading value of each indicator meets the discriminant validity criteria.

Discriminant validity at the latent variable level can be seen from the comparison between the root value of Average Variance Extracted (AVE) and the correlation value of the latent variable in question with other latent variables or what is called the Fornell-Larcker Criterion. A variable is considered valid if the AVE root value is greater than the correlation value with other variables¹⁹. The following are the Fornell-Larcker Criterion values from research data.

Table 2. Fornell-Larcker Criterion.

	X1	X2	X3	X4	X5	X6	Y
X1	0.822						
X2	0.357	0.699					
X3	0.299	0.395	0.672				
X4	-0.279	-0.408	-0.521	0.745			
X5	0.296	0.358	0.506	-0.343	0.827		
X6	0.508	0.553	0.580	-0.601	0.308	0.666	
Y	0.452	0.570	0.609	-0.435	0.561	0.655	0.818

Inner Model Testing

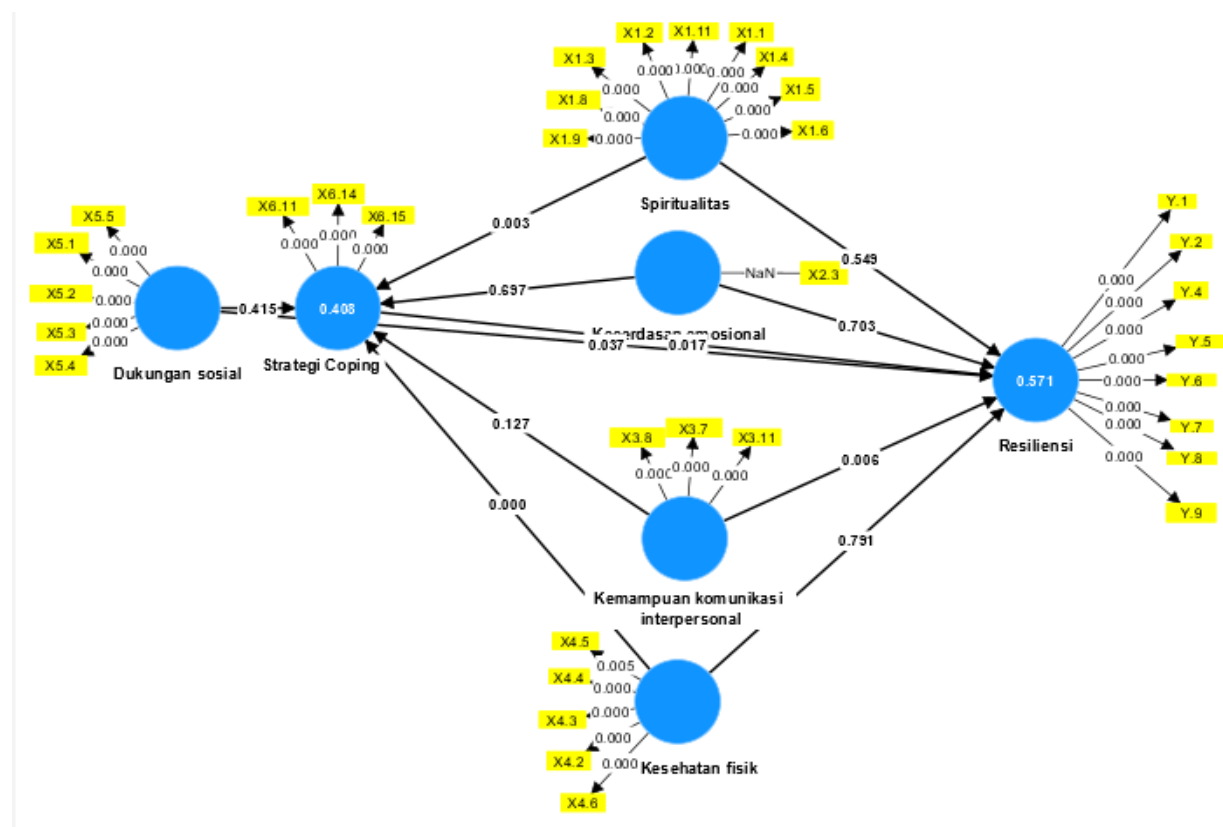


Figure 1. Resilience Model in Master of Nursing Student Who Work on Thesis

After testing the outer model, the authors then tested the inner model. Before testing the inner model, some invalid items

will be removed first. So a new arrangement of variables and indicators is produced as follows:

Table 3. List of Variables and Indicators After Removing Invalid Indicators.

Variables	Indicators
Spirituality (X1)	X1.1, X1.2, X1.3, X1.4, X1.5, X1.6, X1.7, X1.8, X1.11
Emotional Intelligence (X2)	X2.3
Interpersonal Communication Ability (X3)	X3.7, X3.8, X11
Physical Health (X4)	X4.2, X4.3, X4.4, X4.6
Social Support (X5)	X5.1, X5.2, X5.3, X5.4, X5.5
Coping Strategies (X6)	X6.11, X6.14, X6.15
Resilience (Y)	Y.1, Y.2, Y.4, Y.5, Y.6, Y.7, Y.8, Y.9

After removing invalid indicators, the authors then carried out a bootstrapping test. The bootstrapping test is a random multiplying of the number of samples. Table 4. below describes the results of the bootstrapping test.

Table 4. Relationship between Spirituality, Emotional Intelligence, Interpersonal Communication Skills, Physical Health, Social Support and Coping Strategies with Resilience in Master of Nursing Students Work on Thesis

	<i>p-value</i>	Relationship
Spirituality (X1) → Resilience (Y)	0.549	Not Significant
Emotional intelligence (X2) → Resilience (Y)	0.703	Not Significant
Interpersonal communication skills (X3) → Resilience (Y)	0.006	Significant
Physical health (X4) → Resilience (Y)	0.791	Not Significant
Social support (X5) → Resilience (Y)	0.037	Significant
Coping strategies (X6) → Resilience (Y)	0.017	Significant

Table 5. Relationship between Spirituality, Emotional Intelligence, Interpersonal Communication Skills, Physical Health, and Social Support with Coping Strategies in Master of Nursing Students Work on Thesis

	<i>p-value</i>	Relationship
Spirituality (X1) → Coping strategies (X6)	0.003	Significant
Emotional intelligence (X2) → Coping strategies (X6)	0.697	Not Significant
Interpersonal communication skills (X3) → Coping strategies (X6)	0.127	Not Significant
Physical health (X4) → Coping strategies (X6)	0.000	Significant

	<i>p-value</i>	Relationship
Social support (X5) → Coping strategies (X6)	0.415	Not Significant

Good of Fit Testing

To see the fitness of the model with the data, the author carried out a goodness of fit model test. The Goodness of fit test in the smartPLS 4 software can be done by looking at the coefficient of determination and the model fit

Table 6. Adjusted R Square Value of the Resilience Model in Master of Nursing Students Who Work on Thesis

Variable	Adjusted R square
Coping Strategies (X6)	0.408
Resilience (Y)	0.571

Table 7. SRMR Value of the Resilience Model in Master of Nursing Students Who Work on Thesis

	Saturated model	Estimated model
SRMR	0.095	0.095

DISCUSSION

Characteristics of Respondents

Respondents have an age range of 24 to 50 years with a median of 30 years. This shows that respondents is in the young and middle adult age group. Research conducted by Yesilbalkan et al. (2021) also shows that nursing postgraduate students are in the young adult and middle adult age groups²⁰.

The majority of respondents are women. This is shown by the proportion of respondents who are female at 61.9%. Meanwhile, male respondents were only 39.1%. Most of respondents have married. This is shown by the proportion of students who are married at 55.6%. Meanwhile, the remaining 44.4% of students are single. Meanwhile, based on where they live, the majority of students live with their families (63.5%). Some students also

live alone (27%) or with friends (9.5%). Students who live with their families also have higher resilience than students who live alone or with friends.

The majority of respondents are employed. The proportion of students who are employed is 76.2% while those who are unemployed is 23.8%. Most students work in health service facilities, whether hospitals, clinics, health centers or others. The proportion of students working in health care facilities was 52.1%, while the remaining worked in educational institutions (39.5%) and worked as entrepreneurs (8.3%). Meanwhile, for funding sources while being a students, some students received costs from scholarships (34.9%), their own costs (30.2%) or from their families (34.9%).

The GPA of respondents is in the range of 2.85-4.00 with a median value of 3.83. Meanwhile, for the study period, most of the respondents were in semester 3 while the rest were in semesters 5 and 7 or had graduated. Based on these data, it can be concluded that the cognitive abilities of respondents are in the good category.

The spirituality score of respondents is in the range 15-66 with a median score of 50.00. Based on these data, the number of respondents who had a high level of spirituality (≥ 50) was 31 people, while the number of respondents who had a low level of spirituality (< 50) was 32 people. So it can be concluded that the spirituality of majority of respondents is in the low category. this is probably caused by spirituality in this study is not only measured based on how individuals build good relationships with God, but also how individuals build good relationships with fellow humans, such as helping motivate or inviting friends to work on a thesis together. These two things are difficult for students to do considering that the majority of students have other responsibilities such as working or becoming caregivers in the family so they rarely interact with each other directly.

The emotional intelligence scores of the students are in the range 11-24 with a mean score of 18.41. Based on this data, there are 31 students who have a high level of emotional intelligence (≥ 18.41), while there are 32 students who have a low level of emotional intelligence (< 18.41). So it can be concluded that the emotional intelligence of majority of he respondents are in the low category. This

situation is probably caused by students working on their thesis being in a situation that causes stress. This situation can affect the emotions of the students concerned²¹.

Based on the results of data collection, the interpersonal communication skills of the respondents are in the range 27-54 with a median score of 42.00. Based on these data, the number of students with high interpersonal communication skills (≥ 42) was 33 people, while the number of students with low interpersonal communication skills (< 42) was 30 people. So it can be concluded that the majority of respondents have good interpersonal communication skills. The results of this research are in accordance with previous research conducted by Yildirim et al (2021)²².

The physical health score of respondents are in the range 9-41 with a median value 22.00. Based on this data, the number of respondents who have a good level of physical health (< 22) is 30 people, while the number of respondents who have a poor level of physical health (≥ 22) are 33 people. So it can be concluded that the physical health of respondents mostly are in the bad category. This is probably because students who work on theses are in a situation that causes stress. This situation can affect students' physical health. Apart from that, some students had a history of illness such as Asthma, upper respiratory tract infection, Urticaria, Vertigo, Urinary tract infection. Hypothyroidism, and Food Allergies.

Based on the results of data collection, the value of social support received by respondents is in the range 10-25 with a median value of 21.00. Based on this data, there are 33 students who think that social support they receive is adequate (≥ 21), while those who think they receive inadequate social support (< 21) is 30 people. So it can be concluded that most students feel that the social support they receive is adequate. The adequacy of social support felt by students is probably due to the fact that most students live with their families. The family is one of the most important sources of social support, because the family is generally the first person to fulfil an individual's needs and desires²³.

The coping strategy scores of respondents are in the range 28-45 with a median score of 41.00. Based on these data, the number of respondents who had a good level of coping strategy (≥ 41) was 34 people, while the number of respondents who had a bad level of

coping strategy (<41) was 29 people. So it can be concluded that respondents more often use adaptive than maladaptive coping strategies. This is in line with research by Straup et al., (2022), and Putri, Priyono, and Fitrianingrum (2022)^{24,25}. This is probably because respondents already know about adaptive and maladaptive coping strategies. Apart from that, individuals in young adulthood and middle adulthood generally have good decision-making abilities²⁶. This knowledge and ability can be used by students to decide on the best coping strategy that the student can use.

The resilience score of respondents is in the range 13-40 with a median value of 33.00. Based on this data, the number of respondents who have a high level of resilience (≥ 33) is 33 people, while the number of respondents who have a low level of resilience (<33) is 30 people. So it can be concluded that resilience of respondents mostly are in the high category. This is supported by research which shows that student resilience is in the good category²⁷.

The Relationship between Spirituality, Emotional Intelligence, Interpersonal Communication Skills, Physical Health, Social Support and Coping Strategies with Resilience in Master of Nursing Students Who Work on Thesis

Spirituality is not related to resilience (p value 0,549). These results are different from previous research²⁸⁻³⁰. The absence of a significant relationship between spirituality and resilience in this study is possibly caused by the majority of respondents' spirituality values being in the low category while the majority of their resilience values are in the high category.

Emotional intelligence is not related to resilience (p-value 0.703). These results are different from the results of previous research³¹⁻³³. There is no relationship between the variables of emotional intelligence and resilience in this study, possibly due to the majority of values The emotional intelligence of the respondents was in the low category, while the majority's resilience was in the high category.

Interpersonal communication skills are positively related to resilience (p value 0.006). The better a person's interpersonal communication skills, the better their resilience will be. These results are in accordance with previous research conducted by^{22,34,35}.

Interpersonal communication is an

important component in increasing resilience. Effective interpersonal communication can help individuals utilize existing interpersonal resources in their environment when facing stressors³⁵. Individuals who do not have good communication skills may not be able to communicate their thoughts and feelings so that individuals feel not understood, lonely, or experience failure in academic and professional life which can affect their physical and psychological conditions²².

Physical health is not related to resilience (p value 0.791). Previous research discussing physical health and resilience is still very limited. However, physical health can be related to physical fitness. Where physical fitness, based on several cross-sectional and longitudinal studies, can be a protective factor against various mental health problems³⁶.

Social support is positively related to resilience (p value 0.037). The more adequate social support a person feels, the better their resilience will be. These results are in accordance with previous research³⁷⁻³⁹.

Social support can improve well-being and quality of life, hope, satisfaction with life, and resilience as well as reduce various mental health disorders such as anxiety and depression³⁷. The support a person receives can be a key parameter to increase their resilience and enable them to manage negative emotions more effectively³⁹. Research shows that groups of young adults who are resilient generally have something in common, namely having quality relationships with their parents and those around them, and having superior cognitive abilities, both socially and emotionally⁴⁰.

Coping strategies are positively related to resilience (p value 0.017). The less frequently someone uses maladaptive coping strategies, the better their resilience will be. These results are in accordance with previous research⁴¹⁻⁴³.

Coping strategies relate to psychological health and well-being. Adaptive coping strategies are associated with higher levels of adaptation to stressors and lower risk of anxiety and depression. So students who have adaptive coping strategies tend to have better resilience. On the other hand, students who have good resilience are better able to understand the importance of adaptive coping styles and can deal with problems effectively⁴⁴.

Research conducted on health workers in Singapore shows that maladaptive coping strategies are positively related to psychological

morbidity. Health workers who use adaptive coping strategies show lower psychological morbidity. So it can be concluded that maladaptive coping strategies are associated with worse psychological conditions. This can be related to how individuals adapt to the environment negatively which can then affect their mental health ⁴³.

The Relationship between Spirituality, Emotional Intelligence, Interpersonal Communication Skills, Physical Health, and Social Support with Coping Strategies in Master of Nursing Students Who Work on Thesis

Spirituality is positively related to coping strategies (p-value 0.003). The higher a student's spirituality, the less often the student uses maladaptive coping strategies. These results are in accordance with previous ⁴⁵⁻⁴⁷.

Spirituality plays an important role in coping mechanisms as it becomes the first line of defense against adversity and pain. Spirituality can be considered as a force that influences, provides motivation and direction to survive and becomes a guide to achieving life goals. Spirituality can help humans search for meaning and purpose in life to gain hope, love, inner peace, comfort and support. Spirituality can also be a guide for individuals to implement adaptive coping strategies. Therefore, the higher a person's level of spirituality, the better their coping strategies will be ^{45,47,48}.

Emotional intelligence is not related to coping strategies (p-value 0.697). This may be because the coping strategies analyzed in this study were only maladaptive coping strategies (denial, distraction, self-blame). Based on previous research, emotional intelligence has a weak relationship with maladaptive coping strategies ⁴⁹. These results are supported by another research which shows that emotional intelligence has a weak and negative correlation with maladaptive coping strategies ⁵⁰.

Interpersonal communication skills are not related to coping strategies (p-value 0.127). The absence of a significant relationship between interpersonal communication skills and coping strategies in this study is probably because interpersonal communication skills are not directly related to coping strategies. Research shows that interpersonal communication skills can be indirectly related to coping strategies through problem solving skills ^{51,52}.

Physical health is positively related to coping strategies (p-value 0.000). The less frequently students experience physical health problems, the less frequently they use maladaptive coping strategies. There has been no research that directly discusses the relationship between physical health and coping strategies. However, a study conducted to assess the effectiveness of physical and mental health training revealed that such training can influence trainees' choice of coping strategies ⁵³. Another research also found a significant relationship between coping strategies and physical/psychological conditions ⁵⁴.

Social support was not related to coping strategies (p-value 0.415). This is possibly because the coping strategies analysed in this study were only maladaptive coping strategies. Based on research, social support is not directly related to maladaptive coping strategies. However, social support is related to maladaptive coping strategies indirectly through psychological flexibility ⁵⁵.

Resilience Model Good of Fit

To see the fitness of the model, the author carried out a goodness of fit model test. The Goodness of fit test in the smartPLS 4 software can be done by looking at the coefficient of determination and the model fit test. The coefficient of determination can be used to see the relationship between the independent variable and the dependent variable. The coefficient of determination can be seen from the adjusted R-Square value of each variable relationship.

The coefficient of determination (Adjusted R square) shows that interpersonal communication skills, social support and coping strategies have a moderate relationship to resilience (57.1%). Apart from that, spirituality and physical health also have a moderate relationship with coping strategies (40.8%). Next, the author tested the goodness of fit of the model by looking at the SRMR (Standardized Root Mean Square Residual) value.

Based on the SRMR value, it can be concluded that the model has good fit because it has an SRMR value below 0.1. SRMR is defined as the difference between the observed correlation and the correlation matrix implied in the model. Thus, it allows assessment of the average difference between observed and expected correlations as an absolute measure of

the goodness-of-fit criterion (model). Values less than 0.10 or 0.08 (in a more conservative version) are considered appropriate. In this study, the model has met the goodness of fit test criteria so it is considered to have a good fit.

Nursing Implications

Implications for the development of nursing science and research based on this study are Interpersonal communication skills, social support and coping strategies have been proven to have a significant relationship with resilience in master of nursing students. This can be used as a basis for developing interventions to increase resilience by paying attention to factors related to resilience. Apart from that, the spirituality, emotional intelligence and physical health of the respondents in this study are in the low category while their resilience is in the high category, it is feared that this cause no significant relationship between these variables.

Implications for nursing practice based on this study are the spirituality, emotional intelligence and physical health scores of the respondents are in the low category so intervention is needed to improve spirituality, emotional intelligence and physical health of the respondents. Apart from that, some students still have low interpersonal communication skills, social support and coping strategies scores so intervention is needed to overcome these problems.

CONCLUSION

There is a significant relationship between interpersonal communication skills, social support and coping strategies with resilience in master of nursing students who work on thesis. Meanwhile There is no significant relationship between spirituality, emotional intelligence and physical health with resilience in master of nursing students who work on thesis. There is a significant relationship between spirituality and physical health with coping strategies in master of nursing students who work on thesis. Meanwhile There is no significant relationship between emotional intelligence, interpersonal communication skills and social support with coping strategies in master of nursing students who work on thesis.

This study has limitations, namely the number of respondents in this study was only 63 respondents. This is due to the author's

limitations in getting contact with respondents, especially respondents who are working on their thesis in 2022. Apart from that, it is also due to the presence of potential respondents who did not respond when contacted or who were willing to be a respondents. but could not be contacted again for follow-up. In this study, the question items on the instrument used in this research are still related to each other, causing several research indicators to become invalid and have to be deleted. This may influence the content of the variables studied. Further research with an experimental design to improve the score of spirituality, emotional intelligence and physical health is needed to support the results of this study. Apart from that, selecting research instruments that are not related to each other is necessary to increase the validity of indicators and variables studied

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CONFLICTS OF INTEREST

The authors declare that they have no financial or personal interests that could influence the results reported in this article.

REFERENCES

1. Nodine PM, Arbet J, Jenkins PA, Rosenthal L, Carrington S, Purcell SK, et al. Graduate nursing student stressors during the COVID-19 pandemic. *J Prof Nurs* [Internet]. 2021 Jul;37(4):721–8. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S8755722321000661>
2. Aloufi MA, Jarden RJ, Gerdtz MF, Kapp S. Reducing stress, anxiety and depression in undergraduate nursing students: Systematic review. *Nurse Educ Today* [Internet]. 2021;102(April 2020):104877. Available from: <https://doi.org/10.1016/j.nedt.2021.104877>
3. Zakiyah. Gambaran Karakteristik, Tingkat Stres, Ansietas, dan Depresi pada Mahasiswa Keperawatan yang sedang Mengerjakan Skripsi. *J Impuls - Univ Binawan*. 2016;2(September):140–5.
4. Aditama D. Hubungan Antara

- Spiritualitas dan Stres pada Mahasiswa yang Mengerjakan Skripsi. *J eL-Tarbawi*. 2017;10(2):39–62.
5. Azizah JN, Satwika YW. Hubungan Kepribadian Hardiness Dengan Stres Akademik Pada Mahasiswa Kedokteran Universitas Malahayati Selama Pandemi Covid 19. *J Penelit Psikol*. 2021;8(1):212–23.
6. Gamayanti W, Mahardianisa M, Syafei I. Self Disclosure dan Tingkat Stres pada Mahasiswa yang sedang Mengerjakan Skripsi. *Psymphatic J Ilm Psikol*. 2018;5(1):115–30.
7. Uranus HC, Soetikno N, Koesma RE. The Role of Resilience towards Altruism: Be Strong for Yourself before Anyone Else. *J Educ Heal Community Psychol*. 2022;11(2):207–26.
8. Li ZS, Hasson F. Resilience, stress, and psychological well-being in nursing students: A systematic review. *Nurse Educ Today* [Internet]. 2020;90(November 2019):104440. Available from: <https://doi.org/10.1016/j.nedt.2020.104440>
9. Chow KM, Tang WKF, Chan WHC, Sit WHJ, Choi KC, Chan S. Resilience and well-being of university nursing students in Hong Kong: A cross-sectional study. *BMC Med Educ*. 2018;18(1):1–8.
10. Kumpfer KL. Factors and processes contributing to resilience: The resilience framework. In: *Resilience and Development: Positive Life Adaptations*. Glantz, M. Kluwer Academic Publisher; 1999. p. 179–224.
11. Barclay D, Higgins C, Thompson R. The partial least squares (PLS) approach to causal modeling: Personal computer adoption and use as an illustration. *Technol Stud*. 1995;2(2):285–309.
12. Underwood LG, Teresi JA. The Daily Spiritual Experience Scale: Development, Theoretical Description, Reliability, Exploratory Factor Analysis, and Preliminary Construct Validity Using Health Related Data. *Annu Behav Med*. 2002;24:22–3.
13. Davies KA, Lane AM, Devonport TJ, Scott JA. Validity and Reliability of a Brief Emotional Intelligence Scale (BEIS-10). *J Individ Differ*. 2010;31(4):198–208.
14. Schutte NS, Malouff JM. Measuring emotional intelligence and related constructs. *Levinston: Mellen Press*; 1998.
15. Salovey P, Mayer JD. Emotional intelligence. *Imagin Cogn Pers*. 1990;9(3):185–211.
16. Rubin R, Martin MM. Development of a Measure of Interpersonal Communication Competence. *Commun Res Reports*. 1994;11(1):33–44.
17. Schat ACH, Kelloway EK, Desmarais S. The Physical Health Questionnaire (PHQ): Construct validation of a self-report scale of somatic symptoms. *J Occup Health Psychol*. 2005;10(4):363–81.
18. Spence JT, Helmreich RL, Pred RS. Impatience Versus Achievement Strivings in the Type A Pattern: Differential Effects on Students' Health and Academic Achievement. *J Appl Psychol*. 1987;72(4):522–8.
19. Santosa PL. Metode Penelitian Kuantitatif: Pengembangan Hipotesis dan Pengujiannya Menggunakan SmartPLS (1st Edition). *Depok: Penerbit Andi*; 2018.
20. Yesilbalkan OU, Cinar D, Karadakovan A. A Metaphorical Analysis of Postgraduate Nursing Students' Perceptions of the Nursing Profession. *Int J Caring Sci* [Internet]. 2021;14(1):422–32. Available from: <https://www.proquest.com/scholarly-journals/metaphorical-analysis-postgraduate-nursing/docview/2537156928/se-2>
21. Jung YH, Shin NY, Jang JH, Lee WJ, Lee D, Choi Y, et al. Relationships among stress, emotional intelligence, cognitive intelligence, and cytokines. *Med (United States)*. 2019;98(18).
22. Yıldırım S, Kazandı E, Cirit K, Yağız H. The effects of communication skills on resilience in undergraduate nursing students in Turkey. *Perspect Psychiatr Care*. 2021;57(3):1120–5.
23. Hamza JT, Thaer Raheem Kadhém. The Social Support Manifestations, Functions And Sources. *J Posit Sch*

- Psychol. 2022;6(5):6355–61.
24. Straup ML, Prothro K, Sweatt A, Shamji JF, Jenkins SR. Coping Strategies and Trauma-Related Distress of College Students During Covid-19. *J Coll Student Retent Res Theory Pract*. 2022;0(0):1–18.
25. Putri TH, Priyono D, Fitrianingrum I. Coping Strategies Among Indonesian College Students During The Covid-19 Pandemic. *Malaysian J Med Heal Sci*. 2022;18(6):100–7.
26. Huberman barbara. Growth and Development, Ages 18 and Over What Parents Need to Know [Internet]. 2015 [cited 2023 Mar 22]. Available from: <https://www.advocatesforyouth.org/resources/health-information/parents-17/#:~:text=Cognitive Development,Most young adults aged 18 and over will%3A,and prepare to achieve them>
27. Erdogan E, Ozdogan O, Erdogan M. University Students ' Resilience Level : The Effect of Gender and Faculty. *Procedia - Soc Behav Sci* [Internet]. 2015;186:1262–7. Available from: <http://dx.doi.org/10.1016/j.sbspro.2015.04.047>
28. Mk Y. Relationship between spirituality and resilience. *Pharma Innov J*. 2022;11(8):29–30.
29. Siddiq A, Muslim A. The Relationship Between Spirituality and Resilience. *Int Res J*. 2018;002(43053):39–45.
30. Manning LK. Navigating Hardships in Old Age : Exploring the Relationship Between Spirituality and Resilience in Later Life <https://journals.sagepub.com/home/QHR>. *Qual Health Res*. 2015;23(4):568–75.
31. Trigueros R, Padilla AM, Aguilar-Parra JM, Rocamora P, Morales-Gázquez MJ, López-Liria R. The influence of emotional intelligence on resilience, test anxiety, academic stress and the mediterranean diet. A study with university students. *Int J Environ Res Public Health*. 2020;17(6).
32. Sarrionandia A, Ramos-Díaz E, Fernández-Lasarte O. Resilience as a mediator of emotional intelligence and perceived stress: A cross-country study. *Front Psychol*. 2018;9(DEC):1–11.
33. David C M, Vijayan D. Emotional Intelligence and Personality Traits among Young Adults. *Int J Indian Psychol*. 2021;9(3):1835–41.
34. Lee EY, Kim K ja, Ko S, Song EK. Communication competence and resilience are modifiable factors for burnout of operating room nurses in South Korea. *BMC Nurs* [Internet]. 2022;21(1):1–10. Available from: <https://doi.org/10.1186/s12912-022-00985-0>
35. Chen C, Chen Y, Song Y. Reciprocal relationship between interpersonal communication and depressive symptoms and the mediating role of resilience across two years: Three-wave cross-lagged panel model. *J Affect Disord* [Internet]. 2023;334(April):358–69. Available from: <https://doi.org/10.1016/j.jad.2023.04.121>
36. Neumann RJ, Ahrens KF, Kollmann B, Goldbach N, Chmitorz A, Weichert D, et al. The impact of physical fitness on resilience to modern life stress and the mediating role of general self-efficacy. *Eur Arch Psychiatry Clin Neurosci* [Internet]. 2022;272(4):679–92. Available from: <https://doi.org/10.1007/s00406-021-01338-9>
37. Yildirim M, Tanrıverdi FÇ. Social Support, Resilience and Subjective Well-being in College Students. *J Posit Psychol Wellbeing*. 2020;10(10):1–9.
38. Alqu'ana SA, Hanurawan F. The Relationship Between Peer Social Support and Resilience in State University of Malang Students Affected by Distance Learning. *KnE Soc Sci*. 2022;2022(ICoPsy):137–46.
39. Galanis P, Siskou O, Kaitelidou D. Relationship between Social Support and Resilience among Nurses: A Systematic Review. 2022;15(3):1675–81.
40. Yamamoto T, Nishinaka H, Matsumoto Y. Social Sciences & Humanities Open Relationship between resilience , anxiety , and social support resources among Japanese elementary school students. *Soc Sci Humanit Open* [Internet]. 2023;7(1):100458. Available from:

- <https://doi.org/10.1016/j.ssaho.2023.100458>
41. Secades XG, Molinero O, Salguero A. Relationship Between Resilience and Coping Strategies in Competitive Sport. *Percept Mot Skills*. 2016;122(1):336–349.
 42. Wong MCS, Huang J, Wang HHX, Yuan J, Xu W, Zheng ZJ, et al. Resilience level and its association with maladaptive coping behaviours in the COVID-19 pandemic: a global survey of the general populations. *Global Health* [Internet]. 2023;19(1):1–11. Available from: <https://doi.org/10.1186/s12992-022-00903-8>
 43. Kumar S, Kota S, Kayarpady A, Gopal A, Rudra P. A cross-sectional study of coping strategies and resilience and its association with psychological symptoms of doctors working in a dedicated COVID-19 care center. *Ind Psychiatry J* [Internet]. 2023;32(1):31. Available from: https://journals.lww.com/10.4103/ipj.ipj_128_21
 44. Wu Y, Yu W, Wu X, Wan H, Wang Y, Lu G. Psychological resilience and positive coping styles among Chinese undergraduate students: A cross-sectional study. *BMC Psychol*. 2020;8(1):1–11.
 45. Widayati N, Rohmin NS, Purwandari R. Correlation between Spirituality and Coping Strategy in Patients with Type 2 Diabetes Mellitus. 2019;(0331):458–65.
 46. Gayatri D, Nuraini T, Handiyani H, . K. The Correlation of Spirituality and Implementation of Spiritual Care Among Nursing Student in Jakarta. *KnE Med*. 2023;2023(2016):91–9.
 47. Krok D. Religiousness, spirituality, and coping with stress among late adolescents: A meaning-making perspective. *J Adolesc*. 2015;45:196–203.
 48. Krok D. The role of spirituality in coping: Examining the relationships between spiritual dimensions and coping styles. *Ment Heal Relig Cult*. 2008;11(7):643–53.
 49. Macías-Espinoza F, Brambila-Tapia AJL, Reyes-Domínguez YA, Ramírez-García ML. Association between Emotional Intelligence and Stress Coping Strategies According to Sex in Mexican General Population. *Int J Environ Res Public Health* [Internet]. 2022 Jun 14;19(12):7318. Available from: <https://www.mdpi.com/1660-4601/19/12/7318>
 50. Montvilaitė G, Antinienė D. Emotional Intelligence and Stress Coping Strategies of Medical Residents. *Balt J Sport Heal Sci*. 2020;4(115).
 51. Ebrahimi H, Barzanjeh Atri S, Ghavipankeh S, Farnam A, Gholizadeh L. The effect of training problem-solving skills on coping skills of depressed nursing and midwifery students. *J caring Sci* [Internet]. 2013;2(1):1–9. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/25276704> <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PM4161101>
 52. Minarsi M, Nirwana H, Yarmis Y. Contribution of the interpersonal communication toward problem solving strategies of high school students. 2018;80–5.
 53. Maran DA, Zedda M, Varetto A. Physical Practice and Wellness Courses Reduce Distress and Improve Wellbeing in Police Officers. *Int J Environ Res Public Health*. 2018;15(4):578.
 54. Ito M, Matsushima E. Presentation of Coping Strategies Associated with Physical and Mental Health During Health Check-ups. *Community Ment Health J* [Internet]. 2017;53(3):297–305. Available from: <http://dx.doi.org/10.1007/s10597-016-0048-9>
 55. Tindle R, Hemi A, Moustafa AA. Social support, psychological flexibility and coping mediate the association between COVID-19 related stress exposure and psychological distress. *Sci Rep* [Internet]. 2022;12(1):1–11. Available from: <https://doi.org/10.1038/s41598-022-12262-w>

Effect of Using Cow Dung as Organic Fish Pellets

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ABSTRACT

Freshwater cultivation is an economic endeavor for welfare purposes and is currently facing problems. This problem occurs because pellets are not economical and cause environmental pollution. The purpose of this article is to analyze the effect of using cow dung as fish pellets on Abiotic, Biotic, and Cultural (Human Habits). This research is a Quantitative Experimental Research using a Completely Randomized Design (CRD) of 4 treatments with 6 replications, treatment in the form of feeding 3 g/day (Treatment 2) 6 g/day (Treatment 3) 9 g/day (Treatment 4) and Control (Treatment 1) uses chemical pellets 9 g/day. This design is used to see the effect of organic fish pellets on fish growth (biotic) such as fish weight and length. The hypothesis of this research is H1: There is an influence, H0: There is no influence. Hypothesis H1 is accepted if $F_{count} > F_{table}$. Then a measuring instrument is used to measure environmental parameters such as temperature, DO, pH, and Ammonia. The results of this research reveal: there is an influence of fish pellets on fish growth (Biotic), the use of cow dung pellets is still safe in the aquatic environment (Abiotic), cow dung pellets provide socio-economic value such as increasing income and creating new productive habits by making it a job. This research concludes that the use of cow dung pellets reduces environmental pollution, is economical, and is beneficial for humans. It is recommended that this research be further deepened and linked to other sciences.

Keywords: Freshwater, Cow Dung, Pellets, Environmental Health.

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INTRODUCTION

Freshwater cultivation is a productive economic endeavor for welfare purposes¹. Freshwater cultivation in Indonesia is currently facing various problems. Problems such as chemical fish feed have been identified as fundamental to aquaculture in Indonesia². Chemical fish feed is uneconomical and causes environmental pollution.

Environmental pollution is caused by excessive pellet residue which turns into toxic compounds for the environment such as Ammonia (NH₃)³. Ammonia is a compound formed from the decomposition of organic nitrogen. Sources of organic nitrogen in freshwater aquaculture systems are mainly formed from food waste and fish waste

products⁴.

Freshwater cultivation is threatened with stopping because of this, the solution to overcome this problem is the need to make efforts to cultivate freshwater waters that have sustainable principles and are environmentally friendly⁵. Making organic pellets from cow dung is a solution to reduce the use of expensive chemical or inorganic pellets on the market and reduce environmental pollution. Thus increasing fish production. Increasing production of these fish can also increase income⁶.

The purpose of this article is to convey the influence of using cow dung as fish pellets and its influence on Abiotic, Biotic, and Culture (Human Habits) in the environment.

METHOD

This research is a Quantitative Experimental Research (looking at the effect of a treatment using a statistical approach) with a research design using Completely Randomized Design (RAL), 4 treatments with 6 replications, using 4 treatments with 6 replications based on the formula $(t-1)(r-1) > 15$, t : treatment, r : replication. Treatment consisted of feeding 3 g/day (Treatment 2), 6 g/day (Treatment 3), 9 g/day (Treatment 4) and control (Treatment 1) using chemical pellets 9 g/day. This design is used to see the effect of organic fish pellets on fish growth (biotic) such as fish weight and length. The hypothesis of this research is H_1 : There is an influence, H_0 : There is no influence. Hypothesis H_1 is accepted if $F_{\text{count}} > F_{\text{table}}$. Then measuring instruments are used such as a thermometer to measure temperature, a DO meter to measure oxygen in water (DO), a pH meter to measure pH and an Ammonia laboratory test to determine the ammonia value. The results of these measurements were to see the effect of organic fish pellets on the aquatic environment (Abiotic), as a control for water quality, cultivation water was used without processing and to see the effect of using cow dung on habits, the author conducted a literature review.

RESULTS

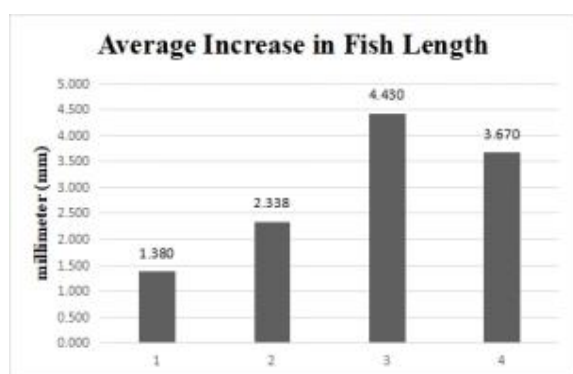


Figure 1. Increase in Fish Length

Table 1. Fish Length ANOVA

Sources of Variation	db	JK	Average Squared	F Statistik	F table
Treatment	3	33.29	11.097	5.128	2.87
Error	20	43.28	2.164		
Total	23	76.57			

Information : $F_{\text{Calculation}} > F_{\text{Table}} = H_0$ is rejected, H_1 is accepted, Organic cow dung pellets increase fish body length

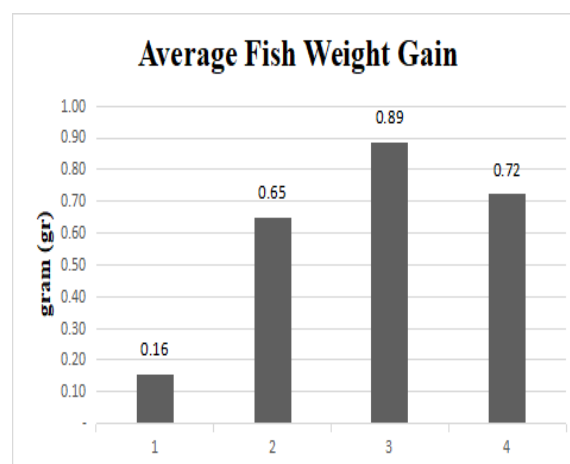


Figure 2. Fish weight gain

Table 2. Fish Weight ANOVA

Sources of Variation	db	JK	Average Squared	F Statistik	F table
Treatment	3	1.78	0.593	3.148	2.87
Error	20	3.77	0.189		
Total	23	5.55			

Information : $F_{\text{Calculation}} > F_{\text{Table}} = H_0$ is rejected, H_1 is accepted, Organic cow dung pellets increase fish weight

Table 3. Data from measurements of research environmental parameters

Parameters	Control	T1	T2	T3	T4	Quality standards		
						C 2	C 3	Note
Temperature (°C)	28.3	28.2	28.4	28.4	28.3	D3	D3	The differer e with the air temper: ure above the wat surface
DO (ppm)	3.85	3.8	5.1	3.3	3.0	4	3	
pH (0-14)	7	7	7	7	7	69	69	
Ammonia (mg/l)	0	0.231	0.393	0.132	0.413	0,2	0,5	

Note: T: Treatment, C: Class, D: Deviation

The table above reveals that the quality of environmental parameters obtained from environmentally friendly fish farming methods implemented during the research period. The quality of environmental parameters is classified as safe (not exceeding the established quality standards).

Table 4. Details of costs for making organic cow dung pellets

No	Material	Cost	Amount
1.	Bran Flour	Rp.10.000,00/ kg @1	Rp. 10.000,00
2.	Tapioca flour	Rp.14.000,00/kg@0,5	Rp. 7.000,00
4.	Cow dung	Rp.2.000,00/ kg @5	Rp. 10.000,00
5.	Coconut water	Rp.1000,00/ 1@2	Rp. 2.000,00
6.	Black Plastic	Rp.2.000/ pcs@ 5	Rp. 10.000
Total cost			Rp. 39.000,00

Table 4 show that 1 kg of bran flour, 0.5 kg of tapioca flour are used to make 5 kg of cow dung pellets, so for 1 kg of cow pellets, the researcher spent Rp. 39,000.00/ 5 = Rp. 7,800.00.

Table 5. Comparison of prices for organic cow dung pellets and inorganic pellets

Pellet Type	Pellet Price
Organik	Rp. 7.800,00/ kg
Anorganik	Rp. 10.000,00/kg

Based on the research results obtained, organic pellets whose raw material comes from cow dung are more economical than the control (inorganic) pellets used in the research. Organic pellets from cow dung cost Rp. 7,800.00/kg, this is cheaper than the inorganic pellets used as a control in this study, these inorganic pellets are worth Rp. 10,000.00/kg.

DISCUSSION

1. The effect of cow dung fish pellets on fish growth (Biotics)

The results of analysis of data on increasing fish body length from this study revealed that $F_{\text{Calculated}} > F_{\text{Table}}$, which means that the initial hypothesis which said "There is an influence of using cow dung pellets on fish length" was accepted (H_0 was rejected). Treatment 3 is the treatment that produces the highest fish body length, while the control using inorganic pellets produces the lowest fish body length.

The results of the analysis of data on fish body weight gain from this study revealed that $F_{\text{Calculated}} > F_{\text{Table}}$, which means that the initial hypothesis which said "There is an influence of the use of cow dung pellets on fish weight" was accepted (H_0 was rejected). Treatment 3 or administration of fish waste pellets at a dose of 6 grams/day was the best result in this study, resulting in an average increase in fish weight of 0.89 grams during the study period. Meanwhile, when compared with the control treatment, the control treatment produced 0.16 grams and this was the lowest average of the 4 treatments applied.

Based on the results of this data analysis, it can be discussed that organic pellets derived from cow dung can be used as an environmentally friendly alternative feed for cultivating freshwater fish. Organic feed from cow dung waste has an effect on body weight and weight gain in fish ⁷. Using cow

dung increases body weight in fish ⁸. Cow dung in fish farming has a positive impact on fish survival, including increasing body weight in fish⁹. Cow manure generally consists of 18.6% hemicellulose; cellulose 25.2%; lignin 20.2%; protein 14.9%; and dust 13%. Cow dung has high levels of organic matter, including N-Total (Amount of N in cow dung)¹⁰.

Considering that cow dung has high organic material such as N-Total and also high protein, cow dung can be used as alternative fish feed (fish pellets). Fish growth is closely related to the availability of protein in feed, because protein is a source of energy for fish and protein is a nutrient that fish really need for growth ¹¹.

2. The effect of cow dung fish pellets on the water environment (Abiotic)

The environmental parameters obtained from the influence of the use of freshwater fish cultivation methods that utilize cow dung as fish feed are still classified as safe (have not passed environmental quality standards for freshwater fish cultivation), meaning that the use of cow dung as raw material for making fish feed is an alternative for waste processing and repair of environmental damage. Using cow dung as feed will reduce the amount of cow dung in the environment (Cow Pen) and make the environment clean ¹². The use of cow dung can reduce piles of cow dung in pens. Cleaned cow dung helps reduce land, water and air pollution ¹³. By reducing the impact of environmental degradation, the cattle farming industry within farmer groups will help realize an environmentally friendly concept ¹⁴.

Water quality for cultivating freshwater fish must meet several requirements because poor water will cause fish to be susceptible to disease. A good water source for fish cultivation must meet water quality criteria which include physical and chemical properties such as temperature, pH, DO, and so on. The quality of water in a cultivation business determines the level of success. High or low water quality will have fatal consequences for fish growth.

Temperature

Temperature is the degree of hot or cold measured with a thermometer. According to the Regulation of the Minister of Health of

the Republic of Indonesia No. 2 Years 2023¹⁵ Quality Standards for a good temperature for a healthy water environment range between 15 - 35° C. If cultivation causes the temperature to exceed this Quality Standard, then life in the environment will be disrupted.

The results of the article synthesis carried out at this research stage, the temperature of the water environment which is influenced by cultivation activities is still in normal conditions, or can be said to be still within the range of environmental quality standards. The results of temperature measurements in the research showed an average value of 28° C, in accordance with the quality standard value, this condition is still considered safe for freshwater fish cultivation activities. Water temperature will increase when the decomposition of organic material by microbes increases¹⁶. The solubility of gases needed for photosynthesis, such as CO₂ and oxygen, dissolves more easily in water at low temperatures than at high temperatures¹⁷.

Increasing temperature increases the metabolism and respiration of aquatic organisms, which results in increased oxygen consumption¹⁸. Drastic changes in temperature can cause aquatic organisms to die¹⁹.

pH (Degree of Acidity)

The majority of aquatic organisms depend on the pH value of waters. For the criteria for waters used for cultivating freshwater fish, the pH value quality standard PP No. 22 of 2021 ranges from 6-9. The condition of these waters is considered good and ideal for the productivity of aquatic organisms, especially for cultivating freshwater fish¹⁹.

According to the results of the article synthesis carried out at this research stage, the pH of the water environment which is influenced by cultivation activities is classified as safe for aquatic life or is still within the range of pH quality standards for aquatic environmental life. The results of pH measurements in this study showed a pH value of 7. This pH value of 7 is a pH value that is good for life, especially the life of freshwater fish.

Organisms are usually more resistant to waters with a neutral pH. Because the amount of dissolved oxygen in water decreases, acidic waters tend to be less productive and can kill farmed animals. In

addition, because CO₂ levels increase, the pH value of the waters becomes acidic²⁰.

DO (Dissolved Oxygen)

Oxygen dissolution value (DO) is a metric that shows the amount of oxygen (O₂) available in a body of water. A higher DO value in water indicates that the water is of good quality, while a lower DO value indicates that the water is polluted. In some waters, most fish die due to lack of oxygen because microorganisms break down organic material²¹.

The research results show that the results of DO measurements during the research show a value of 3-5 ppm, this value is still included in the range of quality standards for the water environment, the quality standard limit for aquatic animal cultivation activities is in the range from 3 to above (≥ 3). If it is below this value, aquatic animals, especially fish in this study, will be stressed due to lack of oxygen supply.

Ammonia (NH₃)

The research results show that the value of the Ammonia measurement is still below environmental quality standards, the results of the Ammonia measurement show a value of 0.1 - 0.4 mg/l. while the value for environmental quality standards for freshwater animal life ranges from 0.1 - 0.5 mg/l.

Ammonia is needed for chemical processes that occur in waters. However, it can be dangerous for the aquatic environment under certain conditions and levels, especially in fish farming systems. After dissolved oxygen, the main limiting factor in fish farming ponds, ammonia management is essential. This is done to avoid the accumulation of ammonia, which can harm fish in cultivation ponds. To increase the percentage of success in fish farming, feeding management can be an effective method for reducing ammonia levels in waters²².

Metabolic waste or fish waste that settles at the bottom of waters can cause high levels of ammonia. High levels of ammonia in waters are caused by the accumulation of waste from aquaculture and aquatic biota. The result of the activity of microorganisms in the decomposition of materials, namely organic materials that are rich in nitrogen or protein²³.

The presence of ammonia causes disease in fish, thereby inhibiting their growth.

Ammonia is the end result of the protein decomposition process resulting from metabolism and leftover feed which settles in the water so that it can cause toxins in the water which are harmful to the fish being kept²⁴.

3. The Influence of Environmental Conditions on Fish Development

Temperature

Increasing temperature increases the metabolism and respiration of aquatic organisms, which results in increased oxygen consumption¹⁸. Drastic changes in temperature can cause aquatic organisms to die¹⁷. Temperature has a direct effect on the rate of photosynthesis and animal physiological processes (the metabolic rate of the reproductive process) which in turn affects how they eat and grow²⁵. Water temperature is affected by brightness and depth. Shallow water and sunlight can increase water temperature.

One of the factors or parameters that greatly influences the life of fish (*Oreochromis niloticus*) is temperature. As the temperature increases in water, the level of oxygen solubility will also become lower, and its toxic power will actually become higher²⁶. This temperature affects many aspects of the life of fish, namely survival rate, appetite, body stability level against disease, growth rate, fish movement, viscosity and blood flow, oxygen consumption, number of leukocytes, glucose levels in the blood, number of erythrocytes, number of platelets, reaction to change ammonium to ammonia, metabolic rate, response to feeding, fish stress level²⁷.

Ph (Degree of Acidity)

Water conditions at pH 6-9 are considered good and ideal for the productivity of aquatic organisms, especially for cultivating freshwater fish¹⁹. Organisms are usually more resistant to waters with a neutral pH. Because the amount of dissolved oxygen in water decreases, acidic waters tend to be less productive and can kill farmed animals. In addition, because CO₂ levels increase, the pH value of the waters becomes acidic²⁰.

Fish can grow and develop well in aquatic environments with neutral acidity (pH) or low alkalinity²⁸. That acidity levels (pH) that are not optimal can cause fish to become

stressed, easily attacked by disease, and low fish productivity and growth. pH can also affect the feed conversion of fish because a low value of the degree of acidity (pH) will result in increased acidity. If this happens it will cause water conditions to decline which can result in a decrease in the fish's appetite²⁹.

DO (Dissolved Oxygen)

In some waters, most fish die due to lack of oxygen because microorganisms break down organic material³⁰. Oxygen in waters is needed by biotic organisms because it is used in the respiration process³¹. The dissolved oxygen content in the water can determine the metabolic rate of fish³².

Oxygen is an absolute factor that must be present so that fish can continue to live. Fish need oxygen for respiration and to support their metabolic processes. Oxygen also affects the speed of growth and development of fish. At oxygen levels <2 mg/l, fish will experience a decrease in appetite and their development will be less than optimal³³. The factors causing the reduction in dissolved oxygen in waters include respiration of aquatic biota, decomposition or breakdown of organic material and the release of oxygen into the air³⁴.

Dissolved oxygen (O₂) together with temperature and pH have the most influence on fish length. Increased length causes increased growth. Decreasing dissolved oxygen (O₂), increasing temperature and pH affect fish mortality³⁵. If the dissolved oxygen content in the rearing media is below 5, this can cause fish death or slow fish growth³⁶. If dissolved oxygen is insufficient, it can inhibit the growth of fish.

Ammonia (NH₃)

Ammonia in freshwater fish cultivation systems that use circulation tends to decrease in value, whereas in still ponds, the value of ammonia tends to increase according to the amount of metabolic waste and leftover feed³⁷. The accumulation of ammonia in cultivation media is one of the causes of decreasing water quality which can result in failure of fish cultivation production³⁸.

Ammonia in water comes from the decomposition process of organic materials which contain lots of nitrogen compounds (protein) originating from food waste³⁹. Ammonia levels of more than 1 mg/l are not

good for keeping fish. The limit of the lethal effect on fish is if the NH_3 concentration in the water is not more than 1 mg/L because it can inhibit the absorption of blood hemoglobin. to oxygen and the fish will die ⁴⁰.

Ammonia in the aquatic environment is in the form of Ammonia (NH_3) and Ammonium (NH_4^+). Both compounds are toxic or toxic to the environment ³. This compound is formed from the decomposition of organic nitrogen. Sources of organic nitrogen in freshwater aquaculture systems are mainly formed from food waste and fish waste products ⁴.

4. The effect of cow dung fish pellets on habits (Culture)

Ecologically, cow dung is waste in the environment and can cause pollution if it is not used⁴¹. Farmers dispose of cow dung waste by throwing it behind houses and in ditches near residential areas without processing it first. Waste that is disposed of carelessly will later become a source of pollutant for ground water when exposed to rainwater. This has an impact on the low quality of the water so that it is not suitable for use as raw drinking water. As a result of livestock management that does not pay attention to the environment, many livestock businesses are unsuccessful due to losses caused by waste that is not managed properly⁴².

Cow dung waste still contains nutrients or solid substances that have the potential to encourage the life of microorganisms that can cause pollution. Apart from water, livestock waste often pollutes the environment biologically, namely as a medium for flies to breed. Cow dung waste even when dry can cause pollution, namely by generating dust⁴³.

Ecologically, cow dung waste has great potential as good quality feed and can reduce environmental pollution⁴⁴. Cow dung has the potential to be used as organic fertilizer, biogas fuel and fish feed⁴⁵.

The social aspect of waste processing has a positive impact on breeders by creating good relationships with the surrounding community and the emergence of mutual cooperation⁴⁶. Farmers are aware that processing cow dung waste can reduce pollution, namely air, water and soil. In the cattle farming business, farmer groups will contribute to realizing the green marketing

concept by reducing the impact of environmental damage ⁴⁷.

From an economic perspective processing cow waste has a positive impact on cattle breeders. This will have a positive impact on farmers who will use cow dung as raw material for making feed (pellets) ⁴⁶. The use of cow dung improves the community's economy ¹².

Recycling cow dung has a positive impact, especially in improving the economy of farmers ⁴⁷. The use of cow dung provides additional income for farmers ⁴⁸. Utilizing cow dung as feed has also become a new livelihood ⁴⁸. This means that using cow dung as fish feed will reduce unemployment and improve welfare. Fish farmers will avoid losses after having a new alternative feed made from cow dung. This is a new breakthrough to reduce waste and improve the economy ⁴⁹.

CONCLUSION

The conclusion of this research is that the use of cow dung pellets reduces environmental pollution, is economical and is beneficial for humans. It is recommended that this research be further deepened and linked to other sciences.

REFERENCES

1. Soedibya PHT, Pramono TB. Budidaya Perairan Tawar. 2018. 1–81.
2. Kadarusman. Buku Besar Maritim Indonesia : Seri Buku 2 Sumber Daya Hayati Maritim. 2019. 38.
3. Camargo JA, Alonso A, Salamanca A. Nitrate toxicity to aquatic animals: A review with new data for freshwater invertebrates. *Chemosphere*. 2005;58(9):1255–67.
4. Hargreaves J. A. TCS. Managing ammonia in fish pond. *SRAC Publ - South Reg Aquac Cent*. 2004;(4608):8.
5. Huwoyon GH, Gustiano R. Peningkatan Produktivitas Budidaya Ikan Di Lahan Gambut Gleni Hasan Huwoyon dan Rudhy Gustiano. *Media Akuakultur*. 2013 Jun 30;8(1):13-22.
6. Afriani DT. Peranan Pembenihan Ikan dalam Usaha Budidaya Ikan. *J War*. 2016;(224):1–16.
7. Zulhelmi Z, Yaman MA, Fitri CA. Pemanfaatan Limbah Feses Sapi

- sebagai Pembuatan Pakan Pelet terhadap Pertambahan Berat Badan Ikan Lele Dumbo. *J Ilm Mhs Pertan.* 2016;1(1):746–57.
8. Natalina. Pemberian Biofertilizer Feses Manusia dan Sapi untuk Memperbaiki Kualitas Tanah dan Air Kolam Budidaya Ikan Patin (*Pangasianodon hypophthalmus*). 2022;27(2):249–55.
 9. Agusta DA, Hasibuan S, Desa G, Nenas K, Tambang K, Kampar K. Pengaruh Campuran Biofertilizer Feses Manusia dengan Feses Sapi terhadap Parameter Fisika Tanah dan Air Media Budidaya Ikan Patin (*Pangasius sp .*) Di Kolam Tanah Gambut Effect of Combinations for Human and Cow Faeces Biofertilizer to Physical Parameter o. 2020;25(2):103–15.
 10. Melsasail L, Warouw VRC, Kamagi YEB. Pengaruh Penambahan Lempung dan Bahan Organik serta Dosis Pupuk NPK terhadap Pertumbuhan dan Hasil Bawang Merah di Media Pasir Pantai. *Cocos.* 2019;2(6):1–14.
 11. Aggraeni. Pengaruh Pemberian Pakan Alami Dan Pakan Buatan Terhadap Pertumbuhan Benih Ikan Betutu (*Oxyeleotris marmorata bleeker*). *J Ilm Perikan dan Kelaut.* 2013;1(1):51.
 12. Hasanah. Dampak Pemanfaatan Limbah Kotoran Sapi Terhadap Peningkatan Kesejahteraan Peternak Sapi di Desa Suntenjaya, Kabupaten Bandung Barat. *Bandung Conf Ser Econ Stud.* 2023;3(1):214–21.
 13. Santoso U, Jarmuji J, Brata B. Pemanfaatan Kotoran Sapi untuk Budidaya Cacing Tanah dan Produksi Vermikompos di Wonoharjo Girimulyo Kabupaten Bengkulu Utara. *Dharma Raflesia J Ilm Pengemb dan Penerapan IPTEKS.* 2020;18(2):119–32.
 14. Muis JM. Kinerja dan prospek pengembangan usaha ternak sapi potong ramah lingkungan di sumatra barat. *Widyaset.* 2015;18(1):59–70.
 15. Kementerian Kesehatan Republik Indonesia. Peraturan Pelaksanaan Peraturan Pemerintah Nomor 66 Tahun 2014 Tentang Kesehatan Lingkungan. Peratur Menteri Kesehat Republik Indones Nomor 4 Tahun 2018. 2018.
 16. Wulandari M, Harfadli MM, Rahmania R. Penentuan Kondisi Kualitas Perairan Muara Sungai Somber, Balikpapan, Kalimantan Timur dengan Metode Indeks Pencemaran (Pollution Index). *SPECTA J Technol.* 2020;4(2):23–34.
 17. Alfatihah A, Latuconsina H, Prasetyo HD. Analisis Kualitas Air berdasarkan Parameter Fisika dan Kimia di Perairan Sungai Patrean Kabupaten Sumenep. *AQUACOASTMARINE J Aquat Fish Sci.* 2022;1(2):76–84.
 18. Nugraha D. Pengaruh perbedaan suhu terhadap perkembangan embrio, daya tetas telur dan kecepatan penyerapan kuning telur ikan black ghost (*Apteronotus albifrons*) pada skala laboratorium. *Management of Aquatic Resources Journal (MAQUARES).* 2012;1(1):38–43.
 19. Kulla OLS, Yuliana E, Supriyono E. Analisis Kualitas Air dan Kualitas Lingkungan untuk Budidaya Ikan di Danau Laimadat, Nusa Tenggara Timur. *Pelagicus.* 2020;1(3):135.
 20. Sawitri R, Takandjandji M. Konservasi Danau Ranu Pane Dan Ranu Regulo Di Taman Nasional Bromo Tengger Semeru. *J Penelit Hutan dan Konserv Alam.* 2019;16(1):35–50.
 21. Sugianti Y, Astuti LP. Respon Oksigen Terlarut Terhadap Pencemaran dan Pengaruhnya Terhadap Keberadaan Sumber Daya Ikan di Sungai Citarum. *J Teknol Lingkung.* 2018;19(2):203.
 22. Wahyuningsih. Amonia Pada Sistem Budidaya Ikan Sri. *Syntax Lit J Ilm Indones* p-ISSN 2541-0849 [Internet]. 2020;2(1):1–12.
 23. Maniagasi R, Tumembouw SS, Mundeng Y. Analisis kualitas fisika kimia air di areal budidaya ikan Danau Tondano Provinsi Sulawesi Utara (Analysis of physical-chemical quality of waters at aquaculture area in Lake Tondano, North Sulawesi Province). *Budid Perair.* 2013;1(2):29–37.
 24. Arifin MY. Pertumbuhan Dan Survival Rate Ikan Nila (*Oreochromis. Sp*) Strain Merah Dan Strain Hitam Yang Dipelihara Pada Media Bersalininitas. *J Ilm Univ Batahnghari Jambi.*

- 2016;16(1):159–66.
25. Andria AF, Rahmaningsih S. Kajian Teknis Faktor Abiotik pada Embung Bekas Galian Tanah Liat PT. Semen Indonesia Tbk. untuk Pemanfaatan Budidaya Ikan dengan Teknologi KJA. *J Ilm Perikan dan Kelaut.* 2018;10(2):95–105.
26. Pramleonita M. Parameter Fisika Dan Kimia Air Kolam Ikan Nila Hitam (*Oreochromis niloticus*). *J Sains Nat Univ Nusa Bangsa.* 2018;8(1):24–34.
27. Cahyanti Y, Awalina I. Studi Literatur: Pengaruh Suhu terhadap Ikan Nila (*Oreochromis niloticus*). *Panthera J Ilm Pendidik Sains dan Terap.* 2022;2(4):224–35.
28. Indriati PA, Hafiludin H. Manajemen Kualitas Air Pada Pembenihan Ikan Nila (*Oreochromis niloticus*) Di Balai Benih Ikan Teja Timur Pamekasan. *Juv Ilm Kelaut dan Perikan.* 2022;3(2):27–31.
29. Dahril I, Tang UM, Putra I. Pengaruh Salinitas Berbeda terhadap Pertumbuhan dan Kelulushidupan Benih Ikan Nila Merah (*Oreochromis sp.*). *Berk Perikan Terubuk.* 2017;45(3):67–75.
30. Sugiarti R, Achyani A, Muhfahroyin M. Upaya Pelestarian Hutan Mangrove Kecamatan Labuhan Maringgai Kabupaten Lampung Timur Untuk Meningkatkan Fungsi Hutan Mangrove. *Bioloa.* 2020;1(1):25–9.
31. Scabra AR, Budiardi T. Optimization of *Anguilla bicolor* oxygen consumption in alkalinity culture media. *IJOTA (Indonesian J Trop Aquat.* 2020;3(1):7–13.
32. Rosariawari F, Wahjudijanto I, Rachmanto TA. Peningkatan Efektifitas Aerasi Dengan Menggunakan Micro Bubble Generator (MBG). *J Ilm Tek Lingkung.* 2018;8(2):88–97.
33. Kisworo Y, Rimalia A, Hikmah N. Laju Pertumbuhan dan Kelangsungan Hidup pada Kepadatan Ikan Nila (*Oreochromis niloticus*) Yang Berbeda Dengan Pakan Terfermentasi. *J TECHNO-FISH.* 2022;6(2):133–43.
34. Kurniasih, Jubaedah D, Syaifudin M. Utilization Of Dolomite Lime [Camg(Co3)2]to Increase The Swamp Water Ph For Striped Catfish (*Pangasius Hypophthalmus*) Rearing. *J Akuakultur Rawa Indones.* 2019;7(1):1–12.
35. Pigafetta A, Harteman E, Wulandari L. Efek Kualitas Air Pada Pertumbuhan Ikan Mas (*Cyprinus carpio L.*) yang Dibudidayakan Dalam Kolam Tanah Mineral. *J Trop Fish.* 2019;14(2):31–43.
36. Arifaldianzah, Khaeriyah A, Anwar A, Burhanuddin, Insana Salam N, Syaiful Saleh M. Laju Pertumbuhan Benih Ikan Nila Salin (*Oreochromis sp.*) yang dibudidaya Pada Sistem Bioflok Menggunakan Pakan Limbah Sayur Terfermentasi. *J Fish Mar Sci.* 2022;5(2):118–28.
37. Marlina E, Peternakan J, Studi Budidaya Perikanan Politeknik Negeri Lampung JlSoekarno-Hatta Rajabasa no P, Lampung B. Prosiding Seminar Nasional Tahunan Ke-V Hasil-Hasil Penelitian Perikanan dan Kelautan Kajian Kandungan Ammonia Pada Budidaya Ikan Nila (*Oreochromis niloticus*) Menggunakan Teknologi Akuaponik Tanaman Tomat (*Solanum lycopersicum*). 2016;181–7.
38. Rahardja BS, Wijaya O, Prayogo P. Pengaruh Padat Tebar Ikan Lele Terhadap Laju Pertumbuhan dan Survival Rate Pada Sistem Akuaponik; The Effect of Stocking Density On Survival Rate and Grow Rate Of Aquaponic System. *J Ilm Perikan dan Kelaut.* 2014;6(1):55–8.
39. Hasniar, Firman, Yunarti. Efektifitas Penggunaan Probiotik Dan Antibiotik Terhadap Kualitas Air Dalam Meningkatkan Sintasan Post Larva. *J Galung Trop.* 2013;1:14–22.
40. Siegers WH, Prayitno Y, Sari A. Pengaruh kualitas air terhadap pertumbuhan ikan nila nirwana (*Oreochromis sp.*) pada tambak payau. *The Journal of Fisheries Development.* 2019 Jul 31;3(2):95–104.
41. Sukamta. Pemanfaatan Limbah Ternak Sebagai Pupuk Organik Untuk Mengurangi Penggunaan Pupuk Kimia. *BERDIKARI.* 2017;5(1):10.
42. Saputra L. Pengaruh Limbah Peternakan Sapi terhadap Kualitas Air Tanah untuk Kebutuhan Air Minum

- (Studi Kasus Di Desa Singosari Kecamatan Mojosongo Kabupaten Boyolali Tahun 2017). 2017.
43. Junus M, Akhiroh P, Putritamara JA. Pengelolaan Limbah Ternak. Pengelolaan Limbah Ternak. 2023;
 44. Sujono. Dengan Memanfaatkan Limbah Plastik. J Dedik. 2013;12:1–12.
 45. Prambudi SBF, Salundik & Muladno. Potensi Pemanfaatan Limbah Peternakan Sapi Pedaging di SPR (Sekolah Peternakan Rakyat) Ngudi Rejeki, Kabupaten Kediri. Jurnal Pusat Inovasi Masyarakat (PIM). 2020 Jun 22;2(3):343-7.
 46. Aziz DN, Widyasworo A, Ari Kustanti NO. Analisis Sosial Ekonomi Pengolahan Limbah Kotoran Sapi Perah Di Kecamatan Kanigoro Kabupaten Blitar. AVES J Ilmu Peternak. 2019;13(1):1–10.
 47. Aryanti NA, Wibowo FAC, Mahidi M, Wardhani FK, Kusuma IKTW. Hubungan Faktor Biotik dan Abiotik Terhadap Keanekaragaman Makrobentos di Hutan Mangrove Kabupaten Lombok Barat. J Kelaut Trop. 2021;24(2):185–94.
 48. Alimin, K. Analisis Pendapatan Dan Efisiensi Usaha Pengolahan Limbah Peternakan Menjadi Pupuk Organik Di Desa Barang Kecamatan Liliriaja Kabupaten Soppeng (Studi Kasus Cv. Hadiwijaya Agro Mulia). Skripsi. Universitas Hasanuddin; 2022.
 49. Susantun I & Saifullah, M. Penyuluhan pemanfaatan Kotoran Hewan sebagai pakan lele. Asian Journal of Innovation and Entrepreneurship (AJIE). 2014 Oct 27;3(03):164-8.

Article Review

Midwives' Role in Managing Pregnant Women with Mental Health Issues and Disorders in Developing Countries: A Rapid Review

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ABSTRACT

The mental health issues of pregnant women must be detected early and addressed quickly to prevent negative impacts on the mother, fetus, and newborn. This review aims to identify current evidence on the role of midwives in managing pregnant women with mental health problems and disorders in developing countries. The review method employed is a rapid review, utilizing the PRISMA-ScR checklist, the PCC framework, and a critical appraisal tool adapted from the Joanna Briggs Institute (JBI) for assessment. A literature search was conducted across three databases (PubMed, Wiley, Science Direct), Google Scholar, and Research Rabbit, with inclusion criteria consisting of all original articles in English or Indonesian from 2018 to 2023, discussing management, midwives' roles, inhibiting factors, supporting factors, and full-text availability. From the search, 300 articles were retrieved, of which 7 were duplicates. Screening based on inclusion criteria yielded 7 articles published in 2020 (2 articles), and 2021 (2 articles), and 2023 (3 articles), with qualitative design (n=4, 57.2%) and cross-sectional design (n=3, 42.8%). Two articles were from Ghana, while the remaining five were from Uganda, Sri Lanka, Ethiopia, China, and India. Three themes emerged regarding the midwives' role in managing pregnant women with mental health problems and disorders: screening, referral, barriers, and supportive factors. Further research is needed to test the effectiveness of midwives' screening for maternal mental health and to develop and evaluate integrated perinatal mental health service models.

Keywords: Midwives, Pregnant women, Depression, Anxiety, Developing countries.

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INTRODUCTION

In Ethiopia Comorbid anxiety and depression were common, with a prevalence of 10.04%. the need to combine psychosocial and psychological counseling as part of general antenatal care, early detection and treatment of pregnancy illnesses and medical illnesses, as

well as marriage counseling is essential to reduce the number of mental disorders that arise during pregnancy¹. In Indonesia, 20% of pregnant women in the second and third trimesters experience pregnancy depression. This increases by 16% in the third trimester and persists up to four weeks and three months after delivery². Based on the results of research at the

Bojong Menteng Community Health Center, Rawalumbu, Bekasi City, it was found that pregnant women experienced depression (22.3%), anxiety (43.2%), sleep disorders (70.4%), and psychosomatic disorders³.

Mental health problems of pregnant women must be detected as early as possible and addressed immediately to prevent negative impacts on the mother, fetus and newborn. The negative impacts on pregnant women's mental health that occur in babies include premature babies, low birth weight babies, respiratory tract infections, low APGAR scores, and disorders of fetal neurological development⁴. While the negative impact that occurs on the mother is that it can trigger miscarriage, anxiety about childbirth, preeclampsia and indications for caesarean section delivery. Risk factors that influence mental health include lack of family support, pregnancy planning, health, education, having children with congenital abnormalities, suffering from chronic diseases, smoking, experiencing domestic violence and family economics⁵.

To overcome the mental stress experienced by pregnant women, the government has a program. Perinatal Mental Health Project (PMHP) with services consisting of: screening, counselors and psychiatry. One of the aims of the Maternal Mental Health Program (PMHP) is to ensure that all mothers have access to high-quality mental health services and to include them in routine midwifery programs.

Collaborative mental health care for pregnant women between mental health professionals and adequate health service program policy support are needed. The main problems of this collaboration include general doctors' and nurses' lack of knowledge about mental health symptoms experienced by pregnant women, inadequate surveillance systems, lack of information about clinical technology, and lack of surveillance systems⁶. Midwives play an important role in public health services, so it is very important for them to have complete knowledge and skills to provide optimal services⁷. Midwives are interested in providing mental health support, but they lack confidence, don't know how to do it, and lack training. Midwife-led counseling interventions are effective, and these deficiencies can be overcome with appropriate training and organizational support⁸.

Identify where the majority of research

currently exists focusing on the prevalence and risk factors of postpartum depression and gaps in health research to provide actionable and relevant evidence in a timely and cost-effective manner using rapid reviews⁹. This approach is effectively directed and supervised by stakeholders, enabling accelerated knowledge synthesis in response to current needs for the role of midwives in the management of pregnant women with mental health problems and disorders in developing countries, to provide high-quality summary data to assist in the implementation of midwifery competencies⁹. The purpose of this review is to identify current evidence midwives' role in managing pregnant women with mental health issues and disorders in developing countries

METHOD

Design

The protocol has been reviewed by two experts and is not published. The review method used is a rapid review. The main reason for choosing this method is to narrow the scope of the research question and reduce the level of data abstraction. This approach is useful for providing actionable and relevant evidence in a timely and cost-effective manner. This is in response to the current need for the role of midwives in the management of pregnant women with mental health problems and disorders in developing countries, to provide high-quality summary data to assist in implementation. midwife competency⁹.

Search

The stages start from setting review questions. The formulation of this research question uses the PCC model framework which is explained in the following table:

Table 1. PCC Framework

P(Population)	C(Concept)	C (Context)
Midwife	The role of midwives in the management of pregnant women with mental health problems and disorders	During pregnancy, in developing countries

After identifying the review question, the next step is to identify relevant articles. In

the literature search using three databases (Pubmed, Wiley, Science Direct) and manual searches (Google Scholar and research rabbit) published from 2018-2023 in developing countries based on world bank criteria, namely low income, lower middle income, and upper middle income .

Inclusion and exclusion criteria

The inclusion criteria in this study were all articles resulting from original research, published from 2018 to 2023, articles discussing the management of pregnant women with mental health problems and disorders in developing countries, articles discussing the role of midwives in the management of pregnant women with problems and mental health disorders in developing countries, articles discussing inhibiting and supporting factors in the readiness of midwives in the management of pregnant women with mental health problems and disorders in developing countries and full text of the article. Exclusion criteria were rapid reviews, opinion articles and review/comment articles.

Main search term

Databases used in the search were PubMed, Wiley, Science Direct, and use of Research Rabbit and Google Scholar. Articles are searched using keywords. Keywords used include: Midwife* OR midwives AND Management OR treatment AND Mental health disorder OR psychological disorder OR anxiety disorder OR depression OR mental health problem AND pregnancy* OR maternal AND Developing Countr*.

Selection of sources of evidence

In the three data-based searches, 300 articles were obtained. After identification, 7 articles were found to be duplicates. Then a screening was carried out based on the inclusion criteria and found 7 articles that met the criteria and objectives of the review. Example of complete search results. Figure 1 shows the article selection process. The initial search obtained 300 articles from three databases (Pubmed 173 articles, Wiley 68 articles, Science Direct 26 articles, and two manual searches (research rabbit 19 articles and Google Scholar 14 articles). After removing duplicate articles, followed by filtering the title and abstract, the results were obtained. 21 articles. Of the 21 articles, 9 articles were found not full text. Then the remaining 12 articles were reviewed based on the related review objectivesLatest on the role of midwives in the management of pregnant women with mental health problems and disorders in developing countries. Based on the 7 articles used, two articles came from Ghana and five other articles came from Uganda, Sri Lanka, Ethiopia, China and India. The research population for studying the role of midwives in managing mental health problems and disorders of pregnant women in developing countries consists of mostly midwives, nurses, health workers in delivery rooms, community-based health educators and pregnant women.

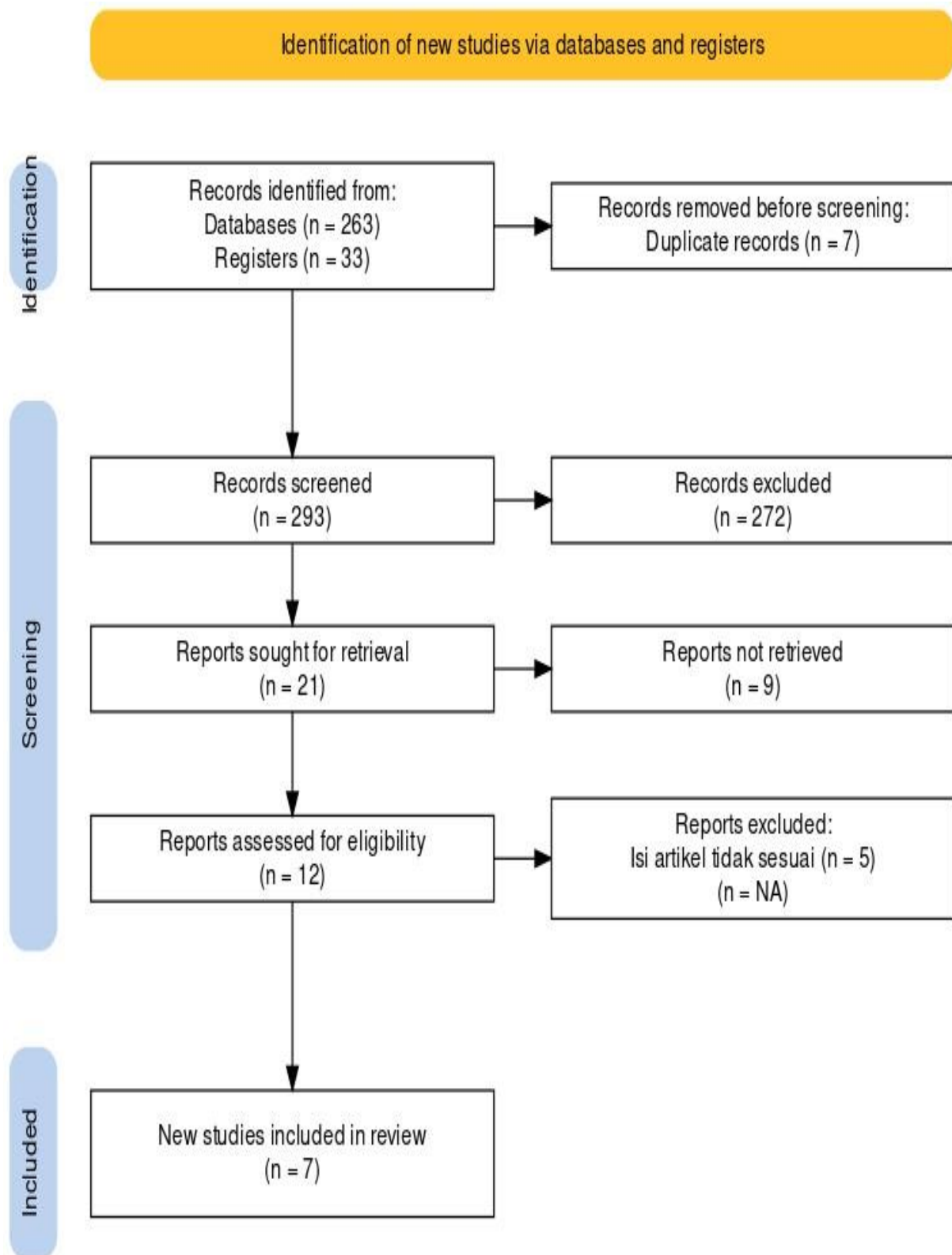


Figure 1. Article Selection Flowchart

Data Charting

In preparing the charting data, discussions with experts were carried out. Synthesis of research article data was carried out using charting data adopted from the Joanna Briggs Institute including data on article author, article title, year, country, research objectives, type of research, data collection methods, number of participants/sample, and review results¹⁰. Based on the critical appraisal that has been carried out on the 7 articles that have been obtained, all of them are of grade A quality

Table 1. Charting Data

No	Title, Author	Country	Objective	Design	Results	Screening Management	Reference	Barriers and Supporting Factors
A1	Barriers to addressing mental health issues in childbearing women in Ghana/ Adjorlolo, S., & Aziato, L. (2020) ¹⁸ .	Ghana	The aim of this study was to investigate factors that hinder the provision of mental health services by nurses and midwives for women of childbearing age to assist in the prioritization and distribution of limited mental health resources.	Cross-sectional	Barriers reported by participants included mental health services not being available (77%), lack of knowledge about mental health among women from different ethnicities (75.7%), lack of clear mental health service pathways (75.1%), heavy workload (74.1%), and lack of knowledge about mental health problems (74.1%).	-	-	Barriers from nurses and midwives are lack of knowledge about mental health, unclear referral pathways, heavy workload
A2	Seeking and receiving help for mental health services among pregnant women in Ghana./Adjorlolo, S, (2023) ¹⁹ .	Ethiopia	The aim of this study was to investigate mental health help seeking of pregnant women in Ghana and the factors that influence it	Cross-sectional	The results showed that only 18.9 percent of pregnant women in Ghana independently requested mental health services. However, 64.8% of patients reported that they consulted their doctor about their mental well-being, and 67.7% of patients sought support from their doctor.	-	-	Barriers from the perspective of pregnant women are 1. medical conditions during pregnancy, 2. violence from partners, 3. low social support, 4. difficulty sleeping, and 5. suicidal ideation 6. fear of vaginal delivery
A3	Maternal mental health screening and management by	Uganda	this study aimed to investigate the knowledge, practices	Qualitative	No special training is given to medical staff, especially midwives, to screen and	Midwives carry out screening using a general form	Midwives refer pregnant	Midwives never receive mental health training, lack of

	health workers in southwestern Uganda: a qualitative analysis of knowledge, practices, and challenges/Nakidde, G., Kumakech, E., & Mugisha, J.F. (2023) ¹³ .		and barriers faced by health workers when screening and treating mothers with maternal mental health disorders in health facilities in southwest Uganda.		help mothers with mental health problems. They treat MMH problems based solely on history and physical examination, and they refer almost all mothers who show symptoms because they feel unprepared to treat them. On the other hand, medical staff specially trained in mental health, especially those working in mental health units, are more likely to use mental health screening tools in addition to the history and physical examination, and they treat any mother who displays symptoms of mental disorders.	(antenatal card). Specialized health workers carry out screening using conventional neuropsychological tests such as the MMSE (Mini mental state examination), DSM-V (Statistical Manual of Mental Disorders V), and PHQ-9 (Patient Health Questionnaires-9)	women with mental health illnesses to mental health specialists (local referral) or to a different higher level facility (external referral)	knowledge to identify mental health, lack of specialist mental health care for pregnant women.
A4	Antenatal depression in Sri Lanka: a qualitative study of public health midwives' views and practices/Wyatt, S., Ostbye, T., Silva, V. De, & Long, Q. (2022) ¹⁴ .	Sri Lanka	The aim of this study was to investigate current clinical guidelines and experience of how midwives diagnose and treat antenatal depression	Qualitative	There was no standardized diagnosis pattern for the midwives (n = 12) and they varied in their level of knowledge about antenatal depression. However, they follow referral and case management follow-up guidelines and build strong and very consistent relationships in their clinical practice. Practice shows that the stigma of mental illness and lack of human resources are still challenges for midwives.	Does not have a standard diagnostic pattern. Screening is carried out based on the midwife's observations	Midwives refer pregnant women to clinic doctors and district psychiatrists. The midwife made a home visit after initiation of treatment.	Supporting factors where the family receives the diagnosis, the family discusses health services, The obstacles encountered were difficulties during the treatment and referral process. Midwives lack time for quality care due to high workload

A5	Stakeholder perspectives on antenatal depression and the potential for psychological intervention in rural Ethiopia: a qualitative study/Bitew, T., Keynejad, R., Honikman, S., Sorsdahl, K., Myers, B., Fekadu, A., & Hanlon, C. (2020) ²¹ .	Ethiopia	This study aimed to understand women's and healthcare workers' perspectives on antenatal depression, their treatment preferences and potential acceptability and feasibility of psychological interventions in a rural Ethiopian context.	Qualitative	The motivation of health workers to provide help, the availability of integrated primary mental health services, and the culture among women in seeking advice are potential facilitators of receiving psychological interventions.	Detecting depression depends on the confidence of the pregnant woman	Referral to a psychiatric nurse at the nearest hospital	Acceptance of psychological interventions
A6	The perceptions and attitudes of obstetric staff and midwives towards perinatal mental health disorders screening: a qualitative exploratory study in Shenzhen, China/Xiao Xiao, Haixia Ma, Shening Zhu1, QL and YC (2023) ¹⁷ .	China	The aim of this study was to explore the perceptions and attitudes of midwifery staff and midwives towards screening for perinatal mental disorders in pregnant women, and identify their needs and motivations in carrying out this task	Qualitative	This research found that medical staff did not have sufficient knowledge and skills about the mental health of pregnant women and were not well prepared to screen pregnant women who may be experiencing mental health disorders. In addition, this research emphasizes how important it is to address the mental health of pregnant women through a multidisciplinary team approach—namely, nurses, midwives, doctors, psychologists, and psychiatrists. In addition, this research found challenges to conducting screening, such as public stigma against mental	Mental health screening can be identified from the mental health status of pregnant women at an early stage. Screening can improve competency as a health professional. Screening by observing their behavior and facial expressions. Screening based on the experience of health workers.	Refer to a professional psychiatrist or psychologist	Barriers to medical staff are inadequate knowledge, excessive workload, fragmented nursing model and societal stigma about mental health disorders. Supporting factors are Medical staff have good listening and communication skills.

					health disorders and a lack of medical personnel. The results suggest that to improve mental health services for pregnant women, medical staff must be trained, society must be more aware of perinatal mental health disorders, and multidisciplinary collaboration is needed.			
A7	Maternal Mental Health: A Baseline Survey of Knowledge, Attitudes and Current Practice among Auxiliary Nurse Midwives./ Poreddi, V., Gandhi, S., Ramachandra, Ganjekar, S., Desai, G., & Chandra, PS (2021) ²⁰ .	India	The aim of this study was to assess the knowledge, attitudes and practices of nurse midwives (ANMs) related to maternal mental health in Karnataka, India. This study aims to identify gaps in knowledge and positive attitudes towards women with mental disorders during pregnancy and after giving birth. Additionally, this study also aims to highlight the need for training programs to improve ANMs' knowledge and skills in identifying mental health problems in women and referring them for early intervention.	Cross-sectional	The majority of midwives were positive and demonstrated better practice in finding and referring mothers with mental health problems. However, they also do not understand the various mental disorders that arise during pregnancy.	All pregnant women need to be routinely screened for anxiety and depression	Referral pathways are needed to provide timely intervention	The obstacle encountered was the midwife's lack of knowledge.

Selection of sources of evidence

For articles included in this review, data were extracted using a standard template that included study title, first author, year of publication, type of literature, study design, population, and conductor of the study. Carrying out a critical appraisal to assess the quality of selected articles using the Joanna Briggs Institute checklist. The choice of checklist from the Joanna Briggs Institute was because JBI provides a complete critical appraisal checklist for all research study designs. In addition, research topics were identified through thematic analysis and organized into themes. In this case, researchers read all the included papers and identify patterns in the findings across the papers to derive themes.

RESULTS

Search Results from Evidence

Of the 7 articles used, there were 6 articles indexed by Quartile 1 and 1 international article not yet indexed by Quartile. There were 2 articles published in 2020, 2 articles in 2021 and 3 articles in 2023. Table 1 shows the research design used. Most of the articles used were qualitative designs (n= 4, 57.2%) and quantitative designs with a cross-sectional approach (n= 3, 42.8%). Based on the 7 selected articles grouped by country of origin, 2 articles were found from Ghana and the other five articles each came from Uganda, Sri Lanka, Ethiopia, China and India. There are 2 articles from low income, 4 large articles from lower middle income and 1 large article from upper middle income. Based on the critical appraisal that has been carried out on the 7 articles that have been obtained, all of them are of grade A quality. Based on the 7 articles used, there are two articles from Ghana and five articles from mental specialists (local referrals) or to different high-level facilities (external referrals), clinic doctors and district psychiatrists, psychiatric nurses at nearby hospitals, professional psychiatrists or other psychologists. originating from Uganda, Sri Lanka, Ethiopia, China and India.

Research Theme

Based on the 7 articles used, three themes emerged. The latest role of midwives in

the management of pregnant women with mental health problems and disorders in developing countries is mental health screening management (4 articles, namely A3, A4, A5, A6), Referral (5 articles, namely A3, A4, A5, A6, A7) and Barriers and supporting factors (7 articles, namely A1, A2, A3, A4, A5, A6, A7).

1. Management of Mental Health Screening for Pregnant Women

Management of screening for mental health disorders and problems is obtained. Midwives carry out screening using a general form (antenatal card). Meanwhile, specialized health workers carry out screening using conventional neuropsychological tests such as the MMSE (Mini mental state examination), DSM-V (Statistical Manual of Mental Disorders V), and PHQ-9 (Patient Health Questionnaires-9). Midwives do not have a standard diagnosis pattern, where screening is carried out based on the midwife's observations of the behavior, facial expressions of pregnant women and screening based on the experience of health workers. Mental health screening can be identified from the mental health status of pregnant women in the early stages which can increase competence as a health professional (A3, A4, A5, A6).

2. Reference

Midwives need referral pathways to provide timely intervention (A7). Referrals made by midwives to pregnant women with mental health illnesses to mental specialists (local referral) or to different higher level facilities (external referral), clinic doctors and district psychiatrists (A3, A5, A6), professional psychiatrists or psychologists. Midwives can also make home visits after initiation of treatment (A4).

3. Barriers and Supporting Factors

Barriers in the management of pregnant women with mental health disorders and problems from the perspective of pregnant women include mental health services not being available (77%), lack of knowledge about mental health in women from different ethnic groups (75.7%), lack of pathways clear mental health services (A1). From the midwife's point of view, these are lack of knowledge about mental health, unclear referral pathways, heavy workload, midwives never receiving mental

health training, lack of specialist mental health care for pregnant women, difficulties during the treatment and referral process as well as a fragmented nursing model and stigma. community about mental health disorders (A2, A3, A4, A5, A6, A7). Supporting factors for the role of midwives in the management of pregnant women with mental health disorders and problems are the family receiving a diagnosis, the family discussing health services, receiving psychological intervention, medical staff having good listening and communication skills (A4, A6).

DISCUSSION

Pregnant women in developing countries experience untreated mental disorders during pregnancy. Mental health should be included in maternal care programs to meet the needs of pregnant women and reduce gaps in diagnosis and treatment. One aspect of improving women's mental health is screening for common perinatal mental disorders. Now more than ever, it is critical to increase access to mental health services for women in low- and middle-income countries¹¹. In some countries, screening for mental health has been integrated into routine maternal health care. The World Psychiatric Association and the Marce International Society have also outlined recommendations for conducting mental health screening in the perinatal period¹².

The results of the Rapid review found that the majority of midwives said that they did not have specific tools to assess and manage maternal mental health illnesses apart from standard clinical assessment methods and physical examinations which only used antenatal forms or questionnaires that assessed the mother's health and mental health history in her family.¹³. All the midwives said that talking to and seeing the mothers they were caring for could help identify depression¹⁴. Meanwhile, mental health officers who specialize in screening and managing maternal mental health conditions are more likely to use conventional neuropsychological tests such as MMSE, DSM-V, and PHQ-9.¹³. The PHQ-9 is a reliable screening tool for identifying depressive symptoms in pregnant women¹⁵. All professionals stated that they faced no problems in using PHQ for screening after training¹⁶. Screening for mental health disorders can

identify pregnant women's mental health conditions at an early stage and offer support to those who may be experiencing difficulties, thereby reducing the possibility of negative effects for mother and baby¹⁷.

One of the main management strategies used by midwives is to refer women with mental health disorders and problems to mental health doctors working in the same hospital (local referral) or in a different high-level care facility with specialized mental health care (external referral).¹³ Interventions for common perinatal mental disorders should be guided by commonly agreed best practices: seeking opportunities to integrate mental health screening and treatment into existing maternal health services¹¹.

Several internal inhibiting factorsThe role of midwives in the management of pregnant women with mental health problems and disorders in developing countries from the perspective of pregnant women includes mental health services not being available (77%), lack of knowledge about mental health in women from different ethnic groups (75.7%) , lack of clear mental health service pathways (75.1%)¹⁸. Additionally, mothers do not want to talk about their own mental health problems when they are not asked to do so by a mental health professional¹². From the midwife's perspective, where the workload is heavy (74.1%), and there is a lack of knowledge about mental health problems (74.1%), midwives are not confident in screening for perinatal mental health disorders due to a lack of knowledge and skills in managing health disorders. mentally^{17,1819}. Currently, midwives only know through their own observations, as there are no screening tools used for women in the antenatal period. Some midwives use screening methods to gather information about their patients' family mental health history. However, the initial diagnosis of depression is most often determined subjectively through mothers' direct observations of how they behave or talk during antenatal visits¹⁴. Midwives do not have special training to screen and treat mothers with mental health problems. They screen and treat maternal mental health problems based solely on history and physical examination, and they refer almost all mothers who show symptoms of mental disorders as feeling unprepared to treat them¹³.

In mental health services for pregnant women, supporting factors were found where the majority of midwives had a positive attitude

and demonstrated better practice in finding and referring mothers with mental health problems²⁰. Factors that may drive acceptance of psychological interventions include the willingness of health workers to offer help, the availability of integrated primary mental health services, and the culture in which women seek advice. Midwives, for example, are considered the most suitable providers of antenatal care to help because they are in close contact with pregnant women²¹.

In the author's opinion, the role of health service leaders plays an important role in formulating policies regarding the role of midwives in the management of pregnant women with mental health problems and disorders in developing standard operational procedures, screening instruments, workload and support for training in mental health services for pregnant women.

Limitations and Weaknesses

Preparation of Rapid review reports it uses the worldwide accepted PRISMA-ScR checklist. Limited resources mean that only articles that can be included in this review are open access articles. The role of midwives in the management of pregnant women with mental health problems and disorders is only limited to screening and referral and no information was found regarding midwife guidelines for health management of pregnant women.

CONCLUSIONS

Based on the 7 articles used, it was obtained 3 themes related to the role of midwives in the management of pregnant women with health problems and disorders in developing countries, namely management of mental health screening of pregnant women, referrals, barriers and supporting factors. Need further research to test the effectiveness of midwives' mental health screening of pregnant women, and to develop and evaluate an integrated perinatal mental health service model.

CONFLICT OF INTEREST

At the time of this rapid review there was no conflict of interest.

REFERENCES

1. Bante A, Mersha A, Zerdo Z, Wassihun B, Yeheyis T. Comorbid anxiety and depression: Prevalence and associated factors among pregnant women in Arba Minch zuria district, Gamo zone, southern Ethiopia. *PLoS One* [Internet]. 2021;16(3 March):1–15. Available from: <http://dx.doi.org/10.1371/journal.pone.0248331>
2. Wulandari RP, Perwitasari. The Correlation between Maternal Age and Parity and Depressive Symptoms in Pregnancy (The Correlation between Depressive Symptoms with Age and Parity Among Pregnant Women). *Midwifery Reprod*. 2021;4(2):81–5.
3. Nuryati T, Amir Y. Mental Health Problems of Pregnant Women, the Causes, and the Need for Social Support. *J Biometrics and Population*. 2022;11(1):80–8.
4. Korhonen LS, Karlsson L, Scheinin NM, Korja R, Tolvanen M, Mertsola J, et al. Prenatal Maternal Psychological Distress and Offspring Risk for Recurrent Respiratory Infections. *J Pediatr*. 2019;208:229–235.e1.
5. Biaggi A, Conroy S, Pawlby S, Pariante CM. Identifying the women at risk of antenatal anxiety and depression: A systematic review. *J Affect Disord*. 2016;191:62–77.
6. Hertati D, Mujahadatuljannah, Rabiattunnisa, Setyoningsih D, Nurhidayati E. Collaborative Care for Perinatal Mental Health: Literature Review. *J Surya Med*. 2022;8(1):21–8.
7. Hajifoghaha M, Nahidi F, Alizadeh S, Golezar S, Dabiri F, Mokhlesi SS, et al. Midwives' educational needs in Iran: A narrative review. *Iran J Nurs Midwifery Res*. 2020;25(1):1–6.
8. Coates D, Foureur M. The role and competence of midwives in supporting women with mental health concerns during the perinatal period: A scoping review. *Health Soc Care Community*. 2019;27(4):e389–405.
9. Andrea C. Tricco Etienne V. LaAndrea C. Tricco Etienne V. Langlois Sharon E. Strausnglois Sharon E. Straus. *Rapid Reviews To Strengthen Health Policies*

- And Systems: A Practical Guide. WHO. 2017.
10. Dehlendorf C, Krajewski C, Borrero S. Contraceptive counseling: Best practices to ensure quality communication and enable effective contraceptive use. *Clin Obstet Gynecol*. 2014;57(4):659–73.
 11. Lasater ME, Beebe M, Gresh A, Blomberg K, Warren N. Addressing the unmet need for maternal mental health services in low-and middle-income countries: Integrating mental health into maternal health care. *Journal of midwifery & women's health*. 2017 Nov;62(6):657.
 12. Shanbhag V, Chandra P, Desai G, Bagadia A, Dref M Le, Bhat S. “if They Don't Ask, We Don't Share” - A Qualitative Study on Barriers and Facilitators to Discussing Mental Health with Obstetric Care Providers in Urban Anganwadis among Pregnant Women in India. *Indian J Soc Psychiatry [Internet]*. 2023;39(3):215–20. Available from: https://api.elsevier.com/content/abstract/scopus_id/85173938815
 13. Nakidde G, Kumakech E, Mugisha JF. Maternal mental health screening and management by health workers in southwestern Uganda: a qualitative analysis of knowledge, practices, and challenges. *BMC Pregnancy Childbirth*. 2023;23(1):477.
 14. Wyatt S, Ostbye T, Silva V De, Long Q. Antenatal depression in Sri Lanka: a qualitative study of public health midwives' views and practices. Vol. 19, *Reproductive health*. 2022. p. 23.
 15. Woldetensay YK, Belachew T, Tesfaye M, Spielman K, Biesalski HK, Kantelhardt EJ, et al. Validation of the Patient Health Questionnaire (PHQ-9) as a screening tool for depression in pregnant women: Afaan Oromo version. *PLOS One*. 2018;13(2):1–15.
 16. Kukreti P, Ransing R, Raghuveer P, Mahdevaiah M, Deshpande S, Kataria D, et al. Stepped care model for developing pathways of screening, referral, and brief intervention for depression in pregnancy: A mixed-method study from development phase. *Indian J Soc Psychiatry*. 2022;38(1):12–20.
 17. Xiao X, Haixia M, Shening Zhu QL and YC. The perceptions and attitudes of obstetric staff and midwives towards perinatal mental health disorders screening: a qualitative exploratory study in Shenzhen, China. *BMC Nurs [Internet]*. 2023;22(313):1–10. Available from: <https://pubmed.ncbi.nlm.nih.gov/37705010>
 18. Adjorlolo S, Aziato L. Barriers to addressing mental health issues in childbearing women in Ghana. *Nurs Open*. 2020;7(6):1779–86.
 19. Adjorlolo S. Seeking and receiving help for mental health services among pregnant women in Ghana. Vol. 18, *PloS one*. 2023.
 20. Poreddi V, Gandhi S, Ramachandra, Ganjekar S, Desai G, Chandra PS. Maternal Mental Health: A Baseline Survey of Knowledge, Attitudes and Current Practice among Auxiliary Nurse Midwives. *Nurs J India [Internet]*. 2021; Available from: <https://doi.org/10.48029/nji.2021.cxii201>
 21. Bitew T, Keynejad R, Honikman S, Sorsdahl K, Myers B, Fekadu A, et al. Stakeholder perspectives on antenatal depression and the potential for psychological intervention in rural Ethiopia: a qualitative study. *BMC Pregnancy Childbirth*. 2020;20:1–11.

Original Article

Application of Rolling and Areola Massage Using Jitu Oil with Murottal Al Qur'an Relaxation for Smooth Exclusive Breastfeeding

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ABSTRACT

Lack of activation of the hormones prolactin and oxytocin can result in irregular milk production after delivery. Areola and rolling massage is a strategy to deal with erratic milk production. Jitu Oil and murottal Al-Quran can help mothers feel more comfortable and comfortable thereby encouraging more milk production. The aim of the research is to explain and examine how the effect of rolling and areola massage using precise oil and murottal Al-Qur'an relaxation on the smooth release of exclusive breastfeeding. Questionnaires and observation notes were the tools used. Instrument validity test out of 19 questions, 2 were invalid, so there were 17 questions used by researchers to measure the smoothness of breastfeeding. The results of the Wilcoxon Pretest and Posttest on the Smooth Expulsion of Exclusive Breast Milk have increased. The results of the Wilcoxon test on days 1 to 7 showed an increase in the baby's weight between the pretest and posttest which was significantly different with all respondents experiencing an increase in the baby's weight. In conclusion, rolling and areola massage using sniper oil and relaxing Al-Qur'an murottal can help expedite the smoothness of breast milk.

Keywords: Rolling, Areola, Jitu Oil, Al-Qur'an, Breast Milk.

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INTRODUCTION

The best way to provide nutrition to babies is through breastfeeding in the early stages. Apart from that, there are reports that the incidence of insufficient breast milk production, which ranges from 11 to 54 percent, is also a problem. Many mothers easily offer prelacteal foods including milk, honey, coconut water, bananas, and starch water because breast milk production is low. As a result of the newborn's digestive system not being ready to consume pre-treat food, prelacteal feeding has an impact on reducing the number of babies who are exclusively breastfed, allergies and infant mortality¹. Preparation for breastfeeding can be

started since pregnancy so that apart from getting information about maternal and infant health, you can also find out about preventing maternal and infant deaths².

By 2030, the neonatal mortality rate must fall by at least 12 per 1,000 live births, and the child mortality rate must fall by at least 25 per 1,000 live births, in accordance with the 2030 Sustainable Development Agenda. One way to achieve this is by practicing effective breastfeeding. Exclusive³. According to WHO 2021, Neonatal deaths reached 17 per 1000 live births (90% UI 17 to 19) in 2019, which is a 52% decrease from 37 in 1990 (90% UI 36 to

38) ⁴. However, only a small percentage of babies aged less than six months are exclusively breastfed, and only 44% of newborns worldwide receive breast milk in the first hour of life. The percentage of developing countries that provide exclusive breastfeeding is 46%. Less than half of babies less than six months are exclusively breastfed nationwide ⁵. The WHO goal, which calls for increasing the percentage of babies exclusively breastfed for at least six months, has not been achieved. This is WHO's fifth goal by 2025 ³. 29.5% of babies in Indonesia receive exclusive breast milk until the age of six months ⁶. This does not meet the target of the Ministry of Health's Strategic Plan, namely that 50% of babies less than 6 months old receive only breast milk, which is the target for the period 2015 to 2019. Breastfeeding early and exclusively for six months helps protect children from digestive conditions that can shorten their growth ⁷. Based on the profile of Situbondo Regency, 758 of 1022 babies evaluated, or 74.2% of them, were exclusively breastfed in Situbondo Regency in 2020, according to monthly data ⁸. Newborn deaths will occur at the Arjasa Community Health Center in 2021 in as many as four cases. The neonatal mortality rate for newborns 0–6 days was 2 cases and for newborns 7–28 days was 2 cases ⁹.

After giving birth (within 1-2 days), the mother should start caring for her breasts and continue to do so regularly. By stimulating the breast muscles, you can encourage the release of the breast milk-producing hormone prolactin ¹⁰. Rolling and areola massage is a breast care technique that is useful for encouraging the pituitary gland to release the chemicals oxytocin and prolactin ¹¹. In addition, using oil can make mothers feel peaceful and relaxed, which is thought to increase breast milk production.

Jitu Oil is an abbreviation of PiJat terapi komplementer, Untuk pelancar ASI Ibu which is the result of research based on VCO, lavender essential oil and lime essential oil. The rolling and areola massage technique combines two methods that can increase oxytocin levels in postpartum women, but little is known about postpartum women, both those who give birth

naturally and those who undergo caesarean section. The additional advantage of murottal Al-Qur'an relaxation has many benefits; they have not been fully utilized by nursing mothers. Based on the results of a preliminary study conducted by researchers of 10 breastfeeding mother respondents. 8 of them had never heard of or knew about rolling massage and areola massage and 3 said they had heard of it but forgot how to apply it. Based on this phenomenon, researchers want to describe and analyze the application of rolling massage using Jitu Oil with murottal Al-Qur'an relaxation on the smooth release of exclusive breast milk.

METHOD

This research methodology uses a quasi-experimental approach with only a single test. The operational area of the Arjasa Health Center was used as a research site. During the research, March-May 2023, the population was 64 breastfeeding mothers, the sampling technique used total sampling. The data collection process began by obtaining approval from the relevant department, consulting with the coordinating midwife regarding the research sample, discussing perceptions with the enumerator on duty, and obtaining informed consent from respondents who met the criteria. Giving souvenirs to respondents, the researcher recapitulated the observation sheet in the final stage. Data analysis used Person Product Moment and Cronbach's Alpha for the smooth breastfeeding questionnaire and the Wilcoxon Pretest and Posttest test to test the smoothness of breast milk, the Spearman Rank Test for the Smooth Excretion of Exclusive Breast Milk with Weight Gain and Observation of Defecation and Baby Tanks. Data presentation. Research using SOP Areola massage, Rolling Massage and Android cellphones that have MP3 Murottal Al-Qur'an installed. Breastfeeding fluency questionnaire, baby defecation and urination observation sheet. The ingredients used by Jitu Oil are the oil used for massage. This research has passed the ethical requirements issued by Faletahan University with number 77/KEPK.UF/IV/2023.

RESULTS

A. Pearson Product Moments

The basis for making decisions on the Person Product Moment Validity Test is by looking at the significance value (Sig.) where:

1. If the significance value ≤ 0.05 = valid
2. If the significance value is > 0.05 = not valid

Table 1. Results of the Pearson product moment and Cronbach's alpha tests for the smooth production of exclusive breast milk

Question Items	Sig value.	Information
Items 1	0,050	Valid
Items 2	0,034	Valid
Items 3	0,000	Valid
Items 4	0,027	Valid
Items 5	0,000	Valid
Items 6	0,046	Valid
Items 7	0,000	Valid
Items 8	0,001	Valid
Items 9	0,002	Valid
Items 10	0,002	Valid
Items 11	0,758	Invalid
Items 12	0,000	Valid
Items 13	0,001	Valid
Items 14	0,793	Invalid
Items 15	0,018	Valid
Items 16	0,009	Valid
Items 17	0,002	Valid
Items 18	0,024	Valid
Items 19	0,010	Valid

Source: Primary data, 2023

Table 3. Normality Test

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Smooth breastfeeding Pre	0,190	64	0,000	0,935	64	0,002
Smooth breastfeeding Post	0,282	64	0,000	0,757	64	0,000

Source: Primary data, 2023

The results of the Kolmogorov Smirnov test on both pretest and posttest data produced a significance value of 0.000 (< 0.05), this indicates that the data is not normally distributed. This results in the data not being able to undergo parametric testing.

Interpretation of Pretest and Posttest Wilcoxon Test Results for Smooth Expression of Exclusive Breast Milk

The basis for making decisions for the Wilcoxon Difference Test is by looking at the significance value (Sig.) where:

1. If the significance value is < 0.05 , then there

B. Cronbach's Alpha

The basis for decision making is the Cronbach's Alpha Reliability Test where the questionnaire is said to be reliable if the Cronbach Alpha value is ≥ 0.6 .

Tabel 2. Reliability Statistics

Cronbach's Alpha	N of Items
0,034	17

Source: Primary data, 2023

The test results on the 17 items of the questionnaire on the smooth delivery of exclusive breast milk which were distributed to 64 respondents obtained a Cronbach's Alpha value of 0.034 (< 0.6), which means that the questionnaire was declared reliable or consistent in repeated measurements.

Interpretation of Kolmogorov Smirnov Pretest and Posttest Test Results for Smooth Expression of Exclusive Breast Milk

The basis for making decisions on the Kolmogorov Smirnov Normality Test is by looking at the significance value (Sig.) where:

1. If the Sig. < 0.05 , then the data is not normally distributed.
2. If the Sig. ≥ 0.05 , then the data is normally distributed

is a difference between the smoothness of exclusive breast milk production before and after the Areola and Rolling Massage intervention using Jitu Oil with Murottal Al-Qur'an Relaxation. If the significance value is > 0.05 , then there is no difference between the smoothness of exclusive breast milk production before and after the Areola and Rolling Massage intervention using Jitu Oil with Murottal Al-Qur'an Relaxation

2. With additional interpretations including :
 - 1) Negative Ranks, which shows a decrease from the pretest score to the posttest score

- 2) Positive Ranks, which shows an increase from the pretest score to the posttest score

Ties, which shows the same value between the pretest and posttest

Table 4. Pretest and Posttest Wilcoxon Test Results for Smooth Exclusion of Exclusive Breast Milk

Negative Ranks	Positive Ranks	Ties	Nilai Sig.	Information
0	64	0	0,000	The smoothness of Exclusive Breast Milk Expenditure between pretest and posttest was significantly different with all respondents experiencing an increase in Independent Breastfeeding Success

Source: Primary data, 2023

The basis for making decisions on the Kolmogorov Smirnov Normality Test is by looking at the significance value (Sig.) where:

1. If the Sig. < 0.05, then the data is not normally distributed.
2. If the Sig. \geq 0.05, then the data is normally distributed.

Table 5. Normality Test

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Day 1 weight	0,114	64	0,037	0,951	64	0,013
Day 7 weight	0,432	64	0,000	0,207	64	0,000

Source: Primary data, 2023

The results of the Kolmogorov Smirnov test were good on day 1 data producing a significance value of 0.037 (<0.05) while day 2 produced a significance value of 0.000 (<0.05), this indicates that the data was not normally distributed. This results in the data not being able to undergo parametric testing.

Interpretation of Wilcoxon Test Results on Day 1 and Day 7 of Baby's Weight Gain

The basis for making decisions for the Wilcoxon Difference Test is by looking at the significance value (Sig.) where:

1. If the significance value is <0.05, then there is a difference between the smoothness of exclusive breast milk production before and after the Areola and Rolling Massage

intervention using Jitu Oil with Murottal Al-Qur'an Relaxation

2. If the significance value is > 0.05, then there is no difference between the smoothness of exclusive breast milk production before and after the Areola and Rolling Massage intervention. Using Jitu Oil with Murottal Al-Qur'an Relaxation With additional interpretations including:
 - 1) Negative Ranks, which shows a decrease from the pretest score to the posttest score
 - 2) Positive Ranks, which shows an increase from the pretest score to the posttest score
 - 3) Ties, which shows the same value between the pretest and posttest

Table 6. Results of the Wilcoxon Test on Day 1 and Day 7 of Baby's Weight Gain

	Minimum body weight	Maximum body weight	Average	Negative Ranks	Positive Ranks	Ties	Sig value.	Information
Day 1 weight	2,6 Kg	3,3 Kg	3,1 Kg	0	64	0	0,000	The increase in baby weight between pretest and posttest was significantly different with all respondents experiencing an increase in baby weight
Day 7 weight	2,7 Kg	3,45 Kg	3,3 Kg					

Source: Primary data, 2023

Interpretation of Kolmogorov Smirnov Test Results Day 1 to Day 7 Observation of BABIES and BABIES

The observation assessment is assessed with each category that meets the normal limits being given 1 point, while those that do not meet it are given 0 points. The categories for normal limits for defecating and urinating for babies include:

1. Normal newborn urination: 4-12 times
2. Characteristics of BAK: Clear yellow
3. Number of bowel movements in 24 hours: 3–12 times a day
4. Characteristics of defecation: babies will have green-brown feces when they are just born. Furthermore, after the third day the

color of the meconium gradually becomes green-brown. Then, it will turn yellow or dark yellow

5. Average baby sleep after breastfeeding: 2-3 hours
6. Frequency of breastfeeding babies: 8–12 times

The basis for making decisions on the Kolmogorov Smirnov Normality Test is by looking at the significance value (Sig.) where:

1. If the significance value is > 0.05 , then the data is declared to be normally distributed
2. If the significance value is < 0.05 , then the data is declared not normally distributed

Table 7. Kolmogorov Smirnov Test Results Day 1 to Day 7 Observation of Baby's Defecation and Urination

Data	Sig value.	Information
Baby's defecation and urination Day 1	0,000	Not Normally Distributed
Baby's defecation and urination Day 2	0,000	Not Normally Distributed
Baby's defecation and urination Day 3	0,000	Not Normally Distributed
Baby's defecation and urination Day 4	0,000	Not Normally Distributed
Baby's defecation and urination Day 5	0,000	Not Normally Distributed
Baby's defecation and urination Day 6	0,000	Not Normally Distributed
Baby's defecation and urination Day 7	0,000	Not Normally Distributed

Source: Primary data, 2023

The results of the Kolmogorov Smirnov test for all days of observation produced a significance of 0.000 (< 0.05), this indicates that the data is not normally distributed. So this results in the data not being able to undergo parametric testing.

Interpretation of Friedman Test Results Day 1 to Day 7 Observation of Babies and Baby Tanks

The basis for making the Kruskal Wallis Difference Test decision is by looking at the significance value (Sig.) where:

1. If the Sig. < 0.05 , then shows
2. that there is at least one significant difference in the results of observing the baby's bowel movements and urination.
3. If the Sig. > 0.05 , then there is not enough statistical evidence of significant differences that can be concluded from the data.

Table 8. Friedman test results from day 1 to day 7. Observation of baby's defecation and urination

Ranks	
	Mean Rank
Day 1	5.01
Day 2	3.73
Day 3	4.03
Day 4	3.94
Day 5	3.86
Day 6	3.82
Day 7	3.61
Test Statistics ^a	
N	64
Chi-Square	25.244
df	6
Asymp. Sig.	.000
a. Friedman Test	

Source: Primary data, 2023

The test results show that day 1 is the day when the baby has the best average normal defecation and urination, but this does not consistently decrease as seen from day 3, it is better than day 2. As for the Sig results. 0.000 (< 0.050) which indicates a difference in the normal level of defecation and urination of the baby on each day.

Interpretation of Spearman's Rank Test Results Smoothness of Exclusive Breast Milk

Table 9. Results of the Spearman Rank Test for Smooth Expression of Exclusive Breast Milk, Weight Increase and Observation of Baby's Defecation and Urination

Connection	Sig value.	Information
The relationship between exclusive breast milk production and weight gain	0,155	Positive Monotonic Relationship Is Not Significant
The relationship between exclusive breast milk production and defecation and urination baby	0,916	Positive Monotonic Relationship Is Not Significant

DISCUSSION

The respondents of this research are all Muslims who like murottal Al-Qur'an. So that the relaxation of the murottal Al'Qur'an can be listened to when doing massage to facilitate breast milk. Based on the observations of researchers and enumerators, the majority of massages on the back (Rolling massage) are assisted by the baby's grandmother rather than the husband. The husband thinks he is not confident in doing this massage. Breastfeeding mothers can massage the areola area independently. Al-Qur'an verses that are played by Surah Ar-Rahman and Al-Wa'qiah. Nursing mothers have downloaded music via YouTube so they can play it offline. The breastfeeding mothers selected as respondents all had babies aged 0-30 days, the babies were only given exclusive breast milk.

Kasova et al. Research shows that back massage in the early postpartum period can reduce noradrenaline and increase oxytocin and prolactin levels. Back massage done regularly increases the amount of breast milk, the baby does not need to be given additional food and will be healthier, and can prevent economic losses ¹⁶. Research by Jogdeo & Bhore (2013) in India found that there was an effect of back massage on increasing the let-down reflex in women undergoing caesarean section (P-value < 0.05) ¹⁷. According to research by Safitri et al., women experience muscle tension between the shoulder blades, therefore massage therapy is used to relax or reduce stress in this area. A

Expenditure with Increase in Weight and Observation

The basis for decision making in the Spearman Rank Relationship Test is by looking at the significance value (Sig.) where:

1. If the Sig. < 0.05 , then there is a significant relationship between the two variables.
2. If the Sig. ≥ 0.05 then there is not enough statistical evidence of a significant relationship between the two variables.

neurogenic response occurs when the spine is massaged, thereby speeding up the ability of the parasympathetic nerves to send commands to the back of the brain. The posterior pituitary responds to stimulation signals by releasing oxytocin into the systemic circulation. The myoepithelial cells surrounding the alveoli receive a blood flow of oxytocin, which stimulates these cells causing the alveolar sacs to narrow, pressure to increase, and the ducts to shorten and widen. Therefore, breast milk comes out faster than saliva when the nipple is sucked ¹⁸. One explanation for labor is that the hormones prolactin and oxytocin replace the hormones estrogen and progesterone when their levels drop drastically. For the lactation process to be successful, the hormones prolactin and oxytocin are very important. Milk production is sufficient, but milk production is limited because of limited oxytocin secretion, not because breast milk production is insufficient ¹⁹. This supports the theory that stimulation of the hormone prolactin produced by the anterior pituitary and oxytocin produced by the posterior pituitary will cause breast milk to flow more naturally if oxytocin massage is carried out along the spine to the fifth and sixth costal bones. Oxytocin massage supports breastfeeding, calms the mother, reduces swelling, smoothes the breasts, encourages the release of the hormone oxytocin, and keeps breast milk production going when the mother and baby are sick. The mother's comfort during the massage is a requirement for oxytocin

massage to be effective²⁰.

Lavender aromatherapy has a psychological therapeutic effect from the aroma that is inhaled through inhalation of volatile components. Lavender is one type of aromatherapy whose properties have activity through the limbic system, especially in the amygdala and hippocampus. Although the cellular mechanisms are not yet known, lavender has properties similar to benzodiazepines and enhances the effects of gamma aminobutyric acid²¹. Apriyanti et al. states that lavender aromatherapy has been shown to significantly increase betaendorphin levels in mothers after cesarean delivery²². Agustina et al. found an increase in prolactin hormone levels in mothers who had oxytocin massage using lavender oil²³. Another study from Tugut et al. stated that lavender aromatherapy can reduce anxiety levels in patients undergoing gynecological procedures²⁴. The use of lavender essential oil is generally used as aromatherapy and massage. Clinically, the main benefits are in the central nervous system. The content of lavender essential oil is expected to help increase relaxation and comfort so that breast milk production is expected to increase. One of the clinical benefits of lavender in neuropsychiatry is as a sedative, anticonvulsant, anxiolytic and analgesic. According to Matsumoto et al., 2013, the use of lavender essential oil is expected to help post-cesarean section mothers to increase relaxation and comfort so that breast milk production is expected to increase. Lavender is a popular essential oil and is widely used in the clinical health sector, especially in treating psychosomatic problems in gynecology²⁵.

Whatever the cause of insufficient breast milk, breast massage can play an important role in increasing milk production. Since breast massage does not require any additional equipment or costs, all postpartum mothers should be demonstrated breast massage techniques that will facilitate milk flow and also help reduce breast engorgement. Lactation counselors must be sufficiently trained to perform and teach breast massage techniques. Delivery room, postpartum ward, and NICU nurses should be trained in breast massage techniques²⁶. In the process of lactogenesis, when the placenta comes out, the hormones progesterone and estrogen which were initially high become reduced. However, there is still residual blood circulation so that minimal

suppressive activity on prolactin remains. As soon as the baby is breastfed, a signal will be sent to the hypothalamus gland in the brain (anterior pituitary) to produce the hormone prolactin. Prolactin will circulate in the blood and enter the breast, causing the development of alveoli cells until the distance between the alveoli cells becomes tight and breast milk production increases. This is where the hormone oxytocin is needed which can release breast milk through the letdown reflex. Causes of oxytocin's work being hampered include post-natal stress, post-natal fatigue, not getting full support from those closest to you, and fear because there is not enough breast milk¹².

Lactation massage is a massage performed on several parts of the body, namely the head, neck, shoulders, back and breasts¹³. Nursing mothers who perform lactation massage will stimulate the blood vessels and muscles of their breasts, thereby increasing breast milk production through the hormone prolactin. Apart from that, lactation massage will produce cleaner, softer and more elastic breasts, making the baby more comfortable when breastfeeding¹⁴. For example, lactation massage can help with the breastfeeding induction process for mothers who have never breastfed, were adopted, or grew up in an orphanage¹⁵.

CONCLUSIONS

The results of the Instrument Validity Test of 19 questions contained 2 that were invalid so they were used by researchers to measure the smooth flow of breast milk. The results of the Wilcoxon Pretest and Posttest Test on the Smoothness of Exclusive Breast Milk Expenditure have increased. The results of the Wilcoxon test on days 1 to 7 showed that the increase in baby's weight between pretest and posttest was significantly different with all respondents experiencing an increase in baby's weight. Further research needs to be carried out regarding the role of biological mothers or close family members other than husbands in making exclusive breastfeeding a success

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CONFLICT OF INTEREST

There was no conflict of interest.

REFERENCES

1. Department of Health R.I., Profil Kesehatan Indonesia. Jakarta; 2015.
2. Ningsih DA, Kholifah UN, Susiana S, Silaturrohmi S, Musyarrofah SH, Nurhidayati S. Kelas Ibu Hamil Bernuansa Islami dalam Upaya Meningkatkan Kesehatan Ibu dan Janin. *Poltekita J Pengabd Masy*. 2022;3(4):732–9.
3. WHO. Trends in Maternal Mortality : 1990 to 2015. World Health Organization. 2014.
4. WHO. Monitoring Health For The SDGs (Sustainable Development Goals). 2021.
5. WHO. World Health Statistics. 2015.
6. Kemenkes. Profil kesehatan Indonesia 2017 Jakarta: kemenkes RI. Diakses pada tanggal 18 Maret 2023 [Internet]. 2018. Available from: <http://www.depkes.go.id/resource%0As/download/pusdatin/profilkesehatan-%0AIndonesia/profilkesehatan-%0AIndonesia-tahun-%0A2017.pdf>
7. WHO. Global Nutrition Targetts 2025 Stunting Policy Brief. 2014.
8. Dinkes Situbondo. Profil Kesehatan Kabupaten Situbondo Tahun 2021. 2021. 100 p.
9. Profil Pukesmas Arjasa Kabupaten Situbondo. 2021.
10. Bobak IM, Lowdermilk DL, Jensen MD. Buku Ajar Keperawatan Maternitas. Jakarta: EGC; 2012.
11. Wiji R. ASI dan Panduan Ibu Menyusui. Yogyakarta: Nuha Medika; 2013.
12. Riordan J, Wambach K. Breasfeeding and Human lactation (4thed ed.). 2015.
13. Dewi AP., Eni I. RK. Kombinasi Pijat Oksitosin dan Endorphin terhadap Produksi ASI pada Ibu Postpartum. *J Ilm Kesehat Keperawatan*. 2017;13(2).
14. Jahriani N. Pengaruh Pijat Laktasi Terhadap Produksi ASI Pada Ibu Menyusui Di Kelurahan Sendang Sari Kabupaten Asahan. *Excell Midwifery J*. 2019;2(2):1–20.
15. Ningsih DA, Sari YM, Kholifah UN. Edukasi Pijat Laktasi dan Endhoprin pada Ibu Menyusui dalam Situasi Pandemi Covid-19. *Poltekita J Pengabdi Masy*. 2022;3(September):405–11.
16. Kosova. The Effect on Lactation of Back Massage Performed in the Early Postpartum Period, Turkey. *J basic appl*. 2016;2(2):113–8.
17. Jogdeo, Bhore. The Effect of Back Massage on Let Down Reflex among Mothers Who Had Undergone Cesarean Section, India. *Int J Sci Res*. 2016;5(3).
18. Safitri WN, Susilaningsih, Panggayuh A. Pijat Punggung dan Percepatan Pengeluaran ASI Pada Ibu Post Partum. *J Inf Kesehat Indones* [Internet]. 2015;1(2):148–53. Available from: <https://adoc.pub/pijat-punggung-dan-percepatan-pengeluaran-asi-pada-ibu-post-.html>
19. Yuviska I, Lathifah, Neneng, Ashari, Via, Anggraini. Oxytocin Massage Effects Increasing Breast Milk Production In Postpartum Mothers. *J Kebidanan Malahayati*. 2022;8:371–7.
20. Utami R. Exclusive breastfeeding. Jakarta: PT Trubus Agri Widia; 2010.
21. Ujiningtyas S. Pengaruh Minyak Esensial Lavender Dibanding Povidone-Iodine Pada Penyembuhan Luka Episiotomi Ibu Post Partum. UGM; 2012.
22. Apriyanti. The Impact of Lavender Aromatherapy on Pain Intensity and Beta-Endorphin Levels in Post-Caesarean Mothers. *Belitung Nurs J*. 2017;3(5).
23. Agustie. Effect of Oxytocin Massage Using Lavender Essential Oil on Prolactin Level and Breast Milk Production in Primiparous Mothers after Caesarean Delivery. *Belitung Nurs J*. 2017;3(4).
24. Tugut. Effects of Lavender Scent on Patients' Anxiety and Pain Levels During Gynecological Examination. *Complement Ther Clin Pract*. 2017;
25. Matsumoto T, Asakura H, Hayashi T. Does Lavender Aromatherapy Alleviate Premenstrual Emotional

- Symptoms? A Randomized Crossover Trial. *BioPsikoSocial Med J*. 2013;7(1).
26. Kraleti SK, Lingaldinna S, Kalvala S, Anjum S, Singh H. To study the impact

of unilateral breast massage on milk volume among postnatal mothers - A quasi-experimental study. *Indian J Child Heal*. 2018;5(12):731–4.

The Effect of Exercise on Mental Health: Coping with Stress and Anxiety Through Physical Activity (Systematic literature review)

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ABSTRACT

This study is a systematic review that aims to evaluate the effect of exercise on mental health, especially in overcoming stress and anxiety. By reviewing a number of studies selected through strict inclusion and exclusion criteria, the review gathered data from a variety of sources including peer-reviewed journals, articles. The data analysis method used is meta-analysis. The results showed that physical activity can significantly reduce symptoms of stress and anxiety. This applies to different types of sports, from aerobics, yoga, to strength training. This therapeutic effect is associated with the release of endorphins and other neurotransmitters that play a role in improving mood and reducing tension. In addition, exercise also improves sleep quality and aids in the regulation of circadian rhythms, which directly affect the management of stress and anxiety. The study also found that exercise intensity and duration played a role in its tiveness. Light to moderate exercise, performed regularly, is more effective in reducing symptoms of stress and anxiety compared to sporadic high-intensity exercise. Consistency and continuity in exercise routines prove to be more important than the intensity of exercise performed. However, the study also acknowledged variations in individual responses to exercise. Factors such as age, gender, initial health conditions, and personal preference for the type of exercise can affect how effective exercise is at coping with stress and anxiety in a particular individual. Taken together, these findings provide strong evidence supporting the use of exercise as a non-pharmacological strategy in managing stress and anxiety. The study encourages health practitioners to recommend exercise as an integral part of mental health treatment plans, as well as suggesting further research to explore specific mechanisms behind the psychological benefits of physical activity.

Keywords: Mental Health, Exercise, Stress, Anxiety.

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INTRODUCTION

Mental health, which is often overlooked in general health discussions, is actually an important aspect that affects a person's quality of life ^{1,2}. Amid stressful modern life, the prevalence of conditions such

as stress and anxiety is on the rise, becoming a major concern in various sectors of society. In this context, non-pharmacological interventions, specifically sports, have begun to gain recognition as effective methods to reduce said symptoms. This study aimed to explore the relationship between physical activity and

mental health, focusing on managing stress and anxiety³⁻⁵.

Although many previous studies have highlighted the benefits of exercise for physical health, research into its impact on mental health is still relatively new⁶⁻⁸. Therefore, this study is expected to provide new insights and enrich the existing scientific literature, provide guidance for health practitioners, and assist individuals in managing stress and anxiety. In analyzing the relationship between exercise and mental health, it is important to understand how physical activity affects the brain and overall body function^{9,10}.

Exercise is known to stimulate the release of neurotransmitters such as endorphins and serotonin, which play a role in improving mood and feelings of happiness^{11,12}. In addition, exercise also contributes to improved sleep quality, decreased levels of stress hormones such as cortisol, and improved self-confidence and body image^{13,14}. All of these factors have a significant positive impact on mental health. The research conducted in this review covered different types of physical activity, from cardiovascular exercise to yoga to strength training, to comprehensively assess mental health benefits^{15,16}. The importance of this systematic review lies in its ability to consolidate various findings from different studies, providing a more holistic and in-depth analysis of this complex topic.

The main challenge in the study was determining the dose and type of physical activity that was most effective in reducing stress and anxiety. This is important because individuals react differently to different types and intensities of exercise¹⁷⁻¹⁹. Therefore, this research approach includes not only the short-term effects of exercise on mental health, but also its long-term implications. These considerations are important to provide more appropriate and personalized recommendations in the use of exercise as a mental health therapy^{20,21}.

In addition, the study also looked at factors such as age, gender, and early health conditions, all of which can affect how a person responds to physical activity. As such, this systematic review not only focuses on the effectiveness of exercise as a tool for managing stress and anxiety, but also seeks to understand the broader context in which exercise can serve

as an integral part of mental health treatment²²⁻²⁴.

In the last decade, understanding of the influence of exercise on mental health has made significant progress. Initially, research in this area focused on the benefits of exercise for physical health, but now the focus has shifted to psychological and emotional benefits^{25,26}. Recent studies have shown that exercise has a strong positive impact in reducing symptoms of stress and anxiety. Research in neuroscience has shown how physical activity affects the brain, especially in terms of the production of neurotransmitters associated with feelings of happiness and relaxation. Factors such as intensity, duration, and type of exercise have been studied in depth to determine the optimal exercise recipe. However, despite significant progress, there is still room for further research, especially in understanding the specific mechanisms behind exercise's benefits for mental health and how individual factors such as genetics and early health conditions affect exercise effectiveness²⁷⁻²⁹.

Recent developments in technology, such as wearable fitness trackers and mobile apps, have made major contributions to sports health research and practice. Data collected from these devices has provided new insights into how daily physical activity can affect mental health^{30,31}. Studies using big data and machine learning have allowed researchers to identify patterns and trends in the relationship between physical activity and mental health, which were previously impossible. This includes analysis of exercise behaviour in the context of everyday life and how this interacts with factors such as work stress, sleep quality, and social interaction. This multidisciplinary approach has provided stronger evidence and more practical recommendations for individuals and health practitioners^{32,33}.

A current challenge in sports health research is the integration of individualized approaches in exercise recommendations. Current research emphasizes the importance of an exercise plan tailored to an individual's needs, preferences, and health conditions. This approach recognizes that there is no one-size-fits-all when it comes to the mental health benefits of exercise^{34,35}. Therefore, researchers are now focusing more on customized intervention studies and clinical trials to evaluate the effectiveness of personalized exercise strategies³⁶⁻³⁸. In addition, there is

increasing interest in understanding how socio-economic, cultural, and environmental factors affect access to and engagement in physical activity. This awareness is important to develop programmes that are inclusive and accessible to different groups of people, ensuring that the mental health benefits of sport can be enjoyed by all, not limited to a specific segment of the population.

This study aimed to investigate the impact of physical exercise on mental health, focusing on the ability of physical exercise to cope with stress and anxiety. Against the backdrop of increasing levels of stress and anxiety in society, this study is important to provide deeper insight into the role of physical activity in mental health management. Through a synthesis of scientific literature, the study hopes to provide a better understanding of the relationship between physical exercise and mental health, with practical implications for mental health professionals, policy actors, and society. It is hoped that the findings of this study will not only make an academic contribution, but also help improve the understanding and application of physical exercise as an effective strategy in managing stress and anxiety, with a positive impact on the mental well-being of individuals and the population as a whole.

METHOD

This research uses a qualitative descriptive research model that is a literature study that uses various literature reviews in strengthening research analysis. This research begins with collecting some literature, then reviewing some important terms in the research, then collecting relevant research literature, then conducting an analysis based on all the literature that has been obtained by compiling a discussion, then formulating conclusions based on the results that have been analyzed and submitting suggestions based on the conclusions obtained.

The data used in this study was using secondary data. ³⁹ states that secondary data is data taken indirectly that can provide information to data collectors. The source of the data obtained is in the form of original scientific reports derived from published scientific articles and journals that have been accredited and indexed, both printed and non-print which are interrelated in the model of application of

blended learning in physical education and sports.

The data collection method used in this study is the documentation method. The documentation method is a method of collecting data by digging and searching for data from the literature related to what is in the problem statement. Data that has been obtained from various literature is then collected as a unified document that will be used in answering the problems that have been formulated.

Article search techniques in this study are through web access mendeley, google scholar, and scinece direct as well as on other journal search access with keywords The Effect of Exercise on Mental Health: Overcoming Stress and Anxiety Through Physical Activity. Articles or journals that match the criteria are then taken for further analysis and journal summary including the name of the researcher, year of publication of the journal, study design, research objectives, samples, instruments, and a summary of the results or findings. The summary of the research journal is entered into a table sorted according to the alphabet and year of publication of the journal and in accordance with the format mentioned above. This literature review uses literature that can be accessed fulltext in pdf format and scholarly (peer reviewed Journal). To further clarify the abstract and full test, the journal is read and examined. The summary of the journal is analyzed on the contents contained in the research objectives and research results / findings. The analysis method used is journal content analysis.

The systematic literature review investigates the impact of exercise on mental health, specifically its efficacy in alleviating stress and anxiety. Through stringent inclusion and exclusion criteria, the study analyzes data from various sources, utilizing meta-analysis as the method of data synthesis. The results indicate a significant reduction in stress and anxiety symptoms through physical activity, encompassing diverse sports like aerobics, yoga, and strength training. The therapeutic effect is attributed to the release of endorphins and neurotransmitters, contributing to mood improvement and tension reduction. Additionally, exercise positively influences sleep quality and circadian rhythm regulation, directly impacting stress and anxiety management. The study underscores the importance of exercise intensity and duration,

highlighting that regular, light to moderate exercise is more effective than sporadic high-intensity sessions. Consistency in exercise routines proves crucial, with acknowledgment of individual variations influenced by factors such as age, gender, health conditions, and exercise preferences. These findings robustly support the non-pharmacological use of exercise in stress and anxiety management. However, the study suggests further research to delve into specific mechanisms behind the psychological benefits of physical activity. While the methodology is described as a qualitative descriptive research model, additional detail on the rationale for choosing this approach and its alignment with research objectives would enhance comprehension of the research process.

RESULTS

This literature review was conducted to determine the Effect of Exercise on Mental Health: Overcoming Stress and Anxiety Through Physical Activity. The collected literature was analyzed with critical appraisal tables to answer the measurement objectives compared to simple measurement results. There are as many as 7 literature that discusses the Effect of Sports on Mental Health: Overcoming Stress and Anxiety Through Physical Activity, all of these journals are nationally accredited journals and international journals that are searched on the Google Scholar, Mendeley, Science direct.com portals by typing keywords "The Effect of Exercise on Mental Health: Overcoming Stress and Anxiety Through Physical Activity" which is then analyzed using critical appraisal analysis to analyze from the core of the journal, as well as the results or findings of these journals. The following is a table of critical appraisal analysis of 7 articles:

Researchers	Title Research	Research results
Zhu, 2023 ⁴⁰	Real-time monitoring for sport and mental health prevention of college student based on wireless sensor network	We have analyzed the system demand information of college students' sport and mental health, and analyzed the problems that the system needs to solve in detail. Through in-depth analysis of the sport and mental health information system, using wireless sensor network technology, we conducts a thorough investigation of the needs of the student sport and mental health system. Then we conduct an in-depth analysis of the system structure, architecture design, business model, available system, database system, to make the system more acceptable to people.
Lange et al., 2023 ⁴¹	Sport and physical exercise in sustainable mental health care of common mental disorders: Lessons from the COVID-19 pandemic	Physical activity and sport, with their global accessibility, significant and clinically meaningful efficacy as well as virtual absence of adverse effects, offer a promising option for the promotion of mental health, including the prevention and treatment of common mental disorders. Physical exercise and sport are likely to become valuable public mental health resources in the future.
O'Connor et al., 2023 ⁴²	An evaluation of a mental health literacy program for community sport leaders	A multivariate analysis of variance (pre-test scores as covariates) revealed participants in the 'Tackle Your Feelings' (TYF) program reported improved outcomes compared to controls on measures tied to leader confidence to support and refer, knowledge of resources to support mental health, general help-seeking and stigmatizing attitudes tied to social distance. A fifth measure of beliefs about

		<p>mental illness was not impacted by the program. A nine-month comparison group follow-up indicated some decay in scores over time. The results suggest that TYF programs can be effective at improving coach mental health literacy in community sporting club contexts.</p> <p>This research would further explore the usage of the Kawa model in addressing various psychological issues and how these improvements can enhance sports and physical performance. The literature search was performed by using Google Scholar, PubMed, Web of Science and Scopus as a database with specific keywords. In conclusion, this research provides an overview of the potential for the use of the Kawa model in promoting mental health ability included self-awareness, self-understanding, goal-setting, self-efficacy, stress and anxiety control for sports and physical performance and lays the foundation for future research in this area.</p>
Foo et al., 2023 ⁴³	Kawa model on mental health, sports and physical performance: A mini review	
Misztal et al., 2023 ⁴⁴	Interactions between genetic risk for 21 neurodevelopmental and psychiatric disorders and sport activity on youth mental health	<p>Participation in non-contact or team sports, as well as more frequent sport participation reduced all cross-sectional CBCL outcomes, whereas involvement in contact sports increased attention problems and rule-breaking behavior. Interactions revealed that more frequent exercise was significantly associated with less rule breaking behavior in individuals with high genetic risk for obsessive compulsive disorder. Associations with longitudinal CBCL outcomes demonstrated weaker effects. We highlight the importance of genetic context when considering sports as an intervention for early life behavioural problems.</p>
Forsdike, et al., 2022 ⁴⁵	Women's use of sport as identity-work in managing mental health and trauma	<p>While there is much research on men's mental health and sport, there has been less focus on women's gendered experiences of mental health and sport. Sport is widely considered to improve or sustain mental health, but it can be a problematic space for women. Focusing on four in-depth interviews with two women from a case study of an Australian field hockey club, we examine how women negotiate and manage their mental health and recovery from trauma through sport participation. Analysis is informed by a narrative approach that focuses on the enactment of gendered identities through stories that complicate relations between playing hockey and mental health. While sport facilitates women's identity-work and mental health recovery, we demonstrate</p>

Haugen, 2022⁴⁶

Athlete Mental Health &
Psychological Impact of
Sport Injury

how it can also produce additional challenges due to the gendered power relations shaping their experiences within sport and society more broadly.

Sport injury and mental health appear to have a bidirectional relationship, and the sport injury and rehabilitation process is associated with a wide variety of psychological and mental health concerns. Existing literature suggests understanding of these variables allows the professional to proactively address psychological readiness for return to sport throughout the injury rehabilitation process. The objective of this paper is to present literature related to athlete mental health and address ways in which sport injury can contribute to athlete mental health, well-being, and psychological readiness for return to sport.

DISCUSSION

From the results of a literature study, 7 articles that have been reviewed previously presented Analysis This discussion opens by exploring the correlation between physical activity and decreased symptoms of stress and anxiety. According to reviewed studies ^{47,48} suggests that exercise plays an important role in modulating the central nervous system, specifically in regulating neurotransmitters responsible for feelings of happiness and relaxation, such as serotonin and endorphins. It is important to note that it is not just the type of exercise that is the main factor, but rather the consistency and duration of sustained physical activity ⁴⁹⁻⁵¹.

This proves that regular exercise, albeit with mild to moderate intensity, is more effective in the long run than sporadic intensive sessions. In this context, exercise is not only a means for physical health, but also as an important strategy in mental health management ^{52,53}. However, more research is needed to explore the relationship between certain types and intensities of exercise with specific improvements in stress and anxiety symptoms ⁵⁴⁻⁵⁶.

Next, the discussion focuses on the importance of personalization in sports recommendations. Based on the data analyzed, responses to physical activity vary widely between individuals, influenced by factors such as age, gender, initial health conditions, and

personal preferences ⁵⁷⁻⁵⁹. The research underscores that there is no 'one-size-fits-all' approach to using exercise as a tool for mental health. Therefore, exercise recommendations should take into account the specific needs and situations of each individual. This demands a more holistic and integrated approach from health professionals in designing exercise programs. This approach not only increases the effectiveness of exercise in coping with stress and anxiety but also increases individual motivation and adherence in carrying out the recommended exercise program ^{60,61}.

The analysis also brings attention to the importance of exercise interventions in the context of community mental health. Studies show that widely accessible exercise programs can play a significant role in improving people's mental well-being ^{62,63}. This is particularly relevant in the context of reducing stigmatization of mental health disorders. Sport, as an inclusive and community activity, offers a unique platform for socialization and the establishment of social support, both of which are important factors in the management of mental health. Therefore, there is a need for more initiatives that promote sport as part of mental health programs at the community level, which focus not only on individuals but also on the establishment of a wider mental health support and awareness network ^{64,65}.

Finally, this study opens insights into the need for more integrated interventions and policies between the health and sports sectors.

The link between sport and mental health demands closer cooperation between professionals in these two fields⁶⁶⁻⁶⁸. Increased awareness and training among health professionals regarding the benefits of exercise in a mental health context can help in integrating physical activity recommendations into treatment plans⁶⁹⁻⁷¹.

On the other hand, sports trainers and fitness instructors also need to be equipped with knowledge regarding mental health aspects to support their participants more effectively⁷²⁻⁷⁴. It includes an understanding of how to identify symptoms of stress and anxiety as well as how to tailor an exercise program to meet individual mental health needs. This collaborative approach will not only improve the quality of care but also the effectiveness of exercise as a tool in mental health treatment⁷⁵⁻⁷⁷.

An in-depth interpretation of the study highlights the fundamental role of exercise in improving mental health, with a particular focus on stress and anxiety reduction^{78,79}. The results of the study confirmed that physical activity is not just a physical intervention, but also has a strong psychological impact. We can see that exercise acts as a mood-regulating mechanism, involving more than just the release of endorphins; It's also about increased self-confidence, goal achievement, and consistent routine structure. In addition, exercise is often done in a social setting, which provides additional benefits through social interaction and the establishment of support networks^{80,81}. Therefore, when evaluating the benefits of exercise, it is important to look beyond just its biochemical effects and recognize its role in enriching the psychosocial aspects of individual well-being^{82,83}.

Further, this interpretation explores the significance of personalization in exercise recommendations. Research findings suggest that there is no universal, workable approach in prescribing exercise for mental health. Factors such as age, sex, initial physical condition, and even personal preference play a critical role in determining the most effective type, intensity, and duration of physical activity for a particular individual⁸⁴⁻⁸⁶. This underscores the importance of a more focused and adaptive approach, which considers not only the physical but also psychological and emotional aspects of the individual. This approach encourages greater participation and sustainability in

physical activity, which in turn increases the effectiveness of exercise in addressing mental health issues^{87,88}.

Finally, this interpretation highlights the need for integration and cooperation between health and exercise professionals. These findings suggest that mental health cannot be viewed in isolation from physical health⁸⁹⁻⁹¹. Therefore, collaboration between experts in these two fields is essential. Cross-education and training between health professionals and sports coaches can create a new paradigm in holistic health approaches. This includes the development of exercise programs that not only focus on improving physical fitness but also on improving mental well-being. This integrated approach offers a more comprehensive and effective way to address mental health issues, ensuring that exercise is used not only as a means to improve physical condition but also as a vital tool in the maintenance of mental health.

CONCLUSION

This research consistently proves that exercise is not only a beneficial activity for physical health, but also has a profound and positive impact on mental health, particularly in reducing stress and anxiety. Through a series of comprehensive analyses, this study confirms that exercise, with its biochemical and psychosocial mechanisms, plays a vital role in improving mood, lowering stress levels, and increasing self-confidence and emotional well-being. The importance of personalization in exercise recommendations has become abundantly clear, highlighting that a one-size-fits-all approach is ineffective. Conversely, recommendations that consider age, sex, physical condition, and individual preferences can increase the effectiveness of exercise as a therapeutic tool. In addition, the study highlights the importance of integration between health and exercise professionals in designing programs that not only improve physical fitness but also support mental health. In conclusion, exercise should be recognized and integrated as a key component in mental health strategies, not just as an additional activity but as an important element in the treatment and prevention of stress and anxiety. This integrated approach paves the way for improved quality of life and general mental

well-being, marking an important step in the recognition and implementation of sport as a valuable mental health tool.

REFERENCES

1. Vella SA, Aidman E, Teychenne M, et al. Optimising the effects of physical activity on mental health and wellbeing: A joint consensus statement from Sports Medicine Australia and the Australian Psychological Society. *J Sci Med Sport*. 2023;26(2):132-139. <https://doi.org/10.1016/j.jsams.2023.01.001>
2. Song Y, Shi C. Association between sports participation and overall health in children and adolescents. *Complement Ther Clin Pract*. 2023;51:101718. <https://doi.org/10.1016/j.ctcp.2022.101718>
3. Pankow K, McHugh T-LF, Mosewich AD, Holt NL. Mental health protective factors among flourishing Canadian women university student-athletes. *Psychol Sport Exerc*. 2021;52:101847. <https://doi.org/10.1016/j.psychsport.2020.101847>
4. Poulus DR, Bennett KJM, Swann C, Moyle GM, Polman RCJ. The influence of an esports-adapted coping effectiveness training (E-CET) on resilience, mental health, and subjective performance among elite league of Legends players: A pilot study. *Psychol Sport Exerc*. 2023;69:102510. <https://doi.org/10.1016/j.psychsport.2023.102510>
5. Callwood D, Smith M. Out on the pitch: sport and mental health in LGBT people. *Lancet*. 2019;394(10210):1704-1705. [https://doi.org/10.1016/S0140-6736\(19\)32646-7](https://doi.org/10.1016/S0140-6736(19)32646-7)
6. Zhang X, Browning MHEM, Luo Y, Li H. Can sports cartoon watching in childhood promote adult physical activity and mental health? A pathway analysis in Chinese adults. *Heliyon*. 2022;8(5):e09417. <https://doi.org/10.1016/j.heliyon.2022.e09417>
7. Ayala E, Nelson L, Bartholomew M, Plummer D. A conceptual model for mental health and performance of North American athletes: A mixed methods study. *Psychol Sport Exerc*. 2022;61:102176. [doi:10.1016/j.psychsport.2022.102176](https://doi.org/10.1016/j.psychsport.2022.102176)
8. Abed V, Kapp S, Bradley T, et al. Orthopaedic Sports Medicine Randomized Controlled Trials Infrequently Report on the Social Determinants of Health Factors of Their Patient Cohorts. *Arthrosc J Arthrosc Relat Surg*. Published online 2023. <https://doi.org/10.1016/j.arthro.2023.10.015>
9. Gorczynski P, Reardon CL, Aron CM. Lesbian, Gay, Bisexual, Trans, and Queer Mental Health in Elite Sport: A Review. *Adv Psychiatry Behav Heal*. 2022;2(1):9-16. <https://doi.org/10.1016/j.ypsc.2022.03.002>
10. Swann C, Telenta J, Draper G, et al. Youth sport as a context for supporting mental health: Adolescent male perspectives. *Psychol Sport Exerc*. 2018;35:55-64. <https://doi.org/10.1016/j.psychsport.2017.11.008>
11. Mahon C, Howard E, O'Reilly A, Dooley B, Fitzgerald A. A cluster analysis of health behaviours and their relationship to mental health difficulties, life satisfaction and functioning in adolescents. *Prev Med (Baltim)*. 2022;164:107332. [doi:https://doi.org/10.1016/j.ypmed.2022.107332](https://doi.org/10.1016/j.ypmed.2022.107332)
12. McLoughlin E, Arnold R, Fletcher D, Spahr CM, Slavich GM, Moore LJ. Assessing lifetime stressor exposure in sport performers: Associations with trait stress appraisals, health, well-being, and performance. *Psychol Sport Exerc*. 2022;58:102078. <https://doi.org/10.1016/j.psychsport.2021.102078>
13. Jones C, Gulliver DA, Keegan DR. A Brief Online Video-Based Intervention to Promote Mental Health Help-Seeking in the Context of Injuries for Athletes: A pilot study. *Psychol Sport*

- Exerc.* 2022;63:102281.
<https://doi.org/10.1016/j.psychsport.2022.102281>
14. Schneider S, Niederberger M, Kurowski L, Bade L. How can outdoor sports protect themselves against climate change-related health risks? – A prevention model based on an expert Delphi study. *J Sci Med Sport*. Published online 2023. <https://doi.org/10.1016/j.jsams.2023.11.002>
15. Guo P, Abdollahpour A, Jazbizadeh MH, Semiromi DT. The amount of improvement and therapeutic effect of sports health by increasing the viscosity of peach juice through reverse osmosis and polymer membrane. *Food Biosci.* 2023;56:103330.
<https://doi.org/10.1016/j.fbio.2023.103330>
16. Vella SA, Swann C, Boydell KM, et al. Sports-based mental health promotion in Australia: Formative evaluation. *Psychol Sport Exerc.* 2019;45:101560.
<https://doi.org/10.1016/j.psychsport.2019.101560>
17. Donohue B, Perry J. Chapter 3 - Mental health and sport performance screens/assessments. In: Donohue B, Perry J, eds. *Athlete Mental Health and Performance Optimization*. Academic Press; 2023:39-42.
<https://doi.org/10.1016/B978-0-323-95276-7.00007-1>
18. Willson E, Buono S, Kerr G, Stirling A. Maltreatment experiences and mental health indicators among elite athletes. *Psychol Sport Exerc.* 2023;69:102493.
<https://doi.org/10.1016/j.psychsport.2023.102493>
19. Frost J, Walton CC, Purcell R, Rice SM. Supporting The Mental Health Of Elite-Level Coaches Through Early Intervention. *Arthrosc Sport Med Rehabil.* 2023;5(4):100734.
<https://doi.org/10.1016/j.asmr.2023.04.017>
20. van Niekerk M, Matzkin E, Christino MA. Psychological Aspects of Return to Sport for the Female Athlete. *Arthrosc Sport Med Rehabil.* 2023;5(4):100738.
<https://doi.org/10.1016/j.asmr.2023.04.021>
21. Stewart AJ, Charles Malveaux WMS, Vieux U. Sports Psychiatry: Assuring a Diverse Workforce in an Area of Increasing Professional Interest. *Child Adolesc Psychiatr Clin N Am.* Published online 2023. <https://doi.org/10.1016/j.chc.2023.11.001>
22. Gucciardi DF, Hanton S, Fleming S. Are mental toughness and mental health contradictory concepts in elite sport? A narrative review of theory and evidence. *J Sci Med Sport.* 2017;20(3):307-311.
<https://doi.org/10.1016/j.jsams.2016.08.006>
23. Cheng VWS, Davenport T, Johnson D, Vella K, Mitchell J, Hickie IB. Naturalistic evaluation of a sport-themed mental health and wellbeing app aimed at men (MindMax), that incorporates applied video games and gamification. *Internet Interv.* 2020;20:100306.
<https://doi.org/10.1016/j.invent.2020.100306>
24. Aitchison B, Rushton AB, Martin P, Barr M, Soundy A, Heneghan NR. The experiences and perceived health benefits of individuals with a disability participating in sport: A systematic review and narrative synthesis. *Disabil Health J.* 2022;15(1):101164.
<https://doi.org/10.1016/j.dhjo.2021.101164>
25. Haslam C, Lam BCP, Yang J, et al. When the final whistle blows: Social identity pathways support mental health and life satisfaction after retirement from competitive sport. *Psychol Sport Exerc.* 2021;57:102049.
<https://doi.org/10.1016/j.psychsport.2021.102049>
26. Currie A, Purcell R. Sport Psychiatry and Its Research Agenda. *Psychiatr Clin North Am.* 2021;44(3):493-505.
<https://doi.org/10.1016/j.psc.2021.04.007>
27. Doré I, O'Loughlin JL, Schnitzer ME, Datta GD, Fournier L. The longitudinal association between the context of physical activity and mental health in early adulthood. *Ment Health Phys Act.*

- 2018;14:121-130.
<https://doi.org/10.1016/j.mhpa.2018.04.001>
28. Kuettel A, Pedersen AK, Larsen CH. To Flourish or Languish, that is the question: Exploring the mental health profiles of Danish elite athletes. *Psychol Sport Exerc.* 2021;52:101837. <https://doi.org/10.1016/j.psychsport.2020.101837>
29. Moore B, Dudley D, Woodcock S. The effect of martial arts training on mental health outcomes: A systematic review and meta-analysis. *J Bodyw Mov Ther.* 2020;24(4):402-412. doi:10.1016/j.jbmt.2020.06.017
30. Chelladurai P, Anderson M. Sport and Mental Health. In: Friedman HS, ed. *Encyclopedia of Mental Health (Second Edition)*. Second Edi. Academic Press; 2016:215-218. <https://doi.org/10.1016/B978-0-12-397045-9.00224-X>
31. Khan A, Werner-Seidler A, Hidajat T, Feng J, Huang WY, Rosenbaum S. Association Between Sports Participation and Psychosocial Wellbeing of Australian Children: An 8-year Longitudinal Study. *J Adolesc Heal.* 2023;73(6):1117-1124. <https://doi.org/10.1016/j.jadohealth.2023.07.011>
32. Willer BS, Haider MN, Wilber C, Esopenko C, Turner M, Leddy J. Long-Term Neurocognitive, Mental Health Consequences of Contact Sports. *Clin Sports Med.* 2021;40(1):173-186. <https://doi.org/10.1016/j.csm.2020.08.012>
33. Jewett R, Kerr G, Dionne M. Canadian athletes' perspectives of mental health care and the importance of clinicians' sport knowledge: A multi-method investigation. *Psychol Sport Exerc.* 2021;53:101849. <https://doi.org/10.1016/j.psychsport.2020.101849>
34. Yang W, Yu JJ, Wong SH-S, Sum RK-W, Carty C, Sit CH-P. Promoting mental health in children and adolescents with disabilities through school-based physical activity intervention during the COVID-19 pandemic. *Ment Health Phys Act.* 2023;25:100554. <https://doi.org/10.1016/j.mhpa.2023.100554>
35. Duong A, Roberts L, Cramm H, et al. I AM FAMILY: Understanding the adapted sport experiences of family members of military personnel with physical and psychological illnesses and injuries through the lens of the Invictus Games. *Psychol Sport Exerc.* 2023;68:102457. <https://doi.org/10.1016/j.psychsport.2023.102457>
36. Andreato LV, dos Santos MG, Andrade A. What do we know about the effects of mental training applied to combat sports? A systematic review. *Psychol Sport Exerc.* 2022;63:102267. <https://doi.org/10.1016/j.psychsport.2022.102267>
37. Sankey C, Wallace L, Caperchione CM. Understanding the role of coaches in supporting the mental health of elite athletes. *J Sci Med Sport.* 2023;26(8):399-404. <https://doi.org/10.1016/j.jsams.2023.06.012>
38. Samarasinghe N, Khan A, McCabe E, Lee A. Does Participation in Organized Sports Influence School Performance, Mental Health, and/or Long-Term Goal Setting in Adolescents? *J Adolesc Heal.* 2017;60(2, Supplement 1):S71. <https://doi.org/10.1016/j.jadohealth.2016.10.323>
39. Sugiyono. *Metode Pendidikan Pendekatan Kuantitatif, Kualitatif, Dan R&D*. Alfabeta; 2015.
40. Zhu J. Real-time monitoring for sport and mental health prevention of college student based on wireless sensor network. *Prev Med (Baltim).* 2023;173:107581. <https://doi.org/10.1016/j.ypmed.2023.107581>
41. Lange KW, Nakamura Y, Reissmann A. Sport and physical exercise in sustainable mental health care of common mental disorders: Lessons from the COVID-19 pandemic. *Sport Med Heal Sci.* 2023;5(2):151-155. <https://doi.org/10.1016/j.smhs.2023.01.005>
42. O'Connor J, Grove C, Jeanes R,

- Lambert K, Bevan N. An evaluation of a mental health literacy program for community sport leaders. *Ment Heal Prev.* 2023;29:200259. <https://doi.org/10.1016/j.mhp.2023.200259>
43. Foo KS, Kueh YC, Leong KJ, et al. Kawa model on mental health, sports and physical performance: A mini review. *Asian J Sport Exerc Psychol.* 2023;3(3):171-176. <https://doi.org/10.1016/j.ajsep.2023.08.002>
 44. Misztal MC, Tio ES, Mohan A, Felsky D. Interactions between genetic risk for 21 neurodevelopmental and psychiatric disorders and sport activity on youth mental health. *Psychiatry Res.* 2023;330:115550. <https://doi.org/10.1016/j.psychres.2023.115550>
 45. Forsdike K, Sawyer A-M, Fullagar S, Marjoribanks T. Women's use of sport as identity-work in managing mental health and trauma. *Womens Stud Int Forum.* 2022;92:102595. doi:10.1016/j.wsif.2022.102595
 46. Haugen E. Athlete Mental Health & Psychological Impact of Sport Injury. *Oper Tech Sports Med.* 2022;30(1):150898. <https://doi.org/10.1016/j.otsm.2022.150898>
 47. Sutcliffe JT, Kelly PJ, Vella SA. Youth sport participation and parental mental health. *Psychol Sport Exerc.* 2021;52:101832. <https://doi.org/10.1016/j.psychsport.2020.101832>
 48. Wei M, Wang J. Potential health risks of foodborne performance-enhancing drugs in competitive sports. *Heliyon.* 2023;9(10):e21104. <https://doi.org/10.1016/j.heliyon.2023.21104>
 49. Xiang M, Soh KG, Xu Y, Ahrari S, Zakaria NS. Experiences of LGBTQ student-athletes in college sports: A meta-ethnography. *Heliyon.* 2023;9(6):e16832. <https://doi.org/10.1016/j.heliyon.2023.216832>
 50. Tuakli-Wosornu YA, Darling-Hammond K. Unapologetic refusals: Black women in sport model a modern mental health promotion strategy. *Lancet Reg Heal - Am.* 2022;15:100342. <https://doi.org/10.1016/j.lana.2022.100342>
 51. AlSamhori JF, Alshrouf MA, AlSamhori ARF, Alshadeedi FM, Madi AS, Alzoubi O. Implications of the COVID-19 pandemic on athletes, sports events, and mass gathering events: Review and recommendations. *Sport Med Heal Sci.* 2023;5(3):165-173. <https://doi.org/10.1016/j.smhs.2023.07.006>
 52. Fiedler R, Heidari J, Birnkraut T, Kellmann M. Digital media and mental health in adolescent athletes. *Psychol Sport Exerc.* 2023;67:102421. <https://doi.org/10.1016/j.psychsport.2023.102421>
 53. Brown DMY, Ronen GM. Associations between 24-hour movement guideline adherence and mental health disorders among young people with active and inactive epilepsy. *Epilepsy Behav.* 2021;125:108386. <https://doi.org/10.1016/j.yebeh.2021.108386>
 54. Deng S, Deng J, Yin M, et al. Short-term effects of SARS-CoV-2 infection and return to sport on neuromuscular performance, body composition, and mental health — A case series of well-trained young kayakers. *J Exerc Sci Fit.* 2023;21(4):345-353. <https://doi.org/10.1016/j.jesf.2023.08.002>
 55. Kandola A, del Pozo Cruz B, Hayes JF, Owen N, Dunstan DW, Hallgren M. Impact on adolescent mental health of replacing screen-use with exercise: A prospective cohort study. *J Affect Disord.* 2022;301:240-247. <https://doi.org/10.1016/j.jad.2021.12.064>
 56. Bennett M, King C. Taking the knee, mental health, and racism in sport. *The Lancet Psychiatry.* 2021;8(10):861-862. [https://doi.org/10.1016/S2215-0366\(21\)00300-X](https://doi.org/10.1016/S2215-0366(21)00300-X)
 57. Waters AM, Sluis RA, Usher W, et al. Kick-starting youth wellbeing and

- access to mental health care: Efficacy of an integrated model of care within a junior sports development program. *Behav Res Ther.* 2022;157:104166. <https://doi.org/10.1016/j.brat.2022.104166>
58. Fisher LA, Miller JF, Keesler J. Chapter 5 - Becoming whole: Mental health and psychosocial considerations of the transgender athlete. In: West AM, ed. *The Transgender Athlete*. Academic Press; 2023:51-65. <https://doi.org/10.1016/B978-0-323-91619-6.00003-8>
 59. Lu L, Xi Y, Zhang X. Application of mobile sensors based on deep neural networks in sports psychological detection and prevention. *Prev Med (Baltim)*. 2023;173:107613. <https://doi.org/10.1016/j.ypmed.2023.107613>
 60. Zimet DM, McDuff DR, Iannone VN, Herzog TP, Moser RP. Retirement from Elite Sport: Factors Associated with Adjustment and Holistic Health Outcomes. *Adv Psychiatry Behav Heal.* 2023;3(1):69-79. <https://doi.org/10.1016/j.ypsc.2023.03.003>
 61. Greydanus DE, Ergun-Longmire B, Cabral MD, Patel DR, Dickson CA. Psychosocial aspects of sports medicine in pediatric athletes: Current concepts in the 21st century. *Disease-a-Month.* 2023;69(8):101482. <https://doi.org/10.1016/j.disamonth.2022.101482>
 62. LaForge-MacKenzie K, Cost KT, Tsujimoto KC, et al. 2.80 The Role of Participating in Extracurricular Activities and School Sports on Child and Youth Mental Health During the COVID-19 Pandemic. *J Am Acad Child Adolesc Psychiatry.* 2022;61(10, Supplement):S209. <https://doi.org/10.1016/j.jaac.2022.09.224>
 63. Niven AG, Strain T. Domains matter: Cross-sectional associations between mental well-being and domain specific physical activity and sedentary behaviour in n=31,818 adults in Scotland. *Ment Health Phys Act.* 2023;25:100556. <https://doi.org/10.1016/j.mhpa.2023.100556>
 64. Vella SA, Liddle SK, Vierimaa M, Blair Evans M. Chapter 16 - Group dynamics and mental health in organized youth sports. In: Bruner MW, Eys MA, Martin LJ, eds. *The Power of Groups in Youth Sport*. Academic Press; 2020:277-301. <https://doi.org/10.1016/B978-0-12-816336-8.00016-0>
 65. Mueller M, Schmidt L, Volpe R, et al. Exploring the Impact of Sport-Related Concussions on Children's Mental Health. *Arch Phys Med Rehabil.* 2020;101(11):e79. <https://doi.org/10.1016/j.apmr.2020.09.239>
 66. Vertommen T, Kampen J, Schipper-van Veldhoven N, Uzieblo K, Van Den Eede F. Severe interpersonal violence against children in sport: Associated mental health problems and quality of life in adulthood. *Child Abuse Negl.* 2018;76:459-468. <https://doi.org/10.1016/j.chiabu.2017.12.013>
 67. Wilcock R, Smith A, Haycock D. Designing community sports-based programmes for men with mental illness: A qualitative study of the Offload rugby league programme. *Ment Health Phys Act.* 2021;20:100386. <https://doi.org/10.1016/j.mhpa.2021.100386>
 68. Vella SA, Schweickle MJ, Sutcliffe JT, Swann C. A systematic review and meta-synthesis of mental health position statements in sport: Scope, quality and future directions. *Psychol Sport Exerc.* 2021;55:101946. <https://doi.org/10.1016/j.psychsport.2021.101946>
 69. McGawley K, Sargent D, Noordhof D, Badenhorst CE, Julian R, Govus AD. Improving menstrual health literacy in sport. *J Sci Med Sport.* 2023;26(7):351-357. <https://doi.org/10.1016/j.jsams.2023.06.007>
 70. Diamond S, Wallace L, English M, Caperchione CM. The impact of mental health literacy initiatives on youth elite

- athletes: A systematic review. *Perform Enhanc Heal.* 2022;10(3):100226. <https://doi.org/10.1016/j.peh.2022.100226>
71. Cosh SM, McNeil DG, Tully PJ. Compulsive exercise and its relationship with mental health and psychosocial wellbeing in recreational exercisers and athletes. *J Sci Med Sport.* 2023;26(7):338-344. <https://doi.org/10.1016/j.jsams.2023.05.006>
72. Carter JS, McNair G, Bushnell A, Saldana L, Grant KE. Sports participation, frequency, and competence differentially impact youth depressive, anxious, and somatic symptoms: Gender, neighborhood, and sports type effects. *Ment Health Phys Act.* 2023;25:100562. <https://doi.org/10.1016/j.mhpa.2023.100562>
73. Boelens M, Smit MS, Raat H, Bramer WM, Jansen W. Impact of organized activities on mental health in children and adolescents: An umbrella review. *Prev Med Reports.* 2022;25:101687. <https://doi.org/10.1016/j.pmedr.2021.101687>
74. Doré I, Sabiston CM, Sylvestre M-P, et al. Years Participating in Sports During Childhood Predicts Mental Health in Adolescence: A 5-Year Longitudinal Study. *J Adolesc Heal.* 2019;64(6):790-796. <https://doi.org/10.1016/j.jadohealth.2018.11.024>
75. Edwards CD, Aron CM. Obsessive–Compulsive Disorder in Sports–Beyond Superstitions. *Adv Psychiatry Behav Heal.* 2023;3(1):43-55. <https://doi.org/10.1016/j.ypsc.2023.03.002>
76. Bafageeh F, Loux T. The relationship between types of physical activity and mental health among U.S. adults. *Ment Heal Prev.* 2022;28:200244. <https://doi.org/10.1016/j.mhp.2022.200244>
77. Ely G, Woodman T, Roberts R, et al. The impact of living in a bio-secure bubble on mental health: An examination in elite cricket. *Psychol Sport Exerc.* 2023;68:102447. doi:10.1016/j.psychsport.2023.102447
78. Lima Y, Öz ND, Denerel N, Treeby MS, Rice S. Mental health correlates of athletic shame and guilt among elite-level youth athletes in Turkey. *J Sci Med Sport.* Published online 2023. <https://doi.org/10.1016/j.jsams.2023.10.013>
79. Fadlih AM, Idham AF, Nugraha AI, Dongoran MF. Effects of doping on physical and mental health of sports athletes. *Enfermería Clínica.* 2020;30:504-506. <https://doi.org/10.1016/j.enfcli.2020.03.011>
80. Stornæs AV, Sundgot-Borgen J, Pettersen G, Rosenvinge JH, Nordin-Bates SM. Mental health profiles among 13-16-year-Old Norwegian talent and mainstream students - A prospective person-centered analytical approach. *Psychol Sport Exerc.* 2023;68:102474. <https://doi.org/10.1016/j.psychsport.2023.102474>
81. Jasser J, Patel DR, Beenen KT. The Role of Psychologists in Sport Medicine Practice. *Pediatr Clin North Am.* 2022;69(5):975-988. <https://doi.org/10.1016/j.pcl.2022.05.010>
82. Liddelow C, White B, Arnold E, Vella SA. A cross-sectional study of the psychosocial predictors of re-engaging in team sport during early motherhood. *Ment Health Phys Act.* 2023;25:100555. <https://doi.org/10.1016/j.mhpa.2023.100555>
83. Latina D, Jaf D, Alberti R, Tilton-Weaver L. Can participation in organized sports help adolescents refrain from self-harm? An analysis of underlying mechanisms. *Psychol Sport Exerc.* 2022;59:102133. <https://doi.org/10.1016/j.psychsport.2022.102133>
84. Ziminski D, Szlyk HS, Baiden P, et al. Sports- and physical activity-related concussion and mental health among adolescents: Findings from the 2017 and 2019 Youth Risk Behavior Survey. *Psychiatry Res.* 2022;312:114542. <https://doi.org/10.1016/j.psychres.2022.114542>

- 2.114542
85. Brick NE, Breslin G, Shevlin M, Shannon S. The impact of verbal and physical abuse on distress, mental health, and intentions to quit in sports officials. *Psychol Sport Exerc.* 2022;63:102274. <https://doi.org/10.1016/j.psychsport.2022.102274>
86. Hurley D, Swann C, Allen MS, Vella SA. A qualitative evaluation of a mental health literacy intervention for parents delivered through community sport clubs. *Psychol Sport Exerc.* 2020;47:101635. <https://doi.org/10.1016/j.psychsport.2019.101635>
87. Logan K, Conde A, Kennedy M. Chapter 6 - Benefits of youth sports. In: Krabak BJ, Brooks A, eds. *The Youth Athlete*. Academic Press; 2023:47-53. <https://doi.org/10.1016/B978-0-323-99992-2.00081-5>
88. Walton CC, Rice S, Hutter RI (Vana), Currie A, Reardon CL, Purcell R. Mental Health in Youth Athletes: A Clinical Review. *Adv Psychiatry Behav Heal.* 2021;1(1):119-133. <https://doi.org/10.1016/j.ypsc.2021.05.011>
89. English M, Wallace L, Evans J, Diamond S, Caperchione CM. The impact of sport and physical activity programs on the mental health and social and emotional wellbeing of young Aboriginal and Torres Strait Islander Australians: A systematic review. *Prev Med Reports.* 2022;25:101676. <https://doi.org/10.1016/j.pmedr.2021.101676>
90. Zhang L, Ge Y, Li D. The features and mission of sport psychology in China. *Asian J Sport Exerc Psychol.* 2021;1(1):45-53. <https://doi.org/10.1016/j.ajsep.2021.03.008>
91. Williams CR, McKenna JL, Artessa L, Moore LBM. Team Effort: A Call for Mental Health Clinicians to Support Sports Access for Transgender and Gender Diverse Youth. *J Am Acad Child Adolesc Psychiatry.* 2023;62(8):837-839. <https://doi.org/10.1016/j.jaac.2023.01.022>

Original Article

Analysis of Patient Satisfaction and Loyalty Mediated by Reputation and Conduct of Public Hospital Staff Government of North Sumatra Province

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ABSTRACT

This research investigates the pivotal role of hospitals in healthcare, categorizing them into general and specialized facilities based on resources and capabilities. Focusing on North Sumatra, the study explores the significance of hospital conditions in influencing patients' choices, particularly in a competitive healthcare landscape driven by responsiveness to quality information. Employing a quantitative approach with non-probability sampling, the research follows a positivist philosophy to examine the connection and influence between independent and dependent variables. Conducted at the General Government Hospital in North Sumatra, the study spans from a preliminary survey in September 2023 to November 2023, with data collection ongoing and results to be presented in a seminar. The analysis reveals a substantial impact of Patient Satisfaction (PS) on Patient Loyalty (PL) (coefficient = 0.581), supported by a t-statistic value of 5.572 (>1.96) and a p-value of 0.000 (<0.05). PS also significantly influences Hospital Staff Behavior (HSB) (coefficient = 0.280, t-statistic = 2.630, p-value = 0.009 <0.05) and Hospital Reputation (HR) (coefficient = 0.450, t-statistic = 4.789, p-value = 0.000 <0.05). Hospital Staff (HS) demonstrates a notable influence (coefficient = 0.101) on PL, though the relationship is not statistically significant (t-statistic = 1.520, p-value = 0.129 >0.05). Similarly, HR influences PL (coefficient = 0.124), but the relationship is not statistically significant (t-statistic = 1.402, p-value = 0.161 >0.05). Furthermore, PS exhibits a mediated influence on PL through HSB (coefficient = 0.028, t-statistic = 1.221, p-value = 0.223 >0.05) and through HR (coefficient = 0.056, t-statistic = 1.269, p-value = 0.205 >0.05). These findings underscore the critical role of patient satisfaction in shaping loyalty, highlighting the mediating effects of Hospital Staff Behavior and Hospital Reputation. Understanding these dynamics is crucial for promoting healthcare competition and enhancing care quality in the North Sumatra region.

Keywords: Hospital, Non-probability, Sampling.

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INTRODUCTION

Changes in hospitals in the last decade, especially homes government hospital which functions as a health service facility and referrals at both secondary and tertiary levels, have undergone changes significant in various aspects like management, management finance, management source Power man, quality service, facility support, and other fields ¹.

Hospitals can be categorized into

general and special categories, differentiated based on the facilities and service capabilities of each. The Ministry of Health Republic Indonesia has arranged the classification of public hospitals in Indonesia based on facilities and ability service. Regulation This covers the distribution of House Sick to classes different, that is, House Sick General Class A, House Sick General Class B, Class C General Hospital, and Class D General Hospital ².

Health facilities influence the level of public health in a countryarea. Health service

facilities are the tools and places used for organize effort service health, Good promotional, retentive, curative or rehabilitative, that is done by the government, local government, and society. North Sumatra Province with numbers population 15,115,206 people, has a number of public hospitals (182), House Sick Special (17), Public health center Treat Stay (188) And Public health center (420) and Clinic/Health Center (15,628). Specially for hospitals general government Which spread on city and regency in the region province North Sumatra numbers 30. With class A (1), class B (6) hospitals And Class C (22) ³.

Has a lot been done to know How to define satisfaction among patients, good experience and satisfaction with treatment? Which will be the most important in context to guarantee quality? Experience patients about the treatment they Alone And their satisfaction is increasingly becoming a key quality indicator in Many countries with system maintenance health Which proceed ⁴. Hospital directors must be able to measure and manage their hospital's reputation to increase patient loyalty. As a health service facility, House Hospital, especially government hospitals, must provide a competitive advantage. The hospital has a reputation with a more substantial influence on patient loyalty than a doctor's reputation ⁵.

It is essential to understand the condition of hospitals in North Sumatra, where patients consider reputation House Sick in choice House Sick when Power is responsive to information. Quality is a prerequisite for promoting competition in quality of care. However, the hospital's reputation can be influenced by word-of-mouth recommendations on perceptions of the quality of House Sick. When a reputation That bad Is delivered, so will a bad image in society. This research will contribute to literature Development, which analyzes the Power of patient responsiveness to the hospital's reputation. In research, where patients accept time journey addition for maintenance in House government hospitals in areas with better reputations and the potential trade-off between hospital reputation and travel time to the hospital ⁶.

However, there are disparities between districts/cities and other districts regarding facility service health and the availability of sources. Power man. Focus study This is an expansion House Sick And allocation doctor

specialist. Equalization No achieved although No There is an obstacle to transportation in North Sumatra ⁷. This phenomenon can linked with accessibility and affordability distance reference in and between districts or cities.

In field health, satisfaction patients identify factors which influence loyalty to the services provided by the provider service from facility health. By theory, satisfaction is understood as part of loyalty ⁸. Construct from service in House Sick general government besides doctor, facilities, And condition physique. Other things in the environment also influence the satisfaction and loyalty of patients at home, namely method officer reputation and officer behavior.

There still exists dissatisfaction in the public of Sumatra North to quality service health, which is not enough. Good in the House Sick General Area in a number of regencies and cities has become a sustainable issue. Complaints, especially concerning the time wait, which is extended for procedure surgery scheduled, capacity, which is not adequate to accommodate inpatient care, the absence of a treating doctor, and inadequate drug shortages ⁹. Hospital Pirmgadi Medan admits it still frequently receives related patient complaints about the treatment. House Sick confessed to a lack of This and Then held training sessions for health workers on duty.

In the contemporary competitive environment, healthcare providers must ensure that their customers are satisfied with the quality-of-service medical services they receive, as this is important in customer retention and use benefit provider service health in a way repeated ¹⁰. The healthcare industry has generally experienced a change in several years Because competition Is strict. More Lots Are expected from House Sick, not only in the offer price, which is competitive but also in giving service, which is quality ¹¹. With hope and patience, which is more critical, giving service quality is a must.

By Because That from explanation and phenomenon on, study This aims to examine the level of patient satisfaction with reputation aspects House Sick and How satisfaction the leads on loyalty. In addition, it investigates how patient loyalty indirectly influences the relationship between satisfaction and hospital reputation and behavior officer House Sick.

METHOD

Approach of study Which will researcher use a quantitative research approach, namely research based on philosophy Positivity is used to examine a particular population or sample ¹². This type of research is associative causality, namely research Which aims to know the connection and influence between the variable free (independent) with the dependent variable ¹². Study This was done in House Sick General Government Sumatra North. This research was carried out when the author conducted a preliminary survey from September 2023 to November 2023 data collection will continue with the results seminar.

Population is combined all over elements, which own series of similar characteristics, which cover the universe for the research problem ¹³. Because researchers don't know exactly how many people have sought

treatment or received health services from the Government General Hospital Province Sumatra North.

Determination sample in study This follows the condition determined by Hair. The minimum number of samples taken is five times the number of indicators used in the study ¹⁴. The indicator study is $13 \times 10 = 130$ samples. The sampling method used in this research is non-probability sampling is a sampling technique sample purposive sampling which does not provide equal opportunity/opportunity for each population to be selected as a sample, so every consumer who meets the population criteria is not own opportunity or the same opportunities for chosen to be sample. How with sharing questionnaires in a way direct to customers Which Once treatment or accept service health from House Sick General Government Province Sumatra North in the past year.

RESULTS

Table 1. Distribution Characteristics Respondent Based on Age

House Sick	Age Respondent					Total
	20-30	31-40	41-50	51-60	60 Up	
RSUP H. Adam Malik Medan	1	3	2	2	2	10
RSU H. A. Manan Simatupang		2	2			4
RSU Sidikalang		1		1	1	3
RSU Deli Serdang	1		1	1	1	4
HOSPITAL Dolok Sanggul		1		3		4

Source: Data Primary processed 2023

Table 1. explains the distribution of characteristics with ages 20-30 years as many as four respondents with a percentage of 3.8%, respondents aged 31-40 years there were 33 respondents with a percentage of 25.4%, and 40 respondents aged 41-50 years with the

percentage was 30.8%, and respondents aged 51-60 years were 34 person respondents with percentage as significant as 26.2%, And respondents with age >61 years as many as 18 respondents with a percentage of 13.8% of the total all over respondents were 130 respondents.

Table 2. Distribution Characteristics Respondent Based on Patient

House Sick	Patient		Total
	Treat Stay	Get treatment Road	
RSUP H. Adam Malik Medan	8	2	10
RSU H. A. Manan Simatupang	2	2	4
RSU Sidikalang	1	2	3
RSU Deli Serdang	2	2	4
HOSPITAL Dolok Sanggul	3	1	4
RSU Kabanjahe		4	4

Rantauprapat General Hospital	2	2	4
RSU Tanjung Pura	2	2	4
RSU Mandailing Christmas	4		4
HOSPITAL Christmas	2	1	3
RSU Mount Sitoli		4	4
HOSPITAL Luke Hilisimaetano	1	3	4
RSU Sibuhuan	2	2	4
RSU Mountain Old	4		4
HOSPITAL Snakefruit	2	1	3
HOSPITAL Dr. Hadrianus Sinaga	2	2	4
HOSPITAL Sultan Solomon	3	1	4
RSU Parapat	2	2	4
HOSPITAL Trading	2	2	4
RSU Sipirok	1	3	4
RSU Pandan	2	2	4
HOSPITAL Tarutung	3	1	4
HOSPITAL Porsea	3	1	4
RSU Dr. R. M. Djoelham Binjai	2	3	5
RSU Dr. Pirngadi Medan	6	3	9
RSU Padangsidempuan	3	1	4
HOSPITAL Dr. Djasamen Saragih	4		4
RSU Dr. F. Lumban Tobbing	3	1	4
RSU Dr. Tengku Mansur	4	1	5
HOSPITAL Dr. H. Pane Group	4		4
Total	79	51	130
%	60.8%	39.2%	100.0%

Table 2. explain distribution characteristics respondents based on patient cometo the hospital, 79 respondents came as inpatients respondents with a percentage of

60.8%, and respondents came as patient's outpatient care as many as 51 respondents with a percentage of 39.2%, from total all respondents as many as 130 respondents.

Table 3. Results Influence Coefficient Track

Hypothesis	Samples (O)	Mean Samples (M)	Std. Dev (STDEV)	T-Statistics (O/STDEV)	P Value
KEP (X1) → LOY (Y1)	0.581	0.576	0.104	5,572	0,000
KEP (X1) → PPR (Z2)	0.280	0.279	0.106	2,630	0.009
KEP (X1) → RSU (Z1)	0.450	0.451	0.094	4,789	0,000
PPR (Z2) → LOY (Y1)	0.101	0.098	0.066	1,520	0.129
RSU (Z1) → LOY (Y1)	0.124	0.114	0.088	1,402	0.161

Note: Satisfaction Patient (KEP), Loyalty Patient (LOY), Behavior Employee RSU (PPR), RS reputation (RSU)

To determine the influence between variables, the bootstrapping method was carried out. Approach bootstrapping represent

nonparametric for precision from estimation. In the PLS method, the decision to accept or reject a hypothesis based on the significance

value (p-value), and if t-table value. In the Smart-PLS application, the significance value can be known by see parameter coefficient values and t statistical significance value.

Criteria reception or rejection hypothesis is If mark significance for t-value > 1.96 And or mark p-value < 0.05 on level significance 5% (α 5%) so H_a accepted And H_o rejected, on the contrary If mark t-value < 1.96 And or mark p-value > 0.05 on level significance 5% (α 5%) so H_a rejected And H_o accepted. For now, connection structural between variable latent, need done testing hypothesis to coefficient track Which connect variable-variable the.

DISCUSSION

Influence Satisfaction Patient Towards Loyalty Patient

The exogenous variable Patient Satisfaction has a significant influence with a value of 0.581 for the endogenous variable Patient Loyalty. t-value the statistics in this relationship are $5.572 > 1.96$ and the p-value is $0.000 < 0.05$. By Because That, hypothesis first one state that Satisfaction Patient has a proven positive and significant influence on Patient Loyalty the truth. This means that there is an influence on better patient satisfaction obtained from House Sick general so will influence Loyalty Patient For using return services health services from hospital.

This research is in line with other research that encourages managers House Sick For notice factors Which contribute to patient loyalty and maintaining patient satisfaction with medical institutions. Study this is one of the few studies on the relationship between satisfaction patient and loyalty patient in House Sick general government, and also explore the direct and indirect impact of patient satisfaction on patient loyalty. The results of this research are in line with the research conducted by Liu et.al (2021) that there is connection between satisfaction patient, and patient trust in the loyalty of public hospital patients in China ¹⁵, which is also in line with research by Susanti et.al (2020) that quality service influential significant to satisfaction patient, satisfaction patient influential significant to loyalty patient, And quality service influential significant to loyalty patient on House Sick general Bandung in Medan ¹⁶. Also, in line with research conducted in

Makasar by Akbolat et.al (2021) that the formation of patient loyalty is by involves the factors of service quality, hospital image, patient value, and satisfaction patients in hospitals, both inpatients and outpatients ¹⁷. This research is also in line with research conducted by Aladwan et.al (2021) who wanted to know the influence of perceptions of health service quality to satisfaction patient and loyalty patient in House Sick government in Jordan. The research results show Patient satisfaction mediates the relationship quality service with loyalty patient in Jordan ¹⁸.

In this study it was shown that patient loyalty to the hospital The government in North Sumatra Province is greatly influenced by patient satisfaction when they receive health services from their previous experiences. This loyalty is formed because there are no competitors from their hospital receive due to referrals from ASTEK, BPJS and Insurance Services, when they receive services from the government hospital and are satisfied with the service they will recommend to others. However, from this research patient weak in give recommendation And No There is desire visit to House Sick government And There is desire for move to House Sick besides House sick from the government.

The Influence of Patient Satisfaction on Hospital Staff Behavior

Variable exogenous Satisfaction Patient have influence Which significant with mark as big as 0.280 to variable endogenous Behavior Officer House Sick. Mark t-statistics in connection This is $2.630 > 1.96$ And mark p-value $0.009 < 0.05$. By Because That, hypothesis second Which state that Satisfaction Patient have influence positive and significant to Behavior Officer House Sick proven the truth. It means there is influence the Better Satisfaction Patient so will influence Behavior Officer House Sick ingive service best they to patient on House Sick general government.

Study This in line with study Seti et.al (2023) Which research behavior and performance of officers on patient satisfaction through service quality inpatient treatment room at Mamuju District Hospital. Research result They have a direct and significant positive influence between Staff Performance with Patient Satisfaction. The caring behavior and performance of officers can provide contribute directly to patient satisfaction and

indirectly¹⁹. Performance officer health on House Sick in category bad although there is connection between performance officer health with satisfaction patient²⁰.

In this research, we try to provide an antecedent to that opinion say that performance officer House Sick always not enough Good to health services, especially health services in public hospitals government. The results of this study indicate that the behavior of hospital staff Can become Good If patient has satisfied with Service House Sick. Results This research shows that there is a relationship between caring attitudes and nurse performance with satisfaction patient in House Sick. It means, attitude care Which Good on performance officer health Which Good will increase satisfaction patient. In study This found Also motivation and discipline officer House Sick Which low so that need get attention from manager House Sick For in upgrade inservice to patient.

Influence Satisfaction Patient to Reputation House Sick

The exogenous variable Patient Satisfaction has a significant influence with a value of 0.450 for the endogenous variable Hospital Reputation. Mark The t-statistic in this relationship is $4.789 > 1.96$, and the p-value is $0.000 < 0.05$. By Because That, hypothesis third Which state that Satisfaction Patient have influence positive and significant to Reputation House Sick proven true. This means that there is an influence on better patient satisfaction it will affect the hospital's reputation in providing services best they to patient on hospital general government.

This is also in line with the research results of Un-Kyong Choi (2020) that quality medical services have a significant influence on patient satisfaction and reputation House Sick, and quality service medical have influence Which most big to satisfaction patient. Satisfaction patient influential positive on the hospital's reputation and patient loyalty and is an important factor in determining patient loyalty²¹. Likewise in research Ratih Respati (2020) Which find that reputation doctor influential on hospital reputation, doctor's reputation has no effect on loyalty patients, and the hospital's reputation influences patient loyalty, and also the doctor's reputation through the hospital's reputation influences patient loyalty²². And research by Indra Maulana

(2021) at Bhakti Hospital Husada II Purwakarta show that Satisfaction Patient influence Reputation House Sick And influential significant²³. However, the research is different from Erpurini et.al's (2022) research conducted in Mitra Kasih Hospital Cimahi patient. Based on the research results, it shows that There is no direct relationship between hospital reputation and satisfaction patient. However, there is a simultaneous influence between hospital reputation and quality Service with patient satisfaction²⁴.

On study This found that patient will loyal and satisfied whensee reputation House Sick, Good That Because service or doctor Which There is in House Sick the. Public believe on reputation government Because considered is House Sick best in the area so that role skill from doctors are an important focus for them to seek treatment and use services Service in House Sick. Expectation patient to reputation doctor influence reputation hospital so increase level patient satisfaction.

Influence Behavior Officer House Sick to Loyalty Patient

Variable exogenous Officer House Sick have influence Which significant with a value of 0.101 for the endogenous variable Patient Loyalty. t-value the statistics in this relationship are $1.520 > 1.96$, and the p-value is $0.129 > 0.05$. By Because That, hypothesis fourth Which state that Loyalty Patient does not have a positive and significant influence on Hospital Staff proven the truth. It means No there is influence Which the Better Behavior Hospital officers who will influence patient loyalty in choosing service on government general hospital.

This research is in line with Susianta (2021) research on Loyalty Citra Medika General Hospital patient, Sidoarjo. From his findings it is known Behavior officer not enough get role Which important for increase Patient loyalty, this is because patients judge based on knowledge and their experiences of nurses²⁵. Different from study Widyantari (2020) And Akbar & Rizky (2020) Which show that the behavior of hospital staff has a very significant relationship to loyalty patient in use service health return, including House Sick²⁶.

The behavior of staff in the hospital, whether doctors or nurses relate directly with patient very sued for give service who care about increasing the level of patient loyalty in using

services Hospital services. From these findings it was found that patients did not like it visit return place they treatment in House Sick government. From patient experiences they gain while in their government hospitals see officer at home Sick not enough motivated and discipline in carry out his job. Need improvements and system manage House Sick Which Professional for House special government sick there are in the area.

Influence Reputation House Sick to Loyalty Patient

Variable exogenous Reputation House Sick have influence Which significant with a value of 0.124 for the endogenous variable Patient Loyalty. The t-statistic value in this relationship is $1.402 > 1.96$, and the p-value is $0.161 > 0.05$. Therefore, the fifth hypothesis states that Patient Loyalty does it have a positive and significant influence on Hospital Reputation? proven the truth. It means No there is influence Which the Better Reputation House Sick Which will influence Loyalty Patient when accept service from the hospital general government.

This result is different from research by Akbolat et.al (2023) which found Doctor's reputation has a positive effect on hospital reputation and loyalty patient. However, reputation House Sick have influence Which stronger to patient loyalty versus doctor's reputation. Finally, the results of this study note that a hospital's reputation and a doctor's honor are not interchangeable. The reputation of the doctor and the reputation of the hospital are very important in ensuring loyalty patient, so that professional health must develop strategy for increase both of them¹⁷. However, study This in line with study Amarat et.al (2022) Which find reputation the company has a positive effect on patient loyalty and patient satisfaction played a positive role in research in Türkiye²⁷.

This research found that the reputation of government hospitals is changing have not been able to provide and increase loyalty to patients in Sumatra North. From the patient's answers, it shows that they don't like using services from government general hospital. It should be the company's reputation directly form trust patient For Keep going using service House Sick Which concerned so that will Keep going influence patient in treatment. On basically reputation House Sick is something

award Which obtained company Because advantages Which There is on House Sick. From findings This can understood that House Sick general government in Sumatra North Not yet Canggih that matter.

Influence Satisfaction Patient to Loyalty Which in mediation Behavior Hospital Officer

The exogenous variable Patient Satisfaction has a significant influence on mark as big as 0.028 to variable endogenous Loyalty Patient Which mediated by variable Behavior Officer House Sick. Mark t-statistics in connection This is $1.221 > 1.96$, and p-value $0.223 > 0.05$. Hence, the sixth hypothesis Which state that Satisfaction Patient have influence positive and significant to Loyalty Patient Which mediated Behavior Officer House Sick not proven to be true. This means that there is no better influence Satisfaction Patient Which mediated Behavior Officer House Sick will affects patient loyalty when receiving services from public hospitals government.

This research is different from research conducted by Yeo et al., (2021). In Yoe's research, the mediator of patient satisfaction and patient loyalty was hospital reputation and research results have a significant positive effect²⁸. In this study, the behavior of hospital staff was unable to mediate enhancement patient satisfaction towards patient loyalty. This result can be seen from the value p-value $0.223 > 0.05$. It can be estimated that this is because the patient is in Sumatra the North has not felt the added value of the services provided by the hospital The government's general opinion is based on the behavior of hospital staff that they perceive when seeking treatment or visiting the government public hospital. Behavior hospital staff that patients feel is due to the low motivation of home workers government hospitals in providing health services received by patients. Moreover, motivation worker at home Sick Which not enough discipline in activity service health in hospital.

Influence Satisfaction Patient to Loyalty Which in mediation Reputation House Sick.

The exogenous variable Patient Satisfaction has a significant influence with mark as big as 0.056 to variable endogenous Loyalty Patient Which mediated by variable Reputation House Sick. Mark t-statistics in

connection This is $1.269 > 1.96$, and the p-value is $0.205 > 0.05$. Hence, hypothesis sixth which states that Patient Satisfaction has a positive influence and significant to Patient Loyalty mediated by House Officer Behavior Pain is not proven true. This means that there is no increasing influence both Patient Satisfaction mediated by Hospital Reputation will influence Loyalty Patient when receiving service from home Sick general government.

The results of this study are not in line with what Yeo et al., (2021) found showed that patient satisfaction mediated the relationship between home reputation patient pain and loyalty; patient trust and loyalty; care relationship patient and loyalty patient²⁸. Study This show reputation House Sick general government Not yet capable interesting interest visit Again or interest for treatment or use health services at government hospitals. This research found that the patient was unable to survive to continue treatment or use service service House Sick government. Matter This Because not enough like it patient towards the government public hospital. It could be considered a low result behavior service from hospital staff.

CONCLUSION

This study concludes that the exogenous variable Patient Satisfaction has a significant influence with a value of 0.581 on the endogenous variable Patient Loyalty. The t-statistic value in this relationship is $5.572 > 1.96$ and the p-value is $0.000 < 0.05$. The exogenous variable Patient Satisfaction has a significant influence with a value of 0.280 on the endogenous variable Hospital Staff Behavior. The t-statistic value in this relationship is $2.630 > 1.96$ and the p-value is $0.009 < 0.05$. The exogenous variable Patient Satisfaction has a significant influence with a value of 0.450 on the endogenous variable Hospital Reputation. The t-statistic value in this relationship is $4.789 > 1.96$, and the p-value is $0.000 < 0.05$. The exogenous variable Hospital Staff has a significant influence with a value of 0.101 on the endogenous variable Patient Loyalty. The t-statistic value in this relationship is $1.520 > 1.96$, and the p-value is $0.129 > 0.05$. The exogenous variable Hospital Reputation has a significant influence with a value of 0.124 on the endogenous variable Patient Loyalty. The t-statistic value in this relationship is $1.402 > 1.96$, and the p-value is $0.161 > 0.05$. The

exogenous variable Patient Satisfaction has a significant influence with a value of 0.028 on the endogenous variable Patient Loyalty which is mediated by the Hospital Staff Behavior variable. The t-statistic value in this relationship is $1.221 > 1.96$, and the p-value is $0.223 > 0.05$. The exogenous variable Patient Satisfaction has a significant influence with a value of 0.056 on the endogenous variable Patient Loyalty which is mediated by the Hospital Reputation variable. The t-statistic value in this relationship is $1.269 > 1.96$, and the p-value is $0.205 > 0.05$.

Patient Which currently undergo maintenance or treatment still get service best from House Sick General Government. This service is provided to patients who seek treatment using ASTEK, BPJS, Insurance, as well general patient.

Professional service health and staff House Sick government pushed for in a way consistent maintain attitude friendly and easy approached when interact with individual Which look for maintenance medical or treatment at the facility.

Recommended so that House Sick General Government prioritize solution facility or infrastructure Which Not yet resolved to use increase its capacity to provide health services very efficient.

REFERENCES

1. Robinsyah M. Pelaksanaan Pelayanan Rumah Sakit Bagi Pasien Bpjs Ditinjau Dari Undang-Undang Nomor 24 Tahun 2011 Tentang BPJS (Studi Kasus Rumah Sakit Umum Kota Dumai). Universitas Islam Riau; 2022.
2. Kemenkes RI. Profil kesehatan indonesia 2020. Kementerian Kesehatan Republik Indones. 2021;139.
3. BPS Provinsi Sumatera Utara. BPS Sumut. Provinsi Sumatera Utara Dalam Angka (Issue 1). 2023.
4. Friedel AL, Siegel S, Kirstein CF, Gerigk M, Bingel U, Diehl A, et al. Measuring Patient Experience and Patient Satisfaction—How Are We Doing It and Why Does It Matter? A Comparison of European and US American Approaches. In: Healthcare. MDPI; 2023. p. 797.
5. Asnawi A, Awang Z, Afthanorhan A, Mohamad M, Karim F. The influence

- of hospital image and service quality on patients' satisfaction and loyalty. *Manag Sci Lett.* 2019;9(6):911–20.
6. Avdic D, Moscelli G, Pilny A, Sriubaite I. Subjective and objective quality and choice of hospital: Evidence from maternal care services in Germany. *J Health Econ.* 2019;68:102229.
 7. Nasution PA, Kurniawan MF. Evaluasi Capaian Pemerataan Layanan Kesehatan yang Berkeadilan di Era JKN di Provinsi Sumatera Utara.
 8. Meesala A, Paul J. Service quality, consumer satisfaction and loyalty in hospitals: Thinking for the future. *J Retail Consum Serv.* 2018;40:261–9.
 9. Lacy BE, Chan JL. Physician burnout: the hidden health care crisis. *Clin Gastroenterol Hepatol.* 2018;16(3):311–7.
 10. Olesen K, Bathula H. A meta-analysis of the determinants of patient satisfaction and loyalty. *Health Mark Q.* 2022;39(2):191–210.
 11. Lacap JP, Alfonso KJ. The Mediating Role of Patient Loyalty on the Relationship Between Satisfaction on Physical Environment and Intention to Recommend. *Asia-Pacific Soc Sci Rev.* 2022;22(2).
 12. Sugiyono D. *Statistika untuk Penelitian (Cetakan ke-30)*. Bandung Cv Alf. 2019;
 13. Malhotra NK. *essentials of arketing Research (Global Edi)*. Engl Pearson Educ Ltd. 2015;
 14. Hair Jr J, Hair Jr JF, Hult GTM, Ringle CM, Sarstedt M. *A primer on partial least squares structural equation modeling (PLS-SEM)*. Sage publications; 2021.
 15. Liu S, Li G, Liu N, Hongwei W. The impact of patient satisfaction on patient loyalty with the mediating effect of patient trust. *Inq J Heal Care Organ Provision, Financ.* 2021;58:00469580211007221.
 16. Susanti I, Nyorong M, Sudiro S. Analysis of factors affecting patient loyalty in Bandung General Hospital in Medan. *J La Medihealtico.* 2020;1(5):6–15.
 17. Akbolat M, Amarat M, Ünal Ö, Sütülü ES. The mediating role of hospital reputation in the effect of doctor reputation on patients loyalty. *Int J Healthc Manag.* 2023;16(1):12–8.
 18. Aladwan MA, Salleh HS, ALhwadi H. The Impact of Hospital Reputation on Patient Loyalty Mediated by Patient Satisfaction. *Turkish Online J Qual Inq.* 2021;12(4).
 19. Seti S, Latief A, Wagiman W, Matalatta M. Analysis of Staff Behavior and Performance on Patient Satisfaction Through The Quality of Inpatient Room Services At The Mamuju District General Hospital. *Point View Res Econ Dev.* 2023;4(1):6–21.
 20. Sasmita FN, Dwiana D, Parera G. Hubungan perilaku asertif perawat dalam memberikan pelayanan keperawatan dengan tingkat kepuasan pasien di ruang seruni RSUD dr. M. Yunus Bengkulu. *Prepotif J Kesehat Masy.* 2020;4(2):121–30.
 21. Choi U-K. The effects of perceived medical service quality on patient satisfaction, hospital's reputation and loyalty. *J Korea Soc Comput Inf.* 2020;25(1):177–85.
 22. Respati R. Analisis Pengaruh Reputasi Dokter Terhadap Loyalitas Pasien Dengan Reputasi Rumah Sakit Sebagai Variabel Intervening (Studi Pada Pasien Rawat Jalan di Rumah Sakit Islam Purwokerto). Universitas Muhammadiyah Purwokerto; 2020.
 23. Maulana I. Peranan Penyampaian dan Operasi Jasa, terhadap Kepuasan Pasien Serta Dampaknya pada Reputasi Rumah Sakit. *J Eknomi Dan Bisnis.* 2021;8(1).
 24. Erpurini W. The Effect Of Hospital Reputation And Quality Of Service On Patient Satisfaction (Cimahi Private Hospital). *J Sci.* 2022;11(01):337–46.
 25. Susianta I. Pengaruh Kompetensi Perawat dan Perilaku Perawat terhadap Kinerja Perawat dan Loyalitas Pasien Rumah Sakit Umum Citra Medika Sidoarjo. *Sasanti J Econ Bus.* 2021;2(1):44–58.
 26. Akbar MI, Risky S. Hubungan kecepatan mendapatkan layanan, ramah dan sikap santun petugas kesehatan terhadap kepuasan pasien rawat inap Rumah Sakit Umum Daerah Buton Utara. *MIRACLE J Public Heal.* 2020;3(1):11–7.

27. Amarat M, Akbolat M, Dizlek K. The mediating role of patient satisfaction in the effect of corporate reputation on patient loyalty. *Int J Heal Manag Tour.* 2022;7(1):64–75.
28. Yeo SF, Tan CL, Goh Y-N. Obstetrics services in Malaysia: factors influencing patient loyalty. *Int J Pharm Healthc Mark.* 2021;15(3):389–409.

Article Review

Covid-19 Non-natural Disaster Mitigation: A Literature Review

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ABSTRACT

Non-natural disasters are defined as types of disasters that occur due to non-natural causes, including technological failure, modernization failure, epidemics, and disease outbreaks. One type of non-natural disaster that occurs in society is the Covid-19 pandemic. There is a need for disaster mitigation due to Covid-19 to minimize the risk of impacts that will or have occurred. This article was prepared to find out the diversity of disaster mitigation that has been implemented all this time. The research method used is literature study or a type of academic survey research where data is obtained from government website reports, expert studies, scientific literature, and research institute studies. This review describes disaster mitigation methods that have been implemented by individuals, schools, communities, hospitals, and governments to minimize the impact of the Covid-19 pandemic. There is cooperation between individuals, communities, and the government in realizing the fruitful implementation of non-natural disaster mitigation, especially COVID-19. Policies that are not on target and do not focus on handling the Covid-19 pandemic will not be able to minimize deaths from Covid-19, and the socio-economic impact of the spread of the virus will be massive and serious.

Keywords: Covid-19, Community Preparedness, Government Preparedness, School Preparedness, Disaster Mitigation

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INTRODUCTION

Non-natural disasters are defined as types of disasters that occurring due to non-natural incident including technological failure, modernization failure, epidemics, and outbreaks of disease¹. One type of non-natural disaster that occurred in the community last year was the Covid-19 Pandemic². The non-natural disaster of the Covid-19 pandemic that occurred in all countries in the world, including Indonesia, is a non-natural disaster or pandemic od disease that has a very large impact that affects all facets of life. The impact of the Covid-19 pandemic is global, short-term and long-term. Therefore, to minimize the risk of impacts that will or have occurred, quality disaster mitigation is required. All this time,

disaster mitigation has only focused on natural disasters, however, specific non-natural disaster mitigation is still very minimally presented. Disaster mitigation is an efforts taken with the goal of minimized the risks and impacts caused by the disaster to the community in disaster-prone areas³.

Non-natural disaster mitigation of the Covid-19 pandemic can be interpreted as efforts taken by individual, communities and governments to reduce the risk and impact of Covid-19 transmission in the community. There are four essentials that must be implemented in disaster mitigation, including information and maps of disaster-prone areas for each category of epidemic disaster, socialization to increasing public understanding and awareness in dealing with pandemic of disease, know what needs to

be done and avoided as well as how to save yourself if the epidemic of a disease occurs suddenly and regulation, arrangement of disaster-prone areas to reduce the threat of disaster⁴. Covid-19 is a virus that transmits from animals to humans. This virus and disease were first announced in Wuhan city, China in December 2019. On March 21 2020, the amount of Covid-19 cases was more increasing. In 2022, the incident of Covid-19 will begin to decline in Indonesia and the world⁵.

There is an opinion that the Indonesian government tends to assumed the Covid-19 as a mild problem. Several study results state that overconfidence and optimistic bias are related to risk perception, errors in decision making, inaccurate, which ultimately resulted to postponed behavior and tend to ignored existing information. When facing a disaster like Covid-19. some countries like USA, Indonesian and Italy tends to experience overconfidence and optimistic bias, as a result, the initial regulations for handling COVID-19 were less accurate, less alert, and not being able to prepared the logistics of providing personal protective equipment like mask, gloves, shield clothing and ventilator. All of these things was resulting in uncontrolled COVID-19 cases and resulted in many people died. The stigma that was formed at the beginning was that the Indonesian people were immune. Covid-19 unable to live in hot climates, making the Indonesian people trapped in the initial paradigm that was formed, thus potentially forming confirmation bias. This condition was seen during the Covid-19 phenomenon in several countries, including Indonesia which tends to present evidence to support the initial hypothesis, so that it influences the rapidity of handling Covid-19⁶⁻⁸.

This article will present the results of a literature review of Covid-19 non-natural disaster mitigation articles sourced from various references both domestically and abroad. The aim is to provide information to readers to find out the disaster mitigation approach model that has been applied all this time either by the community and government, because the Covid-19 pandemic occurred suddenly and all nations did not have proper preparation to facing the Covid-19 pandemic. Covid-19 pandemic occurred suddenly where all Nations did not have careful preparation in dealing with the Covid-19 pandemic. This information is expected to be a lesson for all of us.

METHOD

This research method is the literature review method. This article uses the current references on Covid-19 disaster mitigation both in Indonesia and abroad that we can adopt for the application of disaster mitigation models that are in accordance with the characteristics and conditions in the country.

The articles used as findings are adjusted to the specified inclusion criteria. Article inclusion criteria include international articles that can be accessed in full (full text) relating to: Journals related to Covid-19 MITIGATION, international journals published from 2016-2022 as well as international journals or journals that have ISSN standards.

RESULTS

Tabel 1. The Covid-19 Disaster Mitigation Model

Preparedness	Non-natural Mitigation Model: Covid-19	Disaster
Disaster Mitigation Strategy of Covid-19 in Hospitals	1.	The predictive models. The hospital made projections on the amount of cases, inpatient care and deaths caused by Covid-19 over the next few weeks. The goal is to anticipate the need for care such as: Personal protective equipment, ventilator, number of rooms and bed for patients ⁹ .
	2.	<i>Susceptible-exposed-infectious-recovered Models</i> This model applied separates individuals who are susceptible to exposure to Covid-19 and those who easily recover quickly. This approach estimates the health interventions an individual will receive, the severity of clinical symptoms and the risk for hospitalization ¹⁰ . Improved human resources with the formation of a first-line implementation team, clear division of tasks and provision of communication ways between medical staff ¹¹ .
	3.	<i>Hospital safety index model</i>

Preparedness	Non-natural Mitigation Model: Covid-19	Disaster
	The hospital has increased the role of human resources by forming a disaster committee team, make emergency response plans and ensuring drug availability, instruments, and equipment in disaster situations ¹² .	
	4. <i>Information technology models</i> Hospitals use an information technology approach by developing applications called Hospital Preparedness with the aim of supporting hospitals and stakeholders to carry out a self-assessment regarding hospital preparedness in facing emergencies caused by Covid-19 ¹³ .	
Disaster Mitigation Strategy of Covid-19 for Medical Personnel	1. <i>Applied behavior analysis models</i> This method uses a behavioral analysis approach for medical personnel. This approach aims to prevent transmission of Covid-19 to medical personnel who provide health services during the Covid-19 pandemic. Medical personnel are advised to provide services via telehealth and minimize face-to-face contact ¹⁴ .	
	2. Systematic modeling. Systematic modeling of COVID-19 transmission and mitigation strategies in the ICU that implemented by limiting physical distance between patients and medical personnel to reduce the risk of transmission.	
Disaster Mitigation Strategy of Covid-19 in the community	1. Nutritional approach. Nutrition is very important to prevent transmission of the Covid-19 virus. The certain nutrients able improve physical and mental health during the COVID-19 pandemic ¹⁵ .	
	2. <i>Mitigation self-behaviors approach</i>	

Preparedness	Non-natural Mitigation Model: Covid-19	Disaster
	This approach utilizes changes in individual behavior to avoid transmitted Covid-19 by implementing government-recommended behavior such as washing hands, wearing a mask, keep the distance, avoid crowds and restaurants, places of worship and social activities ^{16,17} .	
	3. Modulation limit contact with new people model Based the research results, repeated contact with interconnected groups (such as at work or within a group of friends) has a lower risk of infected Covid-19 compared to contact with new people ¹⁸ .	
	4. The vaccination and antibody therapy for Covid-19 Predict and mitigate the threat of Covid-19 infection by get vaccinated and antibody therapy for Covid-19 ¹⁹⁻²¹ .	
	5. Lockdown model The community-based mitigation strategy model is implemented by complying with many regulations such as travel restrictions, including reductions in flights and public transportation and crowd-raising activities and get information from authorized government both nationally and internationally to ensure information received about Covid-19 was valid to avoid fake news, rumors and panic ²² .	
	6. <i>Non-Pharmaceutical Interventions (NPIs)</i> Implementation of model lockdowns (NPIs) which means minimizing drug interventions ²³ .	
Disaster Mitigation Strategy of Covid-19 for	1. Division of the student population model The approach is utilize the approach of dividing the	

Preparedness	Non-natural Mitigation Model: Covid-19	Disaster
students at school	number of students into two parts and going to school alternately for face-to-face learning. In addition, regular Covid-19 tests are also needed on teachers and students. Other disaster mitigation measures are also implemented, such as wearing masks, keep distance, improve air ventilation ²⁴ .	
	2. <i>Comprehensive Health School Model (CHSM)</i> Assessment of school readiness to prevent and minimize Covid-19 risks with instruments that include four components of the social and physical environment, teaching and learning, healthy school policies and partnerships and services. Implementation of CHSM in schools is done by arranging the the distance between student seats, open the windows or ventilation and provide disinfectant in the classroom ²⁵ .	
	3. Curriculum adjustments models The school implemented a flexible approach during the Covid-19 pandemic which meant that flexibility to choose a curriculum that retrieved the learning needs of students during the pandemic, distance learning (online) combined with face-to-face learning (hybrid). Face-to-face learning is carried out with implementing health protocols, students and teachers have been vaccinated of Covid-19, and reduced the capacity of students in the same classroom ²⁶ .	
	4. Disaster mitigation education models Implementation of disaster mitigation through	

Preparedness	Non-natural Mitigation Model: Covid-19	Disaster
	education and socialization on preparedness for Covid-19 ^{27,28} . Education can also be conducted by utilizing videos related to Covid-19 disaster mitigation through android smartphones ^{29,30} .	

DISCUSSION

Covid-19 virus is a national disaster as a result all levels of society must take an active role to minimized and improved the behavior of preventing the transmission of Covid-19. The transmission of Covid-19 is very active, was effec in a large number of cases and increasing the death rate. Therefore required the forwardness and preparedness in community to againts the transmitted of this virus. There is community forwardness in preventing disease, standard procedure when exposure and after exposure, able conduct of transmitted and minimize the risk of disadvantage that will be experienced^{31,32}.

There are many methods use to increase community preparedness. One of which is also done by utilizing technology. The health promotion with targeting the general community can be implemented through social media which is useful as an effective learning media. The amount of information obtained, will increase knowledge that is practical for implementing healthy behavior in againts Covid-19³³. Government strategy in the health sector in non-natural disasters Covid-19 mitigation for the community is the action to wear masks, especially when outside the home or public space, contact tracing, education and preparation of independent isolation and hospital isolation³⁴. The health behavior recommended for implementation are keeping health protocols with the habit of washing hands, exercise, wear the mask, keep distance, use hand sanitizer, practice sneezing etiquette, capable to managing stress and eating of nutritious food³⁴.

Risk reduction through mitigating non-natural disasters due to Covid-19 is also done with the same efforts as when againt natural disasters that is community-based disaster risk reduction that has been implemented in Indonesia all this time. The Implementation of a community-based disaster risk reduction

models have been done through a many of activities including the formation of Disaster Resilient Families, Disaster Resilient Village, Disaster Preparedness Village, Disaster Preparedness Cadets in order to increase preparedness and prevention and avoid (prevented and blocked) the potential case and transmission of the Covid-19 pandemic³⁵.

The community mitigation strategies, also include at the individual level. It requires awareness and responsibility individuals to always apply transmission prevention measures to protect people at high risk of Covid-19. After individual level mitigation, Covid-19 disaster mitigation also needs to applied in schools offices and community organizations. Each region needs to do a disaster risk survey of Covid-19 in high risk areas. Disaster risk be the foundation for reasoning to accentuate disaster management efforts in regional development³⁶.

There are many steps taken by the Government to mitigate the Covid-19 disaster. Among others are issued a number of policies related to Covid-19, such as increasing the role of related sectors such as the ministry of health, formation of the Covid-19 cluster, guidelines regarding Covid-19 preparedness and management to prepare a circular compiling government regulatory circulars regarding Covid-19 to be implemented by regional governments. Providing logistics for health protocol equipment for hospitals and other health service institute, procurement of evacuation facilities, prepare of referral hospitals, build the posts, improved of public information technology-based, building a positive paradigm between stakeholders, increasing the role of the epidemiological surveillance system in regularly and periodically, regional quarantine, limitation of foreigner to come in Indonesia and many else³⁷. The regional government is implementing one of the Covid-19 mitigation strategies by utilizing the call center hotline to give clear information, immediate, and bidirectional. The role of the hotline call center is expected to increase community preparedness by providing accurate information, real-time, and persuasive to adjust applicable health protocols and can also be used as a tool of good risk communication for the community³⁸.

Hospitals are also one of the health service institute that had to improve when the Covid-19 pandemic was declared. The hospital preparedness in againts the Covid-19 pandemic

intend to confirm that hospitals are ready at all times to respond to emergency conditions due to Covid-19. Disaster mitigation strategies due to Covid-19 implemented by hospitals include: division of duties and responsibilities for each hospital staff. Furthermore have to prepare of human resources by forming a Rapid Reaction Team (RPT), Communication system support facilities in hospitals can be improved by using Handy Talky (HT), Routing Information Protocol, mobile phones and telephones and improve the process of managing emergency situations¹¹. In addition, hospitals can also form disaster emergency teams and arraged emergency response plans and confirmed drug availability, instruments, equipment for disaster situations to prove that the hospital can be used as a referral for patients exposed to Covid-19¹². Another strategy can also be taken by hospitals with conducting self-efficacy to measure abilities a hospital receiving a surge patients caused Covid-19. Self efficacy can be done by utilizing the Hospital Preparedness application¹³.

One of the school strategies in implementation of disaster mitigation caused Covid-19 is the hybrid method where schools practice the online learning combined with face-to-face learning. However, for face-to-face learning there are several requirement that must be applied are teachers and students must vaccinated, wear masks, keep distance and Class capacity is 50% occupied²⁶.

The Covid-19 disaster mitigation strategy is also done through education. because according to research results, there is compliance with the implementation of health protocols as recommended by the government is influenced by individual knowledge about Covid-19³⁹. The need for disaster mitigation education from an early age in the community is not only carried out through formal education in schools, but also through non-formal education by collaborating with related organizations related to the prevention of Covid-19. Disaster mitigation activities for school children can be carried out through disaster mitigation training, simulations, outreach about disaster preparedness in schools²⁷. Education for students can also be carried out by utilizing the SIGAP covid-19 application technology which is short for preparedness for the coronavirus disease (covid-19) pandemic which is developed in a game so that it can attract students' interest in

knowing about covid-19. The SIGAP application consists of educational material such as washing hands, increasing endurance, questions, preventing Covid-19 and other material²⁹.

CONCLUSION

The Covid-19 mitigation strategy in hospitals is carried out by using information technology and patient triage. Medical personnel utilize telehealth and social distance and use personal protective equipment. Covid-19 mitigation in the wider community is applied with maintaining of nutritional intake, social distance and local lockdown. Meanwhile, mitigation in schools applied with modified online learning methods through the use of smartphones and face-to-face learning is still still implemented but by reducing the capacity of students in the classroom.

There needs to be teamworks between the government, community, hospitals and other institutions in realizing the successful implementation of non-natural disaster mitigation, especially Covid-19. It is recommended that the community to participate actively with the local government in implementing regulations and complying with health protocols to minimize the risk of the impact of Covid-19 on the wider community.

REFERENCES

1. BNPB. Definisi dan Jenis Bencana. Badan Nasional Penanggulangan Bencana. <https://www.bnpb.go.id/definisi-bencana>
2. Presiden Republik Indonesia. Keputusan Presiden Republik Indonesia Nomor 12 Tahun 2020 Tentang Penetapan Bencana Nonalam Penyebaran Corona Virus Disease 2019 Sebagai Bencana Nasional. *Fundam Nurs.* 2020;(01):18–30. <https://peraturan.bpk.go.id/Details/135718/keppres-no-12-tahun-2020>
3. Badan Perencanaan Pembangunan Nasional. Pengarusutamaan Penanggulangan Bencana dalam Perencanaan Pembangunan. Bappenas. 2016. <https://bappeda.ntbprov.go.id/pengarus>

utamaan-manajemen-resikobencana-dalam-perencanaan-penganggaran-pusat-dan-daerah/?utm_source=rss&utm_medium=rss&utm_campaign=pengarusutamaan-manajemen-resikobencana-dalam-perencanaan-penganggaran-pusat-dan-daerah

4. Salman S, Hilmi IL, Gumilar GG. Mitigasi Bencana Non Alam Berbasis Masyarakat Saat Dan Pasca Pandemi Covid_19 Di Kabupaten Karawang. *J Educ Hum Soc Sci.* 2021;3(3):1161–9. DOI: <https://doi.org/10.34007/jehss.v3i3.515>
5. Monardo D dkk. Pedoman Penanganan Cepat Medis dan Kesehatan Masyarakat Covid-19 di Indonesia [Internet]. <https://covid19.go.id/>. 2020. Available from: <http://www.covid19.go.id>
6. Sutisna IPG. Gerakan Literasi Digital Pada Masa Pandemi Covid-19. *Stilistika J Pendidik Bhs dan Seni.* 2020;8(2):268–83. Available from: <https://ojs.ikipgribali.ac.id/index.php/stilistika/article/view/773>
7. Kartikawati E. Perspektif, Pengetahuan dan sikap Masyarakat terhadap Pandemi Covid-19. *Pendipa J Sci Educ.* 2021;5(2):225–8. DOI: <https://doi.org/10.33369/pendipa.5.2.225-228>
8. Agung IM. Memahami Pandemi Covid-19 Dalam Perspektif Psikologi Sosial. *PsikobuletinBuletin Ilm Psikol.* 2020;1(2):68–84. DOI : DOI: <http://dx.doi.org/10.24014/pib.v1i2.9616>
9. Mossa-Basha M, Medverd J, Linnau KF, Lynch JB, Wener MH, Kicska G, et al. Policies and Guidelines for COVID-19 Preparedness: Experiences from the University of Washington. *Radiology.* 2020;296(2):E26–31. DOI: <https://doi.org/10.1148/radiol.2020201326>
10. Tuite AR, Fisman DN, Greer AL. Mathematical modelling of COVID-19 transmission and mitigation strategies in the population of Ontario, Canada. *CMAJ.* 2020;192(19):E497–505. DOI: [10.1503/cmaj.200476](https://doi.org/10.1503/cmaj.200476)
11. Maulana MS Al, Myrnawati. Rumah Sakit Siaga Covid-19. *Excell* 1382

- Midwifery J. 2021;4(2):84–90. DOI: <https://doi.org/10.55541/emj.v4i2.159>
12. Amaliah RU, Dewi FS, Rizal C, Setiawan YI. Kesiapsiagaan Rumah Sakit X dalam Menghadapi Bencana Covid-19 Berdasarkan Hospital Safety Index. J Kesehat Ibnu Sina [Internet]. 2021;2(2):57–69. Available from: <http://ojs3.lppm-uis.org/index.php/J-KIS/article/view/279>. DOI: <https://doi.org/10.36352/j-kis.v2i02.279>
13. Dhamanti I, Nurhaida I, Rachman T, Muhamad R. Attempts To Improve Hospital Preparedness in Dealing With the Covid-19 Pandemic. J Layanan Masy (Journal Public Serv. 2022;6(1):9–14.
14. Cox DJ, Plavnick JB, Brodhead MT. A Proposed Process for Risk Mitigation During the COVID-19 Pandemic. Behav Anal Pract. 2020;13(2):299–305. DOI: 10.1007/s40617-020-00430-1
15. Akhtar S, Das JK, Ismail T, Wahid M, Saeed W, Bhutta ZA. Nutritional perspectives for the prevention and mitigation of COVID-19. Nutr Rev. 2021;79(3):289–300. DOI:<https://doi.org/10.1093/nutrit/nuaa063>
16. Helena, J, Hutchin, Brent, Wolff, Rebecca, et al. COVID-19 Mitigation Behaviors by Age Group United States, April - June 2020. MMWR Morb Mortal Wkly Rep. 2020;69(43):1584–90. DOI: 10.15585/mmwr.mm6943e4
17. Sneppen K, Taylor R, Simonsen L. Impact of Superspreaders on dissemination and mitigation of COVID-19. In: Proceedings of the National Academy of Sciences. 2020. p. 1–20. <https://doi.org/10.1101/2020.05.17.20104745>
18. Nielsen BF, Simonsen L, Sneppen K. COVID-19 Superspreading Suggests Mitigation by Social Network Modulation. Phys Rev Lett [Internet]. 2021;126(11):118301. Available from: <https://doi.org/10.1103/PhysRevLett.126.118301>. <https://doi.org/10.1103/PhysRevLett.126.118301>
19. Chen J, Gao K, Wang R, Wei GW. Prediction and mitigation of mutation threats to COVID-19 vaccines and antibody therapies. Chem Sci. 2021;12(20):6929–48. DOI: <https://doi.org/10.1039/D1SC01203G>
20. Faisal IT, Khaira N, Magfirah, Veri N. Edukasi Bencana Covid-19 Mampu meningkatkan kesiapsiagaan Masyarakat Menghadapi Bencana Non Alam. 2023.
21. Alchalidi, Veri N, Emilda, Dewita, Ramadhani NS. Kejadian Ikutan Pasca Imunisasi Corona Virus Diseases- 19 (Covid-19). Dunia Keperawatan J Keperawatan dan Kesehat. 2022;10(3):298–303. DOI: 10.20527/dk.v10i3.19
22. Ebrahim SH, Ahmed QA, Gozzer E, Schlagenhauf P, Memish ZA. Covid-19 and community mitigation strategies in a pandemic. BMJ [Internet]. 2020;368(March):1–2. Available from: <http://dx.doi.org/doi:10.1136/bmj.m1066>.
23. Gozzi N, Tizzoni M, Chinazzi M, Ferres L, Vespignani A, Perra N. Estimating the effect of social inequalities on the mitigation of COVID-19 across communities in Santiago de Chile. Nat Commun [Internet]. 2021;12(1):1–9. Available from: <http://dx.doi.org/10.1038/s41467-021-22601-6>
24. McGee RS, Homburger JR, Williams HE, Bergstrom CT, Zhou AY. Model-driven mitigation measures for reopening schools during the COVID-19 pandemic. Proc Natl Acad Sci U S A. 2021;118(39):1–10. <https://doi.org/10.1073/pnas.2108909118>
25. Asmarani FL, Syafitri EN, Fatmasari SF. Gambaran Kesiapsiagaan Sekolah Dalam Mencegah Penularan Covid-19 Di Sekolah. In: Strategi Mempertahankan Kualitas Penelitian dan Publikasi Di Era Pandemi. 2021. p. 134–40.
26. Susanto S, Sidqi MF, Fajar DA. Evaluasi Kesiapsiagaan Sekolah Menengah Atas di Kabupaten Pekalongan dalam Penyediaan Mutu dan Inklusivitas Pembelajaran Pasca Pandemic. Ainara J (Jurnal Penelit dan

- PKM Bid Ilmu Pendidikan). 2022;3(1):42–9. DOI: <https://doi.org/10.54371/ainj.v3i1.111>
27. Winugroho T, Apriyadi RK, Aprilyanto. Pengaruh Persepsi Penyebaran Covid-19 terhadap Kesiapsiagaan Bencana Pandemi pada Guru Paud Kota Magelang. *J Anak Usia Dini dan Pendidik Anak Usia Dini*. 2021;7(1):95–105. <https://doi.org/10.30651/pedagogi.v7i1.6980>
 28. Nurul S E, Lathu A F, Aprilia V S. Upaya Tanggap Darurat Bencana Melalui Edukasi Emergency Disaster Response Through Education To Prevent The Transmission Of Covid 19 In School. 2021;231–5.
 29. Rizki MA, Johar A, Faurina R. Aplikasi Animasi Edukasi Kesiapsiagaan Menghadapi Pandemi Coronavirus Disease (Covid-19) Untuk Siswa Sekolah Dasar Berbasis Android (Studi Kasus SDN 69 Kota Bengkulu). *Rekursif J Inform*. 2021;9(2):184–92. <https://doi.org/10.33369/rekursif.v9i2.17248>
 30. Faisal TI, Khaira N, Magfirah, Emilda. Mitigasi Bencana Alam dan Non Alam. 2023. 179 p.
 31. Dewiyuliana, Septiana N. Pengaruh penyebaran informasi covid-19 melalui whatsapp terhadap kesiapsiagaan masyarakat dalam menghadapi covid-19. *J Ilm STIKES Kendal*. 2021;11(1):103–12.
 32. Purnama Y. Faktor Penyebab Seks Bebas Pada Remaja. *Syntax Lit J Ilm Indones [Internet]*. 2020;5(2):156–63. Available from: <http://dx.doi.org/10.1016/j.jss.2014.12.010>
<http://dx.doi.org/10.1016/j.sbspro.2013.03.034>
<https://www.iiste.org/Journals/index.php/JPID/article/viewFile/19288/19711>
<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.678.6911&rep=rep1&type=pdf>
 33. Andriati R, Indah FPS, Andiyana A, Ayu MD. Konseling WhatsApp Gateway untuk Meningkatkan Kesiapsiagaan Masyarakat dalam Menghadapi Covid-19. *Faletehan Heal J*. 2021;8(03):244–9. DOI: 10.33746/fhj.v8i03.303
 34. Margono M, Masithoh RF, Priyo P. Preparedness prevention of Covid-19 Muhammadiyah residents in Magelang, Indonesia. *J Ilm Kesehat Keperawatan*. 2020;16(2):01. <https://doi.org/10.26753/jikk.v16i2.492>
 35. Hadi S. Pengurangan Risiko Pandemi Covid-19 Secara Partisipatif: Suatu Tinjauan Ketahanan Nasional terhadap Bencana. *Indones J Dev Plan*. 2020;4(2):177–90.
 36. Aji A, Hayati R, Benardi AI, Bayu H. Bencana Banjir Pada Masa Pandemi Covid-19 Di Kota Semarang. In: *Konservasi Alam Jilid 1*. 2022. p. 25–46. DOI: <https://doi.org/10.15294/ka.v1i1.83>
 37. Suni NSP. Kesiapsiagaan Indonesia Menghadapi Potensi Penyebaran Corona Virus Disease. *J Info Singkat*. 2020;XII(3):13–8. <https://sdip.dpr.go.id/search/detail/category/Info%20Singkat/id/1033>
 38. Martani HR, Indrapertiwi C, Kusumawati HI, Alim S, Ahmad BF, Setiyarini S, et al. Peran Hotline Call Center dalam Upaya Peningkatan Kesiapsiagaan Masyarakat Mengenai Pandemi COVID -19 di Daerah Istimewa Yogyakarta. *Index Term*. 2020;12(1):47–58. <https://jdpb.bnpb.go.id/index.php/jurnal/article/view/196>
 39. Aulia AV, Amelia AR, Hamzah W. Faktor yang Berhubungan dengan Perilaku Masyarakat terhadap Protokol Kesehatan Covid-19. *Wind Public Heal J*. 2022;2(5):1676–86. <https://doi.org/10.33096/woph.v3i1.356>

Formulation and Effectiveness Testing of Moringa Leaf (*Moringa Oleifera*) Ethanol Extract Lotion as A Skin Moisturizer

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ABSTRACT

This study delves into the formulation of a lotion using different concentrations (0.5%, 2%, and 5%) of Moringa oleifera leaf ethanol extract, aiming to address the constant exposure of the skin to a prooxidant environment. In Indonesia, the rising interest in exploring natural plants for traditional skincare formulations is attributed to their perceived lower side effects compared to chemical substances. Employing an experimental research approach with a pre-test and post-test control group design, the study focuses on observing and controlling the formulation and effectiveness of Moringa oleifera leaf extract lotion in various skin-enhancing aspects. The research findings reveal that the formulated lotions exhibit distinctive aroma, soft texture, ease of spread, and semi-solid or gel consistency without stickiness. Physical homogeneity suggests a well-blended composition, and the pH values (6.32 for 0.5%, 6.30 for 2%, and 6.28 for 5%) fall within the ideal range, ensuring skin compatibility. Spreadability tests show the 5% concentration has the highest spreadability, while adhesive strength analysis indicates all concentrations meet the criteria for good cream adhesive strength. Furthermore, the efficacy of the lotion is assessed for moisturizing, smoothing, pore-shrinking, wrinkle-reducing, and collagen fiber density-increasing properties. Results indicate the 5% concentration is the most effective across these parameters. In conclusion, the ethanol extract lotion formulated from Moringa oleifera leaves holds promise for enhancing skin health, with the 5% concentration demonstrating the highest efficacy. This research contributes valuable insights to the development of natural skincare products with potential applications in dermatology and cosmetology, aligning with the growing interest in sustainable and effective skincare solutions.

Keywords: Lotion Preparation, Moringa Leaves, Skin Moisturizer.

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INTRODUCTION

Skin or also called integumentary tissue, which consists of epithelial, mesenchymal, glandular and neurovascular elements, is not only the covering of the body. The skin plays an important role in maintaining homeostasis. Integumentary tissue has a membrane with the lowest water permeability, thereby preventing skin dehydration in dry weather conditions ¹.

As the body's outermost organ, the skin is directly exposed to a pro-oxidant environment and triggers the formation of free radicals which are also called reactive oxygen species (ROS). The mechanism of damage caused by free radicals is quite complex, through a chain reaction that causes oxidative stress which causes cell damage and skin disorders ².

Dry skin or xerosis cutis is a skin condition that experiences a lack of water

content in the stratum corneum to below 10%. Dry skin is a problem that is often encountered, but is often ignored. Dry skin that is not cared for properly can become a source of infection, disrupt sleep due to itching, and even depression³. Dry skin will also look dull, feel rough, scaly, wrinkled, and less elastic than normal skin. In dry skin, a natural protection factor is available, namely Natural Moisturizing Factor (NMF). However, in certain conditions natural skin protection factors are not sufficient so additional non-natural protection is needed, namely by providing moisturizer. Moisturizers, also known as emollients, are the addition of water to the skin and increase the water binding capacity of the stratum corneum⁴. The stratum corneum layer is an interactive and dynamic structure, its function is to protect and maintain skin moisture. Moisturizer works effectively to treat dry skin and maintain smooth skin. Moisturizer is one of the products that is in great demand, even now moisturizing products have been developed using natural ingredients, such as plants and vitamins. In Indonesia itself, there are many natural plants that can be used as traditional ingredients. Recently, traditional ingredients have been widely used and are starting to be developed because the side effects caused by natural ingredients as ingredients for health and beauty are smaller compared to those from basic ingredients. chemicals. Apart from low side effects, using traditional ingredients can save costs because the price is more affordable⁵.

One natural ingredient that can be used as an anti-oxidant is Moringa oleifera leaves. In previous research it was reported that Moringa leaves contain seven times more vitamin C than oranges, ten times more vitamin A than carrots, seventeen times more calcium than milk, nine times more protein than yoghurt, fifteen times more potassium than bananas and iron are twice as large as spinach. The content of ascorbic acid, β -carotene, tocopherol acid, flavonoids, phenolics, carotenoids, hydroxynamite acid derivatives, and flavonoids means that Moringa leaves can be used as a source of natural antioxidants. This antioxidant activity causes Moringa leaves to be used as antiaging⁶.

Research by Susanty et al (2019) on testing the antioxidant activity of Moringa oleifera leaf extract using the DPPH method

stated that Moringa leaf extract has very strong antioxidant activity⁷. The beta carotene content in Moringa leaf extract also has potential as an antioxidant because it protects lipid membranes from peroxidation and at the same time stops chain reactions from free radicals. The mechanism of beta carotene as an antioxidant occurs indirectly, namely preventing lipid peroxidation in cell membranes by protecting cell membranes and maintaining cell membrane integrity with free radicals.

METHOD

This type of research is experimental research using a pre-test and post-test control group design. Experimental research is a research activity to control and observe research. Experiments were carried out to determine the formulation and effectiveness of Moringa oleifera leaf extract lotion in moisturizing, smoothing, shrinking pores and reducing skin wrinkles and to see the density of collagen fibers. The sample for this research was Moringa oleifera leaf extract lotion obtained from the online shop Shopee.

Making an extract from 600 grams of Moringa leaves soaked in 96% ethanol. In the percolation process, 600 grams of dry Moringa leaf powder were weighed and soaked first in ethanol solvent. Extraction is preceded by soaking the sample for at least 3 hours in a closed vessel, then the extraction process is continued in the percolator for 2 days, until the liquid dripping from the percolator is clear. Then a liquid extract is obtained. This liquid extract is vacuum distilled and then with the help of a rotary evaporator at a temperature of 70⁰ C a thick extract is obtained.

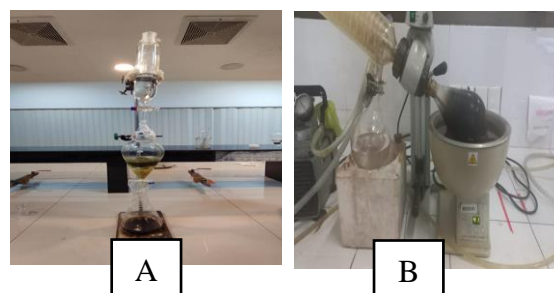


Figure 1. Image (A) is the percolation process and image (B) is the rotary evaporator process

The test animals that will later be used are male Wistar rats obtained from the

Laboratory of the Faculty of Pharmacy, University of North Sumatra, 25 rats weighing 150-250 g. Mice were kept in the Laboratory of the Faculty of Pharmacy, University of North Sumatra. The next treatment on the test animals was that the rat's hair was cut first, then shaved until the rat's skin was visible, and cleaned with 70% alcohol. Then the next step, after the mice were cleaned, the mice were treated with several concentrations of Moringa leaf lotion extract and positive and negative controls. Treatment was given every day during the research process. The procedures and procedures are: Each formula is tested for its effectiveness on the skin of rat test animals, within a period of 6 hours for 2 days of using the skin lightening lotion preparation. The cream application technique is that each formulation tested is taken in the amount of 1 fingertip unit (FTU) as a standard size, smeared on the skin of the test animal at each

concentration. Every time you start applying, the skin of the test animal is measured first and then recorded, all measurement results are recorded in a table.

RESULTS AND DISCUSSION

Test Results of Moringa Leaf Ethanol Extract Lotion Formulation (*Moringa oleifera*)

The following are the results of lotion formulation tests from ethanol extract of *Moringa oleifera* leaves which include organoleptic tests, homogeneity tests, pH tests, spreadability tests, and adhesiveness tests.

Organoleptic Test Results

The following are the results of organoleptic test observations on the Moringa leaf ethanol extract formulation in terms of color, aroma and shape.

Table 1. The result of organoleptic test observations on the preparatory formulation of kelor leaf ethanol extract (*Moringa oleifera*)

Testing	0,5%	2%	5%
Organoleptis -Color	Green	Green	Green
Organoleptis -Aroma	Characteristic smell	Characteristic smell	Characteristic smell
Organoleptis -Shape	Gel	Gel	Gel

Organoleptic examination did not show any color differences in the cream preparations with concentrations of 0.5%, 2% and 5%, all three of which had a green color due to Moringa leaf extract. The three concentrations of *Moringa oleifera* leaf ethanol extract produced produce a distinctive aroma. has a soft texture, spreads easily, forms a semi-

solid or gel consistency, and does not feel sticky.

Homogeneity Test Results

The following are the results of observations for the homogeneity test on the ethanol extract formulation of Moringa leaves (*Moringa Oleifera*)

Table 2. Results of homogeneity test observations on Moringa leaf ethanol extract preparation formulations (*Moringa oleifera*)

Testing	Result		
	0,5%	2%	5%
Homogeneous	Homogeneous	Homogeneous	Homogeneous

The homogeneity examination at the three concentrations of Moringa leaf ethanol extract formulation aims to observe the presence of coarse particles on the slide. The observation results showed that the three concentrations of cream formulation formulations were physically homogeneous,

this shows that the ingredients used in making the cream were mixed perfectly.

pH Test Results

Testing the pH of the preparation is carried out with the aim of determining the

acidity level of the preparation. If the pH of the preparation is low or acidic it will cause irritation to the skin, if the pH of the preparation is high or alkaline it will cause dry

skin when applied. The results of testing the pH of the Moringa leaf ethanol extract formulation can be seen in Table 4.3 below.

Table 3. pH Examination Results

Setup	pH Measurement Results			
		pH		Average \pm STD
0,5%	6,32	6,32	6,31	6.32 \pm 0.06
2%	6,30	6,30	6,29	6.30 \pm 0.06
5%	6,28	6,28	6,28	6.28 \pm 0.00

Table 3 explains the results of the pH test on the Moringa leaf ethanol extract preparation formulation. From the table it can be seen that the 0.5% concentration has an average pH and STD value of 6.32 ± 0.06 , a 2% concentration has an average pH value and The STD is 6.30 ± 0.06 , and the 2% concentration has an average pH and STD value of 6.28 ± 0.00 . From these results it can be said that the pH value is still within the ideal pH range. According to SNI 16-4399-1996 in, the ideal pH of a cream formulation is in accordance with the pH of the skin, which is

in the range of 4.5 - 8.0. If the pH of the cream does not match the pH of the skin, it will cause skin irritation.

Spreadability Test Results

The spreadability test is carried out to determine the base's ability to spread on the skin surface when applied. A good base spreading ability will make it easier when the cream preparation is applied to the skin. The spreadability test results can be seen in table 4 below.

Table 4. Spread Force Test Results on Kelor Leaf Ethanol Extract Preparation (*Moringa oleifera*)

Load mass	Dispersion Force Diameter (cm)		
	0,5%	2%	5%
0	4,2	4,4	4,8
100	4,7	5	5,2
125	5	5,3	5,5

Table 4 explains the results of the spreadability test on Moringa leaf ethanol extract preparations. From the results of observations it can be seen that the 5% concentration has the most dominant or greatest spreadability value compared to concentrations of 0.5% and 2%. From these results it can be concluded that the more The greater the concentration of Moringa leaf ethanol extract preparation, the greater the resulting distribution area due to an increase in

viscosity. The wider the spreading area produced by a cream, the better the spreading ability of the cream will be when applied.

Adhesion Test Results

The adhesion test is intended to determine the ability of the Moringa leaf ethanol extract preparation to adhere to the applied area, namely the skin. The adhesive strength test results of the three concentrations can be seen in table 5 below.

Table 5. Adhesion Test Results

Concentration	Adhesion (Seconds)			Average
	1	2	3	
0,5%	42,57	41,31	42,29	42,05
2%	55,55	54,62	57,35	55,84
5%	77,68	79,91	75,58	77,72

Table 5 explains the results of the adhesion test on the ethanol extract of Moringa leaves. From the results of the observations it was found that the average value of adhesion at a concentration of 0.5% was 42.05, at a concentration of 2% the average was 55.84 and at a concentration of 5% the average was the average is 77.72%. From the results of the average value obtained from the three concentrations above, the three concentrations

in this study fall into the adhesive strength range of 2.00 – 300.00 seconds. The requirement for good cream adhesion is 2.00 – 300.00 seconds (Roosevelt et al., 2018). From these results, the three concentrations in this study meet the requirements to be a preparation for moisturizing the skin, the greater the concentration, the greater the adhesive power.

Table 6. Results of Observation of the Effectiveness of Moringa oleifera Ethanol Extract Lotion Formulation in Moisturizing the Skin

Group	Mean + SD	p-Value	Information
Concentration: 0.5%	18,00 + 1,000	0,119	Data Normal
Concentration: 2%	26,42 + 1,304	0,421	Data Normal
Concentration: 5%	27,50 + 4,000	0,125	Data Normal
Negative Control	10,87± 1,208	0,814	Data Normal
Positive Control	26,58 + 3,775	0,814	Data Normal

Information :

Negative control: Base cream or no treatment

Positive control: Citra Hand Body Lotion

Table 6 shows the results of the moisture test of the Moringa leaf extract lotion, it can be seen that the 0.5% concentration had a percent increase of 18%, the 2% concentration had a percent increase of 26.42% and for the concentration 5% has a percent increase of 27.50%. From these results, it can be seen that the highest percent increase in the effectiveness of skin moisture from the Moringa leaf extract lotion preparation was at

a concentration of 5% with a standard deviation value of 4,000.

The normality test using the Shapiro Wilk test. From the results of the normality test on the skin moisture data, it can be seen that the p value for all research groups has a p value > 0.05, which means that the data for all skin moisture concentration groups is normally distributed.

Table 7. Test Results of the Effectiveness of Moringa oleifera Ethanol Extract Lotion Formulation in Moisturizing the Skin

Group	p-Value
Concentration: 0.5%	0,000
Concentration: 2%	0,000
Concentration: 5%	0,011

Table 7 is the result of testing the effectiveness of the Moringa oleifera (Moringa oleifera) ethanol extract lotion formulation in moisturizing the skin. The research results show that the p value for each group in this

study, namely concentrations of 0.5%, 2% and 5%, are all <0.05 which shows that the ethanol extract of Moringa oleifera leaves at concentrations of 0.5%, 2% and 5% is effective in moisturizing the skin.

Table 8. Results of Observation of the Effectiveness of Moringa Oleifera Ethanol Extract Lotion Formulation in Smoothing the Skin

Group	Mean + SD	p-Value	Information
Concentration: 0.5%	22,02 + 1,000	0,083	Data Normal
Concentration: 2%	30,46 + 1,304	0,135	Data Normal
Concentration: 5%	44,44 + 4,000	0,146	Data Normal

Negative Control	11,69±1,466	0,314	Data Normal
Positive Control	48,13 ± 5,988	0,076	Data Normal

Description

Negative control: Base cream or no treatment

Positive control: Citra Hand Body Lotion

Table 8 shows the results of the mice's skin smoothness, it can be seen that all formula groups showed an increase in skin smoothness with an average percentage increase, concentration 0,5% of 22.02%, concentration 2% of 30.46%, and concentration 5% of 44.44% where at a concentration of 5% showed higher average increase in skin smoothness than other concentration, namely

44.44% with a standard deviation value of 4,000.

The results of the normality test using the Shapiro Wilk test. From the results of the normality test on skin smoothness data, it can be seen that the p value for all research groups has a p value > 0.05, which means that the data for all concentration groups in skin smoothing is normally distributed.

Table 9. Test Results of the Effectiveness of Moringa oleifera Ethanol Extract Lotion Formulation in Smoothing the Skin

Group	p-Value
Concentration: 0.5%	0,000
Concentration: 2%	0,000
Concentration: 5%	0,000

Table 14 is the result of testing the effectiveness of Moringa oleifera lotion formulation in smoothing the skin, from the results of the study showed that the p value of each research group was 0.5%, 2% and 5%

concentrations < 0.05 which showed that Moringa leaf ethanol extract (Moringa oleifera) at concentrations of 0.5%, 2% and 5% had effectiveness in smoothing the skin.

Table 10. Results of Observation of the Effectiveness of Moringa Oleifera Ethanol Extract Lotion Formulation in Shrinking Skin Pores

Group	Mean + SD	p-Value	Information
Concentration: 0.5%	22,03 ± 0,548	0,106	Data Normal
Concentration: 2%	30,05 ± 0,894	0,096	Data Normal
Concentration: 5%	37,22 ± 2,191	0,607	Data Normal
Negative Control	8,23±0,993	0,967	Data Normal
Positive Control	44,51 ± 6,304	0,490	Data Normal

Information :

Negative control : Base cream or no treatment

Positive control : Citra Hand Body Lotion

Table 10 explains the results of observations on the effectiveness of ethanol extract of Moringa oleifera leaves in shrinking the skin. After using the Moringa oleifera (Moringa oleifera) ethanol extract lotion formulation, all formula groups showed skin pore reduction with an average percentage, concentration 0,5% of 22.03%, concentration 2% of 30.05%, and concentration 5% of 37.22% where in a concentration of 5% showed

the highest average skin pore reduction, namely, 37.22% with a standard deviation of 2.191.

The results of the normality test using the Shapiro Wilk test, from the results of the normality test on skin pore reduction data, it can be seen that the p value of all research groups has a p value of > 0.05 which means that the data on all concentration groups in the skin pore are normally distributed.

Table 11. Test Results of the Effectiveness of Moringa oleifera Ethanol Extract Lotion Formulation in Shrinking Skin Pores

Group	p-Value
Concentration: 0.5%	0,000
Concentration: 2%	0,000
Concentration: 5%	0,000

Table 11 is the result of testing the effectiveness of Moringa oleifera lotion formulation in shrinking skin pores, from the results showed that the p value of each study group was 0.5%, 2% and 5% concentrations <

0.05 which showed that Moringa oleifera ethanol extract at concentrations of 0.5%, 2% and 5% had effectiveness in shrinking skin pores.

Table 12. Results of Observation of the Effectiveness of Moringa Oleifera (Moringa oleifera) Ethanol Extract Lotion Formulation in Shrinking Wrinkles

Group	Mean + SD	p-Value	Information
Concentration: 0.5%	18,32 + 1,095	0,135	Data Normal
Concentration: 2%	27,13 + 1,140	0,814	Data Normal
Concentration: 5%	34,92 + 1,517	0,144	Data Normal
Negative Control	6,60 ± 0,944	0,135	Data Normal
Positive Control	43,43 ± 6,898	0,814	Data Normal

Description

Negative control: Base cream or no treatment

Positive control: Citra Hand Body Lotion

Table 12 describes the effectiveness of Moringa oleifera ethanol extract in reducing wrinkles. After the use of Moringa oleifera lotion formulation, all formula groups showed a reduction in wrinkles on the skin with an average percentage, concentration 0,5% by 18.32%, concentration 2% by 27.13%, and concentration 5% by 34.92% where at a concentration of 5% showed the highest average reduction in skin wrinkles, namely,

34.92% with a standard deviation value of 1.517.

The results of the normality test using the *shapiro wilk* test, from the results of the normality test on the data reducing skin wrinkles, it can be seen that the p value of all research groups has a p value of > 0.05 which means that the data on all concentration groups in reducing wrinkles are normally distributed.

Table 13. Test Results of the Effectiveness of Moringa oleifera Ethanol Extract Lotion Formulation in Reducing Wrinkles

Group	p-Value
Concentration: 0.5%	0,000
Concentration: 2%	0,000
Concentration: 5%	0,000

Table 13 is the result of the test of the effectiveness of Moringa oleifera lotion formulation in reducing skin wrinkles, from the results of the study showed that the p value of each study group was a concentration of 0.5%,

2% and 5% in total < 0.05 which showed that Moringa leaf ethanol extract (Moringa oleifera) at concentrations of 0.5%, 2% and 5% had effectiveness in reducing skin wrinkles.

Table 14. Test Results of the Effectiveness of Moringa oleifera Ethanol Extract Lotion Formulation in Increasing the Density of Collagen Fibers

Group	Mean + SD	p-Value
Concentration: 0.5%	3,60 ± 0,548	
Concentration: 2%	4,00 ± 0,000	0,001
Control 5%	4,40 ± 0,548	

Table 26 shows the results on the effectiveness of *Moringa oleifera* lotion formulation in increasing collagen fiber density known $P - Value$ $0.001 < 0.05$, so it can be concluded that *Moringa oleifera* ethanol extract in concentrations of 0.5%, 2% and 5% is effective in increasing collagen fiber density, and the effectiveness of each *Moringa* leaf

ethanol extract group differs in Increasing the density of collagen fibers, judging from the average value for *Moringa* leaf ethanol extract, the most effective in increasing collagen fiber density is *Moringa* leaf ethanol extract with an average concentration of 5% of 4.40 with a standard deviation value of 0.548.

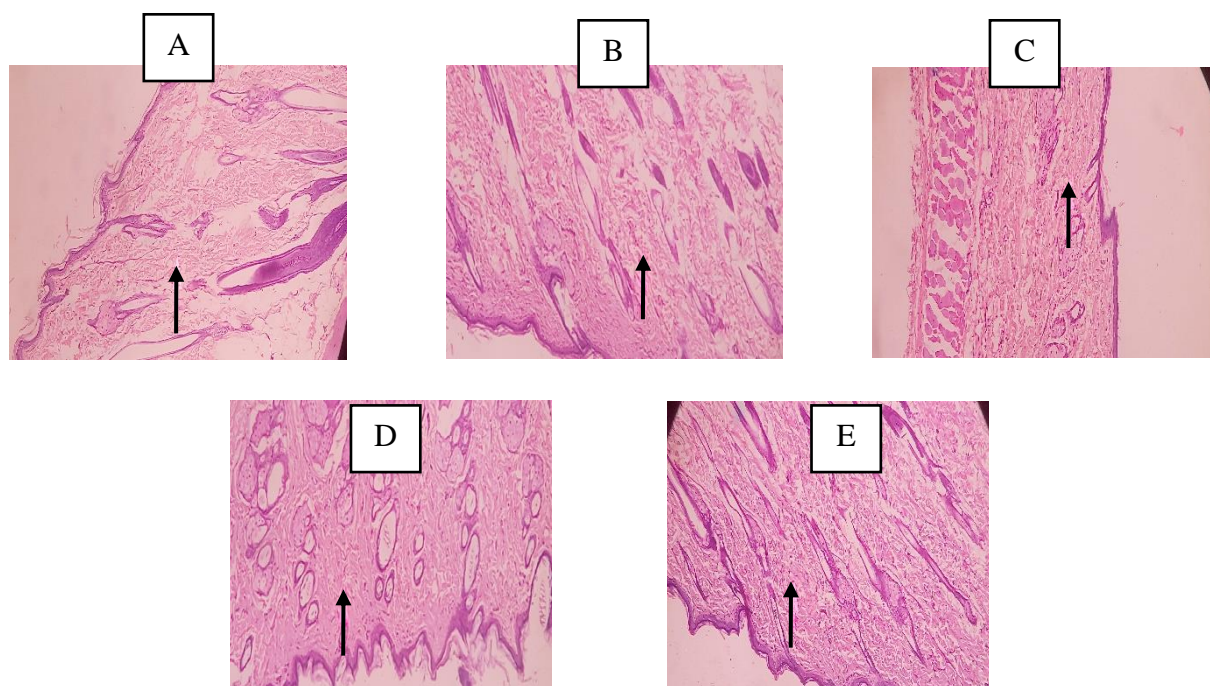


Figure 2. Differences in histopathological features in groups of negative control (A), mice using 0.5% concentration extract lotion (B), mice using 2% concentration extract lotion (C), mice using 5% extract lotion (D) and mice with positive control (E). (A) In these mice, the collagen structure in the dermis is very thin and spread with a collagen density ranging around 10-20%. (B) In this mouse model, the collagen fibers are still thin but the distribution of the collagen density is starting to become denser at around 40-50%. (C) In this mouse model, collagen fibers appear to begin to thicken and spread densely, ranging from 50-60%. This picture is similar to the histopathological picture in mice (D), collagen fibers look thicker with distribution around 80-90%. (E) the collagen fibers are thick and very densely distributed with collagen distribution $>90\%$.

The Effectiveness of *Moringa oleifera* Ethanol Extract Lotion Formulation in Moisturizing the Skin

The results of research regarding the effectiveness of *Moringa oleifera* (*Moringa oleifera*) leaf ethanol extract lotion formulations in moisturizing the skin show that the highest percent increase in the effectiveness of skin moisture from the *Moringa* leaf extract lotion preparation was at a concentration of 5%.

The results of the research show that the p value of each research group <0.05 , which indicates that the ethanol extract of *Moringa oleifera* leaves at a concentration of 0.5%, 2% and 5% is effective in moisturizing the skin. Based on the ANOVA output extract with a concentration of 5% has an average of 27.50 with a standard deviation value of 4.000. The same results were also obtained from research conducted by Sausan (2020) entitled using *Moringa* leaf extract lotion on skin moisture, where the results showed that there was an influence between using *Moringa* leaf extract lotion on skin moisture⁸.

From these results, it can be concluded that the greater the amount of extract added to

the cream base, the greater the vitamin E content in the Moringa leaf extract cream. Vitamin E is able to maintain water bonds in the skin, so that skin elasticity and flexibility is maintained. Apart from that, vitamin E also provides protection to the skin from the bad effects of ultraviolet rays, so that moisture is maintained and the skin does not dry out. Moringa leaves can also treat dry skin due to insufficient intake of nutrient B2. Moringa leaves contain nutrient B2 which is useful for treating dry skin, maintaining skin moisture so that regular consumption of Moringa leaves can maintain skin moisture ⁹.

Based on test results, Moringa Oleifera leaves with a concentration of 7.5% have an SPF value of 39.89, which is a good value for skin care against sunlight. Moringa leaves (Moringa Oleifera) contain phenolics which include flavonoids, flavonol, chlorogenic acid, elagic acid, and ferulic acid, and antioxidants which include vitamin A, vitamin B, vitamin C. Phenolics provide the best protection against enzymes that damage collagen and elastin in skin, β -carotene has been able to increase protein and collagen as well as DNA content and increase the thickening of the epidermis. Vitamin B can maintain skin moisture by drawing water into the stratum corneum to soften the skin ¹⁰.

Effectiveness of Moringa Leaf (Moringa oleifera) Ethanol Extract Lotion Formulation in Smoothing Skin

The results of research regarding the effectiveness of Moringa oleifera (Moringa oleifera) leaf ethanol extract lotion formulations in smoothing the skin showed that all formula groups showed an increase in skin smoothness where the 5% concentration showed the highest average increase in skin smoothness, namely 44.44% with a standard deviation value of 4,000.

The results of the research show that the p value of each research group, namely concentrations of 0.5%, 2% and 5%, are all <0.05 , which indicates that the ethanol extract of Moringa oleifera leaves at a concentration of 0.5%, 2% and 5% is effective in smoothing the skin. B The results of this study are in line with research which shows that ethanol extract cream formulas can be used to soften the skin. ¹¹.

Moringa leaves contain various chemical compounds which are classified as

antioxidants consisting of tannins, flavonoids, steroids, alkaloids and quercetin which are beneficial for body and skin health ¹². Apart from its antioxidant content, Moringa leaves also have a variety of nutritional content consisting of protein, minerals and beta carotene which are beneficial for skin health ¹³.

Effectiveness of Moringa Leaf (Moringa oleifera) Ethanol Extract Lotion Formulation in Shrinking Pores

The results of research regarding the effectiveness of the Moringa oleifera leaf ethanol extract lotion formulation in shrinking skin pores showed that after using the Moringa oleifera leaf ethanol extract lotion formulation, all formula groups showed skin pore reduction where at a concentration of 5% it showed the highest average skin pore reduction, namely, 37.22% with a standard deviation value of 2.191.

The results of the research show that the p value of each research group, namely concentrations of 0.5%, 2% and 5%, is all <0.05 , which shows that the ethanol extract of Moringa oleifera leaves at a concentration of 0.5%, 2% and 5% is effective in shrinking skin pores. The results of this study are in accordance with research which shows that Moringa leaves also contain vitamins A, B1, B2, C and E. Such as the benefits of Moringa leaves, namely hydrating dry skin, treating acne, reducing excess oil on the face, reducing signs of aging, forming collagen. natural on the skin, removes dead skin cells, shrinks skin pores, removes black spots ¹⁴.

The Moringa plant (Moringa oleifera) is a type of tropical plant that is easy to grow in tropical areas like Indonesia. Moringa leaves grow easily in a variety of soil conditions. Moringa leaves contain many high antioxidants because Moringa leaves contain ascorbic acid, flavonoids, phenolics and caratenoids. Moringa leaves can be used as a basic ingredient in making cosmetics. Masks are one of the cosmetics to make facial skin brighter.

Pores can become enlarged due to sun exposure, acne scars and so on. To keep your face clean, apply a Moringa leaf mask to shrink the pores so that they don't become a place for dirt and blackheads to accumulate, or even become a place for acne to grow ¹⁵. The anti-inflammatory and antibacterial content in Moringa leaves helps reduce acne. Moringa

leaves also help clean pores and reduce excess oil production, so the skin becomes cleaner and free from acne. Moringa leaves are effective in shrinking pores on the face. This is because the content of vitamin A and vitamin C in Moringa leaves is quite large. These two vitamins will then help remove dirt from the pores and help reduce blockages. So the skin pores will become smaller ¹⁶.

Effectiveness of Moringa Leaf (Moringa oleifera) Ethanol Extract Lotion Formulation in Reducing Wrinkles

The results of research regarding the effectiveness of the Moringa oleifera leaf ethanol extract lotion formulation in reducing skin wrinkles showed that after using the Moringa oleifera leaf ethanol extract lotion formulation, all formula groups showed a reduction in skin wrinkles where at a concentration of 5% it showed the highest average reduction in skin wrinkles, namely, 34.92% with a standard deviation value of 1.517.

The results of the research show that the p value of each research group, namely concentrations of 0.5%, 2% and 5%, is all <0.05 , which shows that the ethanol extract of Moringa oleifera leaves at a concentration of 0.5%, 2% and 5% is effective in reducing skin wrinkles. This research is in line with research conducted by Baldissarotto et al., (2018) which states that Moringa oleifera leaves can be used as a UV filter, antioxidant and antihyperproliferative as well as reducing wrinkles on the skin, so Moringa leaves can be used to protect against skin aging, brightens the skin, protects against radiation exposure, protects against skin damage, moisturizes the skin and can also be used to rejuvenate the skin. These various uses make Moringa leaves suitable for use as an additional ingredient in moisturizers ¹⁷.

Moringa oil and Moringa leaves can be used for facial masks because they can prevent wrinkles on the face and fight skin damage due to free radicals. Moringa leaves can tighten the skin and make the face youthful ¹⁸. Moringa leaves show extraordinary anti-aging effects, Moringa leaf extract is a very promising natural source of anti-aging skin ingredients, which can be further explored in the cosmetics industry and cosmetics that combat skin aging and wrinkles ¹⁹.

Effectiveness of Moringa Leaf (Moringa oleifera) Ethanol Extract Lotion Formulation in Increasing Collagen Fiber Density

The results of research on the effectiveness of the ethanol extract lotion formulation of Moringa oleifera leaves in increasing the density of collagen fibers have been completed, the results of which show that the effectiveness of the ethanol extract lotion formulation of Moringa oleifera leaves in increasing the density of collagen fibers is known to have a P value of $0.001 < 0,05$, so it can be concluded that the ethanol extract of Moringa oleifera leaves in concentrations of 0.5%, 2% and 5% is effective in increasing the density of collagen fibers, and the effectiveness of each group of Moringa leaf ethanol extract is different in increasing the density of collagen fibers, as seen From the average value for Moringa leaf ethanol extract, the most effective in increasing collagen fiber density is Moringa leaf ethanol extract with a concentration of 5%, the average is 4.40 with a standard deviation value of 0.548.

That giving ethanol extract of Moringa oleiferadose 50 mg/day and 100 mg/day can increase density. Collagen fibers 5 days after incision in deep wounds of Rattus novergicus. Moringa oleifera is a plant that is often found in Indonesia and is one of the traditional medicines. In Indonesia, Moringa oleifera is usually used as a hedge plant to border the land. Moringa oleifera has therapeutic properties and has been used by ancient people to care for the skin and also has properties in the wound healing process. Moringa oleifera can speed up the process of compacting collagen fibers and closing wounds ²⁰.

CONCLUSION

The three concentrations of Moringa oleifera leaf ethanol extract produced produce a distinctive aroma, have a soft texture, spread easily, form a semi-solid or gel consistency, and do not feel sticky. The observation results show that the three cream formulation concentrations are physically homogeneous, this shows that the ingredients used in making the cream are mixed perfectly. The 0.5% concentration has an average pH and STD value of 6.32 ± 0.06 , a 2% concentration has

an average pH and STD value of 6.30 ± 0.06 , and a 2% concentration has an average value. The pH and STD are 6.28 ± 0.00 . From these results it can be said that the pH value is still within the ideal pH range. A concentration of 5% has the most dominant or greatest spreadability value compared to concentrations of 0.5% and 2%. From these results it can be concluded that the greater the concentration of the Moringa leaf ethanol extract preparation, the greater the area of distribution produced due to an increase viscosity. The average adhesion value at a concentration of 0.5% is 42.05, at a concentration of 2% the average is 55.84 and at a concentration of 5% the average is 77.72%. From the results of the average value obtained from the three concentrations above, the three concentrations in this study fall into the adhesive strength range of 2.00 - 300.00 seconds, where this adhesive strength is a requirement for good cream adhesive strength. Lotion formulation of ethanol extract of Moringa leaves (*Moringa oleifera*) in 0.5%, 2% and 5% preparation are effective in moisturizing the skin. The 0.5%, 2% and 5% ethanol extract lotion formulation of Moringa oleifera leaves are effective in smoothing the skin. Lotion formulation of ethanol extract of Moringa leaves (*Moringa oleifera*) in 0.5%, 2% and 5% preparation are effective in shrinking pores. The 0.5%, 2% and 5% ethanol extract lotion formulation of Moringa oleifera leaves are effective in reducing wrinkles. Lotion formulation of ethanol extract of Moringa leaves (*Moringa oleifera*) in 0.5%, 2% and 5% preparation are effective in increasing the density of collagen fibers. The concentration of Moringa oleifera leaf extract in the lotion formulation that are effective in moisturizing the skin, smoothing the skin, shrinking skin pores, reducing wrinkles and increasing collagen fibers are a concentration of 5%.

REFERENCES

1. Camilion J V, Khanna S, Anasseri S, Laney C, Mayrovitz HN. Physiological, pathological, and circadian factors impacting skin hydration. *Cureus*. 2022;14(8).
2. Hussain F, Kayani HUR. Aging-Oxidative stress, antioxidants and computational modeling. *Heliyon*. 2020;6(5).
3. Augustin M, Wilsmann-Theis D, Körber A, Kerscher M, Itschert G, Dippel M, et al. Diagnosis and treatment of xerosis cutis—a position paper. *JDDG J der Dtsch Dermatologischen Gesellschaft*. 2019;17:3–33.
4. Frantz M, Rozot R, Marrot L. NRF2 in dermo-cosmetic: From scientific knowledge to skin care products. *BioFactors*. 2023;49(1):32–61.
5. Bilal M, Mehmood S, Iqbal H. The beast of beauty: environmental and health concerns of toxic components in cosmetics. *Cosmetics*. 2020;7(1):13.
6. Ercan K, Geceseffa OF, Taysi ME, Ali Ali OA, Taysi S. *Moringa oleifera*: a review of its occurrence, pharmacological importance and oxidative stress. *Mini Rev Med Chem*. 2021;21(3):380–96.
7. Susanty S, Ridnugrah NA, Chaerrudin A, Yudistirani SA. Aktivitas antioksidan ekstrak daun kelor (*Moringa Oleifera*) Sebagai zat tambahan pembuatan moisturizer. *Pros Semnastek*. 2019
8. Utami DE. Pengaruh Pemakaian Losion Ekstrak Daun Kelor (*Moringa oleifera*) terhadap Kelembapan Kulit. 2020
9. Marhaeni LS. Daun Kelor (*Moringa oleifera*) sebagai Sumber Pangan Fungsional dan Antioksidan. *AGRISIA-Jurnal Ilmu-Ilmu Pertan*. 2021;13(2).
10. Nieman EA. To B or not to B? The B vitamins and their influence on the body's largest organ. 2022;
11. Ali A, Akhtar N, Chowdhary F. Enhancement of human skin facial revitalization by moringa leaf extract cream. *Adv Dermatology Allergol Dermatologi Alergol*. 2014;31(2):71–6.
12. Shih MC, Chang CM, Kang SM, Tsai ML. Effect of different parts (leaf, stem and stalk) and seasons (summer and winter) on the chemical compositions and antioxidant activity of *Moringa oleifera*. *Int J Mol Sci*. 2011;12(9):6077–88.
13. Islam Z, Islam SM, Hossen F, Mahtab-ul-Islam K, Hasan MR, Karim R. *Moringa oleifera* is a prominent source

- of nutrients with potential health benefits. *Int J Food Sci.* 2021;2021.
14. El Sohaimy SA, Hamad GM, Mohamed SE, Amar MH, Al-Hindi RR. Biochemical and functional properties of *Moringa oleifera* leaves and their potential as a functional food. *Glob Adv Res J Agric Sci.* 2015;4(4):188–99.
 15. Luna JA, Saleah SA, Kim H, Kang D, Seong D, Kim Y, et al. A Case Report on Skin Sebum Extraction Using High Lateral Resolution Spectral-Domain Optical Coherence Tomography. In: *Photonics.* MDPI; 2022. p. 30.
 16. Dixit S, Tripathi A, Kumar P. Medicinal properties of *Moringa oleifera*: A review. *Int J Educ Sci Res Rev.* 2016;3(2):173–85.
 17. Baldisserotto A, Buso P, Radice M, Dissette V, Lampronti I, Gambari R, et al. *Moringa oleifera* leaf extracts as multifunctional ingredients for “natural and organic” sunscreens and photoprotective preparations. *Molecules.* 2018;23(3):664.
 18. Zhao S, Zhang D. Supercritical fluid extraction and characterisation of *Moringa oleifera* leaves oil. *Sep Purif Technol.* 2013;118:497–502.
 19. Xu Y, Chen G, Guo M. Potential anti-aging components from *Moringa oleifera* leaves explored by affinity ultrafiltration with multiple drug targets. *Front Nutr.* 2022;9:854882.
 20. Sabastian G, Dahlia L, Mahrizal M, Mulyoutami E, Roshetko JM, Purnomosidhi P, et al. Ethnobotanical use and commercial potential of *Moringa oleifera* in Indonesia: an underused and under-recognized species. In: *I International Symposium on Moringa 1158.* 2015. p. 349–56.

Original Article

Dynamic System Model Using the Combi (Communication for Behavioral Impact) Method Approach to Early Detection of Stunting Neonates in Pregnant Women North Sumatra

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ABSTRACT

This study addresses the persistent nutritional challenge of stunting in Indonesia, often misconceived as solely hereditary. Research indicates that genetic factors contribute only 15%, emphasizing the significance of nutritional intake, growth hormones, and maternal and toddler health in stunting. The research aims to identify and prevent early stunting in neonates, aligning with the government's goal to combat stunting by 2025. Using an observational research design and dynamic system modeling through Stella software, the study develops an effective strategy model for reducing stunted neonates in the future. Simulation experiments provide reliable insights into dynamic systems, predicting various scenarios based on input data. Results highlight the importance of enhancing Antenatal Care (ANC) standards, iron supplementation, additional nutrition, and effective case management for pregnant women. Implementation of these factors at low to medium levels could potentially reduce stunted neonates by 25%, reaching 44% at a high level compared to current conditions. The study further recommends an empowerment model for pregnant women, involving family assistance in managing highly nutritious food based on local wisdom. This holistic approach addresses the root causes of stunting, contributing to the success of stunting prevention programs in Indonesia. The research emphasizes the multifactorial nature of stunting and provides valuable insights for policymakers and healthcare practitioners to develop comprehensive strategies for effective intervention and prevention.

Keywords: Stunting, Dynamics, Early Detection, Combi.

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INTRODUCTION

Stunting is a disturbance of growth physique, which has already passed, forming a decrease in the speed of growth in human development, which is impacted by nutrition ¹. Food needs more results from no balance factors

growth (internal and external factors) ². Nutrition can occur during some periods of development, such as pregnancy, period perinatal, breastfeeding, infancy, and growth (childhood). This, too, can be caused by deficiencies in various nutrients, for example, micronutrients, proteins, or energy ³.

The country develops, and Asia is known that one in three children experiences stunting, with an incidence reaching 46%, followed by the African region at 38%. The incidence rate of checking in the country developed, and people experiencing poverty reached 32%. Indonesia is the fifth country with a high prevalence of child stunting, 7.8 million, after India, China, Nigeria and Pakistan ⁴.

Stunting data based on Basic Health Research (Riskesdas) results in 2021, namely 37.2%, decreasing to 30.8% in 2020. In 2021, the prevalence of concise growth in toddlers was 18.0%, a decline from 11.5% in 2020. However, the prevalence of short-on toddlers increased from 19.2% in 2020 to 19.3% in 2021. Overall Nationally, the highest majority of very short and short (first order) is occupied by East Nusa Tenggara (NTT) at 42.6%, West Sulawesi at 39.8% and the Province North Sumatra is as big as 37.3% ⁵.

According to the Indonesian Ministry of Health in 2021, the Status Monitoring Survey Nutrition data shows that stunting for the 2018-2021 period is that in 2018 it was 28.9%, in 2019 it was 29%, in 2020 it was 27.5% and in 2021 it was 29.6%. Means from 2019 happen increase compared to 2018, decrease on year 2020 And go on Again on year 2021 ⁶.

The North Sumatra Health Profile in 2019 still found problems related to toddler nutrition, namely Malnutrition at 0.13%, Malnutrition at 1.98%, Short Toddlers at 2.61% and Underweight Toddlers at 2.13%. The prevalence of malnutrition in 2018 and 2019 has the same figure, namely 0.13%, the prevalence of malnutrition compared to 2018 was 1.66% and in 2019 it was 1.98%, there was an increase of 0.32%, for short-term toddlers. In 2018 it was 1.51% and in 2019 it was 2.61%, there was a significant increase of 1.1%, while for underweight toddlers in 2018 it was 2.33% and in 2019 it was 2.13%, there was a decrease of 0.2 % (7). In Medan City Based on the data obtained for malnourished toddlers, as much data was obtained 0.11%, toddlers with wasting as much as 0.46%, and toddlers with stunting 0.3% ⁷.

Energy and substance intake nutrition No adequate, as well as disease infection is a factor that plays a major role in the problem of stunting. Quantity and the quality of protein intake has an

effect on plasma insulin growth levels factor I (IGF-I) and also bone matrix proteins and growth factors which plays an important role in bone formation. Apart from that, in the Lancet Series explains several micronutrients that are very important for preventing the occurrence of stunting, namely vitamin A, zinc, iron and iodine. However, some substances Other micronutrients such as calcium and phosphorus also play a very important role growth linear child ⁸. Status nutrition Mother pregnant very influence circumstances health and development fetus. Disturbance growth in content can causes weight low birth. Research in Nepal shows that babies with heavy born low have risk Which more tall For become stunting ⁹. Long born baby Also relate with incident stunting. Research in Kendal shows that babies with short birth lengths risky tall to incident stunting on toddler ¹⁰. Factor other Which relates with stunting is intake breast milk Exclusive on toddler. Research in Ethiopia South prove that toddler Which No get breast milk exclusive for 6 month risky tall experience stunting ¹¹. Indonesia has set targets in accordance with the SDGs Program in 2030 in the health sector, namely through efforts to improve nutrition and health quality in combating the prevalence of stunting. Achieving the SDGs goals must be prepared from now by coordinating across sectors. Over the last 20 years, handling of the stunting problem has been very slow, globally, the percentage of children whose growth is stunted has decreased by only 0.6% per year since 1999. It is predicted that if this continues, then 15 years later it is estimated that 450 million children will suffer from it. Delayed growth or stunting affects children's level of intelligence and quality of life and will have an impact on the economy of a country because it is influenced by unproductive human resources. The causal factor is thought to be a lack of cross-sectoral roles in preventing stunting, so there is a need to strengthen the role through convergent actions to accelerate stunting reduction in each region. There are two provinces where the prevalence of stunting is very high, namely >40%, namely North Sumatra and South Sumatra. Based on these prevalence figures, it is known that the incidence of stunting in Sumatra is high.

Based on these prevalence figures, it is known that the incidence of stunting in Sumatra

is high. The prevalence of stunting (very short and short) in North Sumatra Province in 2018 was 32.5 percent. The prevalence rate for shortness in Labuhan Batu Regency in 2018 was 16.31% short and 21.06% very short. To achieve the SDGs target of reducing infant, under-five and maternal mortality and overcoming disease, it is necessary to have the managerial capacity of public health service institutions both at the central and regional levels which is very limited so that various basic health service programs do not run effectively. Public health development requires professional staff who are able to manage various health service programs including maternal and child health priorities which are the focus of resolution in the next five year period including increasingly complex and widespread public health problems, such as high infant, child and maternal mortality and the incidence of stunting and wasting in children which has an impact on children's productivity which will decrease due to

impaired growth and development as well as various disease complications occurring in children.

METHOD

In this research, researchers used an observational research design with a dynamic system modeling approach, namely collecting data to design a model using software Stella , which aims to describe and predict the future incidence of neonatal stunting in pregnant women. Model Analysis carried out with simulation experiments. A series of logic related to simulations can provide sufficient results, reliable (although not exact) information about the properties of models that describe and analyze important concepts of dynamic systems in order to predict various cases or situations through input research data or literature data.

RESULTS

Table 1. Distribution of respondents based on characteristics in the treatment group and control group of pregnant women

Characteristics	Group					
	Treatment		Control		Amount	
	N	%	N	%	N	%
Age						
< 20 Years	1	3.7	3	11.1	4	7.4
20 – 40 Years	7	25.9	11	40.8	18	33.3
>40 Years	19	70.4	13	48.1	32	59.3
Parity						
<4 times	13	48.1	14	51.9	27	50
>4 times	14	51.9	13	48.1	27	50
Education						
elementary school	1	3.7	5	18.5	6	11.1
Junior High School	8	29.6	7	25.9	15	27.8
Senior High School	18	66.7	14	51.9	32	59.3
PT	-	-	1	3.7	1	1.8
Work						
Doesn't work	5	18.5	8	29.7	13	24.1
Private	16	59.3	10	37	26	48.1
Civil servants	6	22.2	9	33.3	15	27.8
ANC frequency						
<4 Times	18	66.7	11	40.7	29	53.7
>4 Times	9	33.3	16	59.3	25	46.3

Based on the table above, the results of the univariate analysis show that according to age characteristics in the treatment group, 19 respondents (70.4%) were aged > 40 years in the treatment group, while 13 respondents (70.4%) were in the control group. Meanwhile, education in the treatment group had more than 18 (66.7%) high school education levels and 14 (51.9%) respondents in the control group. Based on the occupation of the respondents, 16 (66.7%) respondents had more private jobs. Meanwhile,

the controls were 10 (37%) respondents. Based on ANC frequency of less than 4 times in the treatment group there were 18 (66.7%) respondents, while the controls were more than 4 times as many as 16 (59.3%).

Based on the 10 ANC Standards showing the results of statistical tests before and after the assistance that pregnant women must receive every time they visit health services, there are 4 (four) antenatal care standards that have not been consistently implemented as in the table below:

Table 2. Distribution based on ANC standards before and after the assistance intervention for pregnant women at high risk of stunting neonates.

ANC standard (score 0-1)	Treatment		Control	
	Pre-test	Post-test	Pre-test	Post-test
	Mean±	Mean±	Mean±	Mean±
Standard 1	0.98	1.00	1.00	1.00
Standard 2	0.98	1.00	1.00	1.00
Standard 3	0.98	1.00	1.00	1.00
Standard 4	0.90	1.00	0.98	1.00
Standard 5	0.86	1.00	0.81	1.00
Standard 6	0.67	1.00	0.74	0.91
Standard 7	0.90	1.00	0.91	0.98
Standard 8	0.42	1.00	0.56	0.74
Standard 9	0.58	0.95	0.49	0.77
Standard 10	0.42	0.93	0.44	0.67

From the table above, it can be seen that before the intervention, in both the treatment and control groups, the implementation of ANC standards that were not running well (below 80%) were standard 6 (administering blood supplement tablets), standard 8 (laboratory examination), standard 9 (counseling), and standard 10 (case management). For the administration of blood

supplement tablets (TTD) after the intervention, both the treatment and control groups experienced an increase. However, the mean level of regularity of respondents taking blood supplement tablets (TTD) only reached 0.58 in the control group and 0.97 in the intervention group.

Table 3. Matrix between factors and scenarios simulated in a dynamic model

	Scenario1 (Pessimistic)	Scenario2 (Moderate)	Scenario3 (Optimistic)
ANC check	Frequency of regular ANC checks every 4 months (2 times in pregnancy (according to existing conditions))	Frequency of ANC visits per 3 months (tri semester)	Regular ANC frequency every 2 months (6 times during pregnancy)
Administration of Fe Tablets	Regular Fe frequency every 4 months (3 times during pregnancy) according to existing conditions	Fe frequency per 3 months (4 times during pregnancy)	Regular Fe frequency per 2 months (6 times during pregnancy)
PMT (Implementen	PMT implementation is running low (30%) according to existing	Implementation of PMT is moderate (50%)	PMT implementation runs optimally (75%)

tation of Nutritional Status)	conditions according to existing conditions		
Case Manageme nt	Implementation of Case Management is still relatively low in terms of frequency, materials, methods, funding and institutions (according to existing conditions)	Implementation of Case Management activities at a medium level in all aspects (frequency, materials, methods, funding and institutions)	Implementation of Case Management at an optimal level in all aspects (frequency, materials, methods, funding and institutions)

These three scenarios are simulated over
a time span of 3 years with intervals (time steps)

every month so that the simulation results will be
shown for $3 \times 12 = 36$ months.

Table 4. Dynamic simulation results of early detection. High risk of stunting in pregnant women

Month	Scenario 1	Scenario 2	Scenario 3
1	90.9787	92.2413	94.1900
2	89.2440	90.6747	92.5660
3	80.4760	82.1100	84.0333
4	75.5100	76.9353	79.7700
5	74.5113	76.0360	77.9800
6	79.7047	81.2500	83.4653
7	77.0867	78.5513	80.8593
8	75.7527	77.2607	79.3007
9	84.2420	85.6753	87.8540
10	89.5393	91.0840	92.7640
11	93.8947	95.2120	96.9500
12	87.1973	88.6573	91.0280

Based on the values in the table above, the difference between scenario 2 and scenario 1 is calculated, so the calculated increase in high-risk ranges from 1.26 to 1.63% with an average of 1.46%. The increase in high-risk cases from scenario 1 to scenario 3 ranges from 3.26 to 4.26% with an average of 3.55%. These results indicate that the simultaneous effect of the ANC implementation scenario, Fe administration and PMT will be able to increase by 1.46% the value of decreasing rest in pregnant women on the incidence of stunting neonates. from low level to medium level and increase by 3.55% from low level to high level.

The effects of implementing ANC, giving Fe and PMT directly affect the growth and development of the fetus in the womb. In a moderate scenario with increased ANC frequency

activity, Fe administration from 4 times to 8 times during pregnancy and increased application of nutritious food management, it can increase fetal growth and development to reduce the occurrence of short retardation in neonates thereby reducing the chance of increasing stunting or short stature due to intake. nutrients, growth hormones and the occurrence of infectious diseases in mothers and neonates can be avoided in the following period so that the stunting-free rate can increase by 1.46%.

DISCUSSION

Stunting is a problem of chronic malnutrition caused by intake Lack of nutrition for a long time due to inadequate food intake according to nutritional needs. Stunting occurs

when the fetus is still in the womb and only appeared when the child was two years old. Malnutrition at an early age increases infant and child mortality rates, causing sufferers to suffer easily sick and having poor posture as an adult. Cognitive abilities sufferers also decrease, resulting in long-term economic losses long for Indonesia. Several efforts to prevent stunting early on toddlers in Indonesia, among others, through the First 1,000 Days of Life Movement and Project Health and Nutrition Based Public (PKGBM)^{11,12,13}.

In the process of child growth and development, UNICEF formulates three factor main Which affect growth and development in no way direct (underlying factors), that is food House ladder, parenting, And sanitation environment. Third factor the influence status nutrition And Also level health child Which Also join in determine quality growth as well as development child¹⁴. Determining good intake is very important to achieve body length which should. Birth weight, birth length, gestational age and pattern foster care is a number of factors that influence the incidence of stunting. Long body born is Wrong one factor risk incident stunting on toddler¹⁵.

Stunting is a problem of chronic malnutrition caused by intake Lack of nutrition for a long time due to inadequate food intake according to nutritional needs. Stunting occurs when the fetus is still in the womb and only appeared when the child was two years old¹⁶. Malnutrition at an early age increases infant and child mortality rates, causing sufferers to suffer easily sick and having poor posture as an adult. Cognitive abilities sufferers also decrease, resulting in long-term economic losses long for Indonesia.

Stunting related with status nutrition is circumstances body Which balance between nutritional intake and needs. Nutrient availability at levels mobile needed for growth, maintenance and operate function body. Poor nutritional status on basically caused by interaction between intake unbalanced nutrition and infectious diseases^{17,18}. According to the United Nations Children's Fund (UNICEF), nutritional problems are caused by various factors, both direct (food unbalanced and infectious diseases) or indirectly include parenting patterns (eating parenting and health

parenting). Eating parenting can be an attitude and behavior Mother or nanny other in give Eat. Pattern foster health and pattern foster self as attitude and action Mother to condition children's environment, including: environmental cleanliness and sanitation, toddler care in circumstances Healthy nor Sick¹⁹.

Behavior health at a time can strengthen theory incident stunting related to nutritional status, Laurence W. Green coined behavioral theory state behavior health influenced by 3 factor main namely: Factors predisposition (predisposing factors), that is: factor trigger behavior like: age, knowledge, experience, education, attitude, trust, confidence, parity, And other so on, supporting factors (enabling factors), namely: factors that support the emergence behavior like environment physique, fund And sources Which There is in society, Reinforcing factors, namely: factors that strengthen or push somebody For behave Which originate from person other for example: regulation And policy government, officer health, figuresociety/religion nor from party family^{20,21}.

In this study, the dynamics of the stunting population were more influenced by aspects of ANC implementation, Fe administration and through improving healthy living behavior and improving case management. The interesting thing about this research is the effect of the PMT scenario of increasing nutritional status in this model²². The effect of PMT will have a direct influence on the growth and development process of the fetus by improving the quality of nutritional intake in pregnant women. The simultaneous effect of implementing the PMT scenario can occur through a mechanism for improving food management in pregnant women's families with the nutritional content needed during pregnancy. This will lead to increased healthy living behavior and efforts to improve nutritional status.

CONCLUSION

Several strategy formulations and recommendations related to efforts to reduce stunting, especially in the stunting locus area at a particular time, are principally built from the results of model simulations associated with implementing ANC implementation scenarios, Fe Fulfillment, and provision of Supplementary

Food. In principle, these three scenarios boil down to efforts to reduce stunting in children. Another scenario that is no less important in this dynamic model research is managing highly nutritious local food to meet the nutritional needs of pregnant women and fetuses and prevent stunted neonates. It is necessary to increase the role and commitment of all those responsible for the program by involving all parties. There is a need for a comprehensive policy in developing strategies to reduce stunting acceleration based on the needs of each region/district, especially stunting locus areas or regions.

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REFERENCES

1. Kemenkes RI. Buletin Stunting. Kementerian Kesehatan RI. 2018;301(5):1163–78.
2. Sandjojo E putro. Buku saku desa dalam penanganan stunting. Buku Saku Desa Dalam Penanganan Stunting. 2017;42.
3. Mustafa J, No S, Selatan T, Komunitas JK. Permasalahan Anak Pendek (Stunting) dan Intervensi untuk Mencegah Terjadinya Stunting (Suatu Kajian Kepustakaan) Stunting Problems and Interventions to Prevent Stunting (A Literature Review). 2015;2(5).
4. Organization WHO, Unicef. Trends in Maternal Mortality: 1990 to 2013: estimates by WHO, UNICEF, UNFPA, The World Bank and the United Nations Population Division. 2021;
5. Kemenkes RI. Riset Kesehatan Dasar. Jakarta Badan Penelitian dan Pengembangan Kesehatan Departemen Kesehatan Republik Indonesia. 2021;
6. Kementerian Kesehatan RI. Data Stunting 2018-2022. Kemenkes RI. 2022;
7. Dinas Kesehatan Sumatera Utara. Profil Kesehatan Sumatera Utara. 2019;
8. Sari EM, Mohammad J, Neti N, Mei NS. Asupan Protein, Kalsium Dan Fosfor Pada Anak Stunting Dan Tidak Stunting Usia 24-59 Bulan. Jurnal Gizi Klinik Indonesia. 2019;12(4):152–9.
9. Namirembe G, Ghosh S, Ausman LM, Shrestha R, Zaharia S, Bashaasha B, et al. Child stunting starts in utero: Growth trajectories and determinants in Ugandan infants. *Matern Child Nutr.* 2022;18(3):1–12.
10. TNP2K. 100 kabupaten/kota Prioritas untuk intervensi anak kerdil (stunting). Tim Nas Percepatan Penanggulangan Kem [Internet]. 2017;(1). Available from: website: www.tnp2k.go.id
11. Hendarwan H, Winarto AT, Raflizar, Handayani K, Ida, Nugroho SU, et al. Pokok-Pokok Hasil Riset Kesehatan Dasar Provinsi Sumatera Utara. 2013. 107 p.
12. Kesehatan D. Riset Kesehatan Dasar (Riskesdas) 2007. 2008;30–35.
13. Gultom YT. Karakteristik Dan Faktor Risiko Anak Dengan Stunting Di Kecamatan Galang Kabupaten Deli Serdang. *Public Heal J.* 2022;8(2).
14. Sholihah LA. Stunting prevalence and its associated factors among children in primary school in Sidoarjo District: A secondary data analysis Prevalensi stunting dan faktor-faktor yang berhubungan dengan stunting pada anak Sekolah Dasar di Kabupaten Sidoarjo: Analisi. 2021;6(2):156–62.
15. Prendergast AJ, Humphrey JH. The stunting syndrome in developing countries. *Paediatr Int Child Health.* 2014;34(4):250–65.
16. Amri AF, Rachmayanti RD. Edukasi Emotional Demonstration dalam Meningkatkan Pengetahuan Ibu terhadap Pencegahan Stunting Emotional Demonstration Education to Increase Mother ' s Knowledge of Stunting Prevention. 2022;5–11.
17. Aryani R, Azizah C. Hubungan Pemberian Asi Eksklusif Dengan Kejadian Stunting Pada Balita 1-5 Tahun Di Wilayah Kerja UPTD Puskesmas Ulee Kareng Kecamatan Ulee Kareng Kota Banda Aceh The Relationship of Exclusive Breast Milk With the Event Stunting in Tolls 1-5 Years Old in Th. J

18. Heal Technol Med. 2022;8(1):81–91.
19. Ban DID. Pencegahan Stunting Melalui Penyuluhan Gizi Seimbang Berbasis Kearifan Lokal. 2022;8:95–103.
20. Dewi ER, Mubaroq MH, Febriani D. Penerapan metode door to door dalam pendampingan gizi balita stunting di Desa Pamotan Kecamatan Pamotan Kabupaten Rembang. Jurnal Pengabdian Kesehatan. 2022 Apr 30;5(2):111-20.
21. Anggreni D, Lubis LA, Kusmanto H. Implementasi program pencegahan stunting di puskesmas Dolok Sigompulon Kabupaten Padang Lawas Utara. Histeria J Ilm Soshum dan Hum. 2022;1(2):91–9.
22. BPS. Kajian Indikator Sustainable Development Goals (SDGs). 2014; Direktorat, Masyarakat P. Strategi Komunikasi Perubahan Perilaku. 2018;(November).

Original Article

Predictor Factors Causing Length of Stay (LOS) in Diabetic Neuropathy Patients

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ABSTRACT

Diabetes mellitus has emerged as a prevalent public health issue, experiencing a steady rise across the globe, in both developed and developing nations. Among the chronic complications frequently observed in diabetic individuals is diabetic neuropathy, characterized by recurrent infections, non-healing ulcers, and the potential for finger or toe amputations. These neuropathic complications often prolong the treatment duration, consequently impacting the length of hospitalization for patients. Neuropathic conditions in Type 2 Diabetes Mellitus (DM) result in a prolonged healing process. This research aims to analyze the predictor factors contributing to the Length of Stay (LOS) in neuropathic DM patients. It employs a quantitative research approach utilizing a descriptive correlation methodology. The research was conducted from October 2023 to February 2024 at Indriati Solo Baru Hospital, with a questionnaire serving as the research instrument. The sample in this research comprised patients with Diabetic Neuropathy (DM Neuropathy) selected using the Purposive Sampling technique and totaled 127 respondents. Data analysis included univariate, bivariate, and multivariate analyses. The outcomes revealed that out of the seven factors examined, only three factors were significantly associated with the Length of Stay (LOS) among neuropathic DM patients: control of blood sugar levels, presence of complications in respondents, and presence of comorbid diseases in respondents. The predictor factor that exerted the greatest influence on the Length of Stay (LOS) level in neuropathic DM patients was the presence of comorbid diseases in respondents. The study primarily focuses on identifying predictor factors for length of stay (LOS) in neuropathic DM patients. However, it did not thoroughly control for potential confounding variables that could influence LOS, such as socioeconomic status, access to healthcare, severity of neuropathy, and presence of other comorbidities aside from diabetes. suggestion to the next research to focus on other variables such as healthcare, the severity of neuropathy, and the presence of other comorbidities aside from diabetes.

Keywords: DM Neuropathy, Length of Stay, Predictor factors.

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INTRODUCTION

Diabetes mellitus accompanied by neuropathy complications necessitates an extended treatment duration, thereby increasing the *Length of Stay* (LOS) or duration of

hospitalization. The outcomes from the research conducted by Bala et al. (2022) indicate that patients with neuropathy complications undergo treatment for approximately 7.3 days

longer compared to DM patients without complications, who typically require around 5.5 days of treatment. Another factor that can affect the length of hospitalization is the age between 18-40 years with a LOS of 6.7 days. Gender can affect the LOS of DM patients with women taking longer than men, namely 7.5 days in women and 7.2 days in men ¹.

Globally, the average hospital stay duration was 7.3 days, which was notably longer for patients diagnosed with type 2 diabetes and specific forms of diabetes compared to those with type 1 diabetes ($p < 0.001$). The length of stay for DM is longer with age (from 5.5 days in those aged 18 to 40 years, 6.7 days in those aged 40 to 65 years, and 8.0 in those aged ≥ 65 years, $p < 0.001$) and higher in women than in men (7.5 days vs. 7.2 days, $p = 0.002$) ².

Diabetic neuropathy refers to a group of nerve disorders resulting from diabetes. Individuals with diabetes undergo nerve damage across their body gradually. While some may exhibit no symptoms of nerve damage, others may experience sensations like pain, tingling, numbness, and loss of sensation in their hands, arms, legs, and feet. Nerve complications can manifest in various organ systems, including the digestive tract, heart, and reproductive organs ³.

Neuropathy denotes a collection of conditions that impact various types of nerves, including sensory, motor, and autonomic nerves. It predominantly occurs in the peripheral body, commonly referred to as *Diabetic Peripheral Neuropathy* (DPN). Sensory impairment can lead to a loss of sensation or numbness, potentially causing injuries in diabetics to go unnoticed. Motor disorders can cause muscle wasting (atrophy), foot deformities, changes in foot biomechanics, and impaired pressure distribution, which increase the likelihood of ulcers. Autonomic disorders can lead to reduced sweat excretion in the feet, resulting in dry skin, fissures, and the formation of *calluses* ⁴.

A research conducted by Bala et al. (2022) revealed that individuals with chronic diabetic complications, including diabetic neuropathy, chronic kidney disease, foot ulceration, and cardiovascular disease, experienced longer hospitalization periods ($p < 0.05$ for all). Conversely, patients with acute diabetic complications had notably shorter mean hospitalization durations compared to

those without acute complications ($p < 0.001$). The length of hospital stay increased from 2015 reaching a maximum in 2016 and decreased thereafter with a minimum duration in 2018 ($p = 0.002$). A similar evolution was seen in the length of hospital stay in patients with type 2 diabetes, women, middle-aged adults, and patients with diabetic retinopathy ($p < 0.05$ for all). There was no observed change over time in individuals with type 1 diabetes, specific forms of diabetes, men, young adults, the elderly, patients with diabetic neuropathy, chronic kidney disease, foot ulceration, or cardiovascular disease (CVD) ⁵.

Neuropathic conditions in Type 2 DM patients will extend the process of care and healing for patients in the hospital. *Length of stay* for Type 2 DM patients will be longer because of the occurrence of new wounds due to neuropathy conditions ⁶. *Length of stay* (LOS) is one of the indicators of the *quality* of medical services provided by hospitals to patients (*quality of patient care*). LOS shows how many days a patient is hospitalized in one period of care ⁷. Hospitalization entails providing patient services for observation, diagnosis, treatment, medical rehabilitation, and/or other healthcare interventions by staying overnight in a hospital. The unit for measuring the length of stay is days, calculated by determining the difference between the discharge date (whether the patient is discharged alive or deceased) and the admission date to the hospital. Typically, this data is documented in the admission and discharge summary forms within the medical records ⁸.

Complications of Type 2 diabetes mellitus (DM) that result in neuropathic conditions are prevalent and pose greater risks across all age groups, emphasizing the importance of preventing the exacerbation of Type 2 DM conditions. Prevention efforts should focus on mitigating and minimizing the risk factors associated with neuropathic conditions. Healing neuropathic conditions in Type 2 DM will require an extended duration. The length of the healing process and treatment in the hospital will have an impact on the patient's *Length of Stay* in the hospital. The results of a preliminary research conducted at Indriati Hospital showed that the number of patients with neuropathic diabetes mellitus during April 2022 - May 2023 was 162 patients. The average *length of stay* for neuropathic diabetes mellitus patients is 4-10 days. Based on

this background, the researcher made a research entitled " Predictor Factors Causing *Length of Stay* (LOS) in Neuropathic DM Patients "

METHOD

This research employs a quantitative research approach, specifically utilizing a *descriptive correlation* methodology. The research methodology involves the use of a questionnaire as the measuring instrument. The independent variables considered in this research encompass age, gender, family history of diabetes, duration of diabetes, presence of complications, blood sugar control, and comorbid diseases. While the dependent variable is *Length Of Stay (LOS)*.

The sample in this research amounted to 127 respondents who were DM Neuropathy patients who were admitted to the inpatient ward and willing to become respondents. The sampling technique in this research used *Purposive sampling* technique and totaled 127 respondents. This research was conducted in October 2023-February 2024 at Indriati Solo Baru hospital.

The instrument utilized in the research was a questionnaire comprising demographic data of respondents and the duration of their *Length of Stay*.

To address the research questions, the analyses included univariate, bivariate, and multivariate tests. Univariate tests for sample characteristics were presented as percentage proportions (%), while bivariate test analyses involved normality and correlation tests. The normality test employed the Kolmogorov-Smirnov test (for samples >50), the correlation test utilized Chi-Square, and the multivariate test employed logistic regression. The data analysis used focuses on what variables can influence LOS in diabetic ulcer patients, namely by regression test analysis.

RESULTS

Table 1. Distribution of predictors of *Length of Stay* (LOS) in patients with DM Neuropathy

Gender	Frequency	Percent
Male	47	37,0
Women	80	63,0
Age		
26-35 Years	6	4,7
36-45 Years	11	8,7

46-55 Years	43	33,9
56-65 Years	58	55,7
>65 Years	9	7,1
Family History		
No	51	40,2
Yes	76	59,8
Duration of DM		
1-3 Years	26	20,5
>3 Years	101	79,5
Complications		
No	47	37,0
Yes	80	63,0
GD Control		
1 Time	47	37,0
2 Times	52	40,9
3 Times	17	13,4
>3 Times	11	8,7
Comorbid Diseases		
No	39	30,7
Yes	88	69,3
LOS		
Normal LOS	45	35,4
High LOS	82	64,6

Based on Table 1, the majority of respondents were female, comprising 80 individuals (63%). The age range of most respondents fell between 56 and 65 years old, totaling 58 individuals (55.7%). Furthermore, a significant proportion of respondents had a family history of DM disease, amounting to 76 individuals (59.8%). The most prevalent duration of DM was over 3 years, with 101 individuals (79.5%). Additionally, the majority of respondents experienced complications, accounting for 80 individuals (63%). Regarding blood sugar control, 52 individuals (40.9%) checked their blood sugar twice a day. Additionally, 88 individuals (69.3%) had comorbid diseases. In terms of Length of Stay (LOS) values, the majority of respondents, totaling 82 individuals (64.6%), had a high LOS of ≥ 5 days.

Table 2. Most risky factors in the cause of predictors of *length of stay* (LOS) in patients with DM neuropathy

Variable	p-value	OR	Exp.B
Gender-LOS	0,342	0,671	0,267
Age-LOS	0,427	Unable	0,002
Family History - LOS	0,088	0,549	-
Duration of DM	0,364	0,413	-
Complications -LOS	0,023	0,302	0-,650

GD-LOS contro	0,038	Unable	0,245
Comorbid Diseases-LOS	0,000	0,176	-1,525

Based on Table 2, the results of the chi-square test indicate that there are four variables not associated with LOS, as the p-values are greater than 0.05. These variables are gender ($p = 0.342$), age ($p = 0.427$), family history ($p = 0.088$), and DM duration ($p = 0.364$). On the other hand, three variables showed an association with LOS, with p-values less than 0.05. These variables are complications ($p = 0.023$), blood sugar control ($p = 0.038$), and comorbid diseases ($p = 0.000$). The Odds Ratio value indicates that two variables cannot be determined because Odds Ratio can only be calculated for 2x2 tables, whereas kx2 tables cannot be tested for Odds Ratio. The highest Odds Ratio value was observed for complications, with a value of 0.302.

The results of the logistic regression test reveal that the highest coefficient beta value is observed for comorbid diseases, with a coefficient beta value of -2.579. This indicates that a 1% change in comorbid diseases can affect the Length of Stay (LOS) by 1.525.

Table 3. Multikolinieraity Test

Multikolinerity	VIF	Tolerance
Complication	0,922	1,085
Blood sugar control	0,880	1,137
Comorbid diseases	0,901	1,110

The results of the multicollinearity test show that the complication variable has a VIF value of 0.922, the blood sugar control variable has a VIF value of 0.880 and the comorbid disease variable has a VIF value of 0.901, so that when a variable has a VIF value > 0.1 . The tolerance value for the complication variable is 1.085, blood sugar control is 1.137 and comorbid disease is 1.110 so that the three variables have a tolerance value of <10 . Based on these results, multicollinearity does not occur.

Table 4. Auto correlation test

Analysis	Durbin Watson
d	1,661
d _l	1,482
d _u	1,604

The results of the Durbin Watson test show a d value of 1.661 with a dl value

according to the Durbin Watson table with a population of 127 and independent variable 3, namely 1.482 and a du value of 1.604. Interpretation of the results shows the value $d > d_u > d_l$ which means there is no autocorrelation.

DISCUSSION

Distribution of predictors of *Length of Stay (LOS)* in patients with DM Neuropathy

The outcomes of this research are consistent with those of the research conducted by Mildawati, Diani, & Wahid (2019), which demonstrated that the characteristics of diabetic peripheral neuropathic patients include a majority of female gender, comprising 59 individuals (71.15%), the most common age group being 46-65 years old, totaling 38 individuals (45.85%), and a duration of suffering of 5 years, involving 35 individuals (42.25%)⁹.

Women are at a higher risk of experiencing neuropathy complications associated with parity and pregnancy, both of which are risk factors for diabetes mellitus. The research's outcomes indicated that neuropathy complications in diabetic patients were more common among women (63%) compared to men (37%). Female gender tends to be more susceptible to diabetes mellitus due to factors such as a high body mass index, menstrual cycle syndrome, and the onset of menopause, leading to increased fat accumulation and hindrance in the transport of glucose into cells¹⁰.

Furthermore, the outcomes of this research suggest that the risk of neuropathy complications increases with advancing age. However, this does not eliminate the possibility of peripheral neuropathy occurring in younger individuals with diabetes. Neuropathy complications can affect diabetic patients of various age groups. Individuals aged over 30 may undergo physiological changes that can diminish bodily functions⁸. Peripheral neuropathy is frequently identified after an individual reaches the age of 50 years. The research's outcomes indicated that out of 1788 diabetic patients, 90% experienced peripheral neuropathy between the ages of 40 and 79, with an average age of diabetic patients being 55.5 years. This is in accordance with other studies that found the prevalence of DPN (*diabetic peripheral neuropaty*) as much as 47.5% occurred in diabetics aged 50-59 years⁹.

According to Kamenov et al., there were no significant sex differences observed in diabetes control measures such as HbA1c and mean plasma glucose. However, the duration of diabetes was found to be longer in women compared to men. Despite the varying durations of diabetes between genders, the prevalence of diabetic neuropathy did not exhibit significant differences based on sex¹¹. This is corroborated by research indicating that complications typically manifest after the disease has progressed for 10-15 years. Prolonged suffering from type 2 diabetes mellitus leads to continuous accumulation of glucose in the blood, resulting in the onset of complications. Additionally, outcomes from other studies support the notion that the duration of diabetes mellitus correlates with the emergence of complications. In essence, the longer an individual has diabetes mellitus, the greater the likelihood of experiencing complications¹. This contradicts research on factors linked to the occurrence of diabetic peripheral neuropathy, which indicates that there is no association between age and the duration of diabetes mellitus¹.

The outcomes indicated that there is a correlation between the duration of suffering and the risk of peripheral neuropathy in patients with type 2 diabetes mellitus (DM). The longer an individual suffers from DM, the higher the risk of developing neuropathy. Prolonged suffering from DM, coupled with elevated blood glucose levels, can weaken and damage the walls of capillaries that supply blood to the nerves, leading to nerve damage, known as neuropathy¹².

The outcomes from the research conducted by Tofure et al. revealed that the majority of respondents, totaling 28 individuals (100%), had comorbidities. In this research, diabetic peripheral neuropathy coexisting with hypertensive disease is attributed to prolonged suffering from DM with hyperglycemia, which affects alterations in the blood vessel wall and blood pressure. Fundamental changes primarily occur in vascular endothelium, vascular smooth muscle cells, and renal mesangial cells, all of which contribute to diabetic vascular complications¹³.

High blood sugar levels in the results of blood sugar checks in this research will cause various disorders in the somatosensory (*visual, vestibular, proprioceptive*) and motor (*musculoskeletal, muscles, soft tissue joints*)

systems that can interfere with the balance system and increase the risk of falls¹⁴. The blood sugar level obtained in the blood glucose test (GDS) is derived from carbohydrate intake and the various processes of gluconeogenesis and glycogenolysis that occur in the body. Blood sugar levels obtained through GDS examination do not entirely reflect the increase in blood sugar levels that occur. Elevated admission GDS levels in research subjects can also be influenced by various conditions, including high carbohydrate intake, low physical activity, and underlying diseases, particularly diabetes mellitus (DM)¹⁴.

The most risky factor in the cause of predictors of length of stay (LOS) in patients with DM neuropathy

The outcomes of Lubis & Susilawati's research indicate that factors such as gender (p.958) and age (p.928) do not have an impact on the Length of Stay (LOS) in neuropathic DM. However, complications (p.024) were found to significantly affect the LOS in neuropathic DM⁸.

This illustrates that diabetes mellitus (DM) should be regularly controlled, as complications such as hypertension can suddenly arise due to the manifestation of the patient's poor lifestyle, leading to inadequate blood sugar control. The success of treating diabetes mellitus largely relies on the patient. The five key components of successful diabetes mellitus treatment include dietary management, physical activity, regular blood monitoring, medication adherence, and regular medical check-ups⁴.

Complications

Complications of diabetes mellitus (DM) can manifest as acute conditions such as hypoglycemia and chronic conditions like heart disease, vascular issues, kidney failure, visual impairment (retinopathy), erectile dysfunction, foot ulcers, and gangrene. According to the International Diabetes Federation, individuals with diabetes are susceptible to complications such as retinopathy, nephropathy, and neuropathy, which can impact their motivation and life expectancy. Psychological factors also influence the length of hospitalization, emphasizing the importance of treatment adherence. Research outcomes demonstrate that non-adherence is linked to deteriorating health

status, increasing the risk of hospitalization and mortality¹⁵.

Complications in diabetic ulcer sufferers can worsen the condition of the wound, due to disruption of the function of blood vascularization to the periphery. Disruption of peripheral vascularization will disrupt the supply of oxygen and nutrients to peripheral tissue so that the process of forming new tissue in the wound becomes hampered. Impaired peripheral vascularization can impact the supply of antibodies to the wound so that the wound healing process is hampered. Complications in diabetic ulcer sufferers will prolong the long wound healing process which will have an impact on the length of hospital stay. The results of Salim, Lubis & Sugeng's research show that there are several complications that can prolong LOS in Diabetic Ulcer patients such as hypertension, neuropathy, coronary heart disease and stroke¹⁶.

The outcomes from the research conducted by Nita et al. (2021) indicate that the factors influencing Length of Stay (LOS) in neuropathic DM include complications ($p=0.028$) and comorbid diseases ($p=0.022$). These results were corroborated by Bala et al. (2022), demonstrating that the primary factor affecting LOS in neuropathic DM patients was comorbid disease, with a p -value of <0.001 ¹⁴.

Chronic complications associated with diabetes are preventable, and interventions aimed at modifying the risk of these complications constitute strategies in diabetes management that can aid in reducing healthcare costs. Our outcomes indicate that, alongside length of stay and age, chronic complications of diabetes such as cardiovascular disease (CVD), foot ulceration, and chronic kidney disease are the primary contributors to disease costs. Previous studies have similarly identified chronic complications and the duration of diabetes-related hospital stays as key factors driving inpatient medical care costs¹⁷.

In a recent research investigating the cost of hospitalization for individuals with diabetes in Irish public hospitals, age and chronic complicated diabetes emerged as significant factors influencing hospitalization costs¹⁸. Similar outcomes were also reported in Bulgaria, where 54% and 41% of hospitalizations were attributed to chronic macro- and microvascular complications of

diabetes in patients with type 2 diabetes and type 1 diabetes, respectively¹⁹.

Blood Sugar Control

Blood sugar control is used to observe whether the blood glucose condition is stable or not. Blood sugar control must be carried out regularly because unstable blood sugar conditions will prevent the growth of new cells and tissue in the ulcer²⁰. Unstable blood sugar conditions or hyperglycemia will cause blood flow to become obstructed due to blood density levels so that nutrients, antibodies and oxygen are blocked from reaching the wound so that cells are unable to carry out metabolism and are unable to repair damaged cells and inhibit the formation of cells and tissue. new to the wound²¹.

Wound conditions that cannot heal quickly due to hyperglycemia will make the treatment process take a long time²². The treatment process will focus on two things, namely stabilizing blood glucose levels and treating diabetic ulcers. The treatment process for diabetic ulcers will experience an extended time which has an impact on LOS⁷.

The research results of Simbolon & Ibrahim (2020) show that blood glucose levels are an important factor that can influence LOS in diabetic ulcer patients. Unstable blood glucose conditions will worsen the condition of wounds and hinder the wound healing process, because wounds cannot be healed due to poor blood vascularization to the periphery⁴.

Research conducted by Darwis et al. revealed that the most influential factors affecting Length of Stay (LOS) in neuropathic DM patients include blood glucose levels ($p < 0.001$)²³. Simbolon et al, showed that factors affecting LOS in neuropathic DM include the presence of ulcers ($p = 0.034$), depth of ulcers ($p = 0.003$), Hb ($p = 0.033$), albumin ($p = 0.017$)⁴.

Comorbid Diseases

Comorbid Diseases Accompanying diseases (comorbidities) that coexist with diabetic ulcer sufferers will cause worsening of the wound condition. Accompanying diseases such as hypertension, atherosclerosis, stroke, lung disease and immune system diseases will greatly influence the wound healing process in diabetic ulcers^{24,25}. Accompanying diseases will have an impact on the vascularization of blood circulation to the periphery as well as

insufficient oxygen supply due to lung disease. Immune diseases can affect the long wound healing process because the body has to focus on healing itself from infection so that ulcers will be hampered in the wound healing process. Prolonged wound healing will have an impact on lengthening LOS⁷.

The results of Nita et al's research show that the factors that influence LOS in DM neuropathy are complications (0.028) and comorbid diseases (0.022). The results of this study were confirmed by Bala et al,⁷ who showed that the factor that most influences LOS in neuropathic DM patients is comorbid diseases with a p value <0.001¹⁴.

The results of Darwis et al's research show that many factors can influence LOS in diabetic ulcers, one of which is comorbid diseases. The presence of comorbid diseases will worsen the condition of diabetic ulcers and the treatment process should not only focus on healing the wound but also focus on the comorbidities²³.

CONCLUSION

Based on the conducted research, it can be concluded that out of the 7 factors examined, only 3 factors are correlated with the Length of Stay (LOS) level in neuropathic DM patients, namely, blood sugar level control, presence of complications, and presence of comorbid diseases. Additionally, the predictor factor that predominantly influences the LOS level in neuropathic DM patients is the presence of comorbid diseases in respondents. Suggestions for future researchers include exploring other potential factors that may contribute to the LOS level in neuropathic DM patients, such as environmental, genetic, or psychosocial factors.

The study primarily focuses on identifying predictor factors for length of stay (LOS) in neuropathic DM patients. However, it not thoroughly control for potential confounding variables that could influence LOS, such as socioeconomic status, access to healthcare, severity of neuropathy, and presence of other comorbidities aside from diabetes. suggestion to next research to focuses in another variable such as healthcare, severity of neuropathy, and presence of other comorbidities aside from diabetes.

This research still has many limitations, such as the data collection process which only uses one place, not being able to control

confounding variables, and not being able to carry out modeling analysis to see whether there is a relationship between the independent variables.

REFERENCES

1. Simanjuntak GV, Simamora M. Lama menderit diabetes mellitus tipe 2 sebagai faktor risiko neuropati perifer diabetik. *Holistik J Kesehat*. 2020;14(1):96–100.
2. Park JH, Kim DS. The necessity of the simple tests for diabetic peripheral neuropathy in type 2 diabetes mellitus patients without neuropathic symptoms in clinical practice. *Diabetes Metab J*. 2018;42(5):442–6.
3. Bakara DM, Khoirini F, Manik MJ. The Effect of Neuropathic Exercise on HbA1c Value in Patients with Type 2 Diabetes Mellitus. *Int J Nurs Educ*. 2023;15(4):4–9.
4. Simbolon P, Ibrahim H. Risk Factors that Influence Hospital Length of Stay in Diabetic Foot Ulcer with Negative Pressure Wound Therapy at RS. dr. Cipto Mangunkusumo. *New Ropanasuri J Surg*. 2020;5(1):20–4.
5. Lubis IKS. Analisis Length Of Stay (LOS) Berdasarkan Faktor Prediktor Pada Pasien DM Tipe II di RS PKU Muhammadiyah Yogyakarta. *J Kesehat Vokasional*. 2017;2(2):161–6.
6. Amiman RC, Tumboimbela MJ, Kembuan MAHN. Gambaran length of stay pada pasien stroke rawat inap di RSUP Prof. Dr. R. D. Kandou Manado periode Juli 2015-Juni 2016. *e-CliniC*. 2016;4(2).
7. Bala C, Rusu A, Ciobanu D, Roman G. Length of Hospital Stay, Hospitalization Costs, and Their Drivers in Adults with Diabetes in the Romanian Public Hospital System. *Int J Environ Res Public Health*. 2022;19(16).
8. Lubis IK, Susilawati S. Analisis Length Of Stay (Los) Berdasarkan Faktor Prediktor Pada Pasien DM Tipe II di RS PKU Muhammadiyah Yogyakarta. *J Kesehat Vokasional*. 2018;2(2):161.
9. Mildawati, Diani N, Wahid A. Hubungan Usia, Jenis Kelamin dan

- Lama Menderita Diabetes dengan Kejadian Neuropati Perifer Diabateik. *Caring Nurs J*. 2019;3(2):31–7.
10. Shamim A, Haq A, Ali M. Prevalence of peripheral diabetic neuropathy and its association with patients related factors. *Pakistan J Med Heal Sci*. 2017;11(3):1130–2.
11. Kamenov ZA, Romyana AP, Romyana TG. Earlier Development of Diabetic Neuropathy in Men Than in Women with Type 2 Diabetes Mellitus. *Gend Med*. 2012;7(6):600–15.
12. Putri AM, Hasneli Y, Safri. Faktor-Faktor Yang Mempengaruhi Derajat Keparahan Neuropati Perifer Pada Pasien Diabetes Melitus : Literature Review. *J Ilmu Keperawatan*. 2020;8(1):38–53.
13. Tofure IR, Huwae L, Astuty E. Karakteristik pasien penderita neuropati perifer diabetik di poli klinik saraf. *Molucca Medica*. 2021;14(2):97–108.
14. NIȚĂ G, GHERASIM A, NIȚĂ O, POPA AD, ARHIRE LI, MIHALACHE L, et al. Factors influencing length of hospital stay in patients with diabetic foot ulcers. *Rom J Med Pract*. 2021;16(2):234–40.
15. Kebede SA, Tusa BS, Weldesenbet AB, Tessema ZT, Ayele TA. Time to diabetic neuropathy and its predictors among newly diagnosed type 2 diabetes mellitus patients in Northwest Ethiopia. *Egypt J Neurol Psychiatry Neurosurg [Internet]*. 2021;57(1). Available from: <https://doi.org/10.1186/s41983-021-00402-4>
16. Salim MF, Lubis IK, Sugeng S. Perbedaan Length of Stay (LOS) Pasien Diabetes Mellitus Berdasarkan Komplikasi Di RSUP Dr. Sardjito Yogyakarta. *J Manaj Inf Kesehat Indones*. 2019;7(1):17.
17. Andersson E, Persson S, Hallén N, Ericsson Å, Thielke D, Lindgren P, et al. Costs of diabetes complications: Hospital-based care and absence from work for 392,200 people with type 2 diabetes and matched control participants in Sweden. *Diabetologia*. 2020;63:2582–2594.
18. Friel K., Gillespie P, Coates V, McCauley C, McCann M, O’Kane M, et al. Estimating and examining the costs of inpatient diabetes care in an Irish Public Hospital. *Diabet. Med*. 2021;28.
19. Cheng S., Wang C., Ko Y. Costs and Length of Stay of Hospitalizations due to Diabetes-Related Complications. *Diabetes Res*. 2019;
20. Rosyid FN, Prasetyo TA, Safitri L. Correlation of Peripheral Vascular Status with Quality of Life Type 2 Diabetes Mellitus Patients (Measured By Ankle Brachial Value Index). 2017;3(Inc):98–100.
21. Pop-Busui R, Boulton AJ, Feldman EL, Bril V, Freeman R, Ziegler D. Diabetic neuropathy: a position statement by the American Diabetes Association. *Diabetes Care*. 2017;40(1).
22. Nur Rosyid F, Heri Nugroho H S K, . M, . S. Glycated Albumin Value and Its Relation with The Improvement of Diabetic Ulcers: Pilot Study. *KnE Soc Sci*. 2023;2023:763–71.
23. Darwis P, Simanjuntak BH, Wangge G, Pratama D, Bakri A, Telaumbanua R. Factors Affecting Hospital Length of Stay in Patient with Diabetic Foot Ulcer. *J Ilmu Bedah Indones*. 2019;47(2):3–16.
24. Rosyid FN. Knowledge of diabetic ulcers and foot care in patients with type 2. 2021;
25. Cahyono TD, Purwanti OS. Hubungan Antara Lama Menderita Diabetes Dengan Nilai Ankle Brachial Index. *J Ber Ilmu Keperawatan*. 2019;12(2):65–71.

Article Review

Factors Influencing and Information Technology Interventions for Nurse Compliance on Patient Safety: A Systematic Review

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ABSTRACT

Patient safety is a critical global issue, prevalent in many countries. This research aims to review publications and literature regarding the factors and interventions that aid in nurse compliance with patient safety measures. Due to limited published studies on this topic, we conducted a systematic review to identify these factors and interventions based on existing literature. We searched databases including Scopus, Science Direct, PubMed, and ClinicalKey Nursing, using specific keywords, filtering 1918 articles down to 22 articles for analysis. The study reveals that nurse implementation of patient safety is influenced by organizational culture and leadership, resource accessibility, physical facilities, communication and collaboration, workload and job satisfaction, nurses' knowledge and skills, demographic factors, and their attitudes and perceptions. Interventions for enhancing nurse compliance in patient safety include providing training and education through technological approaches, and health service delivery via information technology systems. This review offers insights into resolving nurse compliance issues in patient safety, highlighting the importance of not only individual nurses but also hospital management and the healthcare delivery system. Effective management strategies to increase nurse compliance in patient safety should involve hospital authorities and improvements in the nursing service system.

Keywords: *Influencing Factors, Information Technology Interventions, Nurse Compliance, Patient Safety.*

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INTRODUCTION

Patient safety refers to efforts to prevent incidents causing adverse effects on patients, potentially leading to injuries or complications, through the use of high-quality practices that result in optimal healthcare ¹. It is a global issue prevalent in various countries. Hospitals, being

environments rich in labor, capital, technology, and problems with various procedures, professions, and standards, are particularly susceptible to patient safety incidents ². A patient safety incident is any unintended occurrence that could cause injury to a patient and is preventable ³. In Indonesia, among 2,877

accredited hospitals, there is a 12% incidence of patient safety incidents, totaling 7,465 reports. These incidents include 171 deaths, 80 severe injuries, 372 moderate injuries, 1,183 minor injuries, and 5,659 without injury, categorized as 38% Near Miss events, 31% No Harm events, and 31% Adverse events ⁴.

Compliance with patient safety is influenced by various factors, including nurses' knowledge, skills, workload, job satisfaction, communication, and collaboration ^{5,6}. Factors such as individual discipline, high work pressure, poor team communication and relationships, fatigue, stress, and unfavorable work environments affect the implementation of patient safety strategies in hospitals ⁵. The impact of nurses' non-compliance in implementing patient safety can lead to long-term or permanent physical, mental, or social effects on patients, reducing life expectancy or causing death due to incorrect diagnosis and initial management ⁷.

The Indonesian Government's efforts to reduce patient safety incidents include standardizing hospitals through the Hospital Accreditation Commission (HAC) in 2018. This includes six Patient Safety Goal Indicators (PSGI), such as accurate patient identification, enhancing effective communication, improving the safety of high-alert medications, ensuring correct patient, site, and procedure in surgery; reducing healthcare-associated infection risks, and minimizing patient injury risks from falls ⁸. Increasing nurse compliance in fall prevention interventions can be enhanced through nurse compliance monitoring, audits, feedback, leadership, staff education, and information technology systems ⁹.

Information technology is a technology used for managing information, whereas an information system is a combination of information technology and its users ¹⁰. Information technology can be leveraged through electronic devices to assist nurses in accessing information, communicating, and monitoring swiftly ¹¹. The enhancement of patient care quality, reduction of errors, and decrease in care costs can be achieved by utilizing information technology ¹².

Based on the above research, patient

safety remains a significant global health issue. A systematic review is needed to conclude the factors and interventions contributing to nurse compliance in implementing patient safety. These factors and interventions can significantly influence healthcare service delivery. A detailed analysis of these factors and interventions affecting nurse compliance in implementing patient safety has not been previously reviewed. Existing research typically addresses only one of these factors or interventions. This study aims to provide an overview of the barriers to nurse compliance in patient safety and interventions that can enhance such compliance.

METHOD

A systematic literature review was conducted following the principles of the PRISMA statement ⁽¹³⁾.

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Nurse and intervention involvement

The systematic review focuses on factors Influencing and Information Technology Interventions for nurse compliance on patient safety.

Search Strategy and selection criteria

We searched electronic databases including Scopus, Science Direct, PubMed, and Clinical Key Nursing, using keywords: factor AND influencing AND nurse OR nurses AND Information Technology OR technology AND Interventions OR Information Technology Interventions AND compliance OR adherence AND patient safety. From 1918 articles, 137 were initially identified based on the inclusion criteria of being from 2018-2023, original articles, open access & open archive, and in English. After further refinement, excluding those unrelated to patient safety, influencing factors, interventions, and with available full texts, 28 articles were selected, with 22 ultimately analyzed. service delivery via information technology systems.

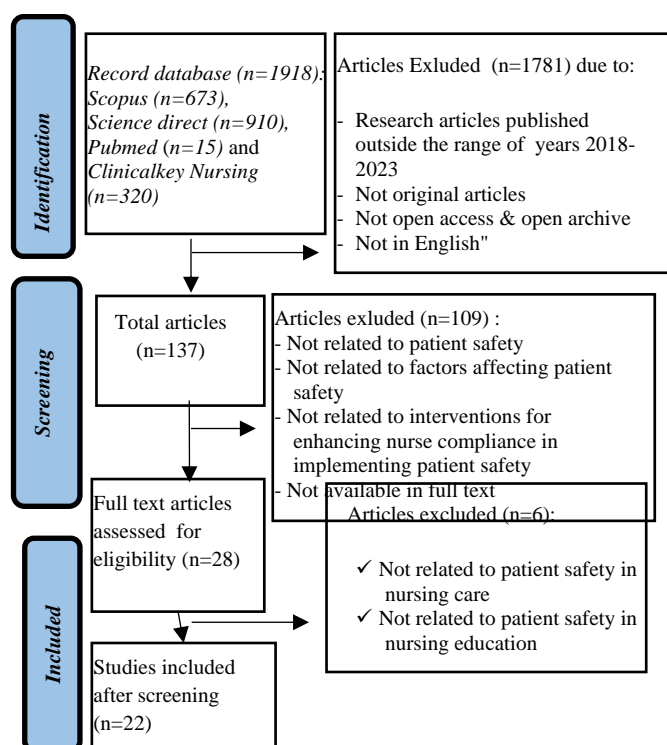


Figure 1. Prisma Flowchart

RESULTS

Table 1. Factors Influencing and Information Technology Interventions for Nurse Compliance on Patient Safety

No	Title, Author, Year, Journal and DOI	Research methods	Result
1	Effects of Nurses' Perceptions of Patient safety Rules and Procedures on Their Patient safety Performance: The Mediating Roles of Communication about Errors and Coworker Support ¹⁴ Journal of Nursing Management doi:10.1155/2023/2403986	Cross-Sectional	Nurses' perception of the usefulness and effectiveness of rules and procedures regarding patient safety, communication with colleagues, and support from coworkers positively correlates with patient safety performance.

2 The Effects of a Simulation Based Patient Safety Education Program on Compliance with Patient safety, Perception of Patient safety Culture, and Educational Satisfaction of Operating Room Nurses Healthcare¹⁵

doi:10.3390/healthcare11212824

Equivalent Research Design with A Pretest Post Test Control Group

3 Mediating roles of patient safety knowledge and motivation in the relationship between safety climate and nurses' patient safety behaviors: a structural equation modeling analysis ¹⁶ BMC Nursing

doi:10.1186/s12912-022-01123-6

Cross-Sectional

The attitudes/behaviors of nurses in implementing patient safety compliance, knowledge about patient safety, and intrinsic motivation of nurses.

4 Experiencing and witnessing disruptive behaviors toward nurses in COVID-19 teams, patient safety, and errors in care ¹⁷ Journal of Nursing Scholarship

doi:10.1111/jnu.

Cross-Sectional

Leadership, communication, collaboration with the team work

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- | | | | |
|---|--|-----------------|--|
| 5 | A Mixed Methods Sequential Explanatory Study of the Factors That Impact Nurses' Perspectives toward Nurse Practitioners' Roles in Saudi Arabia ¹⁸
Healthcare | A Mixed-Methods | Effective collaboration with other staff |
|---|--|-----------------|--|
- doi:10.3390/healthcare11010146
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- | | | | |
|---|---|-----------------|--|
| 6 | Association between Hospital Nurses' Perception of Patient safety Management and Standard Precaution Adherence: A Cross-Sectional Study ¹⁹
International Journal of Environment Research and Public Health (IJERPH)
doi:10.3390/ijerph16234744 | Cross-Sectional | Participants' perception of patient safety management. |
|---|---|-----------------|--|
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- | | | | |
|---|---|-----------------|--|
| 7 | Teamwork, psychological safety, and patient safety competency among emergency nurses ²⁰
International Emergency Nursing | Cross-Sectional | Situation monitoring, reporting of patient safety side effects, number of night shifts per month, and psychological safety are significant factors affecting patient safety competence |
|---|---|-----------------|--|
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- doi:10.1016/j.ienj.2020.100892
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|---|---|--------------|--|
| 8 | Privacy, confidentiality, security and patient safety concerns about electronic health records. ²¹
International Nursing Review | Mixed-Method | Ethical code policies, training, and awareness |
|---|---|--------------|--|
- doi:10.1111/inr.12585
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- | | | | |
|---|--|-------------|---|
| 9 | Nurses' knowledge and deliberations crucial to Barcoded Medication Administration technology in a Dutch hospital: Discovering nurses' agency inside ruling. ²²
Sage Journals | Qualitative | Factors such as nurses' knowledge and experience in medication administration, effective communication and collaboration among healthcare professionals, appropriate staffing levels and workload management, a supportive organizational culture and leadership, the availability of user-friendly and efficient technology systems, and a reporting and identification system that encourages nurses to identify and report potential patient safety risks. |
|---|--|-------------|---|
- https://doi.org/10.1177/1363459318800155
-
- | | | | |
|----|--|----------------------------|--------------------------------------|
| 10 | Use, Perceived Usability, and Barriers to Implementation | Cluster Randomized Stepped | Insights into risks and information. |
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	n of a Patient safety Dashboard Integrated within a Vendor HER. ²³ Applied Clinical Informatics	Wedge Trial		acute care setting: A quasi-experimental study. ²⁶ Nursing and Health Sciences	content and processes, leadership support, and the use of structured handover modules
	doi:10.1055/s-0039-3402756			doi:10.1111/nhs.12836	
11	Patient safety Competency and its Related Aspects in Professional Education among Nursing Students of Two Nursing Schools in Iran: A Comparative Study. ²⁴ Applied Clinical Informatics	Cross-Sectional	Nursing education, safety culture in healthcare organizations, effective communication and teamwork, continuous evaluation and improvement	14 Nurses' Compliance with Patient safety Standards in an Accredited Hospital. ²⁷ Egyptian Journal of Health Care	Cross-Sectional Routine work experience, leadership training, hospital accreditation
	doi:10.1055/s-0039-3402756			doi:10.21608/ejhc.2019.26753	
12	Factors Related with Nurse Compliance in The Implementation of Patient safety Indicators at Hospital. ²⁵ Jurnal Keperawatan Indonesia	Cross-Sectional	The leadership style of head nurses, nurse motivation, and other factors such as age, marital status, resources, and perceptions can also affect compliance	15 Efficacy of observational hand hygiene audit with targeted feedback on doctors' hand hygiene compliance: A retrospective time series analysis. ²⁸ Journal of Infection Preventions	Retro-spective Interrupt ed Time Series Study Design Audits and feedback, training and education, visual reminders, educating about institutional safety climate, support from senior management, and collaboration with management teams
	doi:10.7454/jki.v23i3.975			doi:10.1177/1757177419833165	
13	Translating evidence-based nursing clinical handover practice in an	Quasi-Experimental	Effective information transfer, improvements in handover	16 Effectiveness of a virtual reality application-based education programme on patient safety management for nursing students: A pre-test-post-test study ²⁹	control group pre-test-post study Mobile app-based education using virtual reality is effective in enhancing patient safety management in nursing education.

Nursing Open			s.12836		
doi:10.1002/no p2.2001					
17	The Influence of Human Factors Training in Air Rescue Service on Patient safety in Hospitals: Results of an Online Survey ³⁰ Medicines	A quantitative test procedure was performed using the modified questionnaire on team work and patient safety	KSkills acquired in Crew Resource Management (CRM) training are highly beneficial for routine healthcare tasks in hospitals to enhance the implementation of patient safety.	20	Internet of things in health-care for patient safety: an empirical study ³² BMC Health Services Research doi:10.1186/s12913-022-07620-3
18	Sustaining a culture of safety and optimising patient outcomes while implementing zero harm programme: a 2-year project of the nursing services – SBAHC ³¹ BMJ Open Quality	The concept of zero harm was introduced to test the effectiveness of the interventions.	The concept of zero harm, incorporating the just culture into electronic reporting systems, has been proven to motivate nursing staff to uphold a higher standard of patient safety culture.	21	Understanding Mental Health Nurses' Perceptions of Barcode Medication Administration: A Qualitative Descriptive Study ³³ Issues in mental Health Nursing doi:10.1080/01612840.2018.1528321
19	Translating evidence-based nursing clinical handover practice in an acute care setting: A quasi-experimental study ²⁶	A quasi-experimental study	Integrated electronic Medical Records (IeMR), computerized provider order entry systems Decision support systems, and the ottawa model for research use	22	Impact of using data from electronic protocols in nursing performance management: A qualitative interview study ³⁴ Journal of Nursing Management doi:10.1111/jonm.12858
Nursing and Health Sciences					
doi:10.1111/nh					

Factors influencing nurses' compliance in implementing patient safety include:

1. **Organizational Culture and Leadership:** An organizational culture that promotes patient safety and commitment from leadership can contribute to increased patient safety compliance. A supportive environment that encourages reporting and learning from safety events is also vital.
2. **Resources and Accessibility:** Availability of resources and access to necessary equipment, tools, and information for patient safety practices can impact compliance. Limited resources or restricted access can become barriers in implementing safety practices.
3. **Physical Facilities:** Factors such as healthcare facility design, cleanliness, and the availability of necessary medical equipment and materials can influence patient safety compliance. Facilities designed with patient safety in mind can improve compliance.
4. **Communication and Collaboration:** Effective communication and collaboration between nurses and other healthcare team members are crucial for patient safety compliance. Good communication ensures a clear understanding of safety practices and encourages cooperative teamwork.
5. **Workload and Job Satisfaction:** High workload, fatigue, and lack of job satisfaction among nurses can negatively impact patient safety compliance. Efforts to reduce excessive workload and increase nurse job satisfaction can enhance their compliance.
6. **Nurses' Knowledge and Skills:** Nurses' knowledge and skills in patient safety practices play a significant role in patient safety compliance. Nurses with a good understanding of safety practices and who can apply them consistently can improve patient compliance.
7. **Demographic Factors:** Factors such as age, education, and work experience can also influence nurses' compliance in implementing patient safety.
8. **Nurses' Attitudes and Perceptions:** Nurses' attitudes and perceptions

towards patient safety practices can affect their compliance level. Nurses with a positive attitude and correct perception of the importance of safety are more likely to comply with patient safety practices.

Interventions to enhance nurse compliance in implementing patient safety include:

1. **Mobile App-Based Education Using Virtual Reality:** Mobile app-based education using virtual reality is effective in improving patient safety management in nursing education.
2. **Crew Resource Management (CRM) Training:** Skills acquired in CRM training are highly beneficial for routine healthcare tasks in hospitals to enhance the implementation of patient safety.
3. **Zero Harm with Just Culture Model in Electronic Reporting Systems:** The concept of zero harm, incorporating the just culture model into electronic reporting systems, has been proven to motivate nursing staff to uphold a higher standard of patient safety culture.
4. **Health Information Systems and Electronic Health Records (EHRs):** Effective integration and use of Electronic Health Records and other health information systems can facilitate clinical processes, reduce errors, and support safe patient discharge. For example, integrating EHRs and investigation order procedures in emergency patient discharge can clarify roles in the discharge process and improve the safety of discharged patients.
5. **Bar-coded Medication Administration (BCMA):** Implementing and adopting BCMA technology can reduce medication errors and improve patient safety, especially in mental health inpatient care settings. Successful adoption of this technology requires proper practice, education, and strategies to ensure effective adoption and support clinical workflow and accountability.
6. **Internet of Things (IoT) in Healthcare:** IoT devices, such as patient monitoring devices and asset management

solutions, can provide real-time data and insights that help improve clinical decisions, reduce errors, and enhance patient safety.

This systematic review research still finds limitations in not covering the influence or role of patient families in achieving patient condition improvement and efforts to enhance patient safety aspects.

DISCUSSION

This research indicates that nurses' compliance in implementing patient safety is influenced by factors such as organizational culture and leadership, resources and accessibility, physical facilities, communication and collaboration, workload and job satisfaction, nurses' knowledge and skills, demographic factors, and nurses' attitudes and perceptions³⁵⁻⁴¹. Leadership in hospitals significantly contributes to nurses' adherence to patient safety guidelines³⁹. Support from leaders is crucial in optimizing patient safety in healthcare services³⁹. Healthcare leaders are responsible and accountable for strengthening the healthcare system by enhancing infrastructure, providing adequate support and resources, and conducting comprehensive monitoring and evaluation of patient safety^{42,43}. Opportunities for hand hygiene training and higher education by leaders can also enhance understanding of infection prevention, impacting patient care⁴⁴.

Other studies mention that patient safety is a responsibility of nurses, divided into civil and criminal responsibilities⁴⁵. Organizational structure is closely related to nurses' compliance in implementing patient safety. The quality and safety of care, influenced by various factors within the system, organization, and work environment, affect the quality and safety of clients⁴⁶. The organizational structure of client safety units or teams in hospitals significantly impacts client safety⁴⁷.

Supervision encourages nurses in applying patient safety goals. Furthermore, stating a relationship between supervision and the implementation of patient safety in inpatient wards⁴⁸. Interprofessional collaboration also enhances patient safety. Doctor-nurse collaboration is significantly positively correlated with all levels of patient safety culture ($P < 0.01$)⁴⁹. Another finding states that

interprofessional collaboration positively impacts patient safety⁵⁰.

Understanding is the fundamental basis for forming good behavior, especially in maintaining patient safety. Inadequate understanding of patient safety concepts can hinder the improvement of processes and practices in the healthcare service system⁵¹. Defining and clarifying aspects of patient safety regularly to nurses can enhance their understanding and perception of patient safety⁵².

Demographic characteristics in this study indicate age as a factor affecting nurses' implementation of patient safety. Age determines a person's ability to work, including how they respond to stimuli. Age is the duration of a human's life since birth⁵³. Age is a factor in nurses' implementation of patient safety goals in hospitals^{53,54}, as it reflects nurses' behavior, views, and responsibilities in implementing these goals effectively. This is supported by other research showing that age positively influences the implementation of patient safety programs⁵⁵. Another study shows that increasing healthcare worker age is accompanied by a decrease in patient safety incidents, as healthcare workers in hospitals become wiser, more cautious, and adhere to policies, procedures, and SPOs in providing healthcare⁵⁶.

Attitude is the tendency to react to something, a person, or an object with liking, disliking, or indifference⁵⁷. Attitude has a positive influence on the implementation of patient safety⁵⁸. A higher attitude score leads to higher patient safety implementation. Nurses' attitudes towards patient safety are related to education level, experience, and frequency of attending patient safety training⁵⁸. Nurses implementing patient safety poorly tend to have negative attitudes, such as impatience, non-compliance, and irresponsibility⁵⁹.

Research states that there is an influence of knowledge on the behavior of implementing patient safety goals in hospitals^{60,61}. This is supported by other research showing that among 16 nurses with good knowledge, 13 implement patient safety well⁶¹. In this regard, nurses are expected to thoroughly understand the Concept of Hospital Patient Safety (CHPS) the six patient safety goals, and the six Patient Safety Goals (PSG)⁶². Knowledge is the result of knowing, occurring after a person senses an object⁶³.

This result indicates that motivation is a factor affecting the implementation of patient safety. Motivation is the process of needs driving a person to engage in activities leading to a specific goal ⁶⁴. This aligns with other research showing a significant influence of motivation variables on the implementation of patient safety programs ⁵⁵. The influence of motivation on the behavior of implementing the six PSG found a p-value = 0.007, meaning there is an influence of motivation on this behavior ⁶¹. Nurses with high motivation to implement patient safety goals are internally driven to achieve this, conscientiously implementing these goals even in environments without reward and punishment systems.

Nurses' length of service, the duration since officially employed in a hospital or other healthcare facility, is associated with increased skills and knowledge, challenging work, recognition, and rewards ⁶⁵. A significant influence of length of service on behavior in implementing the 6 PSG in Inpatient Wards ⁶¹. Nurses implementing patient safety goals well mostly have over five years of service. Relating to the other research where the average nurse work duration is over 5 years, it implies increased skills in implementing the six patient safety goals and habitual application ⁶⁶. Nurses need adequate work experience to understand specific client needs.

Education level is an individual characteristic influencing nurses' skills and knowledge ³⁶. Higher educated nurses can think rationally in performing nursing actions, impacting client safety ^{35,67}. These studies indicate that educational background influences nurses' compliance in implementing patient safety guidelines ^{35,36,67}.

Patient safety is crucial for nurses in providing healthcare services. This study shows that efforts to enhance nurses' compliance in implementing patient safety include providing training and education using technological approaches and healthcare services using information technology systems. Training nurses using mobile apps positively impacts implementing Patient Safety ⁶⁸. Therefore, reveals that implementing PATRICIA, mCARE, iAMP, and mHAL can enhance patient safety in general mental health situations ⁶⁹. PATRICIA, observed as an app using avatars and wearable sensors to record skin temperature, heart rate, acceleration, and respiratory rate during exercises, facilitates

healthcare providers in enhancing patient safety by enabling them to track and review individual exercise performance ⁶⁹.

In Indonesia, devices and mobile apps are widely used by different health institutions with varied instructions, resulting in beneficial outcomes, including improved healthcare conditions for patients and better safety maintenance in clinical settings ⁷⁰. Additionally, these devices and apps are used to reduce medical care costs; enhance the productivity of medical professionals involved in healthcare service delivery; and decrease hospital congestion levels ⁷¹. Various medical apps, including clinical handbook Epocrates, Medscape, PubMed mobile, and Oxford, are used to enhance patient safety in different healthcare institutions in Indonesia ⁷².

The eMoods Bipolar Mood Tracker app can be considered for evaluating the effectiveness of using mobile devices. This device aims to provide information to enhance patient safety ⁷³. This specific mobile app involves a daily tracking mechanism, allowing patients to check their subjective mood ratings and monitor medication use and anxiety levels, thus ensuring enhanced safety in clinical settings ⁷³. Secondary research findings highlight certain potential ways in which patient safety in healthcare can be improved using devices and smart mobiles, including allowing patients to directly access health information through drug guide apps or dosage calculator apps ⁷⁴.

In the healthcare context, ensuring patient safety under any clinical setting is guaranteed by maintaining the confidentiality of patient health records ⁷⁵. It also focuses on allowing only responsible medical professionals to access it. Thus, some hospitals, nursing homes, and other healthcare units more effectively use specific barcodes/ QR codes to ensure that the personal health information of patients is not accessible to everyone. Barcodes/ QR codes not only contribute to maintaining overall patient safety but also aid in enhancing the quality of care along with individual care. These specific codes can be operated with the support of smartphone (mobile) devices and their apps, easily downloadable from the internet ⁷⁶. Research findings presented indicate that the Translation app has been introduced and supports healthcare institutions and medical professionals in ensuring patient safety by obtaining accurate and clear care assessments

and plans, including voice recognition and conversion mode ⁷⁶.

The development of Fall Prevention Patient Information System (FPPIS) is an innovation developed to improve nurse compliance in fall prevention. Nurse compliance assessment in the FPPIS app is immediately displayed (real-time) in the e-compliance menu after filling in the monitoring ⁷⁷. Direct feedback is a strategy to enhance nurse compliance ⁷⁸.

To maximize patient safety compliance, continuous education and training on patient safety practices and the use of innovative and effective information technology are necessary. This requires a coordinated effort from healthcare authorities, educational institutions, healthcare service providers, and healthcare professionals to develop and implement strategies and interventions aimed at increasing awareness, knowledge, and competence in patient safety. Careful implementation of information technology, considering specific needs and clinical contexts, is also crucial in addressing challenges and barriers that may arise during the process of integrating technology into clinical practice.

LIMITATION

This research has limitations. First, despite the effortful data collection process to identify and collect all studies relevant from the period 2018 to 2023 in digital libraries (Scopus, Science Direct, PubMed, and ClinicalKey Nursing), some studies are relevant and has the potential to cause publication bias.

Determination of inclusion and exclusion criteria in systematic review only studies that use the language English, and does not consider research that published in other languages, as well as the text of articles that are not easy to obtain so it has the potential to cause bias. However, by combining all relevant evidence available in English, research collects thousands of articles worthy of providing insight into decision-making managerial.

Article taken from the digital library in this research does not pay attention to journal rankings Scimago Journal & Country Rank, this addition is felt, it is important to know whether a journal has a ranking Q1, Q2, Q3, Q4, so that there is no garbage in garbage out.

CONCLUSION

The review of various articles indicates that nurses' implementation of patient safety is influenced by factors such as organizational culture and leadership, resources and accessibility, physical facilities, communication and collaboration, workload and job satisfaction, nurses' knowledge and skills, demographic factors, and nurses' attitudes and perceptions. Additionally, this research identifies interventions to enhance nurse compliance in implementing patient safety, including training and education using technological approaches and healthcare services using information technology systems. This review provides insights into resolving nurse compliance issues in implementing patient safety, not only from individual nurses but also from hospitals, management, and the nursing service system used. However, further and more comprehensive research is needed to confirm these findings so that patient safety is more assured and achievable. Management strategies to enhance nurse compliance in implementing patient safety should involve hospital parties and improvements in the healthcare service system.

REFERENCES

1. World Health Organization. WHO traditional medicine strategy; 2014-2023. 2014. 76 p.
2. Kuriakose R, Aggarwal A, Sohi R, Goel R, Rashmi N, Gambhir R. Patient safety in primary and outpatient health care. *J Family Med Prim Care*. 2020;9(1):7.
3. Shenoy A. Patient safety from the perspective of quality management frameworks: a review. Vol. 15, *Patient Safety in Surgery*. BioMed Central Ltd; 2021.
4. Pelaporan dan Pembelajaran Keselamatan Pasien Nasional SS. Konsultan Manajemen risiko RS Persahabatan. Wakil Direktur Medik & Asist Direktur RS Sentra Medika. 2019.
5. Aiken LH, Sloane DM, Bruyneel L, Van Den Heede K, Griffiths P, Busse R,

- et al. Nurse staffing and education and hospital mortality in nine European countries: a retrospective observational study. *Lancet* [Internet]. 2014 [cited 2023 Dec 30];383(9931):1824–30. Available from: <https://pubmed.ncbi.nlm.nih.gov/24581683/>
6. Lee WC, Wung HY, Liao HH, Lo CM, Chang FL, Wang PC, et al. Hospital safety culture in Taiwan: a nationwide survey using Chinese version Safety Attitude Questionnaire. *BMC Health Serv Res* [Internet]. 2010 [cited 2023 Dec 30];10. Available from: <https://pubmed.ncbi.nlm.nih.gov/20698965/>
7. Cooper Z, Gibbons S, Skellern M. Does competition from private surgical centres improve public hospitals' performance? Evidence from the English National Health Service. *J Public Econ*. 2018 Oct 1;166:63–80.
8. Larasati A, Dhamanti I. Study Literature Open Access Literature Review: Implementation of Patient Safety Goals in Hospitals in Indonesia. 2021.
9. Schiff G, Shojania KG. Looking back on the history of patient safety: An opportunity to reflect and ponder future challenges. *BMJ Quality and Safety*. BMJ Publishing Group; 2023.
10. Huter K, Krick T, Domhoff D, Seibert K, Wolf-Ostermann K, Rothgang H. Effectiveness of digital technologies to support nursing care: Results of a scoping review. Vol. 13, *Journal of Multidisciplinary Healthcare*. Dove Medical Press Ltd; 2020. p. 1905–26.
11. Sittig DF, Wright A, Coiera E, Magrabi F, Ratwani R, Bates DW, et al. Current challenges in health information technology-related patient safety. *Health Informatics J*. 2020 Mar 1;26(1):181–9.
12. Sheikh A, Anderson M, Albala S, Casadei B, Franklin BD, Richards M, et al. Health information technology and digital innovation for national learning health and care systems. Vol. 3, *The Lancet Digital Health*. Elsevier Ltd; 2021. p. e383–96.
13. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* [Internet]. 2021 Mar 29 [cited 2023 Dec 30];372. Available from: <https://www.bmj.com/content/372/bmj.n71>
14. Seo JK, Lee SE. Effects of Nurses' Perceptions of Patient Safety Rules and Procedures on Their Patient Safety Performance: The Mediating Roles of Communication about Errors and Coworker Support. *J Nurs Manag*. 2023;2023.
15. Park OB, Jeon MY, Kim MS, Kim BA, Jeong HC. The Effects of a Simulation-Based Patient Safety Education Program on Compliance with Patient Safety, Perception of Patient Safety Culture, and Educational Satisfaction of Operating Room Nurses. *Healthcare (Switzerland)*. 2023;11(21).
16. Seo JK, Lee SE. Mediating roles of patient safety knowledge and motivation in the relationship between safety climate and nurses' patient safety behaviors: a structural equation modeling analysis. *BMC Nurs*. 2022 Dec;21(1).
17. Shafran Tikva S, Gabay G, Asraf L, Kluger AN, Lerman Y. Experiencing and witnessing disruptive behaviors toward nurses in COVID-19 teams, patient safety, and errors in care. *Journal of Nursing Scholarship*. 2023;55(1):253–61.
18. Kerari A, Bahari G, Aldossery N, Qadhi O, Alghamdi A. A Mixed-Methods Sequential Explanatory Study of the Factors That Impact Nurses' Perspectives toward Nurse Practitioners' Roles in Saudi Arabia. *Healthcare (Switzerland)*. 2023;11(1).
19. Lim JH, Ahn JW, Son YJ. Association between hospital nurses' perception of patient safety management and standard precaution adherence: A cross-sectional study. *Int J Environ Res Public Health*. 2019;16(23):1–12.
20. Han JH, Roh YS. Teamwork, psychological safety, and patient safety competency among emergency nurses. *Int Emerg Nurs*. 2020;51(May):100892.
21. Bani Issa W, Al Akour I, Ibrahim A,

- Almarzouqi A, Abbas S, Hisham F, et al. Privacy, confidentiality, security and patient safety concerns about electronic health records. *Int Nurs Rev.* 2020 Jun;67(2):218–30.
22. Boonen M, Rankin J, Vosman F, Niemeijer A. Nurses' knowledge and deliberations crucial to Barcoded Medication Administration technology in a Dutch hospital: Discovering nurses' agency inside ruling. *Health: An Interdisciplinary Journal for the Social Study of Health, Illness and Medicine.* 2020 May;24(3):279–98.
23. Bersani K, Fuller TE, Garabedian P, Espares J, Mlaver E, Businger A, et al. Use, Perceived Usability, and Barriers to Implementation of a Patient Safety Dashboard Integrated within a Vendor EHR. *Appl Clin Inform.* 2020 Jan;11(1):34–45.
24. Farokhzadian J, Tayebi Myaneh Z, Khodabandeh Shahrakia S, Malakoutikhah A, Nosratabadi I, Rafiee Sarbijan-Nasab F. Patient Safety Competency and its Related Aspects in Professional Education among Nursing Students of Two Nursing Schools in Iran: A Comparative Study. *Nurse Media Journal of Nursing.* 2022 Aug;12(2):223–32.
25. Alhidayah T, Susilaningsih FS, Somantri I. Factors Related with Nurse Compliance in the Implementation of Patient Safety Indicators at Hospital. *Jurnal Keperawatan Indonesia.* 2020 Dec;23(3):170–83.
26. Hada A, Jones L V., Jack LC, Coyer F. Translating evidence-based nursing clinical handover practice in an acute care setting: A quasi-experimental study. *Nurs Health Sci.* 2021 Jun;23(2):466–76.
27. Ywakaim Andrawes S, Faisal Fakhry S, Abd El Azeem H. Nurses' Compliance with Patient Safety Standards in an Accredited Hospital. *Egyptian Journal of Health Care.* 2019;10(1):65–79.
28. Smiddy MP, Murphy OM, Savage E, Fitzgerald AP, O' Sullivan B, Murphy C, et al. Efficacy of observational hand hygiene audit with targeted feedback on doctors' hand hygiene compliance: A retrospective time series analysis. *J Infect Prev.* 2019 Jul;20(4):164–70.
29. Oh JW, Kim JE. Effectiveness of a virtual reality application-based education programme on patient safety management for nursing students: A pre-test–post-test study. *Nurs Open.* 2023;(June 2022):7622–30.
30. von Rüden C, Ewers A, Brand A, Hungerer S, Erichsen CJ, Dahlmann P, et al. The Influence of Human Factors Training in Air Rescue Service on Patient Safety in Hospitals: Results of an Online Survey. *Medicines.* 2022;10(1):2.
31. Obaid LM, Ali I, Al Baker A, Al Shiekh Abdallah WO, Plando RL, Khawaldeh ME, et al. Sustaining a culture of safety and optimising patient outcomes while implementing zero harm programme: A 2-year project of the nursing services - SBAHC. *BMJ Open Qual.* 2023;12(4):1–10.
32. Yesmin T, Carter MW, Gladman AS. Internet of things in healthcare for patient safety: an empirical study. *BMC Health Serv Res.* 2022 Dec;22(1).
33. Xie N, Kalia K, Strudwick G, Lau F. Understanding Mental Health Nurses' Perceptions of Barcode Medication Administration: A Qualitative Descriptive Study. *Issues Ment Health Nurs.* 2019;40(4):326–34.
34. Hope J, Griffiths P, Schmidt PE, Recio-Saucedo A, Smith GB. Impact of using data from electronic protocols in nursing performance management: A qualitative interview study. *J Nurs Manag.* 2019 Nov;27(8):1682–90.
35. Farokhzadian J, Myaneh ZT, Shahraki SK, Malakoutikhah A, Nosratabadi I, Sarbijan-Nasab FR. Patient Safety Competency and its Related Aspects in Professional Education among Nursing Students of Two Nursing Schools in Iran: A Comparative Study. *Nurse Media Journal of Nursing.* 2022 Aug 1;12(2):223–32.
36. von Harbou K, Sawanpanyalert N, Trewin A, ... Strengthening emergency preparedness through the WHO emergency medical team mentorship and verification process: experience from Thailand. ... of Public Health [Internet]. 2020; Available from: <https://apps.who.int/iris/handle/10665/331828>

37. Obaid JM, Bailey G, Wheeler H, Meyers L, ... Utilization of functional exercises to build regional emergency preparedness among rural health organizations in the US. ... and disaster medicine [Internet]. 2017; Available from: <https://www.cambridge.org/core/journals/prehospital-and-disaster-medicine/article/utilization-of-functional-exercises-to-build-regional-emergency-preparedness-among-rural-health-organizations-in-the-us/36C5925B30707F16A9322C212615F5C4>
38. Smiddy MP, Murphy OM, Savage E, Fitzgerald AP, O' Sullivan B, Murphy C, et al. Efficacy of observational hand hygiene audit with targeted feedback on doctors' hand hygiene compliance: A retrospective time series analysis. *J Infect Prev.* 2019 Jul 1;20(4):164–70.
39. Shafran Tikva S, Gabay G, Asraf L, Kluger AN, Lerman Y. Experiencing and witnessing disruptive behaviors toward nurses in COVID-19 teams, patient safety, and errors in care. *Journal of Nursing Scholarship.* 2023 Jan 1;55(1):253–61.
40. Wallin A, Bazzi M, Ringdal M, Ahlberg K, Lundén M. Radiographers' perception of patient safety culture in radiology. *Radiography.* 2023 May 1;29(3):610–6.
41. Heideveld-Chevalking AJ, Calsbeek H, Griffioen I, Damen J, Meijerink WJHJ, Wolff AP. Development and validation of a Self-assessment Instrument for Perioperative Patient Safety (SIPPS). *BJS Open.* 2018 Dec;2(6):381–91.
42. Al Sawafi KM. Examining the Importance of Hand Hygiene Policy and Patient Safety Culture on Improving Healthcare Workers' Adherence to Hand Hygiene Practice in Critical Care Settings in the Sultanate of Oman: A Scoping Review. *Cureus [Internet].* 2021 Nov 20 [cited 2023 Dec 30];13(11). Available from: <https://pubmed.ncbi.nlm.nih.gov/34950551/>
43. Chellan J, Sibiyi MN. An audit tool for relicensing inspection for private hospitals in Etheke District, South Africa. *Afr Health Sci.* 2020 Jun 1;20(2):936–47.
44. Tadesse M, Shimelash A, Tegegne E. Level of Hand Hygiene Compliance and Its Associated Factors Among Health Care Workers at Eka Kotebe General Hospital, Addis Ababa, Ethiopia. *Environ Health Insights [Internet].* 2022 [cited 2023 Dec 30];16. Available from: <https://pubmed.ncbi.nlm.nih.gov/35873715/>
45. Sukendar S, Santoso APA, Rifai A, Wahab S, Fawzi'ah NI. Juridical Review of Nurse's Legal Responsibility for Patient Safety in Self Nursing Practice. *UNIFIKASI : Jurnal Ilmu Hukum.* 2021 Nov 8;8(2):167–75.
46. Hughes JC, Rog E. Talent management: A strategy for improving employee recruitment, retention and engagement within hospitality organizations. *International journal of contemporary hospitality management.* 2008;20(7):743–57.
47. Yahya KK, Mansor F, Warokka A. An empirical study on the influence of perceived organizational support on academic expatriates' organizational commitment. *The Journal of Organizational Management Studies.* 2012;2012:1–14.
48. Kalsum U, Harlen, Machasin. Pengaruh Budaya Organisasi Dan Komitmen Organisasi Terhadap Kepuasan Kerja dan Turnover Intention Pada Perawat RSIA Eria Bunda Pekanbaru. *Jurnal Sosial Humaniora Terapan.* 2022 Jun 28;5(1).
49. Kalsum U, Harlen H, Machasin M. Pengaruh Budaya Organisasi Dan Komitmen Organisasi Terhadap Kepuasan Kerja dan Turnover Intention Pada Perawat RSIA Eria Bunda Pekanbaru. *Jurnal Sosial Humaniora Terapan [Internet].* 2023 [cited 2023 Dec 30];5(1). Available from: <https://scholarhub.ui.ac.id/jsht/vol5/iss1/5>
50. Purnasiwi D, Jenie IM. Literature Review: Effect of Interprofessional Collaboration Implementation of Patient Services. *Indonesian Journal of Occupational Safety and Health.* 2021 Jul 30;10(2):265–72.
51. Pelzang R, Hutchinson AM. Patient

- safety issues and concerns in Bhutan's healthcare system: A qualitative exploratory descriptive study. *BMJ Open*. 2018 Jul 1;8(7).
52. Pelzang R, Hutchinson AM. How Is Patient Safety Understood by Healthcare Professionals? The Case of Bhutan. *J Patient Saf* [Internet]. 2020 Mar 1 [cited 2023 Dec 30];16(1):106–9. Available from: <https://pubmed.ncbi.nlm.nih.gov/32106178/>
 53. Wachman EM, Grossman M, Schiff DM, Philipp BL, Minear S, Hutton E, et al. Quality improvement initiative to improve inpatient outcomes for Neonatal Abstinence Syndrome. *J Perinatol* [Internet]. 2018 Aug 1 [cited 2023 Dec 30];38(8):1114–22. Available from: <https://pubmed.ncbi.nlm.nih.gov/29740196/>
 54. Galleryzki AR, Hariyati RTS, Afriani T, Rahman LO. Hubungan Sikap Keselamatan dengan Implementasi Sasaran Keselamatan Pasien oleh Perawat di Rumah Sakit. *Jurnal Kepemimpinan dan Manajemen Keperawatan*. 2021 May 29;4(1).
 55. Handayani Y V, Kusumapradja R. Pengaruh Motivasi Kerja Perawat Terhadap Penerapan Program Keselamatan Pasien di Unit Rawat Inap Rumah Sakit X Tangerang Selatan. Vol. 1. 2018.
 56. Rahayu S, Sulistiadi W, Trigono A. Pengaruh Karakteristik Individu dan Implementasi Budaya Keselamatan Pasien Terhadap Insiden Keselamatan Pasien di Rumah Sakit Umum Daerah Banten. Vol. 2, *Jurnal Manajemen dan Administrasi Rumah Sakit*. 2018.
 57. Sabri A. *Psikologi pendidikan*. Jakarta: pedomani ilmu jaya. 1996;
 58. Aminayanti N, Kusumapradja R, Arrozi M. Pengaruh Pengetahuan, Sikap dan Motivasi Perawat Terhadap Pelaksanaan Keselamatan Pasien pada Unit Rawat Inap Rumah Sakit Umum Daerah Sekayu. *Jurnal Health Sains*. 2021;2(7):915–22.
 59. Veronica SY, Agustriyani F, Isnaini M, Mukhlis H. Correlation Between Knowledge About the Provision of Covid-19 Vaccines to The Anxiety Level of Pregnant Women at The Adiluhur Health Center in Mesuji Regency. *Jurnal Aisyah: Jurnal Ilmu Kesehatan*. 2022;7(S1):38.
 60. Alhidayah T, Susilaningsih FS, Somantri I. Literature Review: Patient Safety Implementation by Nurse in Hospital. In: *International Conference on Health Care and Management 2018*. 2018.
 61. Pambudi YDW, Sutriningsih A, Desnani D, Yasin F, Program M, Ilmu S, et al. Faktor-Faktor Yang Mempengaruhi Perawat Dalam Penerapan 6 SKP (Sasaran Keselamatan Pasien) Pada Akreditasi JCI (Joint Commission International) Di Ruang Rawat Inap Rumah Sakit Panti Waluya Malang. Vol. 3, *Nursing News*. 2018.
 62. Faridah I, Ispahani R, Badriah EL, Santika JA. Faktor-faktor yang mempengaruhi penerapan budaya keselamatan pasien (patient safety culture) pada perawat di rawat inap rsu kabupaten tangerang. *Jurnal Kesehatan*. 2019;8:21–39.
 63. Adiputra IMS, Trisnadewi NW, Oktaviani NPW, Munthe SA, Hulu VT, Budiastutik I, et al. *Metodologi Penelitian Kesehatan*. Yayasan Kita Menulis. 2021;
 64. Abbas SA. Faktor-Faktor Pendorong Motivasi dan Perannya dalam Mendorong Peningkatan Kinerja. *Balanca: Jurnal Ekonomi Islam* [ONLINE} [Internet]. 2023;5(1). Available from: <https://ejurnal.iainpare.ac.id/index.php/balanca/index>
 65. Damayanti A, Herawati J, Kurniawan IS. Pengaruh pemimpin, budaya organisasi, efikasi diri, dan stabilitas emosional terhadap kinerja karyawan. (Online) *JURNAL MANAJEMEN*. 2022;14(1):2022–191.
 66. Putri ME, Fithriyani F, Sari MT. Faktor yang Berhubungan dengan Penerapan 6 Sasaran Keselamatan Pasien. *Jurnal Akademika Baiturrahim Jambi*. 2022 Mar 30;11(1):55.
 67. Oh JW, Kim JE. Effectiveness of a virtual reality application-based education programme on patient safety management for nursing students: A

- pre-test–post-test study. *Nurs Open*. 2023 Dec 1;
68. Oktariani M, Nurlaily AP. Pengaruh Pemberian Pelatihan Penerapan Sasaran Patient Safety Berbasis Aplikasi Mobile Terhadap Perilaku Perawat di Ruang IGD Puskesmas Grogol Sukoharjo. *Jurnal Kesehatan Kusuma Husada*-Juli. 2019.
 69. Shore S, Carey EP, Turakhia MP, Jackevicius CA, Cunningham F, Pilote L, et al. Adherence to dabigatran therapy and longitudinal patient outcomes: insights from the veterans health administration. *Am Heart J*. 2014;167(6):810–7.
 70. Hope J, Griffiths P, Schmidt PE, Recio-Saucedo A, Smith GB. Impact of using data from electronic protocols in nursing performance management: A qualitative interview study. *J Nurs Manag*. 2019 Nov 1;27(8):1682–90.
 71. Aldhaban F, Daim TU, Harmon R. Exploring the adoption and use of the smartphone technology in emerging regions: Case of Saudi Arabia. In: 2016 Portland International Conference on Management of Engineering and Technology (PICMET). IEEE; 2016. p. 2922–30.
 72. Nugroho A, Christiananta B, Wulani F, Pratama I. Exploring the Association Among Just in Time, Total Quality and Supply Chain Management Influence on Firm Performance: Evidence from Indonesia. 2022;
 73. Luxton DD, McCann RA, Bush NE, Mishkind MC, Reger GM. mHealth for mental health: Integrating smartphone technology in behavioral healthcare. *Prof Psychol Res Pr*. 2011;42(6):505.
 74. Andrianto W, Athira AB. Telemedicine (online medical services) dalam era new normal ditinjau berdasarkan hukum kesehatan (studi: program telemedicine Indonesia/temenin di rumah sakit dr. Cipto mangunkusumo). *Jurnal Hukum & Pembangunan*. 2022;52(1):220–50.
 75. Puspitaningrum I, Supriatun E, Putri SD. Dokumentasi Keperawatan Berbasis Elektronik Meningkatkan Keselamatan Pasien dan Mutu Asuhan Keperawatan. *DIAGNOSA: Jurnal Ilmu Kesehatan dan Keperawatan*. 2023;1(3):255–67.
 76. Baca K, Rico M, Stoner M. Embracing technology to strengthen care and enhance human connection. Vol. 34, *Dimensions of Critical Care Nursing*. Lippincott Williams and Wilkins; 2015. p. 179–80.
 77. Timur CN, Pawelas Arso S, Ardani MH. Artikel Penelitian Inovasi Pengembangan Sistem Infomasi untuk Meningkatkan Kepatuhan Perawat dalam Pencegahan Pasien Jatuh. *Jurnal Kepemimpinan dan Manajemen Keperawatan* [Internet]. 2020;3(1). Available from: <http://dx.doi.org/10.26594/jkkm.v3.i1.545>
 78. Timur CN, Pawelas Arso S, Ardani MH. Artikel Penelitian Inovasi Pengembangan Sistem Infomasi untuk Meningkatkan Kepatuhan Perawat dalam Pencegahan Pasien Jatuh. *Jurnal Kepemimpinan dan Manajemen Keperawatan* [Internet]. 2020;3(1). Available from: <http://dx.doi.org/10.26594/jkkm.v3.i1.545>

Original Article

Analysing the Relationship between Knowledge, Education Level and Economic Status with Early Marriage in Married Couples in Sindangheula Village, Serang Regency

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ABSTRACT

Early marriage is a social issue that affects various aspects of community life, including individual and family welfare. Knowledge, education level, and economic status have been identified as factors that may influence of early marriage in the region. The purpose of this study was to determine the relationship between knowledge, education level, and economic status with early marriage in married couples in Sindangheula Village, Serang Regency in 2023. This study used a correlational method with a cross-sectional approach. The sample was 79 respondents selected using a random generator system where all names within the population were included in the system and then randomly chosen according to a predetermined quantity. Findings indicated a minority (20.3%) reported early marriage, while a significant proportion exhibited poor knowledge (35.4%) and low education levels (41.8%). Moreover, a minority (29.1%) reported poor economic status. Statistical analysis revealed significant relationships between knowledge ($p = .025$), education level ($p = .001$), economic status ($p = .002$), and early marriage. Multivariate analysis further confirmed these associations ($R^2 = .154$, adjusted $R^2 = .120$, $F = 4.540$, $P < 0.05$), with a positive β value (0.263). The research results also revealed a positive β value (0.263). It is recommended that village officials can provide information and health education to adolescents and parents about marriage as well as provide motivation and beneficial activities for the development of the Sindangheula Village, Serang Regency.

Keywords: Knowledge, Education Level, Economic Status, Early Marriage, Health Education.

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INTRODUCTION

Early marriage, which is a marriage entered into by young people under the age of 20 who are not physically or mentally ready to enter a marriage bond, is a phenomenon that has plagued many countries around the world¹. The impact of early marriage is not only local but also has significant consequences globally. Moreover, Indonesia is one of the countries

with a high rate of early marriage, with the number of marriages of children under the age of 18 reaching alarming numbers².

The impact of early marriage is not limited to reproductive health issues but also includes the risk of forced marriage, early sexual intercourse, teenage pregnancy, and complications that can arise during pregnancy and childbirth. In Indonesia alone, data shows that the highest rates of early marriage are

found in several provinces, such as South Kalimantan, West Java, and East Kalimantan, with alarming rates³.

The consequences of early marriage not only impact physical health but also the psychological for the couples involved. Lack of adequate preparation and knowledge about marital responsibilities can cause deep stress and trauma, even potentially disrupting harmony in newly built families⁴.

The causes of early marriage vary according to the circumstances of society and social life. Low education and low-paid jobs can also cause children to marry young. Marrying young reduces the burden on parents. Low-income parents more often marry their children and economic factors become an obstacle to sending children to college⁵. Well-informed people tend not to marry young, especially to see the lives of young couples who marry young and gain knowledge about early marriage from those around them. Most young couples experience financial difficulties. However, there are still many people who lack knowledge because they do not know the impact of marrying at a young age, do not think about the next life, and cannot assess whether the decision to build a family will lead to a comfortable life⁶.

Education level and economic status have also been shown to be significant factors in early marriage trends. Low education and economic limitations are often the driving forces for children to marry at a very young age. Unstable social and economic conditions often force children to make inappropriate decisions about marriage.

Although several studies have been conducted to identify factors contributing to early marriage, further research is needed to better understand the relationship between knowledge, education, and economic status with the phenomenon of early marriage at the local level, such as in Sindangheula Village, Serang Regency. Through this research, it is hoped that effective strategies can be found to reduce the prevalence of early marriage and improve community welfare in Sindangheula Village as well as other areas in Indonesia that experience similar problems. With a better

understanding of the factors that influence early marriage, appropriate programs can be implemented to prevent this practice and protect the rights and welfare of children in the future.

The results of a preliminary study that involved interviews with seven teenagers who got married young were as follows: three said they got married because they couldn't afford to go to school; two said they thought getting married would ease the financial burden of raising a family because their parents' income was only mediocre; and two said it was better to get married than to sin. According to data collected from Sindang Heula Village, 16 individuals between the ages of 18 and 19 were married early in 2021, and 16 individuals between the ages of 16 and 19 were married early in 2022 and 2023. In addition, from the initial survey, 5 out of 7 respondents experienced pregnancy and childbirth at a very young age, 1 of them had a miscarriage, 2 of them experienced delayed child growth because they did not know how to process food for their babies, 2 people experienced postpartum blues. Based on the data and phenomena above, the researcher is interested in knowing "Analysing the Relationship between Knowledge, Education Level and Economic Status with Early Marriage in Married Couples in Sindangheula Village, Serang Regency in 2023".

METHOD

The type of research in this study is correlational through a *cross-sectional* approach. The population used in this study were 259 couples who got married in 2021-2023 in Sindangheula Village, Serang Regency. The sample size was 79 respondents. The sampling technique is a *simple random sampling* technique. This research was started from March to June 2023. The research instrument used in this study was a questionnaire about the level of education, economic status, and knowledge of early marriage. This research activity was carried out after obtaining *ethical clearance* ethical number: No. 225/KEPK.UF/V/2023.

RESULTS

Table 1. Frequency distribution of knowledge, education level, and economic status of early marriage in married couples in Sindangheula Village, Serang Regency in 2023.

Variables	Frequency (f)	Percentage (%)
Wedding		
Early Marriage	16	20,3
Not Married Early	63	79,7
Total	79	100
Knowledge		
Less good	42	53,2
Good	37	46,8
Education Level		
Low	33	41,8
High	46	58,2
Economic Status		
Less <UMR	23	29,1
Good \geq minimum wage	56	70,9
Total	79	100

Based on Table 1, it is known that out of a total of 79 (100%) respondents, it was found that most couples did not marry at an early age, namely 63 respondents (79.7%), almost most had poor knowledge, namely 42

respondents (53.2%), almost most had high education, namely 46 respondents (58.2%), most had good economic status, namely 56 respondents (70.9%).

Table 2. Relationship between knowledge, education level, economic status and early marriage

Knowledge	Wedding				Total		P-value	OR
	Early Marriage		Not Married Early					
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%		
Less good	13	31,0	29	69,0	42	100	0,025	5,080
Good	3	8,1	34	91,9	37	100		
Education Level								
Low	13	39,4	20	60,6	33	100	0,001	9,317
High	3	6,5	43	93,5	46	100		
Economic Status								
Less <UMR	10	43,5	13	56,5	23	100	0,002	6,410
Good ≥ minimum wage	6	10,7	50	89,3	56	100		
Total	16	20,3	63	79,7	79	100		

Based on table 2, it is known that out of a total of 42 (100%) respondents whose knowledge is not good, most of them do not marry at an early age, namely 29 respondents (69.0%). Meanwhile, out of a total of 37 (100%) respondents whose knowledge was good, almost all did not marry at an early age, namely 34 respondents (91.9%). The results of

statistical tests found there was a relationship between knowledge and early marriage in Sindangheula Village. The results of other statistical tests obtained an OR value of 5.080, meaning that the poor knowledge group has a risk of 5.080 times performing early marriage compared to the good knowledge respondent group.

Table 3. Final Results of Logistic Regression of Early Marriage Incidence in Sindangheula Village, Serang Regency in 2023

Variables Associated with Early Marriage	Coefficient β	Standard Error	Standard β	t
Knowledge	0,246	0,287	0,106	0,856
Education Level	1,547	0,637	0,263	2,429
Economic Status	1,111	0,801	0,174	1,387

R² .154, Adjusted R² .120, F= 4,540

**p-value < 0,05*

Based on Table 3, the results of the multivariate analysis show that all factors related to early marriage yielded $R^2 = .154$, adjusted $R^2 = .120$, $F = 4.540$, and $p\text{-value} < 0.05$. The research results also revealed a positive β value (0.263), indicating a positive relationship between education level and the likelihood of early marriage. This means that the higher someone's level of education, the higher the likelihood of them not marrying at an early age. The $p\text{-value}$ of 0.018 indicates that the relationship between education level and early marriage is statistically significant because it is smaller than the common significance level ($p\text{-value} < 0.05$).

DISCUSSION

Frequency Distribution of Knowledge, Education Level, Economic Status of Early Marriage in Married Couples in Sindangheula Village, Serang Regency, 2023

Early marriage is the marriage of adolescents under the age of 20 who should not be ready for marriage⁷. The National Population and Family Planning Agency (BKKBN) states that the ideal age for someone to have their first marriage is 21 years for women and 25 years for men with consideration of the maturity of a person's biological and psychological conditions at that age⁸. The results showed that although most couples did not marry at an early age, there were still a small number who married at an early age. Marriage at an early age is a serious problem because it can have an impact from various aspects such as the impact on health, the impact on psychology, and the impact on socio-economics. The impact of early marriage also occurs in the community such as social problems, gender inequality, causing sustainable poverty status, increased illiteracy, and disconnection from poor health education, and can deprive the wider community of productivity both in the short and long term⁹.

The results of research on knowledge show that there are still respondents who do not know that women who marry at a young age tend to experience bleeding due to immature reproductive health, do not know the

age that many pregnancy complications at the age of < 20 years and > 35 years and early marriage can have a health impact on the baby. Women's knowledge indirectly influences the implementation of early marriage¹⁰. Early marriage is an underage marriage whose preparation target has not been maximized - physical, mental, and material preparation. Because of this, early marriage can be said to be a rushed marriage, because everything has not been carefully prepared, in other words, this marriage decision is due to a lack of knowledge about the risks that can be experienced if marriage is carried out at an early age.

The results of the study found that couples who married at an early age almost all their last education at the first school, and then they dropped out of school because they had to get married. Low levels of education and knowledge among children can cause a tendency to marry at an early age¹¹. This is in line with research by Hermambang et al, (2021) showing that women with a junior high school education tend to marry early by 10.561 times compared to women with at least a high school education¹². Meanwhile, women with primary school education tend to marry early by 50.105 times compared to women with at least high school education. Women who have never attended school tend to marry early by 94.418 times compared to women who have at least a high school education¹².

Income level is related to the amount of income a person earns¹³. The results of the research conducted by the researcher found that most family incomes were \geq IDR 4,000,000, but there were also those whose income was IDR 4,000,000 a month. Economic problems in the family often cause parents to marry off their children to people who are considered more capable, because parents are no longer able to pay for their living and school needs, thus making children make the decision to marry at an early age on the grounds of reducing the family's economic burden¹⁴. Economic conditions are one of the factors related to early marriage, in addition to knowledge, education, environment, culture, and mass media¹⁰.

The relationship between knowledge, education level, economic status and early marriage in couples who marry at an early age in Sindangheula Village, Serang Regency, 2023

The results of the research based on Table 2 show that out of a total of 33 (100%) respondents with low education, most of them did not marry at an early age, namely 20 respondents (60.6%). Meanwhile, out of a total of 46 (100%) respondents whose education is high, almost all of them did not marry at an early age, namely 43 respondents (93.5%). The results of statistical tests found there was a relationship between education level and early marriage. The results of other statistical tests obtained an OR value of 9.317, meaning that the low education group has a 9.317 times risk of early marriage compared to the high education respondent group.

The results of research based on Table 2 also found that of the 23 (100%) respondents whose economic status was poor, almost most did not marry at an early age, namely 13 respondents (56.5%). Meanwhile, out of a total of 56 (100%) respondents whose economic status was good, almost all did not marry at an early age, namely 50 respondents (89.3%). The results of statistical tests found there was a relationship between economic status and early marriage in Sindangheula Village. The results of other statistical tests obtained an OR value of 6.410, meaning that the economic status group has a risk of 6.410 times performing early marriage compared to the good economic status respondent group.

The results of this study are in accordance with Supriati (2018) research, it is known that there is a significant relationship between knowledge and early marriage, obtained a value of $P = 0.005$ (<0.05), with an odd ratio value of 0.097, meaning that adolescents with poor knowledge have a 0.097 times chance of accepting early marriage¹⁵. This can be interpreted that the higher the knowledge, the lower the respondent's attitude towards early marriage and vice versa¹⁵.

Another study from Arikhman, et al (2019) found a p-value = 0.014, indicating a significant relationship between knowledge and early marriage⁶. According to researchers, this is due to low knowledge about the various consequences of early marriage. Such as not knowing that marrying at a young age tends to experience bleeding due to immature

reproductive health, experiencing pregnancy complications, not knowing that marrying at an early age can lead to problems of domestic violence, divorce, and early marriage can have health effects on the baby they are carrying⁶.

According to Susanti and Sari (2018), a low level of education leads to low knowledge of parents, children, and the community about the impact of early marriage¹⁶. The lower the level of education of adolescents, the more often marriage occurs at an early age. The role of education level is closely related to the understanding of family. In other words, education is the root of all problems in individuals, because from education individuals will gain knowledge to determine their attitude in making decisions. Including making decisions about whether they are ready to marry and become mothers at a very early age¹⁶.

This is in line with research conducted by Vidalia and Azinar (2022) in this study which shows that there is a significant relationship between education level and early marriage in Sukadana District ($p=0.004$). In this study, respondents who had a low level of education had a 2.648 times greater risk of early marriage compared to respondents who had a high level of knowledge⁷.

The results of this study are also in line with Nasution (2020) The results of Chi Square analysis show that the p value is 0.037 ($p < 0.05$), meaning that H_a is accepted, and H_o is rejected¹⁷. These results prove that there is a significant relationship between respondent education and Early Marriage in Janjimaui Muaratais III Village, Angkola muaratais District in 2019. A high level of education will provide mature understanding to individuals to choose and decide on something. A high level of education makes a lot of learning from the surrounding environment and the media so that it can change attitudes and views according to what he understands¹⁷.

This is in line with research conducted by Vidalia and Azinar (2022) in this study showing that there is a significant relationship between family income and early marriage with (p value = 0.000). While the OR value = 6.920, then adolescents with low family income 6.920 times perform early marriage compared to high family income. Economic factors are the main drivers that can drive many sectors in humans⁷.

The results of this study are also in line with the results of Nasution's research that most parents have a low income as many as 33 people (82.5%) and high income only 7 people (17.5%).⁹ The results of statistical tests show that there is a significant relationship between parental income and early marriage with a p value = 0.037 ($p < 0.05$)¹⁷.

The results of research by Wulandari & Laksono (2020) with the title of the relationship between Economic Status and Early Marriage in women in rural Indonesia found that the poorest women had a higher probability of 2.23 times experiencing early marriage than the richest women. Poor women have a 1.68 times higher chance of experiencing early marriage than the richest women¹⁸.

According to the researcher's assumption, parents who marry off their children at a young age assume that by marrying off their children, the family's economic burden will be reduced. This factor is related to the low economic status of the family. The assumption is that if a young woman is married, her responsibilities will be transferred to her husband. Even parents who marry off their children at an early age also hope that if their children are married, they will be able to help improve their parents' lives.

Final Results of Logistic Regression of Early Marriage Incidence in Sindangheula Village, Serang Regency in 2023

Based on Table 3, the results of the multivariate analysis show that all factors related to early marriage yielded $R^2 = .154$, adjusted $R^2 = .120$, $F = 4.540$, and $p\text{-value} < 0.05$. The research results also revealed a positive β value (0.263), indicating a positive relationship between education level and the likelihood of early marriage. This means that the higher someone's level of education, the higher the likelihood of them not marrying at an early age. The p-value of 0.018 indicates that the relationship between education level and early marriage is statistically significant because it is smaller than the common significance level ($p\text{-value} < 0.05$).

This result shows the importance of education level in influencing one's marriage decision. With a positive β value and strong statistical significance, it can be concluded that individuals with higher levels of education

tend to have a lower likelihood of experiencing early marriage. This could be due to a variety of factors, including an awareness of a wider range of life choices, a focus on career or personal development, or a postponement of the marriage decision until feeling more financially or emotionally prepared. This emphasizes the importance of education in providing individuals with the opportunity and knowledge to make better decisions in their lives.

The limitations of this study are that it was only conducted in one village and specific region, thus generalizing its results to a broader population should be done cautiously, and other factors influencing early marriage, such as cultural and religious factors, could not be further discussed

CONCLUSION

The research findings indicate that although the majority of couples do not marry at a young age, there is still a significant number who do, underscoring the importance of addressing this issue comprehensively. Factors such as low education levels, economic limitations, and inadequate knowledge contribute to the trend of early marriage. Couples often cite financial pressure and societal expectations as reasons for early marriage. Moreover, low levels of education and economic status correlate with a higher likelihood of early marriage, emphasizing the critical role of education in decision-making processes. This research emphasizes the need for targeted interventions to effectively address early marriage. By enhancing education and economic opportunities, communities can empower individuals to make informed decisions about marriage. Future research should focus on exploring the impact of specific interventions aimed at reducing the incidence of early marriage, particularly in vulnerable communities such as Sindangheula Village..

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CONFLICTS OF INTEREST

We affirm our commitment to transparency regarding any potential biases or influences that may affect the research findings. The authors declare no conflicts of interest that could impact the objectivity or integrity of this study. We state that this research was conducted solely for academic purposes and to contribute to the understanding of early marriage dynamics in the specified community. No external funding or affiliations with organizations that could potentially influence the interpretation or dissemination of the results were involved in this study. We adhere to ethical principles and scientific rigor in the collection, analysis, and reporting of data to ensure the credibility and validity of our findings

REFERENCES

1. Tamhur, R., Anwary, A., & Anam, K. Hubungan Pengetahuan, Pendapatan dan Budaya Dengan Kejadian Pernikahan Usia Dini Pada Remaja Putri Di Kecamatan Martapura Kota . *Jurnal Kesehatan Masyarakat*, 2020; 1-8.
2. UNICEF. *Pencegahan Perkawinan Anak Percepatan yang Tidak Bisa Ditunda*. Jakarta: Badan Pusat Statistik; 2020.
3. Sudargo, T., Aristasari, T., & Aulia'afifah. *1.000 hari pertama kehidupan*. yogyakarta: Gajah Mada Universiti Press, Anggota IKAPI, Anggota APPTI; 2018.
4. Indrianingsih I, Nurafifah F, Januarti L. Analisis dampak pernikahan usia dini dan upaya pencegahan di desa Janapria. *Jurnal Warta Desa (JWD)*. 2020 May 11;2(1):16-26.
5. Wijayati NA, Soemanto RB, Pamungkasari EP. Socioeconomic and cultural determinants of early marriage in Ngawi, East Java: Application of PRECEDE-PROCEED Model. *Journal of Health Promotion and Behavior*. 2017;2(4):302-12.
6. Arikhman N, Efendi TM, Putri GE. Faktor yang Mempengaruhi Pernikahan Usia Dini di Desa Baru Kabupaten Kerinci. *Jurnal Endurance: Kajian Ilmiah Problema Kesehatan*. 2019 Oct 27;4(3):470-80.
7. Vidalia, R., & Azinar, M. Faktor-Faktor Yang Mempengaruhi Pernikahan Usia Dini Di Kecamatan Sukadana. *Jurnal Kesehatan Masyarakat*, 2022; 10, 115-121.
8. BKKBN. Badan Kependudukan Keluarga Berencana Nasional. *Survei Demografi dan Kesehatan Indonesia; 2020*.
9. Rosyidah EN, Listya A. Infografis dampak fisik dan psikologis pernikahan dini bagi remaja perempuan. *Visual Heritage: Jurnal Kreasi Seni dan Budaya*. 2019 May 3;1(03):191-204.
10. Sari RM, Silviani YE, Supriyanto G. Faktor-Faktor yang Mempengaruhi Terjadinya Pernikahan Dini di Desa Ujung Alih Kecamatan Tebing Tinggi Kabupaten Empat Lawang Tahun 2019. *Nursing Inside Community*. 2020 Apr 30;2(2):51-8.
11. Soraya, D. *Dampak pernikahan usia dini: analisis feminis pada pernikahan anak perempuan di Desa Cibunar Kecamatan Cibatu Kabupaten Garut*. UIN Sunan Gunung Bandung; 2018.
12. Hermambang A, Ummah C, Gratia ES, Sanusi F, Ulfa WM, Nooraeni R. Faktor-Faktor yang memengaruhi pernikahan dini di Indonesia. *Jurnal Kependudukan Indonesia*. 2021 Nov 2;16(1):1-12.
13. Benu FZ, Hinga IA, Bunga EZ. Correlation between Socio-economic Factors and Stress with Hypertension Cases during the Covid-19 Pandemic. *Poltekita: Jurnal Ilmu Kesehatan*. 2023 Feb 28;16(4):436-42.
14. Tampubolon, EP. Permasalahan Perkawinan Dini di Indonesia. *Jurnal Indonesia Sosial Sains*, 2021; 2, 738 – 745. doi:10.36418/jiss.v2i5.279
15. Supriati S. Hubungan Pengetahuan Dan Sikap Pada Remaja Tentang Pernikahan Dini Di Dusun Iv Desa

- Kolam Kecamatan Percut Sei Tuan Kabupaten Deli Serdang Tahun 2018. *Jurnal Darma Agung Husada*. 2019 Apr 25;5(1):52-61.
16. Susanti, D., & Sari, W. Hubungan Tingkat Pendidikan Perempuan dan Orang Tua dengan Pernikahan Perempuan Usia Dini. *Jurnal Ilmu Kesehatan*, 2018; 3, 35-41. doi:10.33757/jik.v3i1.177
 17. Nasution LK. Hubungan pendidikan pekerjaan dan peran teman sebaya dengan terjadinya pernikahan usia dini di desa janjimauli muaratais iii. *Jurnal Education and development*. 2020 Aug 10;8(3):124-129.
 18. Wulandari RD, Laksono AD. Hubungan status ekonomi terhadap pernikahan dini pada perempuan di perdesaan Indonesia. *Jurnal Kesehatan Reproduksi*. 2020;11(2):115-24.

Original Article

Comparison of Antioxidants in Red Ginger Powder Preparations with the Addition of Sucrose and Red Ginger Powder Preparations Without the Addition of Sucrose

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ABSTRACT

Antioxidants are compounds that can inhibit oxidation reactions in the human body. Antioxidants can be obtained from food intake. Intake containing antioxidant compounds can also be found in red ginger. Red ginger is available in the form of instant powder obtained through a crystallization process using sucrose as the main agent. Granulated sugar has a sucrose content of 99.95% and functions as a sweetener as well as a crystallization agent that affects the speed of crystallization. This study aims to determine the comparison of antioxidant levels contained in red ginger powder with the addition of sucrose and without the addition of sucrose. The research design used was experimental research design by testing the comparison of antioxidant compound activity between red ginger powder added sucrose and red ginger powder without added sucrose using DPPH reagent measured by spectrophotometer. The measurement of antioxidant content showed that red ginger powder without added sucrose has a very strong IC50 value of antioxidant activity with a value of 46.12 ppm while red ginger powder without added sucrose has a weak IC50 value of antioxidant activity with a value of 205.47 ppm. The results of antioxidant activity testing on both red ginger powders were then statistically tested using the unpaired T-Test test with a p-value <0.05 which means significant. It can be concluded that there is a significant difference in antioxidant activity values between red ginger powder without added sucrose and red ginger powder with added sucrose.

Keywords: Powder, Red Ginger, Antioxidants, Sucrose, DPPH.

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INTRODUCTION

The current modern era and the rapid development of technology and science as well as changes in people's lifestyles to a more practical life can be the cause of the formation of free radicals. Free radicals can enter and form in the body through breathing, unhealthy environmental conditions, and foods containing fat¹⁻³.

Free radicals react with proteins, fatty acids, and even DNA so that they can cause cell and tissue damage which is the root of various diseases. The above conditions cause the body to need an intake containing antioxidant compounds which are able to capture and neutralize free radicals. Antioxidants can be defined as compounds that are able to delay, slow down, or inhibit oxidation reactions. One intake that contains antioxidant compounds is ginger^{1,3,4}.

Ginger is a spice plant that originates from South Asia and has spread throughout the world. Apart from being used as a cooking spice, people in Asia, one of which is Indonesia, also use the ginger plant as a traditional medicinal plant. In research conducted by Rahmin Munandi (2018), the results showed that one type of ginger, namely red ginger, contains tannins, flavonoids, saponins, alkaloids and terpenoids which have very strong antioxidant activity.⁵⁻⁷.

Red ginger in fresh form has a fairly short shelf life, therefore it is necessary to process ginger in various preparations so that it can be used for a long period of time. One of the processed red ginger preparations available to the public is processed red ginger in instant powder form. Preparations in instant powder form have several advantages, including being more practical in serving and having a long shelf life. Preparations in powder/instant powder form are usually made through a crystallization process using the main crystallization agent, namely sucrose. Granulated sugar has a sucrose content of 99.95% and functions as a sweetener and as a crystallization agent which influences the speed of crystallization⁸⁻¹¹.

Based on the description above, researchers are interested in comparing the antioxidant activity between red ginger powder with the addition of sucrose and red ginger powder without the addition of sucrose.

METHOD

This research uses an experimental type of research using the DPPH method. The research was carried out in the Pharmacognosy-Phytochemistry laboratory, Faculty of Pharmacy, Indonesian Muslim University, which was carried out in November-December 2023. The variables in this study were red ginger powder with added sucrose and red ginger powder without added sucrose as the independent variable and antioxidant content as the dependent variable. The samples in this study were red ginger that met the inclusion criteria, namely red ginger that was large and felt hard, ginger with smooth and dry skin, and was still fresh.

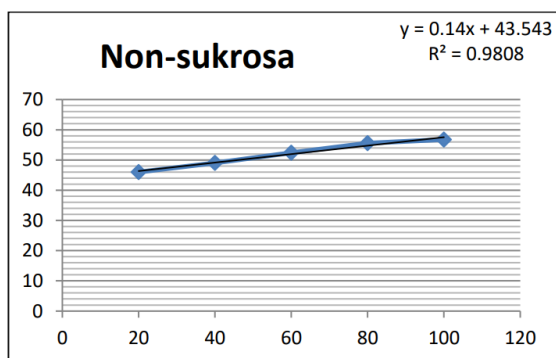
The tools used in this research are analytical scales, filter paper, blender, chemical glass/beaker, aluminum foil, dropper pipette, UV-Vis spectrophotometer, sieve, rotary evaporator, measuring flask, soaking container, drying cabinet. Meanwhile, the materials used were red ginger samples that had been made into powder, 96% ethanol, DPPH reagent and sucrose solution. Quercetin. Data analysis was carried out by calculating and analyzing the IC₅₀ value obtained from the linear regression equation using the Microsoft Excel program via the T-test method. The smaller the IC₅₀, the stronger the antioxidant activity.

RESULTS

Table 1. Antioxidant Activity Test Results on Red Ginger Powder Without Added Sucrose

Concentration	Absorbance	% inhibition	IC ₅₀	Antioxidant activity
20	0.567	46.00	46.12	Very strong (IC ₅₀ < 50)
40	0.535	49.05		
60	0.500	52.38		
80	0.467	55.52		
100	0.454	56.76		

Based on the table above, it can be seen that as the concentration increases, the % inhibition increases and the absorbance value decreases. The linear regression curve equation for calculating antioxidants in red ginger powder without the addition of sucrose can be seen below.



Picture1. Graph of concentration and % inhibition of red ginger powder extract without the addition of sucrose

Table 2. Antioxidant activity test results red ginger powder with the addition of sucrose

Concentration	Absorbance	% inhibition	IC50	Antioxidant activity
20	0.585	44.29	205.47	Weak (IC50 150-200)
40	0.579	44.86		
60	0.570	45.71		
80	0.563	46.38		
100	0.561	46.57		

From the table above it can be seen that as the concentration increases, the % inhibition increases and the absorbance value decreases. The linear regression curve equation for calculating antioxidants in red ginger powder with the addition of sucrose can be seen below.

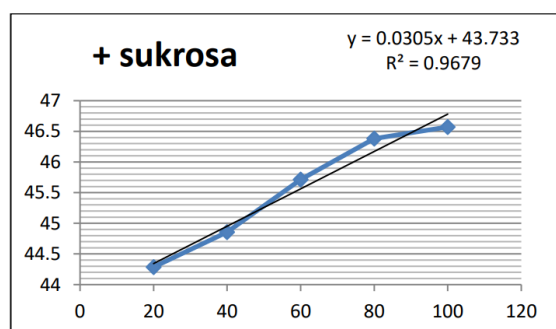


Figure 2. Graph of concentration and % inhibition of red ginger powder extract with the addition of sucrose

Based on the data that has been presented, the results obtained from calculating antioxidant activity using the linear regression equation $y = ax + b$ show that the antioxidant activity value of red ginger without added sucrose (table 1 and graph 1) is stronger than the antioxidant activity of red ginger powder with added sucrose. (table 2 graph 2).

Red Ginger Powder Phytochemical Screening Test Results

Table 3. Phytochemical Screening Test Results for Red Ginger Powder Without Sucrose

No	Compound Classes	Reactor	information
1	Tannin	FeCl3	(+) Tannin
2.	flavonoids	AlCl3	(+) flavonoids
3.	steroids	Liberman Bauchardat	(-) steroids
4.	Soponin	Hot water + Hcl 2N	(-) soponin
5.	alkaloids	mayer Dragendrof bauchardat	(+) alkaloids (+) alkaloids (+) alkaloids

From the table above, it can be seen that red ginger powder without added sucrose contains secondary metabolite compounds in the form of tannins, flavonoids and alkaloids.

Table 4. Phytochemical Screening Test Results for Red Ginger Powder with Sucrose

No	Compound Classes	Reactor	Information
1	Tannin	FeCl3	(+) Tannin
2.	flavonoids	AlCl3	(+) flavonoids
3.	steroids	Liberman Bauchardat	(-) steroids
4.	Soponin	Hot water + Hcl 2N	(-) soponin
5.	alkaloids	mayer Dragendrof bauchardat	(-) alkaloids (-) alkaloids (+) alkaloids

From the table above, it can be seen that red ginger powder to which sucrose is added contains secondary metabolite compounds in the form of tannins, flavonoids and alkaloids.

Based on the results of phytochemical screening on the two red ginger powders, it was found that both red ginger powders both contain secondary metabolite compounds in the form of tannins, flavonoids and alkaloids.

Table 5. Comparison Test Results for Antioxidant Activity Using Independent Sample T-Test

Red ginger without sucrose and plus sucrose	Sig. (2-tailed) P-Value < 0.05
	.014
	.031

In the table above you can see the significance value (2-tailed) for both powder

samples, namely <0.05 . From this data it can be determined that H_1 is accepted and H_0 is rejected. This indicates that there is a significant difference in levels of antioxidant activity in the two powders.

DISCUSSION

Measurement of Antioxidant Activity of Red Ginger Powder Samples Without Addition of Sucrose

Based on table 1 and graph 1 presented, it can be seen that testing samples of red ginger powder extract without added sucrose were made with 5 concentrations, namely 20, 40, 60, 80 and 100 ppm. After that, we continued calculating the antioxidant activity values using a linear regression equation. The R^2 value obtained for red ginger powder extract which did not add sucrose was 0.9808 with a value = 0.14 and b value = 43.543. where the R^2 value illustrates that as the concentration of the extract increases, the antioxidant activity will also increase¹²⁻¹⁴.

Based on the IC50 value calculation carried out on samples of red ginger powder extract without added sucrose, the IC50 value was 46.12 ppm. where this value is classified as very strong antioxidant activity ($<50 \mu\text{g/mL}$). This can be caused because the compounds contained in the red ginger powder preparation without the addition of sucrose are still pure. As mentioned in research conducted by Irma Erika Herawati and Nyi Mekar Saptarini in 2019, it is known that red ginger contains compounds in the form of flavonoids, tannins and alkaloids. All of these structures have hydroxyl groups that can donate hydrogen to interact with DPPH radicals to produce DPPH-H. Apart from that, red ginger also contains the compound zingerone, which is one of the active non-volatile phenolic compounds which has been proven to have the ability to act as an antioxidant.^{6,15,16}

Another thing that can influence the high levels of antioxidant activity in red ginger powder is the total phenol content. The reason why red ginger powder does not have added sucrose is the total phenol content contained in red ginger powder. The greater the ratio of red ginger powder to ethanol, the higher the instantaneous total phenol content of red ginger, the higher the antioxidant activity. In the data displayed, it can be seen that the greater the

concentration of the red ginger powder solution without sucrose, the more antioxidant compounds will become hydrogen or electron donors for DPPH radicals, resulting in a change in the color of DPPH which causes the resulting absorbance to be smaller. The presence of antioxidants in the test sample plays a role in neutralizing DPPH free radicals. Color loss will be proportional to the number of electrons taken by DPPH so it can be measured spectrophotometrically^{17,18}.

Measurement of Antioxidant Activity of Red Ginger Powder Samples with Sucrose Addition

Based on table 2 and graph 2, it can be observed that testing samples of red ginger powder extract with the addition of sucrose was carried out by making 5 concentration series, namely 20, 40, 60, 80 and 100 ppm, then antioxidant testing was carried out using a linear regression equation to obtain a value of $R = 0.9679$. The R value illustrates that the greater the concentration of the extract, the greater the antioxidant activity. Based on antioxidant activity test data, the IC50 value of red ginger powder extract with the addition of sucrose was obtained from the results of linear regression calculations. The y variable in this linear regression equation is IC50, the variables a and b are constants while the x variable acts as the concentration needed to reduce 50% of DPPH radicals.¹²⁻¹⁴

In the sample of red ginger powder extract which added sucrose, a linear regression equation was obtained, namely $y = 0.305x + 43.733$ and $R^2 = 0.9679$. Then proceed with calculating the antioxidant value and the result was 205.47 ppm, which is classified as a weak antioxidant ($> 150 \mu\text{g/mL}$). This is possibly caused by the sucrose content in the red ginger powder preparation which can inhibit the active compounds contained in the red ginger powder. As a result, the antioxidant activity contained in red ginger powder decreases and results in secondary metabolite compounds which act as antioxidants being damaged even though the antioxidants are naturally found in food. This research is also in line with research conducted by Anis Usfah Prastujati et al in 2023 with the results that the addition of sucrose can affect the reduction of antioxidant activity^{6,19-21}.

Differences in Antioxidant Activity in Red Ginger Powder with Sucrose Added and Red Ginger Powder without Sucrose Added

In this study, the comparison of antioxidant activity of red ginger powder with added sucrose and that without added sucrose was tested using the T-test method. T-test or T-test is one of the testing methods of parametric statistical tests. T-Test This test aims to compare or compare whether the average of a population or 2 populations has significant differences. The T-test is divided into two, namely the dependent t-test and the independent t-test. In this study, the independent t-test was used. The term independent sample t test is a test of unrelated or unpaired samples (independent samples). Comparative test data on antioxidant activity between red ginger powder with added sucrose and red ginger powder without added sucrose can be seen in the table^{5,22-24}.

From the results presented in table 5, it can be concluded that there is a significant difference in antioxidant activity between red ginger powder without addition and red ginger powder with added sucrose. There are several factors that can cause a decrease in antioxidant activity, some of which are drying time, temperature, heating time, processing process and mixture of other ingredients. In this study, the decrease in antioxidant activity in red ginger powder was caused by the addition of sucrose to one of the powders. Added sucrose can affect antioxidant activity because it can reduce methylation groups and H atoms, resulting in a reduction in H atoms, where H atoms are free radical hydrogen donors and can also degrade antioxidant compounds. This is different from red ginger powder which does not add sucrose. The compounds contained in red ginger powder without the addition of sucrose are natural compounds that act as antioxidants^{16,25-28}.

CONCLUSIONS

Based on the results and discussion of the research, it can be concluded that there is a significant difference in antioxidant levels in red ginger powder added with sucrose and red ginger powder added with sucrose. Red ginger powder without the addition of sucrose contains secondary metabolite compounds in the form of tannins, flavonoids and alkaloids. Meanwhile, red ginger powder with the addition of sucrose

contains secondary metabolite compounds in the form of tannins, flavonoids and alkaloids. This research provides an illustration that red ginger powder will be very beneficial for health because it contains very strong antioxidants when consumed without the addition of sucrose (sugar). Future researchers are advised to carry out further research on the effects of antioxidants and test them clinically, examine further what compounds are contained in red ginger powder with added sucrose and red ginger powder without added sucrose and can carry out comparative tests of antioxidant levels in red ginger powder with different methods.

REFERENCES

1. Maharani AI, Riskierdi F, Febriani I et al. The Role of Natural Antioxidants Made from Local Food in Preventing the Effects of Free Radicals. *Pros Semin Nas Bio*. 2021;1(2):390–9.
2. Ibroham MH, Jamilatun S K. A Review: The Potential of Plants in Indonesia as Natural Antioxidants. *J UMJ*. 2022;1–13.
3. Antarti AN LR. Test of the Antioxidant Activity of Solanum Family Leaf Ethanol Extract Using the DPPH Free Radical Reduction Method. *JPSCR J Pharm Sci Clin Res*. 2018;3(2):62.
4. Kameliani D, Salamah N GA. Test of the Antioxidant Activity of Green Algae Extract (*Ulva Lactuca L.*) with Varying Ethanol Solvent Concentrations of 60%, 75%, and 96% Using the Dpph (1,1-Diphenyl-2-Picrylhydrazyl) Method. *J Ilm Ibnu Sina Farm and Health Science*. 2020;5(2):387–96.
5. IW RA. Benefits of Ginger for Health. *Widya Health*. 2019;1(2):39–43.
6. Rukhayyah KK, Kawareng AT SY. Literature Study: Antioxidant Activity Test of Red Ginger Extract (*Zingiber officinale* var. *Rubrum*) Using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) Method. In: *Proceedings Mulawarman Pharm Conf*. 2022. p. 15:242-245.
7. RM Chemical Component Analysis and Antioxidant Test of Red Rhizome Extract (*Zingiber offinale* Rosc.Var *rubrum*). *Cokroaminoto J Chem Sci*. 2018;1(2):1–6.
8. Prasetyo RA, Setiawan MJ HK. Making Instant Drink from Red Ginger (*Zingiber Officinale* Var. *Rubrum*) with Stevia Sweetener. Instant Drink Production From Ginger (*Zingiber officinale* var. *Rubrum*). 8th *Univ Res Colloq* 2018 *Univ Muhammadiyah Purwokerto*. :325–31.

9. Wardani, Gatut A., Pebiansyah A., Wulandari, S., Hawa, FA, Rianty, AD EH. Utilization of Instant Ginger Powder to Increase Community Immunity in COVID-19 Pandemic Period. *JMM- J Masy Mandiri*. 2021;5(5):2625–2639.
10. Fortin GA, Asnia KKP, Ramadhani AS MM. Instant Functional Drink Powder Rich in Antioxidants From Vegetable Ingredients. *Agrointek J Teknol Ind Agriculture*. 2021;15(4):984–991.
11. Nisfiah IL, Isnindar DR. Formulation of Instant Powder Drink Combination of Ginger (*Zingiber officinale rosc*) and Turmeric (*Curcuma domestica val.*) with Variations of Granulated Sugar and Brown Sugar. *J Mhs Farm Fak Kedokt UNTAN*. 2022;6(1):1–9.
12. Agustiarini V WD. Test of Antioxidant Activity of Ethanol-Water Extract (1:1) of Rosella Flowers (*Hibiscus sabdariffa L.*) using the DPPH (1,1-diphenyl-2-picrylhydrazyl) Method. *J Science Researcher*. 2022;24(1):29.
13. Then Septian M, Dwi Wahyuni F NA. Antioxidant Activity Test Using the Dpph Method and Identification of Secondary Metabolite Groups in Sweet Potato Flesh from Various Regions in Indonesia Antioxidant Activity Test Using the Dpph Method and Identification of Secondary. *Spin J Kim Educator Kim*. 2022;4(2):185–196.
14. Binuni R, Maarisit W, Hariyadi H SY. Test of Antioxidant Activity of *Sonneratia alba* Mangrove Leaf Extract from Tagulandang District, North Sulawesi Using the DPPH Method. *Trop Biopharmaceuticals*. 2020;3(1):79–85.
15. Handayani PA, Kolong Y, Ayunda FD, Debora O KM. Use of Red Ginger (*Zingiber Officinale*) as an Immunomodulator During the Pandemic. 2020;1(2):40–6.
16. Herawati IE SN. Phytochemical Studies on Red Ginger (*Zingiber officinale Roscoe Var. Sunti Val.*) Maj. *Pharmacy*. 2020;4(1):22–7.
17. D. SH. National Seminar on Nutrition, Food Safety and Halal Products. 2014.
18. Khairunnisa A MD. Formula Optimization and Antioxidant Activity Test of Red Ginger Instant Drink (*Zingiber officinale Var. Roscoe*) Using the DPPH Method. *J Heal Med Sci*. 2022;1(3):77–84.
19. Fauzi MN SJ. Qualitative Test and Antioxidant Activity Test of Ethanolic Extract of Maja Fruit (*Aegle Marmelos (L.) Correa*) using the DPPH Method. *J Ris Farm*. 2021;1(1):1–8.
20. Septiani S, Gatera VA RD. Analysis Antioxidants in Instant Ginger Drinks Using the 1,1-Diphenyl-2-Picrylhydrazyl (DPPH) Method. *J Educator and Counselling*. 2022;4(6):286–292.
21. Prastujati AU, Hilmi M, Khusna A WN. Effect of Sucrose Concentration on Physical Quality and Antioxidant Levels of Nata De Dragon. *Agribios*. 2023;21(1):41.
22. Magdalena R AKM. Analysis of Causes and Solutions for Finished Goods Reconciliation Using Statistical Hypothesis with the Independent Sample T-Test Testing Method at PT.Merck, Tbk. *J Techno*. 2019;16(2):35–48.
23. Mustari M, Bakhtiar B. Implementation of Human Values and Justice Values in Female Workers (Analysis of Employment Laws). *SUPREMACY J Thought, Researcher in Social Sciences and Their Teaching*.
24. Pradana GW, Ma'ruf MF ED. Application of the Student T-Test to Assess the Effectiveness of Textbook Development for the Fiscal Decentralization Course in the Department of Public Administration, Unesa. *J Educator and Learning Dimensions*. 2020;10(2):182–90.
25. Sidoretno WM F DA. Antioxidant Activity of Matoa (*Pometia Pinnata*) Leaves with Varying Drying Temperature. *Indonesian Nat Res Pharm J*. 2018;3(1):2502–8421.
26. Umami C AD. Effect of Adding Cinnamon on Antioxidant Activity and Total Sugar Content of Functional Drinks Secang and Stevia Leaves as Alternative Drinks for Type 2 Diabetes Mellitus Sufferers. *J Nutr Coll*. 2015;4(4):645–651.
27. Y S. Effect of Sucrose Concentration and Fermentation Time on the Characteristics of Bongkok Salak Kombu (*Salacca edulis. Reinw.*) *Agroscience (AGSCi)*. *Agroscience (AGSCi)*. 2019;9(1):56.
28. Nainggolan I, Ruswanto A WR. Study of Variations in Sugar Addition and Heating Time on the Characteristics of Lemon Juice (*Citrus Limon*) Drinks. *Agroforetech*. 2023;1(03):1863–1872.

Original Article

Comparison of D-dimer Levels Based on COVID-19 Severity Degree in Third-trimester Pregnant Women at dr. Doris Sylvanus Hospital

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ABSTRACT

Pregnant women are vulnerable to COVID-19 due to the physiological adaptive changes and immunosuppressive state during pregnancy. Various studies on COVID-19 patients have shown the prognostic value of elevated D-dimer. Pregnant women with COVID-19 experience hypercoagulability and hyperfibrinolysis, as indicated by the increased D-dimer levels that exceed normal limits during pregnancy. This study aims to determine the comparison of D-dimer levels based on the COVID-19 severity degree in third-trimester pregnant women at dr. Doris Sylvanus Hospital Palangka Raya. This research is an analytical observational study with a cross-sectional design. It used the medical record data of third-trimester pregnant women confirmed positive for COVID-19 who underwent D-dimer examination at dr. Doris Sylvanus Hospital, Palangka Raya, during November 2020–October 2021, and limited to be generalized to places that has similarity with this hospital. Descriptive analysis in this study used the Kruskal Wallis test and Mann Whitney test. There is a significant difference in D-dimer levels based on the severity of COVID-19 with mild and moderate severity as indicated by the $p=0.000$ value. In mild and severe severity, the value of $p=0.001$ means that there is a significant difference, whereas in moderate and severe severity showed a value of $p=0.101$ which means there was no significant difference. Mild severity has median 1.21, Moderate 2.71 and Severe 4.20. D-dimer and SpO2 data showed non-normally distributed data. It is an important topic to be studied because D-dimer levels can be the parameter for patients with COVID-19 severity status.

Keywords: Pregnant women, D-dimer levels, COVID-19.

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INTRODUCTION

The Severe Acute Respiratory Syndrome Coronavirus-2, or also known as SARS-CoV-2 virus infection is the cause of COVID-19 disease. The disease was first reported in Wuhan, Hubei Province, China, in late December 2019. The WHO declared

COVID-19 a pandemic on March 11, 2020¹. This disease has resulted in more than 6 million deaths worldwide². The infection itself may be without or with symptoms, namely life-threatening sepsis and upper respiratory tract infection³. As many as 80% of COVID-19 infections are classified as asymptomatic or with mild symptoms, 15% with moderate

symptoms requiring oxygen, and 5% with severe symptoms requiring ventilators.

On January 30, 2020, WHO declared the this outbreak as a global public health emergency. It had been reported that, from around the world, there were about more than 80,000 confirmed cases since February 28, 2020⁴. In Indonesia, COVID-19 cases were first announced on March 2, 2020. Up until December 21, 2021, there were total 4,262,720 confirmed cases, where 4,292 of them are active cases. By age group, most COVID-19 cases occurred in the age groups 31–45 years (984,723 people), 19–30 years (863,297 people), and 46–59 years (740,913 people) and included both female and male sexes⁵. Transmission of the virus is possible to occur not only through respiratory droplets but also through direct contact with patients, which is also a source of transmission.

The Indonesian Ministry of Health reported that in 2021, there were 7,389 maternal deaths in Indonesia. In 2020–2021, there were 41,672 confirmed cases of COVID-19 in Central Kalimantan Province, including 1,063 deaths. Based on cumulative cases of COVID-19 by district or city and type of disease in Central Kalimantan in 2021, Palangka Raya City ranked first with the most confirmed cases of COVID-19, with a total of 13,127 cases. One group that contributes to the number of cases is pregnant women. Pregnant women are more vulnerable to COVID-19 since they experience physiological adaptive changes and immunosuppressive conditions during pregnancy⁶. A normal pregnancy lasts 280 days or within 40 weeks or 10 months (lunar months). There are three trimesters of pregnancy. The first trimester lasts about three months or 12 weeks, the second trimester happened from 13th to the 27th week, for about 15 weeks, and the last or third trimester happened from the 28th to the 40th week, for about 13 weeks^{7,8}.

The probable length of pregnancy can be estimated from: 1) Duration of amenorrhoea. Sometimes pregnancy can occur after a period of physiological amenorrhea, for example, during lactation. 2) Height of the fundus uteri. Before the third month, the fundus uteri cannot be palpated from the outside, and by the 9th month, the fundus uteri in primigravida falls again because the head begins to descend into the pelvic cavity. On lying down multigravida, the fundus uteri remain at the level of the arcus

costarum and is more prominent forward. 3) Gestational age, which can be seen from the size of the fetus, especially the size of the fetal head. The biparietal diameter can be measured precisely by ultrasound. 4) When movement and fetal heart sounds are felt. 5) Whether or not the head has entered the pelvic cavity. 6) Amniocentesis examination (orange-stained cells, creatinine, etc.)^{8,9}.

There are some typical symptoms found in hospitalized COVID-19 patients. Those symptoms are dry cough (60–86%), fever (70–90%), fatigue (38%), shortness of breath (53–80%), myalgia (15–44%), nausea/vomiting or diarrhea (15–39%), headache, weakness (25%), and rhinorrhea (7%). Various studies in COVID-19 patients have shown the prognostic value of elevated D-dimer. Several studies have revealed a correlation between elevated D-dimer (prevalence up to 46.4%) and increased severity and poor clinical outcomes in COVID-19 patients. The trend of D-dimer elevation experienced by the patient also affect the clinical outcome of COVID-19¹⁰.

D-dimer is a fibrin degradation fragment that indicates the occurrence of thrombosis and is an indicator of hemostasis and fibrinolysis. On the admission, the elevated D-dimer levels are linked with the elevation risk of disease severity and mortality in patients with the infection¹¹. D-dimer examination is one of the parameters in the fibrinolysis examination that is important for monitoring disease progressivity, especially in the early phase of infection¹².

People with more than 1000 ng/mL D-dimer may cause a 20-fold higher risk of mortality than those with a lower D-dimer. Thus, D-dimer examination is a probable screening tool for venous thromboembolism in confirmed COVID-19 patients. With reference to the elevated D-dimer value, administering therapeutic doses of anticoagulants is more beneficial than prophylactic doses. Therefore, it is important to monitored the D-dimer levels of these patients at the beginning of admission¹⁰.

Pregnant women who were infected by the COVID-19 experience hypercoagulability and hyperfibrinolysis, characterized by an increase in D-dimer levels that exceed normal limits in pregnancy. D-dimer in pregnant women with COVID-19 can increase 2–3 times. COVID-19 infection is associated with higher mortality rates⁶. In conditions such as

pregnancy, inflammation, malignancy, and surgery, D-dimer levels may increase. Age is a factor that can worsen the infection of COVID-19. The older a person is, the more likely the body's function will decline and the risk of pregnancy will also increase. Relatively weaker immune responses occur in older pregnant women compared to young pregnant women, so the severity caused by SARS-CoV-2 may be more severe. Pre-existing disease is also thought to be an additional factor that worsens the course of COVID-19¹³.

D-dimer and fibrinogen levels will increase in the primary phase of the COVID-19 infection. D-dimer levels can be used for early diagnosis and therapy to reduce morbidity and mortality, as high D-dimer levels are thought to predict COVID-19 severity, lung complications, and thromboembolic events¹⁴.

METHOD

This research is an analytical observational study with a cross-sectional research design. It aims to determine the comparison of D-dimer levels based on the severity of COVID-19 in third-trimester pregnant women. The population used were the third-trimester pregnant women with D-dimer levels based on the severity of COVID-19 at dr. Doris Sylvanus Hospital Palangka Raya during the period of November 2020–October 2021.

The samples used were third-trimester pregnant women who were positive for COVID-19 and met the inclusion and exclusion criteria. The sampling techniques used is total population sampling. In the research process, out of 115 pregnant women with confirmed COVID-19, only 38 patients had records of D-dimer examinations, so all pregnant women who had this data (38 people) were used as research samples. The method of sample selection is probability sampling. The data was analyzed using the SPSS program. Descriptive analysis in this study used the Kruskal Wallis test which was used to determine the median difference of D-dimer levels comprehensively.

This research was done with the full consent of people who were chosen as the study sample. The ethical clearance was obtained from the research ethics team of dr. Doris Sylvanus Hospital, Palangka Raya. Letter number: 3955/UM-TU/RSUD/08-2023.

RESULTS

After the analysis using the sample (38 pregnant women), the following test results were obtained. Table 1 contains the frequency distribution of characteristics based on age, occupation, and gestational age.

Table 1. Frequency Distribution of Characteristics by Age, Occupation and Gestational Age (n=38).

Characteristics	Positive COVID-19	
	Total	%
Age		
17-25 years (late teens)	9	23.7%
26-35 years (young adult)	16	42.1%
36-42 years (late adult)	13	34.2%
Total	38	100%
Occupation		
Housewife	14	36.8%
Civil servant	14	36.8%
Entrepreneur	8	21.0%
Student	2	5.2%
Total	38	100%
Gestational Age		
Preterm	23	60.5%
Aterm	11	28.9%
Post Date	4	10.5%
Total	38	100%

According to the table 1, the pregnant women in their third trimester who are confirmed positive for COVID-19 are mostly between 26-35 years old, namely 16 pregnant women (42.1%) out of the total sample, working as housewives and civil servants, with 14 pregnant women with a percentage of 36.8% in each category. The most cases occurred in preterm pregnancy, with 23 pregnant women (60.5%). The following Table 2 shows the frequency distribution of characteristics based on regional origin.

The regional origin of patients who dominate in this study is Palangka Raya City, with 26 pregnant women (68.4%) out of the total sample. The D-dimer and SpO2 data showed non-normally distributed data. Comparison of haematological features based on the severity of COVID-19 in third-trimester pregnant women is the D-dimer level. For more detailed information, the data can be seen in Table 2 below.

Table 2. Frequency Distribution of Characteristics Based on Regional Origin

Regional Origin	Positive COVID-19	
	Total	%
Palangka Raya	26	68.4%
Katingan	4	10.5%
South Barito	2	5.3%
Murung Raya	2	5.3%
Pulang Pisau	2	5.3%
Others	2	5.3%
Total	38	100%

The results of the comparative analysis of D-dimer levels based on the severity of COVID-19 in third-trimester pregnant women can be seen in Table 3.

Table 3. Results of Descriptive Analysis Comparison of D-dimer Levels based on the severity of COVID-19 in Third-trimester Pregnant Women

COVID-19 severity	Median	Minimum	Maximum	P*
Mild (SpO2 \geq 96%)	1.21	0.20	4.69	0,000
Moderate (SpO2 =94-95%)	2.71	1.19	6.04	
Severe (SpO2 \leq 93%)	4.20	1.89	46.0	

*Kruskal Wallis test

Kruskal Wallis analysis technique were chosen to determine the difference between the three sample groups. By the results, a value of $p=0.000$ was obtained. In conclusion, there were differences in D-dimer levels in each sample group. The Mann-Whitney test was done to determine the median difference in D-dimer values. It was found that the more severe, the higher the median of D-dimer level will be. D-dimer and SpO2 data showed that the data were not normally distributed. The median value of the D-dimer examination based on the degree of severity of mild COVID-19 is 1.21 ($\geq 96\%$), the median value of the moderate degree is 2.71 (94-95%), and the median value of the severe degree is 4.20 ($\leq 93\%$). It can be concluded that the more severe the severity of COVID-19, the higher the median value.

Table 4. Results of Comparative Test Analysis of D-dimer Levels based on the severity of COVID-19 in Third-trimester pregnant women

Group 1	Group 2	P*
Mild	Moderate	0.000
Mild	Severe	0.001
Moderate	Severe	0.101

*Mann Whitney test

From Table 4, it can be seen that there is a significant difference in D-dimer levels based on the severity of COVID-19 in the group of third-trimester pregnant women with mild and moderate severity, as indicated by the $p=0.000$. In mild and severe severity, the value of $p=0.001$ shows that there is a significant difference. Whereas the group of moderate and severe level of severity showed a value of $p=0.101$ which means there was no significant difference.

DISCUSSION

Lowering the rate of maternal mortality to less than 70 cases per 100,000 live births by 2030 is one of the Sustainable Development Goals targets. Globally, in 2020, maternal deaths are estimated to be 287,000 cases, leading to an overall MMR of 223 cases per 100,000 births¹⁵. Pregnant women are very vulnerable of the risk of infection due to the body's physiological changes and a decrease in the immune system^{16, 17}.

Physiological changes in the body during pregnancy have an impact on reducing the ability of the body's immune system, which causes an increased risk of infection. Early detection of infectious diseases needs to be done for pregnant women to avoid complications during pregnancy until delivery and reduce the risk of death¹⁸. One of this infectious disease is COVID-19. Pregnant women who are infected with COVID-19 are very possible to experience harms and issues that can affect the pregnancy and the baby's development. During pregnancy, COVID-19 may increase the risk of delivering a premature (less than 36 weeks) or stillborn baby¹⁹.

The Centers for Disease Control and Prevention (CDC) concluded that the following are significantly associated with increased risk of severe COVID-19: cerebrovascular disease, chronic kidney disease, cancer, chronic obstructive pulmonary disease (COPD), type 1 and type 2 diabetes mellitus, etc.²⁰. The severity

of COVID-19 affects the high level of inflammation that occurs in the body, so the higher the severity of COVID-19, the higher the D-dimer levels in the body²¹.

Based on the result of this study, the highest number of pregnant women confirmed positive for COVID-19 was found in the age group of 26–35 years (42.1%). This age group is a productive age to experience pregnancy and childbirth¹⁶. The majority of them had a relatively low risk of labor complications when concluded based on age only²². Schwartz et al. analyzed 38 pregnant women in the age range of 26–40 years with confirmed COVID-19 in China²³. During pregnancy with symptomatic conditions, severe complications of COVID-19 were found¹.

The mothers mostly worked as civil servants and housewives. Each group consist of 14 mothers with a percentage of 36.8%. Working pregnant women can get health information more easily than the pregnant women who choose to be housewives²⁴. The majority of the sample came from Palangka Raya City, with the total of 26 people with a percentage of 68.4%. This is in accordance with the cumulative data of confirmed cases of COVID-19 in 2021 which shows Palangka Raya City as the first rank with the most cases in Central Kalimantan, with the total of 13,127 cases²⁵. The majority of the gestational age of pregnant women in this study was less than 37 weeks (preterm), namely 23 people with a percentage of 60.5%. A study at the University of California San Francisco found that the risk of preterm birth was higher by 60% in pregnancies less than 32 weeks, while the risk of preterm birth was higher by 40% in pregnancies less than 37 weeks²⁶.

D-dimer is a readily-available and commonly-used indication of inflammation that have a very important role in pneumonia caused by the COVID-19 infection in assessing the disease severity and response to treatment during hospitalization. In this study, there was a significant difference in D-dimer levels based on the severity of COVID-19 in the group of third-trimester pregnant women with mild and moderate severity, as indicated by the $p=0.000$ value. In mild and severe severity, the value of $p=0.001$ was obtained, which means there is a significant difference. Whereas in moderate and severe severity, the value of $p=0.101$ means that there is no significant difference. Nonetheless, the median difference of moderate and severe

severity are almost twice bigger. It can be considered that there was a quite big gap difference of these two groups. This is in accordance with a previous study²⁷ that found that there was a very significant difference in the average value of D-dimer in mild and severe severity with a value of $p=0.000$.

It was also found that D-dimer levels increased significantly with an increase in the severity of COVID-19 ($p=0.000$)²⁸. Another similar study also found that D-dimer levels were associated with mortality in COVID-19 patients, showing $p=0.000$, which means that there is a significant relationship between D-dimer levels and mortality in COVID-19 patients¹. The severity of COVID-19 affects the high level of inflammation that occurs in the body. The higher the severity of COVID-19 in pregnant women, the higher the D-dimer levels in the body. In pregnant women with severe COVID-19, a significant increase in D-dimer was found²¹.

Pregnancy is one of the factors that can cause an increase in D-dimer levels. Gestational age in pregnant women will affect the high and low levels of D-dimer in the body²¹. In normal pregnancy, there will be an increase in D-dimer levels from conception, labor, and postpartum. D-dimer levels can be used as an early and advanced screening test to identify women with high-risk pregnancies that require more intensive fetomaternal monitoring and management. D-dimer can also be used as an initial screening and follow-up test for coagulopathy and to identify whether an individual is at high risk for more severe disease. A positive D-dimer result indicates the presence of high fibrin degradation products in the body. This is characterized by the presence of a significant amount of thrombus. Pregnant women with high D-dimer levels will have increased chances of labor and possible placental abruption.

The D-dimer examination is one of the supporting assessment to examine the presence of coagulation disorders in patients with COVID-19²⁹. D-dimer levels increase gradually during normal pregnancy and peak in the third-trimester of pregnancy. Evidence of coagulopathy reported in COVID-19 infection shows elevated D-dimer levels. COVID-19 infection in pregnant women has been associated with a higher rate of mortality⁶. Low oxygen saturation, also known as hypoxia, is a poor predictor of COVID-19 because hypoxia

is a trigger for excessive coagulation caused by an increase in hypoxia-inducible transcription factor which will increase D-dimer levels³⁰.

CONCLUSION

In third-trimester pregnant women who are confirmed positive for COVID-19 at dr. Doris Sylvanus Hospital Palangka Raya in November 2020–October 2021, the median value for mild D-dimer level is 1.21 ($\geq 96\%$), the median value for moderate D-dimer level is 2.71 (94–95%), and the median value for severe D-dimer level is 4.20 ($\leq 93\%$). There is also a significant difference of D-dimer. The degree of mild-moderate severity obtained a p value=0.000, the degree of mild-severe severity obtained a p value=0.001, and the degree of moderate-severe severity obtained a p value=0.101. It means that there was no significant difference in D-dimer levels. D-dimer levels increased significantly along the increase of COVID-19 severity.

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CONFLICTS OF INTEREST

The authors declare no competing interests or conflicts that may have influenced the study outcome.

REFERENCES

1. Aulia Ramadhan MA, Sawitri E, Wahyunie S. Association of Neutrophil-Lymphocyte Ratio (NLR) and D-Dimer Levels with COVID-19 Mortality. *J Kesehat Pasak Bumi Kalimantan* [Internet]. 2022;5(2):167–73. Available from: <https://e-journals.unmul.ac.id/index.php/JKPB> K
2. Cascella M, Rajnik M, Aleem A, Dulebohn SC, Napoli R Di. Features, Evaluation, and Treatment of Coronavirus (COVID-19) [Internet]. National Library of Medicine. 2023. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK554776/>
3. Wiersinga WJ, Rhodes A, Cheng AC, Peacock SJ, Prescott HC. Pathophysiology, Transmission, Diagnosis, and Treatment of Coronavirus Disease 2019 (COVID-19): A Review. *JAMA - J Am Med Assoc*. 2020;324(8):782–93.
4. Kementerian Kesehatan Republik Indonesia. Profil Kesehatan Indonesia 2021. Kementerian Kesehatan Republik Indonesia. Jakarta: Kementerian Kesehatan Republik Indonesia; 2022. 1–285 p.
5. Wang Z, Wang Z, Xiong G. Clinical characteristics and laboratory results of pregnant women with COVID-19 in Wuhan, China. *Int J Gynecol Obstet*. 2020;150(3):312–7.
6. Fauzan F, Sriyanti R, Djanas D, Nindrea RD. Analisis Ketahanan Hidup Ibu Hamil dengan COVID 19 Berdasarkan Kadar D-Dimer Terhadap Luaran di RSUP DR. M. Djamil, Padang. *Syntax Lit J Ilm Indones*. 2022;7(6):8734–42.
7. Prawirohardjo S. Ilmu Kebidanan. Keempat. Saifuddin AB, Rachimhadhi T, Wiknjosastro GH, editors. Jakarta: PT. Bina Pustaka Sarwono Prawirohardjo; 2008. 1–765 p.
8. Bagian Obstetri & Ginekologi Fakultas Kedokteran Universitas Padjajaran Bandung. *Obstetri Fisiologi*. Bandung: Eleman; 1983. 1–338 p.
9. Rustam M. Sinopsis Obstetri. Second. Lutan D, editor. Jakarta: Penerbit Buku Kedokteran EGC; 1998. 1–453 p.
10. Sunardi Asih NW. Hubungan NLR, Kadar CRP dan D-dimer Terhadap Derajat Keparahan Penyakit Pasien COVID-19 di RSUD Wangaya Denpasar. *J Med Udayana* [Internet]. 2022;11(12):14–21. Available from: <http://ojs.unud.ac.id/index.php/eum>
11. Amelia R, Nur Anissa DF, Luhulima D. Perbedaan Peningkatan Kadar D-dimer pada Dewasa dan Lansia yang Terkonfirmasi COVID-19 di RS Swasta Bintaro. *J Res Educ Chem*. 2022;4(1):1.
12. Putri Pradnyasari SAN, Hidayat M, Fathana PB. Hubungan Kadar D-dimer dan C-Reactive Protein terhadap Berat Gejala pada Pasien COVID-19. *J*

- Kedokt Unram. 2022;11(4):1192–7.
13. Darmawan NWAN, Bayuningrat IGNM, Witari NPD. Hubungan antara Usia, Usia Kehamilan, Kadar Leukosit, dan Paritas dengan Tingkat Keparahan Gejala Covid-19 pada Ibu Hamil di Rumah Sakit Umum Daerah Sanjiwani Gianyar pada Tahun 2020-2021. *Aesculapius Med J*. 2023;3(2):277–83.
14. Pradnya Angela KA, Duwi Sumohadi IM. Hubungan D-dimer dengan Tingkat Keparahan Infeksi COVID-19. *Intisari Sains Medis*. 2022;13(2):393–8.
15. World Health Organization. TRENDS IN MATERNAL MORTALITY: 2000 TO 2017 [Internet]. Vol. WHO/RHR/19. Geneva: World Health Organization; 2019. Available from: https://www.unfpa.org/sites/default/files/pub-pdf/Maternal_mortality_report.pdf
16. Alifiah N, E. Berhimpon SL, Rambert GI. Description of Leucocyte Differential Count in Pregnant Women with COVID-19. *Med Scope J* [Internet]. 2022;3(2):151–6. Available from: <https://ejournal.unsrat.ac.id/index.php/msj/index>
17. Prawirohardjo S. Ilmu Kebidanan. 4th ed. Jakarta: Bina Pustaka Sarwono Prawirohardjo; 2010.
18. Manopo FF, E. Berhimpon SL, Wowor MF. Gambaran Hematologi pada Wanita Hamil Trimester 3 yang Terkonfirmasi Positif SARS-CoV-2 di RSUP Prof. Dr. R.D. Kandou Periode Juli-September 2020. *e-Biomedik*. 2021;9(1):46–51.
19. Centers of Diseases and Control Prevention. Pregnant and Recently Pregnant People at Increased Risk for Severe Illness from COVID-19 [Internet]. Georgia: Centers for Disease Control and Prevention; 2022. p. 1–4. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/pregnant-people.html>
20. Li H, Liu S ming, Yu X hua, Tang S lin, Tang C ke. Coronavirus disease 2019 (COVID-19): current status and future perspectives. *Int J Antimicrob Agents* [Internet]. 2020;55(5):1–8. Available from: <https://www.sciencedirect.com/science/article/pii/S0924857920301011?via%3Dihub>
21. Reiki H, Armanza F, Aditya R, Hendriyono FX, Rahmiati. Perbedaan Kadar D-Dimer pada Ibu Hamil dengan COVID-19 Tanpa dan Disertai Preeklampsia: Penelitian di RSUD Ulin Banjarmasin Periode Maret 2020-Februari 2022. *Homeostasis*. 2023;6(1):51–8.
22. Octaviani Katili DN, Husna Ali RN, Puspita N, Paramata A. Kualitas Hidup Wanita dengan Kehamilan Risiko Tinggi pada Masa Pandemi COVID-19. *Heal Inf J Penelit* [Internet]. 2022;14(2):219–28. Available from: <https://myjurnal.poltekkes-kdi.ac.id/index.php/hijp/article/view/676>
23. Schwartz DA. An Analysis of 38 Pregnant Women with COVID-19, Their Newborn Infants, and Maternal-Fetal Transmission of SARS-CoV-2: Maternal Coronavirus Infections and Pregnancy Outcomes. *Arch Pathol Lab Med*. 2020;144(7):799–805.
24. Sagita W. Faktor-Faktor yang Berhubungan dengan Pengetahuan Ibu Hamil Tentang COVID-19 di Wilayah Jabodetabek Tahun 2020. *J Ilm Kesehat BPI*. 2021;5(1):1–5.
25. Badan Pusat Statistik Kalimantan Tengah. Provinsi Kalimantan Tengah Dalam Angka 2022. 2022;1–863.
26. Fernandez E. COVID-19 During Pregnancy Associated with Preterm Birth [Internet]. *The Lancet Regional Health-Americas*. 2021 [cited 2023 Dec 1]. Available from: <https://www.ucsf.edu/news/2021/08/421181/covid-19-during-pregnancy-associated-preterm-birth>
27. Gustian H, Budi Pratiwi RA, Riantie R. Comparison of D-Dimer Level on Mild, Moderate and Severe COVID-19 at Immanuel Hospital Bandung City October 1st - December 31st, 2020. *Blood* [Internet]. 2021;138(November):4268. Available from: <https://ashpublications.org/blood/article/138/Supplement1/4268/481600/Comparison-of-D->

28. Dimer-Level-on-Mild-Moderate-and
Atmaja KS, Wicaksana AAGOS, Putra
IWAS, Putra WWS. Hubungan
konsentrasi serum C-Reactive Protein
dan D-dimer dengan derajat keparahan
dan mortalitas pasien COVID-19.
Intisari Sains Medis. 2021;12(2):680–
5.
29. Wati L, Nugraheni DM, Ratnaningrum
K, Novitasari A. C-Reactive Protein
Berkorelasi Terhadap Kadar D-Dimer
Pasien COVID-19. Al-Iqra Med J J
Berk Ilm Kedokt. 2021;5(1):1–9.
30. Patil S, Acharya A, Gondhali G,
Narwade G. Does Follow-up D-Dimer
Level Help in Predicting Oxygenation
Status, Ventilatory Support
Requirement, Lung Fibrosis, and
Thromboembolic Events in
Coronavirus Disease 2019 Pneumonia?
A Prospective Observational Study in a
Tertiary Care Setting in India. *Ann Afr
Med* [Internet]. 2023;22(3):286–92.
Available from:
[https://www.ncbi.nlm.nih.gov/pmc/arti
cles/PMC10445714/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10445714/)

Original Article

Cersenlau Sugar (Cherry Kersen & Telang Ungu): A Potential Antidiabetic Agent for Pancreatic Beta-Cell Repair in Rats

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ABSTRACT

This study aimed to find out the antidiabetic effects of CERSENLAU Sugar (Cherry Kersen & Telang Ungu) on the histological of the pancreas of diabetic rats. Method: The type of research used is purely experimental with a pre-post test control group design. The subject of the study was a male white Wistar rat (Rattus Norvegicus) aged 2-3 months and weighing an average weight of between 150-200 grams. On this plan the subject was randomized and then divided into 2 groups that is normal control and treatment group consisting of 4 subgroups namely: 1. The group diabetes was given commercial sugar diabetes and 3 diabetes groups were given CERSENLAU Sugar with different levels (100 mg/kg Body Weight; 200 mg/ kg Body Weight; 400 mg/Kg Body Weight). Each group consisted of six test animals. The total number of test animals was 30. Kruskall Wallis test to determine the significant differences between the treatment group and the control group with a p-value < 0.05 selected as the degree of significance. Results: CERSENLAU Sugar (Cherry Kersen Telang Ungu) contains phenols (86.63 mg), flavonoids (48.72), vitamin C (45,76 mg/100 ml), sugar (1,11%), anthocyanin (1,64 mg/100ml) and fiber (1,51%). Based on the results of the observations of the histopathology preparation of the pancreatic rat and the analysis carried out, it was proved that the administration of Cersenlau affected the histopathology figure of the pancreas of rats induced by alloxan. But at doses of 200 mg/kg Body Weight and 400 mg/ kg Body Weight, the effect is not very good compared to the dose of 100 mg/kg Body Weight which has a better effect. Conclusion: CERSENLAU Sugar (Cherry Kersen & Telang Ungu) repairs damage to pancreatic beta cells in mice with diabetes mellitus and affects pancreatic tissue regeneration as seen from the level of damage to pancreatic beta cells in animal models of diabetes.

Keywords : Cersenlau Sugar, Cherry Kersen, Telang Ungu, Histologist, Pancreas, Diabetes Mellitus

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INTRODUCTION

Type 2 diabetes mellitus is a chronic disease characterized by hyperglycaemia which is the result of the occurrence of body resistance to the effects of insulin produced by pancreatic beta cells ¹. According to the International Diabetes Federation (IDF), the prevalence of diabetes mellitus in the world is 1.9% and has made it the seventh leading cause of death worldwide. It is estimated from the prevalence

of 463 million people in the world suffering from diabetes in 2019 and by 2030 the number of people with DM is predicted to climb up to 578 million and an increase is expected to 700 million patients in 2045 ². According to Rikesdas 2018, the prevalence of diabetes mellitus based on medical diagnosis in the population aged ≥ 15 years showed a figure of 2.0% and the prevalence of diabetes mellitus based on medical diagnosis in the population of all ages shows 1.5% ³.

During this time, commercial sugar products for diabetics that circulate on the market only offer that the sugar contains zero calories without containing phytochemical compounds that are beneficial as antidiabetics. This research wants to develop sugar products that have multiple benefits besides as sweeteners also have therapeutic benefits. Due to their higher nutritional value and content of health-promoting compounds, natural sugars offer potential benefits that can potentially mitigate the negative effects of refined sugar. This suggests that promoting reduced or eliminated consumption of refined sugar in favor of natural options could contribute to healthier dietary choices ⁴.

Cherry kersen (*Muntingia calabura* L.) and telang ungu (*Clitoria ternatea*) are two plants that have long been known to have health benefits. Recent studies have shown that these two plants also have the potential as anti-diabetes sugar. Cherry kersen contains flavonoid antioxidants that can protect pancreatic beta cells from damage caused by oxidative stress ⁵. Oxidative stress is one of the factors that contributes to the development of type 2 diabetes. In addition, cherry kersen can also increase the proliferation of pancreatic beta cells, thereby increasing insulin production ⁶. Telang ungu also contains flavonoid antioxidants that can protect pancreatic beta cells from damage ⁷. In addition, telang ungu can also lower blood sugar levels by increasing insulin sensitivity and reducing glucose production in the liver ⁸.

The hypoglycaemic effects of *telang ungu* flower extract have been proven through several studies ⁹. An oral administration of telang ungu extract (400 mg/kg BW) to rats decreased the serum glucose and Hb glycosylation as well as increased serum insulin, liver and bone muscle glycogen ¹⁰. The administration of methanol, ethyl acetate or chlorophore extracts of up to 300 mg/kg BW Rats showed hypoglycaemic activity in albino rats that was more effective than the diabetic medication glibenclamide (10mg/kg) ¹¹. Hypoglycemia mechanisms through increased serum insulin secretion, glycogen levels, and active components that inhibit the formation of advanced glycation end products (AGEs) ¹². Ethanol extract lowers sugar in the serum of diabetic mice by inhibiting the activity of the enzymes β -galactosidase and β -glucosidase but does not inhibit the activity of the β -d-

fructokinase enzyme ¹³. Based on the findings, the researchers wanted to see the diabetic potential of the active compound in both the cersenlau sugar ingredients, the cherry kersen fruit and the purple oak flower. This study aimed to find out the antidiabetic effects of cersenlau sugar on the histological picture of the pancreas of diabetic rats.

METHOD

The type of research used is purely experimental with a pre-post test control group design. The subject of the study was a male white wistar rat (*Rattus Norvegicus*) aged 2-3 months and weighing an average weight of between 150-200 grams. The subjects of this study were obtained from the laboratory of Universitas Udayana. On this plan the subject was randomized and then divided into 2 groups that is normal control and treatment group consisting of 4 subgroups namely: 1. The group diabetes was given commercial sugar diabetes and 3 diabetes groups were given cersenlau sugar with different levels (100 mg/kg Body Weight; 200 mg/ kg Body Weight; 400 mg/Kg Body Weight). Each group consisted of six test animals. The total number of test animals was 30.

Before the treatment, both groups tested rate of pancreatic beta cell damage. After a specified period of time, both the treatment and control groups re-checked histologic pancreatic. After the pancreas is removed from the body of the mouse, the preparation of the pancreatic preparation is performed with the following steps: The organ wash is washed using NaCl 0.9%, the fixation stage with formalin solution 10%, the dehydration stage using alcohol 70%, 80%, 90% and 95%, the clearing stage using toluene 3 times, respectively for 1-2 hours, the infiltration stage of paraffin using pure paraffin I, pure paraffin II and pure paraffin III, followed by the embedding process, the organ stage is inserted into the paraffin blocks, the sectioning stage, the cutting stage of organ block using a microtome. With a strain density of 6 microns, staging stage, using Albumin MAYER, stage of deparaffination, using xylol for 15 minutes, staining stage, immersed in alcohol 95%, 80%, 70%, 60%, 50%, 40%, 30%, aquades 10 seconds, after which hematoxylin. Washed the flowing water, soaked back into alcohol 30%, 40%, 50%, 60%, 70% then eosine. Then

back to alcohol 70%, 80%, 95%, then xylol for 10 minutes, Canada balm and then cover glass.

The microscopic data obtained was data scoring the degree of pancreatic damage of male white rats. The subsequent analysis used the nonparametric Kruskal Wallis test to determine the significant differences between the treatment group and the control group with a p-value < 0.05 selected as the degree of significance. If there are significant differences, then a Mann-Whitney test is performed to see what the differences mean for each group.

RESULTS

The measurement of the active substances contained in cersenlau sugar was carried out at the Food Technology Laboratory of Universitas Udayana. From the results of quantitative examination using the spectroscopic method, it was found that cerenlau sugar contains phenols (86.63 mg), flavonoids (48.72), vitamin C (45,76 mg/100 ml), sugar (1,11%), anthocyanin (1,64 mg/100ml) and fiber (1,51%).

Table 1. Bioactive Compound of CERSENLAU Sugar (*Cherry Kersen Telang Ungu*)

Test Parameters	Unit	Result
Total Fenol	mg GAE/ 100 mL	86,63
Total Flavonoid	mg QE/ 100 mL	48,72
Antioxidant Capacity	mg GAEAC/ 100 mL	178,25
Vitamin C	mg/ 100 mL	45,76
Beta carotene	mg/ 100 mL	ttd
Anthocyanin	mg/ 100 mL	1,64
Fiber	%	1,51
Total Sugar	%	1,11

The weight of the mice was weighed once a week to monitor the state of health of the rats and to know the progress of the weight of each week. The average weight development of mice of each group during the treatment is shown in Figure 1.

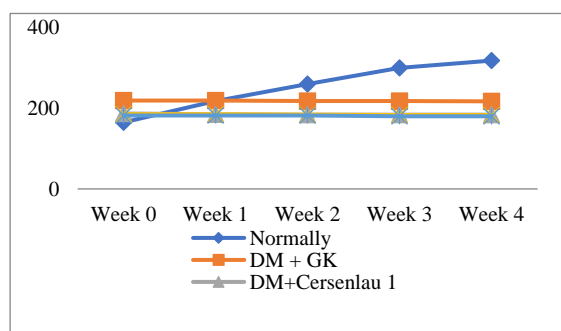


Figure 1. The average weight development of mice of each group during the treatment.

In the normal control group, there was an increase in weight from 171, 21 grams at the beginning of treatment to 323,02 grams on the end of treatment. In the diabetic group with commercial sugar, the weight at the start of treatment 214,53 grams decreased to 213, 22 grams in the end. The diabetes group treated with cersenlau sugar level 1 (100 mg/kg Body Weight) had a decrease in weight of 184, 13 grams to 180,47 grams after treatment.

The normal control group of rats experienced significant weight gain ($p=0,000$) during the treatment. The non-treated group of diabetic mice had an insignificant weight loss ($p = 0,456$). The group of diabetes mice with cersenlau sugar treatment had a significant decrease of 1.2, and 3 levels ($p<0,005$). Anova analysis showed that the average weight change in the group of diabetic mice control with commercial DM sugar, diabetes mice with censenlau sugar therapy was significantly different from the normal control ($p < 0,005$).

The microscopic data obtained was data scoring the degree of pancreatic damage of male white rats. Pancreatic beta cells in diabetic mice induced by alloxane showed damage. However, after treatment with Cersenlau sugar level 1 (100 mg/kg BW), level 2 (200 mg/ kg BW) and level 3 (400 mg/ Kg BW) improved at the end of treatment. Average changes in the damage score at the end of the treatment of each group can be seen in table 1.

Table 2. Rat Pancreatic Damage Score

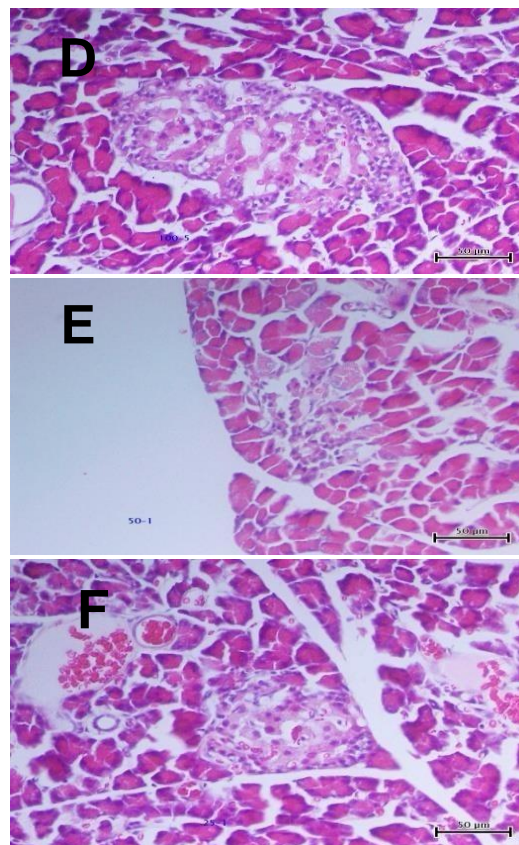
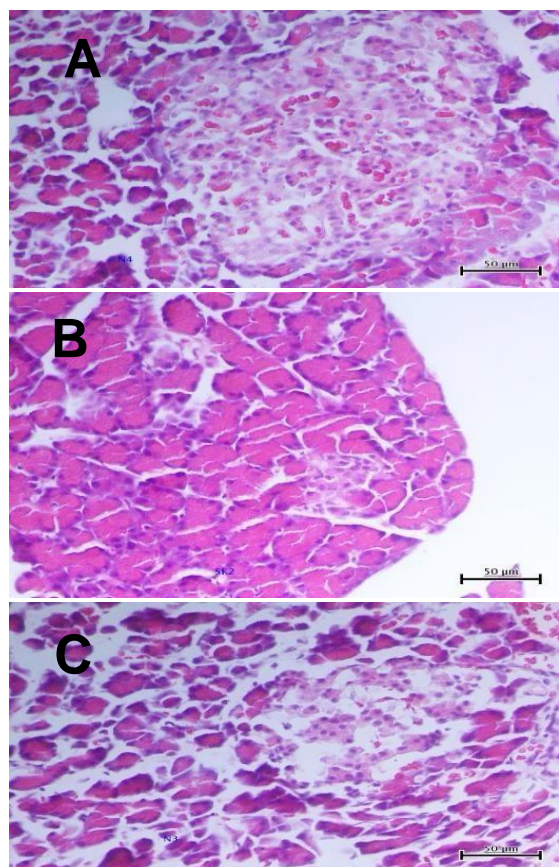
Groups	Damage Cell Score				Mean± SD Damage
	1	2	3	4	
Normally	0	0	0	0	4 ± 0^c
DM + GK	4	4	4	4	$1,25 \pm 0,5^b$
DM + GC 1	1	1	1	2	$1,75 \pm 0,5^a$
DM + GC 2	2	2	2	2	$2,25 \pm 0,5^a$
DM + GC 3	3	3	3	3	3 ± 0^a

Based on the results of Mann-Whitney's analysis in Table 2 showed that there were significant differences in the histopathological picture of pancreatic mice from their respective treatment groups ($p<0,05$): the normal group differs significantly from all treatment groups, the DM control group with Commercial Sugar Diabetes is significantly different from the normal groups, and the 200 mg/kg BW dose control group ($p < 0,05$), but differs non-

significantly from the 300 mg/ kg BW dose treatment group ($p>0,05$).

Based on the results of the observations of the histopathology preparation of the pancreatic rat and the analysis carried out, it was proved that the administration of Cersenlau affected the histopathology figure of the pancreas of rats induced by alloxan. But at doses of 200 mg/kg Body Weight and 400 mg/ kg Body Weight, the effect is not very good compared to the dose of 100 mg/kg Body Weight which has a better effect (Figure 2).

Based on data scoring pancreatic histological damage on the normal control given to Na CMC 0.5% obtained average rate of pancreas damage mice 0 seen no change, where the morphology of the island Langerhans still looks normal and the cells in it do not experience necrosis. On positive controls induced by alloxan and given CMC Na 0.5% as well as commercial sugar obtained averages of the rate of pancreatic damage of rats 4 suffered extremely severe cell necrosis. The occurrence of this necrosis is characterized by the presence of holes on the island of Langerhans. Necrosis is the death of cells or tissues as a result of a reversible degeneration process.



(A. Normally; B. DM + GK; C. DM + GC 1; D. DM + GC 2; E. DM + GC 3)

Figure 2. Histology of pancreatic tissue of mice with HE coloring with magnification 400x

DISCUSSION

Doses of 100 mg/ kg BW, doses 200 mg/kg BW and doses 400 mg/ Kg BW obtained average values of levels of pancreatic damage respectively (1,75), (2,75), and (3) showed a better figure of the morphology of the Langerhans island compared to commercial sugar DM control and relatively reduced necrosis cells. This suggests that the administration of cersenlau sugar can regenerate the beta cells of the pancreas. The diagram shows that commercial sugar DM controls experience the highest level of damage among all treatment groups.

Pancreas histological damage on normal control given Na CMC 0.5% obtained average rate of pancreatic damage mice 0 seen no change, where the morphology of the island langerhans still look normal and the cells in it do not experience necrosis. On negative control that is induced by streptozotocin and given

NaCMC 0.5% gained average value of the rate of pancreas damage 4 mice suffered very severe cell necrosis. The occurrence of this necrosis is characterized by the presence of holes on the island of Langerhans. Living cells and tissues can succumb to necrosis, a process where they die due to irreversible damage. This can be triggered by various factors, such as poisonous substances, medication side effects, inadequate blood flow, extreme temperatures, radiation exposure, or physical injuries¹⁴. It shows that administering 0.5% Na CMC only functions as a suspending agent and has no regenerative activity on pancreatic β cells. On positive controls given commercial sugar obtained an average rate of pancreatic damage in the rat (1,25) the presence of necrosis in the Langerhans island cells was decreased. This is because metformin is a dimethyl derivative of mainly inhibits the formation of glucose in the liver as well as lowers LDL and triglyceride cholesterol and suppresses appetite and unlike sulphonylurea does not increase weight¹⁵. At doses of 100 mg/kg BW, doses 200 mg/kg BW and doses 400mg/kg obtained mean values of pancreas damage rates (1,75), (2,75), and (3) respectively showed a better picture of the Langerhans island morphology compared to negative control and relatively reduced necrosis cells. This suggests that the administration of Telang ungu cherry kersen sugar (cersenlau sugar) can regenerate the beta cells of the pancreas.

For decades, researchers have explored the use of antioxidant supplements to combat oxidative stress in type 2 diabetes¹⁶. These antioxidants are hypothesized to promote the proliferation and function of pancreatic β -cells, potentially improving overall disease management¹⁷.

In mice with artificially induced high blood sugar (hyperglycemia) achieved through alloxan administration, an ethanol extract of cherry (*Muntingia calabura* L.) leaves significantly improved the histological structure of their pancreases, particularly the cells within the islets of Langerhans responsible for insulin production. Notably, the pancreatic structure of healthy mice was largely similar to those treated with a moderate dose of the extract (500 mg/kg body weight), suggesting the extract itself was not harmful to healthy pancreatic tissue¹⁸.

Kersen leaves contain potent antioxidants, particularly flavonoids, which hold promise for alleviating type 2 diabetes.

These antioxidants are believed to protect pancreatic beta cells within the islets of Langerhans, preventing damage and promoting their regeneration. This, in turn, could enhance insulin secretion, potentially offering therapeutic benefits for type 2 diabetic patients¹⁹.

Administration of an ethanol extract of kersen leaves (*Muntingia calabura* L. folium) at an effective dose of 0.3 mg/g body weight significantly increased the number of pancreatic beta cells in white rats (*Rattus norvegicus*) of the Wistar strain previously induced with streptozotocin and nicotinamide (STZ-NA) to mimic type 2 diabetes⁶.

In type 2 diabetes mellitus (T2DM), high blood sugar (hyperglycemia) triggers pancreatic beta cells to produce excessive reactive oxygen species (ROS)²⁰. This rise in ROS leads to beta cell damage, ultimately impacting their quality and quantity. Various factors can influence the fate of beta cells in T2DM, including their ability to regenerate, survive, adapt to stress, resist cell death (apoptosis), and maintain proper metabolic function²¹.

The regeneration of the pancreatic β cells occurs due to the presence of a compound contained in the purple of dandelions, one of which is a flavonoid, fenol, vitamin C and anthocyanin that plays a role in preventing damage to the beta cell in the pancreas by inhibiting the occurrence of oxidative stress.

CONCLUSION

CERSENLAU Sugar (*Cherry Kersen Telang Ungu*) repairs damage to pancreatic beta cells in mice with diabetes mellitus and has an effect on pancreatic tissue regeneration as seen from the level of damage to pancreatic beta cells in animal models of diabetes.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Dilworth L, Facey A, Omoruyi F. Diabetes Mellitus and Its Metabolic Complications:

- The Role of Adipose Tissues. *International Journal of Molecular Sciences*. 2021 Jan;22(14):7644.
2. International Diabetes Federation. IDF Diabetes Atlas 2021 | IDF Diabetes Atlas [Internet]. 2021 [cited 2023 Nov 10]. Available from: <https://diabetesatlas.org/atlas/tenth-edition/>
3. Kemenkes RI. Riset Kesehatan Dasar tahun 2013. Jakarta: Badan Litbangkes Kementrian Kesehatan RI; 2013.
4. Arshad S, Rehman T, Saif S, Rajoka MSR, Ranjha MMAN, Hassoun A, et al. Replacement of refined sugar by natural sweeteners: focus on potential health benefits. *Heliyon*. 2022 Sep 1;8(9):e10711.
5. Indriawati R, Nugroho A. Antioxidant Potential of Kersen Leaves Steeping (*Muntingia calabura* L.) Against Endogenous Enzyme Superoxide Dismutase (SOD) Levels in Diabetes Mellitus Rats. *Journal of Cardiovascular Disease Research*. 2021;12(4):628–35.
6. Muthmainah SM, Romdhoni MF, Ningrom IC, Annisa Y. The Effect of Kersen (*Muntingia calabura*) Extract on The Number of Pancreatic Beta Cells: Experiment Study In Rat. *Herb-Medicine Journal: Terbitan Berkala Ilmiah Herbal, Kedokteran dan Kesehatan*. 2023 Apr 3;5(4):17–22.
7. Simangunsong EMV, Febriani Y, Saputri M, Arisa D, Afifah GZ. Effectiveness of Butterfly Pea Ethanol Extract on Decreasing Blood Glucose Levels of Male Mice. *Jambura Journal of Health Sciences and Research*. 2023 Apr 27;5(2):707–21.
8. Indriyati YF, Dewi DN. Stematic Review: The Potential of Butterfly Pea Flower (*Clitoria ternatea*) as Antidiabetic. *Generics: Journal of Research in Pharmacy*. 2022;2(1):1–8.
9. Chusak C, Thilavech T, Henry CJ, Adisakwattana S. Acute effect of *Clitoria ternatea* flower beverage on glycemic response and antioxidant capacity in healthy subjects: a randomized crossover trial. *BMC Complement Altern Med*. 2018 Jan 8;18(6):1–11.
10. Daisy P, Jasmine R, Ignacimuthu S, Murugan E. A novel steroid from *Elephantopus scaber* L. an ethnomedicinal plant with antidiabetic activity. *Phytomedicine*. 2009 Mar;16(2–3):252–7.
11. Rajamanickam M, Kalaivanan P, Sivagnanam I. Evaluation of Anti-oxidant and Anti-diabetic Activity of Flower Extract of *Clitoria ternatea* L. *J App Pharm Sci*. 2015;5:131–8.
12. AL-Ishaq RK, Abotaleb M, Kubatka P, Kajo K, Büsselberg D. Flavonoids and Their Anti-Diabetic Effects: Cellular Mechanisms and Effects to Improve Blood Sugar Levels. *Biomolecules*. 2019 Sep 1;9(9):430.
13. Cahyaningsih E, Yuda PESK, Santoso P. Skrining Fitokimia Dan Uji Aktivitas Antioksidan Ekstrak Etanol Bunga Telang (*Clitoria ternatea* L.) Dengan Metode Spektrofotometri UV-VIS. *Jurnal Ilmiah Medicamento*. 2019 Mar 30;5(1):51–7.
14. Miller MA, Zachary JF. Mechanisms and Morphology of Cellular Injury, Adaptation, and Death. *Pathologic Basis of Veterinary Disease*. 2017;2-43.e19.
15. Bailey C. Metformin: Effects on Micro and Macrovascular Complications in Type 2 Diabetes. *Cardiovascular drugs and therapy / sponsored by the International Society of Cardiovascular Pharmacotherapy*. 2008 Mar 1;22(3):215–24.
16. Nasri H, Shirzad H, Baradaran A, Rafieian-Kopaei M. Antioxidant plants and diabetes mellitus. *J Res Med Sci*. 2015 May;20(5):491–502.
17. Tangvarasittichai S. Oxidative stress, insulin resistance, dyslipidemia and type 2 diabetes mellitus. *World J Diabetes*. 2015 Apr 15;6(3):456–80.
18. Busman H, Lestari RP, Rosa E, Arifiyanto A. Kersen (*Muntingia calabura* L.) Ethanol Extract Repairs Pancreatic Cell Damage, Total Coliforms, and Lactic Acid Bacteria in Hyperglycemic Mice. *J Pure Appl Microbiol*. 2022 Sep 1;16(3):1943–52.
19. Kurnia DC. Pemanfaatan Daun Kersen (*Muntingia calabura* L.) dalam Penanganan Diabetes Mellitus. *bimfi*. 2020 Sep 4;7(1):017–25.
20. Khin PP, Lee JH, Jun HS. Pancreatic Beta-cell Dysfunction in Type 2 Diabetes. *Eur J Inflamm*. 2023 Dec 1;21:1721727X231154152.
21. Eguchi N, Vaziri ND, Dafoe DC, Ichii H. The Role of Oxidative Stress in Pancreatic β Cell Dysfunction in Diabetes. *Int J Mol Sci*. 2021 Feb 3;22(4):1509.

Original Article

Prevalence and Factors Associated with Pre-marital Sexual Intercourse Among Adolescents of School Age in Bima City

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ABSTRACT

Pre-marital sexual behavior among adolescents is still a concern in most of the countries, including Indonesia. The condition would be worse due to the discontinuation of the study, pre-marital pregnancy, and risk of sexually transmitted diseases. This study aimed to examine the prevalence of pre-marital sexual intercourse and factors associated among adolescents of school age in Kendal, Indonesia. This cross-sectional study employed 176 in grade XI from 9 classes in Senior High School 4 Bima, aged 15 to 18 years old in Bima City, Indonesia. The sample was selected by proportionate stratified random sampling. The dependent variable is pre-marital sex and the independent variables are knowledge, self-control, relationship status, role of teacher, and role of health worker. The data analysis was done using univariate (frequency and percentage) and bivariate analysis (Chi-square and simple logistic regression) using SPSS software. The result found prevalence of adolescents who were at risk of having sexual intercourse was 26.1%. The factors significantly associated with pre-marital sex are not having self-control (COR 8.5) and being in a relationship (COR 5.0). However, other variables including knowledge, the role of the teacher, and the role of health workers did not find significant association with pre-marital sex. Future studies can add more potential predictors to the study including the level of household, school, and community. The government needs to add the issue of pre-marital sex as well as the tendency to discontinue the study if pre-marital pregnancy occurs. Self-control can be strengthened by involving religious activity in school. Some recommendations for school-based sexual education programs, youth counseling services, or community interventions for the target population could work more to prevent pre-marital sexual intercourse among adolescents of school age.

Keywords: Pre-Marital Sex, Adolescent, Bima City

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INTRODUCTION

Pre-marital sexual intercourse among adolescents is a significant concern globally, especially in developing countries. In Ethiopia, studies have shown that 31.3 percent of adolescent students engage in pre-marital sexual intercourse¹. Factors influencing this behavior include residing in urban areas, where adolescents were found to be more likely to engage in pre-marital sexual practices². Additionally, being female has been linked to

an increased likelihood of early sexual initiation in Ethiopia³. In Nigeria, gender norms play a role in shaping adolescent sexuality, with adolescent girls often choosing sexual abstinence due to fears of social and health consequences, while boys may exhibit more tolerance towards pre-marital sexual relationships⁴. Furthermore, in Uganda, participating in sexual activity, regardless of marital status, can lead to negative reproductive health outcomes among adolescents⁵.

In Indonesia's context, a study analyzing data from the 2015 Global School-based Health Survey revealed that a higher percentage of adolescent boys (6.9%) in Indonesia reported engaging in sexual intercourse compared to girls (3.8%)⁶. Furthermore, a study conducted in Bali, Indonesia, found a significant influence of peer relationships on the premarital sexual behaviors of teenagers in the country⁷. Additionally, research on early adolescents in Semarang, Central Java, aimed to understand sexual intercourse patterns among different age groups⁸.

Pre-marital sexual intercourse among adolescents can have significant consequences on their health and well-being. Research has shown that adolescents who engage in pre-marital sexual intercourse are at an increased risk of having multiple sexual partners, sexually transmitted diseases (STDs), and unintended pregnancies². Additionally, early sexual debut has been associated with poor mental health outcomes, including symptoms of depression and suicidal behaviors among adolescents⁹.

Moreover, pre-marital sexual behavior in adolescents can lead to a range of negative health outcomes, such as unwanted pregnancies, teenage pregnancies, abortions, sexually transmitted infections (STIs), HIV/AIDS, feelings of guilt, loss of self-respect, depression, substance abuse, and even suicidal ideation^{10,11}. Furthermore, pre-marital sexual intercourse among adolescents the social and psychological including psychological distress, stress, depression, and suicidal ideation^{6,9,12,13}.

The challenges of improving sex education among adolescents include the lack of information from family, school, and peers. Additionally, the taboo and uncommon discussion about sex leads difficulties to promote the risk factor of pre-marital sexual behavior.

Sex and reproductive health education should be given to children who are already adults or teenagers, either through formal or informal education. This is important to prevent biased sex education and knowledge about reproductive health among teenagers¹⁴.

The purpose of this study is to examine the prevalence of pre-marital sexual intercourse risk and risk factors among adolescents in Senior High School Number 4, in Bina City.

METHOD

This study used a cross-sectional time frame. The data collection was conducted during July 2023. The validity and reliability tests were done among 20 students in grade XI at Senior High School Number 4 Bima City.

The population of this study were all students in grade XI in Senior High School Number 4 in Bima City with a total number of 313 students. To select the representative sample, it was used the Slovin formula which resulted in 176 students. Those students were selected using proportionate stratified random sampling from 9 classes in grade XI as representative. The inclusion criteria are students aged 15 to 18 years old and willing to complete the survey.

The pre-marital sex behavior in this study was defined based on 10 questions. Those who answered "yes" to at least one question will be categorized as "risky". The explanatory variables include knowledge (5 questions), which is categorized as good if more than or equal mean score. The self-control consists of 8 questions which are categorized as "yes" if the score is higher or equal mean score. The relationship status consisted of 2 questions which were categorized as "no" if students answered not in relationship. The role of teachers consists of 9 questions which are categorized as "yes" if the score is higher than or equal mean score. The role of health worker is categorized as "yes" if higher or equal mean score. All of the questions were asked using a questionnaire face by face.

The data was analyzed using univariate and bivariate analysis. The statistical software SPSS version 25 was employed during data analysis. The bivariate analysis was done using Chi-square and a simple logistic regression test to examine the correlation between each explanatory variable and pre-marital sex behavior. The 95% confidence interval was used to define the significance level. Moreover, the Odd Ratio (OR) is used to quantify the strength of the association. This study has been approved by the Ethical Committee for Health Research, College of Health Science, Kendal, Central Java Province, Indonesia, with number: 073/EC/KEPK_STIKES_KENDAL/VII/2023. Informed consent was obtained from the participants. Confidentiality and privacy were ensured during data collection including participant protections that enhance the

transparency and credibility of the study.

RESULTS

The result of this study consisted of univariate, bivariate using Chi-square test, and simple logistic regression. Table 1 below describes the information about each variable. Among 176 adolescents involved in this study, 26.1% of them were at risk of pre-marital sex. In terms of knowledge, the majority of them had good sexual and reproductive knowledge (73.3%). According to having self-control, most of them have self-control (64.2%). More than half of them were in a relationship (57.4%). The role of teachers and health workers showed 68.2%, and 42.6%, respectively.

Table 1. The characteristics of the respondents

Variables (n=176)	Frequency	Percentage
Pre-marital sex		
Not risky	130	73.9
Risky	46	26.1
Knowledge		
Good	129	73.3
Poor	47	26.7
Having self-control		
Yes	113	64.2
No	63	35.8
In relationship		
No	75	42.6
Yes	101	57.4
Role of teacher		
Yes	120	68.2
No	56	31.8
Role of health worker		
Yes	75	42.6
No	101	57.4

Table 2 below describes the bivariate analysis using the Chi-square test which showed that the the risky population in this study had good knowledge, did not have self-control, in relationships, involved the role of teacher, and did not involve health workers role.

Table 2. The bivariate analysis results

Variables	Pre-marital sex		Total
	Not risky	Risky	
Knowledge			
Good	99 (76.7)	30 (23.3)	129 (100)
Poor	31 (66.0)	16 (34.0)	47 (100)
Having self-control			
Yes	100 (88.5)	13 (11.5)	113 (100)
No	30 (47.6)	33 (52.4)	63 (100)
In relationship			

No	67 (89.30)	8 (10.7)	75 (100)
Yes	63 (62.40)	38 (37.60)	101 (100)
Role of teacher			
Yes	90 (75.0)	30 (25.0)	120 (100)
No	40 (71.4)	16 (28.6)	56 (100)
Role of health worker			
Yes	54 (72.00)	21 (28.0)	75 (100)
No	76 (75.20)	25 (24.8)	101 (100)

Table 3 below shows the simple logistic regression to see the crude odd ratio of each independent variable related to pre-marital sex. It showed that some variables including having self-control and being in a relationship were significantly associated with pre-marital sex. However, other variables including knowledge, the role of the teacher, and the role of health workers did not find significant association with pre-marital sex. In detail, compared to those who had self-control, adolescents who did not have self-control were 8.5 times more likely to have pre-marital sex. Moreover, compared to those who were not in a relationship, those who were in a relationship were 5.0 times more likely to have pre-marital sex.

Table 3. The Crude Odds Ratio of Correlation

Variables	COR	95%CI (lower-upper)	p-value
Knowledge			
Good (ref)	1		
Poor	1.703	(0.822 – 3.529)	0.212
Having self-control			
Yes (ref)	1		
No	8.462	(3.955 – 18.102)	0.000
In relationship			
No (ref)	1		
Yes	5.052	(2.189 – 11.659)	0.000
Role of teacher			
Yes (ref)	1		
No	1.200	(0.589 – 2.446)	0.750
Role of health worker			
Yes (ref)	1		
No	0.846	(0.430 – 1.665)	0.755

The result of this study revealed that self-control is the strongest factor influencing adolescents to have pre-marital sex. Furthermore, in relationships was found to significantly increasing the odds of having pre-marital sex.

DISCUSSION

Factors associated with pre-marital sex

are influenced by a variety of social, cultural, and individual factors. This current study found the impact of not having self-control and being in a relationship as predictors of having pre-marital sexual intercourse. These findings differ from previous research with some mechanisms driving these associations. In line with findings from this study, the study in Kendal, Indonesia revealed the role of religiosity on sexual behavior¹⁵.

However, previous studies have shown that peer pressure, exposure to pornography, substance use, and gender norms play significant roles in the prevalence of pre-marital sexual activity^{4,16,17}. For instance, research in Ethiopia found that peer pressure, watching pornographic videos, and substance use were significantly associated with pre-marital sexual debut among university students¹⁸. Additionally, gender norms and ideologies about adolescent sexuality were found to influence attitudes towards pre-marital sex, with adolescent boys being less likely to believe in pre-marital abstinence compared to girls⁴. Furthermore, traditional gender roles and religiosity were identified as significant factors contributing to conservative attitudes toward pre-marital sex in Turkey¹⁹.

Furthermore, the influence of cultural and societal factors on pre-marital sex has been investigated. In Nigeria, for example, the stigma and cultural sensitivity surrounding pre-marital sex have led to denial of its prevalence among teenagers²⁰. Additionally, the transactional nature of sexual relationships and power imbalances have been identified as important factors in determining when such relationships are considered exploitative²¹.

The relationship between pre-marital sex and various factors has been the subject of extensive research. Studies have explored the influence of factors such as alcohol consumption, religiosity, gender norms, and parental attachment on pre-marital sexual behavior among adolescents^{4,18,22–26}. Additionally, the impact of marital satisfaction, sexual interaction, and marital disillusionment on pre-marital sex has been investigated^{27–30}. Furthermore, the prevalence and consequences of pre-marital sex among university students and the experience of marital infidelity have been examined^{31,32}. The socio-demographic determinants of money script patterns and the consequences of pre-marital sex among female undergraduate students have also been explored

^{33,34}.

Pre-marital sex among adolescents in school age is influenced by various factors. Studies have shown that liberal attitudes towards pre-marital sexual intercourse, incomplete knowledge of sexual and reproductive health, and limited access to appropriate services are determinants of teenage pregnancy³⁵. Additionally, increased pre-marital sex, deterioration of traditional norms and values, and media influence have been associated with risky sexual behaviors among adolescents³⁶. Furthermore, illegal abortions, the risk of HIV infections, and school dropout have been identified as negative consequences of pre-marital sex among high school youths²². In India, it was found that education and pre-marital sex are negatively correlated at the individual level, while factors such as parental disapproval of pre-marital sexual activities and parental connectedness were associated with preventing or delaying pre-marital sexual initiation among young people, especially young women³⁷. Gender norms and ideologies about adolescent sexuality also play a significant role, with adolescent boys being less likely to believe in pre-marital abstinence compared to girls⁴.

Moreover, the consumption of alcohol has been linked to an increased chance of pre-marital sex among secondary school adolescent students^{25,38}. Self-control, parental attachment, and peer roles have been identified as influential factors in pre-marital sexual behavior among adolescents²⁶. Utilization of information centers and youth counseling has been associated with adolescents' attitudes and practices of pre-marital sex³⁹. Additionally, pre-marital sexual behavior has been found to impact the health of adolescents, leading to consequences such as unwanted pregnancy, abortion, sexually transmitted infections, and mental health issues⁴⁰.

The role of self-control in pre-marital sexual behavior among adolescents is a significant area of study. Low self-control has been associated with an increased likelihood of engaging in pre-marital sexual activities⁴¹. Furthermore, the influence of self-control on pre-marital sexual behavior has been highlighted in the context of factors such as peer pressure and watching pornography, which are associated with pre-marital sexual practices among young individuals⁴². The ability to exercise self-control is crucial in resisting peer

pressure and making informed decisions regarding sexual behavior.

Moreover, the influence of self-control on pre-marital sexual behavior has been explored in the context of parental attachment and peer roles²⁶. Self-control has been identified as a factor that can influence pre-marital sexual behavior among adolescents, highlighting the importance of individual psychological factors in shaping sexual decision-making²⁶. Additionally, the relationship between self-control and risky sexual behavior has been examined, with studies indicating that self-control plays a role in mitigating risky sexual behaviors among adolescents⁴³. This underscores the importance of self-control as a protective factor against engaging in pre-marital sexual activities that may lead to adverse health outcomes.

This study cannot be generalized with different populations and times. There are some potential biases in the validity and reliability of the study. Future studies can include the factors of smoking behavior, access to pornography, and religiosity as the potential determinants of pre-marital sexual intercourse. It could be better to discuss methodological approaches in more detail, research gaps, or theoretical frameworks that could further advance understanding of risk factors of pre-marital sexual behavior.

Some recommendations for school-based sexual education programs, youth counseling services, or community interventions for the target population could work more to prevent pre-marital sexual intercourse among adolescents of school age.

CONCLUSION

The prevalence of adolescents who were at risk of having sexual intercourse was 26.1%. The factors significantly associated with pre-marital sex are not having self-control and being in a relationship. Future studies can add more potential predictors to the study including the level of household, school, and community. The government needs to add the issue of pre-marital sex as well as the tendency to discontinue the study if pre-marital pregnancy occurs. Self-control can be strengthened by involving religious activity in school. To prevent pre-marital sex, the risk of engaging in relationships can be promoted by the school.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Behulu GK, Anteneh KT, Aynalem GL. Premarital Sexual Intercourse and Associated Factors Among Adolescent Students in Debre-Markos Town Secondary and Preparatory Schools, North West Ethiopia, 2017. *BMC Res Notes*. 2019;
2. Biratu B, Garoma S, Getachew M, Desalegn M. Drinking Alcohol Raises the Chance of Premarital Sex by Four Folds Among Secondary School Adolescent Students in Jima Arjo, Southwestern Ethiopia, 2018: A School-Based Cross-Sectional Study. *Contracept Reprod Med*. 2022;
3. Turi E, Merga BT, Fekadu G, Abajobir AA. <p>Why Too Soon? Early Initiation of Sexual Intercourse Among Adolescent Females in Ethiopia: Evidence From 2016 Ethiopian Demographic and Health Survey</p><p>International Journal of Women S Health. 2020;
4. Agu IC, Mbachu C, Ezenwaka U, Eze II, Ezumah N, Onwujekwe O. Gender Norms and Ideologies About Adolescent Sexuality: A Mixed-Method Study of Adolescents in Communities, South-Eastern, Nigeria. *Frontiers in Sociology*. 2022;
5. Bukenya J, Nakafeero M, Ssekamatte T, Isabirye N, Guwatudde D, Fawzi WW. Sexual Behaviours Among Adolescents in a Rural Setting in Eastern Uganda: A Cross-sectional Study. *Tropical Medicine & International Health*. 2019;
6. Rizkianti A, Maisya IB, Kusumawardani N, Linhart C, Pardosi JF. Sexual Intercourse and Its Correlates Among School-Aged Adolescents in Indonesia: Analysis of the 2015 Global School-Based Health Survey. *Journal of Preventive Medicine and Public Health*. 2020;
7. Wijaya MK, Giri MKW, Wahyuni

- NPDS, Setiawan KH. Premarital Sex Behaviors of Teenagers: A Case in Bali, Indonesia. *Int J Health Sci (Qassim)*. 2018;
8. Perestroika GD, Prabandari YS, Wilopo SA. Sexual Intercourse Among Early Adolescents in Semarang, Central Java, Indonesia: Survey Using Respondent-Driven Sampling (RDS). 2021;
 9. Baiden P, Panisch LS, Kim YJ, LaBrenz CA, Kim Y, Onyeaka H. Association Between First Sexual Intercourse and Sexual Violence Victimization, Symptoms of Depression, and Suicidal Behaviors Among Adolescents in the United States: Findings From 2017 and 2019 National Youth Risk Behavior Survey. *Int J Environ Res Public Health*. 2021;
 10. Shrestha RB. Premarital Sexual Behaviour and Its Impact on Health Among Adolescents. *Journal of Health Promotion*. 2019;
 11. Upreti YR, Acharya D. Premarital Sexual Behaviours Among Secondary School Adolescents: A Cross-Sectional Study in Kathmandu. *Journal of Health Promotion*. 2020;
 12. Lee E, Kim Y. A Study on Stress, Depression and Suicidal Ideation According to Sexual Behaviours Among Korean Adolescents. *Cent Eur J Public Health*. 2018;
 13. Ezumah N, Agu IC, Okeke C, Agu C, Mbachu C, Onwujekwe O. Adolescents' Perceptions About Dating and Sexual Permissiveness in Ebonyi State, Nigeria: What Can Be Done to Enhance Adolescents' Sexual Health and Well-Being. *Frontiers in Reproductive Health*. 2021;
 14. Patty FU, Hukubun RD, Mahu SA, Tetelepta N, Linansera V. Sosialisasi Sex Education: Pentingnya Pengenalan Pendidikan Seks pada Remaja sebagai Upaya Meminimalisir Penyakit Menular Seksual. *ABDIKAN: Jurnal Pengabdian Masyarakat Bidang Sains dan Teknologi*. 2022;1(2):225–31.
 15. Rosalina AF, Handayani A. Perilaku Seksual Remaja Ditinjau Dari Religiusitas dan Pola Asuh Permisif Pada Sma "X" Rowosari Kendal. In: *Prosiding Seminar Nasional Psikologi Unissula*. 2018.
 16. Gebregziabher H, Kahsay A, Gebrearegay F, Berhe K, Gebremariam A, Gebretsadik GG. Food taboos and their perceived reasons among pregnant women in Ethiopia: a systematic review, 2022. *BMC Pregnancy Childbirth*. 2023 Dec 1;23(1).
 17. Mai V, Kittisuksathit S. Factors Influencing Pre-Marital Sexual Intercourse Among Unmarried Young Individuals in Cambodia. *Makara Journal of Health Research*. 2019;
 18. Kebede A, Molla B, Gerensea H. Assessment of Risky Sexual Behavior and Practice Among Aksum University Students, Shire Campus, Shire Town, Tigray, Ethiopia, 2017. *BMC Res Notes*. 2018;
 19. Karaman N, Alagoz R, Fidan A. Türkiye’de Cinsiyet Roller, Din, Ve Eşcinsellik Ve Evlilik Öncesi Cinsel İlişkiye Karşı Tutumlar. *Pamukkale University Journal of Social Sciences Institute*. 2022;
 20. Adem M, Hailu S, Assefa N, Assebe T. Correlates of Teenage Pregnancy Among Female Secondary School Students in Dire Dawa City, East Ethiopia. 2023;
 21. Wamoyi J, Heise L, Meiksin R, Kyegombe N, Nyato D, Buller AM. Is Transactional Sex Exploitative? A Social Norms Perspective, With Implications for Interventions With Adolescent Girls and Young Women in Tanzania. *PLoS One*. 2019;
 22. Arega WL, Zewale TA, Bogale KA. Premarital Sexual Practice and Associated Factors Among High School Youths in Debretabor Town, South Gondar Zone, North West Ethiopia, 2017. *BMC Res Notes*. 2019;
 23. Hernandez-Kane KM, Mahoney A. Sex Through a Sacred Lens: Longitudinal Effects of Sanctification of Marital Sexuality. *Journal of Family Psychology*. 2018;
 24. Dobrowolska M, Groyecka A, Sorokowski P, Randall AK, Hilpert P, Ahmadi K, et al. Global Perspective on Marital Satisfaction. *Sustainability*. 2020;

25. Biratu B, Garoma S, Getachew M, Desalegn M. Drinking Alcohol Raises the Chance of Premarital Sex by Four Folds Among Secondary School Adolescent Students in Jima Arjo, Southwestern Ethiopia, 2018: A School-Based Cross-Sectional Study. *Contracept Reprod Med.* 2022;
26. Malihah Z, Latifah M, Hastuti D. Pre-Marital Sexual Behavior of Adolescents: The Influence of Self-Control, Parental Attachment, and Peer Roles. *Journal of Family Sciences.* 2022;
27. Shao J, Chen C, Borelli JL. Rethinking the Dichotomy of Sexual Identity and Relational Intimacies: Chinese Gay Men's Mental Health in Mixed-Orientation Marriages. *Psychol Sex.* 2021;
28. Manjula VD, Manjula M, Navaneetham J, Philip M. Quality of Marital Relationship and Sexual Interaction in Couples With Sexual Dysfunction: An Exploratory Study From India. *Journal of Psychosexual Health.* 2021;
29. hallaji SH, Khademi A, Vafa MA, Esmali A. The Efficacy of Mindfulness in Sex Therapy on Sexual Sensation Seeking, Extramarital Relationships and Marital Disillusionment of Couples. *The Journal of Psychological Science.* 2021;
30. Jeanfreau MM, Wright L, Noguchi K. Marital Satisfaction and Sexting Behavior Among Individuals in Relationships. *The Family Journal.* 2018;
31. Zahedi R, Nasiri N, Zeinali M, Noroozi A, Hajebi A, Haghdoost AA, et al. The Prevalence and Associated Factors of Extra/Pre-Marital Sexual Behaviors Among University Students in Kerman, Iran. *International Journal High Risk Behaviors & Addiction.* 2019;
32. Scheeren PA, Apellániz IAM, Wagner A. Marital Infidelity: The Experience of Men and Women. *Temas Em Psicología.* 2018;
33. Atiri SO, Bello ST. Socio-Demographic Determinant of Money Script Pattern of Undergraduates of University of Lagos. *Psychocentrum Review.* 2021;
34. Alade TT, T OS, O BT. Consequences of Pre-Marital Sex Among Female Undergraduate Students. *International Journal of Research and Innovation in Social Science.* 2021;
35. Sychareun V, Vongxay V, Houaboun S, Thammavongsa V, Phummavongsa P, Chaleunvong K, et al. Determinants of Adolescent Pregnancy and Access to Reproductive and Sexual Health Services for Married and Unmarried Adolescents in Rural Lao PDR: A Qualitative Study. *BMC Pregnancy Childbirth.* 2018;
36. Keto T, Tilahun A, Mamo A. Knowledge, Attitude and Practice Towards Risky Sexual Behaviors Among Secondary and Preparatory Students of Metu Town, South Western Ethiopia. *BMC Public Health.* 2020;
37. Das U, Rout S. Are Delay Ages at Marriage Increasing? Pre-Marital Sexual Relation Among Youth People in the Place of Residence in India. *BMC Women S Health.* 2023;
38. Biratu B, Garoma S, Getachew M, Beyene MD. Drinking Alcohol Raise Chance Pre-Marital Sex by Four Folds Among Secondary School Adolescent Students in Jima Arjo, South Western Ethiopia, 2018. 2020;
39. Nindra RRS, I'tishom R, Handayani S. The Relationship Between Utilization of Information Center and Youth Counseling (PIK-R) Towards Adolescents Attitude and Practice of Pre-Marital Sex. *International Journal of Research Publications.* 2022;
40. Shrestha RB. Premarital Sexual Behaviour and Its Impact on Health Among Adolescents. *Journal of Health Promotion.* 2019;
41. Magnusson BM, Crandall A, Evans K. Early Sexual Debut and Risky Sex in Young Adults: The Role of Low Self-Control. *BMC Public Health.* 2019;
42. Damtie Y, Cherie N, Fentaw H, Kefale B, Addisu E, Yalew M, et al. Pre-Marital Sex and Its Association With Peer Pressure and Watching Pornography Among Young Individuals in Ethiopia: A Systematic

- Review and Meta-Analysis. *Sci Rep.* 2022;
43. Knowles A, Rinehart JK, Steinberg L, Frick PJ, Cauffman E. Risky Sexual Behavior Among Arrested Adolescent Males: The Role of Future Expectations and Impulse Control. *Journal of Research on Adolescence.* 2019;

Implementation of Digital Parenting on Early Childhood Gadget Addiction: A Scoping Review

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ABSTRACT

The case of gadget addiction among children is quite alarming. Survey results from the Indonesian Child Protection Commission (KPAI) state that as many as 79% of children are allowed to use gadgets. In this case, the role of parents is very important in supervising children when using gadgets. Supervision in this case is by the digital parenting method used by parents in an effort to limit the use of gadgets in early childhood. This study aims to discuss some appropriate implementations in the application of digital parenting applied by parents to children's behavior in using gadgets. The method used in this research is a scoping review using two databases namely PubMed and Science Direct with Indonesian language articles, published from 2018-2022. The results obtained from 5 articles show that parents' experiences related to the implementation of digital parenting that can be used as an effort to prevent gadget addiction are the role of parents in mentoring and time management in the use of gadgets in early childhood. The conclusion of this study is that the implementation of digital parenting through the role of parents in mentoring and implementing time management can be applied in preventing gadget addiction in early childhood.

Keywords: *Early Childhood, Gadget Addiction, Digital Parenting.*

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INTRODUCTION

Communication technology in this day and age is very rapidly advancing, as evidenced by the presence of sophisticated technology such as those that have become the main needs of both children and adults. Gadgets are not only a tool for communication but can also help facilitate other activities. Today's children are born in the era of digital technology, playing computers and gadgets is a common thing in this era. The case of addiction or smartphone

Protection Commission (KPAI) state that as many as 79% of children are allowed to use gadgets. According to Subarkah (2019) seen psychologically, childhood is a golden period where at this time the growth in children's brain cells develops very quickly and is sensitive to external stimuli. All positive information can be received by children which will then affect the child's growth and development process¹. And vice versa, if the information is negative, it will have a negative impact on inhibiting the development of growth

and development in children.

The American and Canadian Pediatrics Associations emphasize that children aged 0 to 2 years should not use gadgets. While children aged 3 to 5 years are limited to one hour per day and two hours per day for children aged 6 to 18 years. The WHO also emphasizes that babies as young as 1 year old are not recommended to be introduced to gadgets. Gadgets are recommended by WHO at 2 years old, but the duration should not exceed 1 hour. But in reality, children have been introduced to gadgets by parents from the age of 1 year and the duration can be more than 1 hour. In 2020, in Indonesia, 29% of early childhood use gadgets. West Java Province reached 35,100,611 people in using the internet the most².

The impact caused by gadgets is that children become dependent on gadgets and leave various types of games that do not involve gadgets. Gadget or smartphone addiction itself is defined as loss of control, becoming more obsessive, interpersonal problems, lack of tolerance, and symptoms of withdrawal so that it becomes dependent on smartphones³.

The impact caused can have a positive and negative impact on child development. Therefore, the role of parents is very important in supervising children when using gadgets, so that the impact of using gadgets does not affect behavior in children, especially in early childhood⁴. The role of parents in this case provides optimal developmental stimulation in children through the motor aspects of children⁵. In addition, parenting also plays a very important role in children during the golden age. Various studies have shown that parenting is the main factor affecting child development. in order to stimulate optimal child growth and development⁶.

According to Setiawan et al (2022) the techniques used so that children are not exposed to negative content from using gadgets are certainly inseparable from the big role of parents who are always at the forefront in today's millennial era⁷. Parents are required to better understand introducing children to applications that are suitable for early childhood. Several studies discuss the implementation of digital parenting, which is basically interpreted as an effort to supervise, limit, and assist parents in children's behavior in using gadgets⁸. Furthermore, the process is carried out to prevent the negative impact of

gadget use on children and tends to optimize the positive impact obtained from gadgets⁹. This study aims to discuss some appropriate implementations in the application of digital parenting applied by parents to children's behavior in using gadgets.

METHODS

The writing method applied to this scoping review is to collect from several published research articles. A three-step search strategy will be used in this study. The initial search will be conducted using two databases, PubMed and ScienceDirect, to identify articles with suitable topics, followed by analyzing the titles and abstracts as well as the terms used in describing the topics in the articles.

1. Identification of Research Questions

Databases that will be used in this study include PubMed and ScienceDirect. Articles published from November 2018 - November 2022 in English.

Table 1. Scoping Review Questions

P	I	C	O
Early childhood OR Child	Digital parenting OR Smart Parenting	-	Gadget Addiction OR Smartphone Addiction

2. Identification of Relevant Studies

Secondary data search sources collected were 5 articles on the PubMed and ScienceDirect databases in the period 2018-2022.

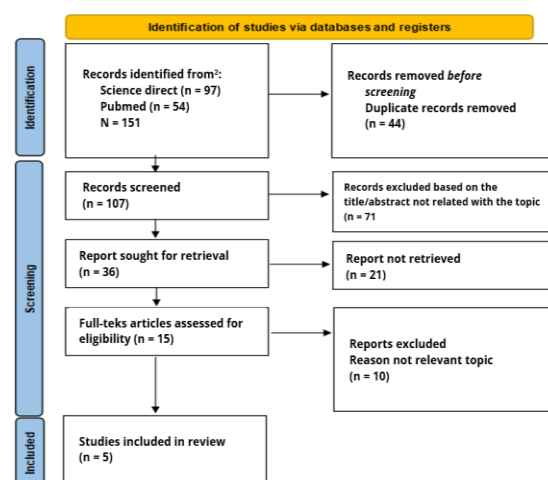


Figure 1. PRISMA Flow Chart

3. Study Selection

After searching several databases, all identified citations will be selected and screened according to the criteria previously mentioned in the database software, then check the article based on the title and abstract. If it meets the criteria after reviewing according to the participants, concepts, context, research methods and relevant keyword findings, the full-text of the article will be searched and selected based on the predetermined inclusion criteria and referring to the objectives of the review. Articles will be excluded from the review if they do not meet the criteria such as no effective digital parenting implementation and research sample > 5 years.

4. Data Extraction

Data extraction focused on the

information used in the implementation of digital parenting for gadget addiction. The components reviewed included age parameters, respondents, number of question items assessed, scale, scoring, and success of the technique.

RESULTS

In the literature search on several databases, 151 journals were obtained, which were then selected through several stages and produced 5 journals. The articles obtained discuss the implementation of digital parenting efforts to prevent gadget addiction with 5 articles obtained

Table 2. Data Extraction

Author & Publisher	Title & Year	Subject	Design	Aim	Method	Result
Budi ¹⁰ Rosyada: Islamic Guidance and Counseling	Implementat ion of Digital Parenting Classes with the theme How to Prevent Gadget Addiction in the Golden Age Period Year 2020	Parents of students at Baitul Qur'an Baitul Qur'an Islamic Boarding School (PAS) Ngabar Siman Ponorogo numbered eleven.	This research used a descriptive qualitative approach. The research was conducted at... The variable in this study is the implementa tion of digital parenting classes.	describe the implementati on of digital parenting classes on how to prevent gadget addiction in the golden age period in detail and in depth	Digital parenting class	The results showed that with the digital parenting class, participants' knowledge about digital parenting also increased. Based on this, 90% of participants stated that digital parenting classes were useful for increasing their knowledge about digital parenting.
Sisbintari ¹¹ Journal of Obsession: Journal of Early Childhood Education	Digital parenting as an Effort to Prevent Gadget Addiction in Early Childhood during the Covid-19 Pandemic Year 2021	Parents of kindergarten students in Kulonprogo Regency, Yogyakarta Special Region with an age range of 4-6 years old	This research uses a qualitative approach. The type of research used is descriptive qualitative research	Describe the role of parents in implementin g Digital parenting as an effort made to prevent gadget addiction in children during the Covid-19 pandemic.	Digital pattern of time manage ment - Parental assistanc e App utilizatio n	From the results of the study, it shows that there are several techniques that are carried out by creating a Digital parenting pattern of time management for gadget use, assistance from parents, utilizing the youtube kids application, monitoring

						browsing activities, not introducing games to children, and implementing screen time on gadgets.
Asmawati ¹² Journal of Obsession: Journal of Early Childhood Education Volume 6 Issue 1 (2022) Pages 30-44	The Role of Parents in the Utilization of Digital Technology in Early Childhood Year 2021	There are 277 parents with young children in Banten Province.	This research uses quantitative research. The method used is the survey method	Determine the effect of digital technology utilization on the role of parents in early childhood.	Parental assistance in gadget use	The results showed that there is a positive and significant influence of digital technology on the role of parents in utilizing gadgets. In this case, parents play an active role in guiding, educating, and supervising children in responding to the use of gadgets.
Alia, et al ¹³ Polyglot: A Scientific Journal, 14(1).	Parent Mentoring of Young Children in the Use of Digital Technology Tahun 2018	Parents of young children who are negatively affected by the internet	Qualitative research methods	Knowing that parents can supervise children and direct positive content for children to use technological advances appropriately in accordance with the child's developmental period.	Effective communication to supervise children in gadget use	The results of this study indicate that in this case the role of parents is as good communicators for children, as for effective communication methods, namely, determining time contracts with children, using language that is easily understood by children, using good attitudes when communicating, and sorting out which communication is effective when done by children.
Setiawan ⁷ Journal of PAJAR (Education and Teaching), 6(4), 1188- 1197. DOI : http://dx.doi.org/10.33578/pjr.v6i4.8793	The Effect of Smart Parenting Media on Parents' Digital Mediation Skills During Pandemic at Tk Al-Azhar 54	Parents who have children aged 5-6 years in Al-Azhar 54 Kindergarten Pekanbaru City	Experimental method with one group pretest posttest design	Knowing the effect of Smart Parenting media on parents' digital mediation skills during the pandemic	Digital mediation (parental supervision, restriction, and assistance)	Smart Parenting media is proven effective to improve parents' digital mediation skills at Al-Azhar 54 Kindergarten in Pekanbaru City. (Setiawan et al., 2022)

DISCUSSION

In the literature search on several databases, 151 journals were obtained which were then selected through several stages and 5 journals were produced. The articles obtained discuss the implementation of digital parenting efforts to prevent smartphone addiction with 5 articles obtained.

Method described above, parents and children can have a sense of responsibility that both must do. In addition, with the agreement applied by parents and children, parenting behavior is well established between mother and child, so that the process of child development and growth can develop optimally. By implementing time management parents can also make their children's attention diverted from gadgets and tend to play more productive activities. Various applications are carried out by parents to apply Digital parenting to children to prevent gadget addiction. However, the use of gadgets in children must still be controlled so as not to interfere with their growth and development. In addition, parents must be disciplined and committed to the schedule and rule agreements that have been made. This time management pattern tends to be effective because children can successfully divert to more productive play activities with their friends. Based on the description of the data, it can be concluded that the application of time management in gadget use can be used as a good digital parenting method to be used to prevent gadget addiction in children.

CONCLUSION

From the discussion above, it can be concluded that the implementation of digital parenting that is widely applied by parents in an effort to reduce the use of gadgets in children is by implementing mentoring and time management. The assistance that parents do is by sorting out what applications the child can access so that it does not have a negative impact on the child. The role of parents in assisting children in using digital technology is a form of primary

responsibility because the family is the first place of education. However, the use of gadgets in children must still be controlled so as not to interfere with their growth and development. Furthermore, by doing time management in giving time limits for gadget use so that children are accustomed to using gadgets at certain times only.

REFERENCES

1. Subarkah MA. Pengaruh gadget terhadap perkembangan anak. Rausyan Fikr: Jurnal Pemikiran Dan Pencerahan. 2019 Feb 28;15(1).
2. Apsari NC, Nurfauziah LS, Asiah DH. Dampak Penggunaan Gawai (Gadget) Terhadap Perilaku Sosial Anak Usia Dini. Share: Social Work Journal. 2023 Aug 11;13(1):11-22.
3. Park E. The adoption of tele-presence systems: Factors affecting intention to use tele-presence systems. Kybernetes. 2013 Jun 24;42(6):869-87.
4. Ariston Y, Frahasini F. Dampak penggunaan gadget bagi perkembangan sosial anak sekolah dasar. Journal of Educational Review and Research. 2018 Dec 31;1(2):86-91.
5. Brooks AMT., Stuart GW., Sundeen SJ. Principles And Practice Of Psychiatric Nursing. *The American Journal Of Nursing*, 1981; 81(12).
6. Ramadhani MR, Fernanda R, Sari R, Lubis H. Peran pola asuh orang tua dalam membentuk karakter peduli lingkungan. Psikostudia: Jurnal Psikologi. 2018 Dec 15;7(2):61-70.
7. Setiawan EP, Novianti R, Chairilisyah D. Pengaruh Media Smart Parenting Terhadap Kemampuan Mediasi Digital Orang Tua Selama Pandemi Di Tk Al-Azhar 54 Kota Pekanbaru. Jurnal PAJAR (Pendidikan dan Pengajaran). 2022;6(4):1188-97
8. Yusuf M, Witro D, Diana R, Santosa TA, Alfikri AA, Jalwis J. Digital

- parenting to children using the internet. *Pedagogik Journal of Islamic Elementary School*. 2020 May 19;3(1):1-4.
9. Martínez I, Murgui S, Garcia OF, Garcia F. Parenting in the digital era: Protective and risk parenting styles for traditional bullying and cyberbullying victimization. *Computers in human behavior*. 2019 Jan 1;90:84-92.
 10. Budi ME. Pelaksanaan kelas digital parenting bertema cara mencegah kecanduan gadget di masa golden age. *ROSYADA: Islamic Guidance and Counseling*. 2021 Jan 25;1(1).
 11. Sisbintari KD, Setiawati FA. Digital Parenting sebagai Upaya Mencegah Kecanduan Gadget pada Anak Usia Dini saat Pandemi Covid-19. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*. 2021 Oct 7;6(3):1562-75.
 12. Asmawati L. Peran Orang Tua dalam pemanfaatan teknologi digital pada anak usia dini. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*. 2021 Mar 29;6(1):82-96.
 13. Alia T, Irwansyah I. Pendampingan orang tua pada anak usia dini dalam penggunaan teknologi digital [parent mentoring of young children in the use of digital technology]. *Polyglot: Jurnal Ilmiah*. 2018 Jan 30;14(1):65-78.

Article Review

Strategies and Challenges in the Distribution of Public Health Centre Doctors in Indonesia

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ABSTRACT

Adequacy of doctors through the deployment of public health center doctors to achieve equity in health services for the community. Maldistribution doctors cause a shortage in central and eastern, especially in remote areas. The deployment of public health center doctors has been implemented through various policies but there are still public health centers that do not have a doctor. This study aims to explore the strategies, and challenges, and successfully resolve the maldistribution of doctors. Document analysis of legal documents was approached using the READ method to determine the distribution strategy of doctors, ten legal documents were found. A Systematic Literature Review (SLR) was conducted using the PRISMA protocol from two online database search engines, where 21 articles were found that meet the research objectives, inclusion, and exclusion criteria. Effectiveness of doctor deployment meeting the need for doctors in remote areas and improving health programs in public health centers. The challenges of the distribution of public health center doctors are due to deployment for remote and very remote areas. Factors that challenge the distribution of doctors are individual factors, work factors, living environment factors, and health system factors. Addressing these challenges needs a combination of attractive incentives that can increase the effectiveness of deploying doctors in remote areas.

Keywords: Doctor, Public Health Center, Remote Area

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INTRODUCTION

Public health development requires health resources to improve public health for the achievement of national development goals ¹. Health resources including doctors are the main pillar to achieve health service equity, especially for areas with geographical barriers ². Public health centers provide essential health services that are more affordable and accessible to the community than hospitals ³. Public health center is the main provider of health services in rural and remote areas, especially those with

limited access to hospitals⁴.

The availability of doctors in public health centers is one of the dimensions of accessibility of health services based on Minister of Health Regulation No. 43/2019. Indonesia faces the problem of the doctor's maldistribution which accumulates in big cities such as Java, Sumatra, and Sulawesi ⁵. This has resulted in a shortage of doctors generally in rural public health centers in central and eastern Indonesia ⁶⁻⁸.

The government recruits and deploys doctors to public health centers using various

strategies, including the Non-Permanent Employee Program (PTT) and Program Penugasan Khusus Tenaga Kesehatan. The challenges with doctor distribution, such as shortages in remote areas, inability to retain doctors, and lack of interest among doctors to participate in deployment programs. This study aims to explore the government's strategies in addressing these challenges and assessing whether the maldistribution of doctors has been successfully resolved.

METHOD

This study used document analysis and Systematic Literature Review approaches. Document analysis was conducted by collecting the policies of the doctor deployment program for public health centers that have been implemented by the government through the Ministry of Health, which were examined systematically. Researchers collected legal documents in the form of Laws, Presidential Regulations, Minister of Health Regulations, Presidential Decrees, Minister of Health Decrees, and Presidential Instructions for the doctor deployment program. The data collected was obtained through the internet and interviews with contacts at the Ministry of Health. Document analysis using the READ approach involves preparing materials, extracting data, analyzing data, and filtering findings⁹. The limitations of document analysis in this study are biases in document selection and the possibility of missing the relevant documents.

The next stage is to conduct a Systematic Literature Review to find out the challenges of the doctor's deployment programs for public health centers in Indonesia by developing a protocol that will guide data collection with Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA). The limitations of the literature review are that no research articles were found for the Inpres Doctor Programme, which is assumed to be due to the limited publication of research articles before 1992 that can be accessed by researchers via the internet and the

limited research articles obtained by researchers on the mandatory PTT Doctor Program only one research article. Researchers conducted searches through online database search engines from Google Scholar and Garuda looking for policies in Indonesia, the search did not limit the year because the doctor deployment program was implemented from 1974 to the present, and the literature search process was carried out on 19- 20 January 2024 with the following results:

Table 1. Online Database Search

Search Engine	Keywords	Identification Process	Results
Google Scholar	"Nusantara sehat", "Dokter Inpres", "Inpres Dokter", "PTT Dokter", "Dokter PTT", "penempatan dokter"	Unfiltered	1,209
Garuda	Nusantara Sehat, dokter Inpres, dokter PTT puskesmas	Locking keywords in the abstract	1,044

Screening by removing duplicates and looking at titles and abstracts. One reviewer independently screened titles and abstracts that were potentially relevant to doctor deployment programs at public health centers. Issues were identified with the PICO framework i.e. Population (P): public health center doctors; Intervention (I): doctor deployment program by Ministry of Health; Comparison (C): none; Output (O): public health center doctor deployment challenges. Potentially relevant articles were included in the full-text review. Articles were sorted according to inclusion and exclusion criteria. Inclusion criteria in the search were research articles, available in full text, Indonesian or English language. Exclusion criteria were literature reviews, grey literature and not found by the research objectives. Screening of articles using PRISMA guidelines. The data analysis was done descriptively to identify the challenges of each program. The final stage was to synthesize and interpret the findings descriptively on the challenges of the doctor deployment program.

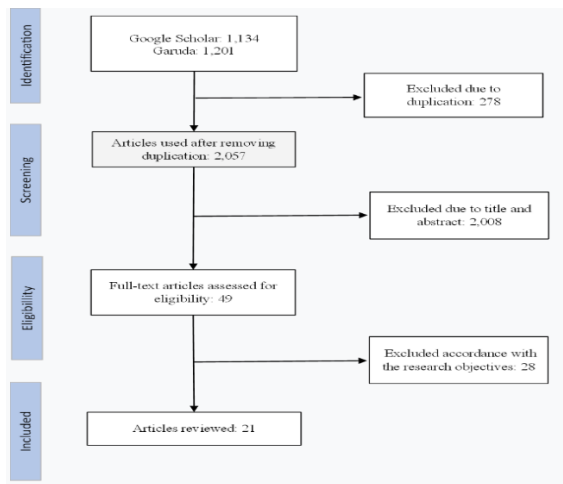


Figure 1. PRISMA flow

RESULTS

Based on the search results, ten legal documents related to the deployment of doctors by the government through the Ministry of Health were obtained. These regulations govern the deployment program of doctors at public health centers from 1974 to the present. The strategy of the doctor deployment program can be seen in the table below:

Table 2. Public Health Centre Doctor Deployment Program in Indonesia

Period Program	Legislation	Strategy
1974-1992	Presidential Instruction No. 5/1974	Mandatory; deployment status of Civil Servants (PNS); temporary work
Dokter Inpres	Presidential Regulation No. 1/ 1988 concerning the Period of Service and Practice of Doctors and Dentists	Mandatory; work in government-owned or private health facilities designated by the government; temporary work
1992-2015	Presidential Decree No. 37/1991 on the Appointment of Doctors as Non-Permanent Employees During the Period of Service	Mandatory; non-civil servant status; deployment in remote and very remote health care facilities prioritized for civil servant appointments, given incentives, reduced duty period
PTT Dokter	Minister of Health Decree 1540/Menkes/SK/XII/2 002 on the Placement of Medical Personnel through Period of Service and Other	Voluntary; temporary work for ordinary areas or remote or conflict areas; giving incentives; deployment in remote and very remote areas get bonus points to take part in CPNS selection
	Decree of the Minister of Health No. 132/Menkes/SK/III/20 06 on the Determination of the Length of Assignment of Non-Permanent Employee Doctors/Dentists in Remote and Very Remote Areas	Assignment in remote areas for one year and very remote areas for six months
	Minister of Health Regulation No.7/2013 on Guidelines for the Appointment and Placement of Doctors and Midwives as Non-Permanent Employees	Deployment outside Java and Bali in underdeveloped, border and island areas (DTPK); temporary work service in remote and very remote healthcare facilities
2015- present	Minister of Health Regulation No. 23/2015 on Penugasan Khusus Tenaga Kesehatan Berbasis Tim (Team Based) in support of Nusantara Sehat Program	Deployment in DTPK and health problem areas (DBK); assignment of teams (five types of health workers) in border areas and outer islands; public health centers with no health workers are prioritized for placement; giving incentives; temporary work
Penugasan Khusus	Minister of Health Regulation No. 16/2017 on Penugasan Khusus Tenaga Kesehatan in support of Nusantara Sehat Program	Assignment at DTPK public health centers; assignment to remote and very remote criteria health centers; team-based or individual assignments; giving participants training to improve their competence; giving incentives
Tenaga Kesehatan dalam Mendukung Program Nusantara Sehat	Minister of Health Regulation No. 33/2018 on Penugasan Khusus Tenaga Kesehatan dalam Mendukung Program Nusantara Sehat Program	Deployment in public health care in DTPK; assignment to urban, rural, remote, and very remote health centers; giving incentives, ensuring the security and safety of participants, preparing infrastructure and shelter

From the table above, it can be seen that the distribution of public health center doctors through a mandatory mechanism with permanent assignments because the doctors had civil servant status as well as in the PTT program then changed to voluntary with giving of incentives from the government. The government currently continues to deploy doctors at public health centers through the Penugasan Khusus Program

with a voluntary mechanism and incentives. The PTT and Penugasan Khusus programs are increasing the accessibility of health services for remote and very remote areas.

The results of a systematic literature review search obtained 21 articles that have been published in scientific journals as can be seen in the table below:

Table 3. Challenges of the Public Health Center Doctor Distribution Program

Author (Year) Title	Methods	Results
	Program	
	Study Locus	
Sulistiyawati, H. et al. (1997) ¹⁰	Mix method	84.9% of PTT doctors stated that their performance was not optimal due to uncertainty of status after the service period (45.6%), having different authorities from civil servants (21.7%), and lack of nonmedical skills (10.3%).
Studi Tentang Faktor-faktor yang Mempengaruhi Penampilan Kerja Dokter PTT di Indonesia	PTT	
	8 provinces	
Suwandono, A., Setijadi, G. and Sumantri, S. (2002) ¹¹	Quantitative	<ul style="list-style-type: none"> 87% of provinces stated that PTT doctors were constrained by recruitment due to central bureaucracy (62.5%); The performance of PTT doctors is hampered because they do not want to occupy service posts in need; there are no adequate transport facilities, adequate housing facilities Obstacles to choosing a post-PTT career 66.7% of provinces were unable to support the PTT doctor program
Hasil Awal Angket Dokter PTT	PTT	
	All provinces in Indonesia	
Freely, N.W. (2004) ¹²	Cross-sectional	<ul style="list-style-type: none"> 20% of the coassistants were not interested in PTT because of inadequate salary, want to continue specialist doctors, not being allowed by family, and safety concerns. 65% of the coassistants were interested in undergoing PTT to get a Practice Licence (SIP) and continue as a specialist doctor at a lower tuition fee, career security, and dedication.
Pengetahuan, Sikap dan Persepsi Koasisten tentang Kebijakan Dokter Pegawai Tidak Tetap (PTT) di Tiga Fakultas Kedokteran di Jawa Barat	PTT	
	3 medical faculty in West Java	
Herman, H. and Mubasysyr, H. (2008) ¹³	Qualitative	<ul style="list-style-type: none"> Doctors are not retained in very remote health centers because there are no incentives available, career development patterns are unclear, geographical conditions Health worker placement policies are still generalized and short-term orientated. Dependence on doctor recruitment from the national government
Evaluasi kebijakan penempatan tenaga kesehatan di puskesmas sangat terpencil di Kabupaten Buton	PTT	
	Buton District, Southeast Sulawesi Province	
Gondodiputro, S., Djuhaeni, H. and Wiwaha, G. (2009) ¹⁴	Cross-sectional	<ul style="list-style-type: none"> Students who are interested in working in primary care facilities 26.72%, interested in working in primary and secondary care facilities 37.40%, interested in working in secondary care 20.61%, interested in working in the health sector 13.74%.
Ekspektasi Rencanana Masa Depan Mahasiswa Program Pendidikan Kepaniteraan Dokter (P3D) Tahap Dua Fakultas Kedokteran	PTT	
	Medical faculty, Padjajaran University, West Java Province	

Author (Year) Title	Methods	Results
	Program Study Locus	
Universitas Padjadjaran Angkatan 2000-2001		
Laksmiarti, T. and Hanggara, Y.S. (2013) ¹⁵	Qualitative PTT	The era of decentralization gives local governments the authority to recruit doctors, but North Minahasa District has never recruited a doctor because there is no budget for doctor incentives so the recruitment of doctors in DTPK is an assignment of the Ministry of Health.
Synchronization Placement Regulation Legislation on Personnel Placement in Remote, the Border and Islands	Sumenep district and North Minahasa city	
Erlan, A. (2015) ¹⁶	Qualitative	PTT doctors with a one-year contract who serve as heads of a public health center pose a problem of program continuity when doctors complete their assignments.
Condition of Health Problems in the District Parigi Moutong Central Sulawesi Province, Efforts in Response to Health Problem	PTT	
	Parigi Moutong District Central Sulawesi	
Indahyani, R. (2015) ¹⁷	Qualitative	Doctors recruitment in 2012-2014 were nine PTT doctors from APBN funds and nine PTT doctors from APBD funds but there is still a shortage of doctors. Recruitment of more doctors could not be done because of the lack of budget for PTT honor payments.
Analisis Implementasi Kebijakan dalam Penggunaan Dana APBN dan DAK di Kabupaten Jayawijaya Tahun Anggaran 2012-2014	PTT	
	Kabupaten Jayawijaya	
Palembangan, P., Rantetampang, A. and Pongtiku (2015) ¹⁸	Cross-sectional PTT	Factors affecting the performance of PTT doctors are the payroll system for PTT doctors is unsatisfactory (70.7%), career certainty after joining PTT is not sure (65.9%), facilities and infrastructure are not feasible (65.9%), the supervision system for the performance of doctors is not good (61%), the security condition of the place of duty is not conducive (73.2%)
Factors Affecting the Performance of Non-Permanent Medical Health Employees in the Bintang Mountains, Papua	Pegunungan District Bintang	
Syahmar, I. et al. (2015) ¹⁹	Cross-sectional	<ul style="list-style-type: none"> Factors influencing not intending to practice in rural areas are spousal influence, career advancement opportunities Close to family influenced not to apply for the PTT program as most respondents were from urban
Indonesian medical students' preferences associated with the intention toward rural practice	PTT Medical student 4th and 5th year Universitas Indonesia	
Arifandi, A. and Meliala, A. (2017) ²⁰	Qualitative	<ul style="list-style-type: none"> Working environment conditions in remote areas are less satisfactory, and division tasks are not good because of the shortage of health workers; high workload due to shortage of doctors; the district health office has not provided supervision There are no opportunities for further education and career development; educational facilities for children are still lacking; the condition of the very remote areas is limited to transport, access to communication
Faktor yang Mempengaruhi Rekrutmen Dokter di Puskesmas Wilayah Kerja Dinas Kesehatan Kabupaten Buol Tahun 2016	PTT Buol District	
Nurchahyo, H., Suryoputro, A. and Jati, S.P. (2016) ²¹	Qualitative Penugasan Khusus	
Analisis Proses Rekrutmen		

Author (Year) Title	Methods	Results
	Program	
	Study Locus	
Dan Seleksi Tenaga Kesehatan Tim Nusantara Sehat Dalam Program Nusantara Sehat Kementerian Kesehatan	Badan Pengembangan dan Pendayagunaan SDM Kesehatan, Ministry of Health	participating in the program; do not have clarity on career paths after assignment. • First-period recruitment was centralized in Jakarta, resulting in transportation costs for participants
Soewondo, P. et al. (2019) ²²	Qualitative	Barriers to access to public health centers in DTPK are poor road infrastructure conditions
Inspecting primary healthcare centers in remote areas: Facilities, activities, and finances	Penugasan Khusus 18 public health centers in Penugasan Khusus Nusantara Sehat locus	
Laing, E. (2020) ²³	Qualitative	The status of PTT or Nusantara Sehat doctors who work with a contract system per year cannot guarantee the sustainability of doctors in the border area.
Pelaksanaan Pembangunan Bidang Kesehatan Di Kecamatan Kayan Selatan Kabupaten Malinau	PTT and Penugasan Khusus South Kayan Subdistrict, Malinau District	
Nurlinawati, I. and Putranto, R.H. (2020) ²⁴	Mix method Penugasan Khusus	• Public health centers that are committed to providing housing for the Nusantara Sehat team on duty are 89.1%. • Public health centers committed to providing vehicles that can be used by the Nusantara Sehat team are 67%.
Factors Related to Health Workers' Placement in First-Level Health Care Facilities in Remote Areas	193 health centres proposed locus for Penugasan Khusus with Nusantara Sehat Teams in 24 provinces in 2019	
Akbar, M.I. (2020) ²⁵	Qualitative Penugasan Khusus	• The Nusantara Sehat program has not fulfilled the shortage of general practitioners in Muna District due to the lack of interest from doctors who would be assigned in remote areas
Analysis Of The Needs Of General Practitioners In Public Health Centers Using Health Workload Method	Tampo and Wapunto Public Health Center in Muna District	
Noya, F. et al. (2021) ²⁶	Cross-sectional Penugasan Khusus	• The Nusantara Sehat program is a temporary assignment that does not guarantee the continuity of doctors in remote areas
Factors associated with the rural and remote practice of medical workforce in Maluku Islands of Indonesia: a cross-sectional study	Maluku Province	• Doctors who want to continue practicing in Maluku are doctors born in Maluku, graduates of Pattimura University, and unlikely to be with temporary employment status.
Su'udi, A. et al. ²⁷	Cross-sectional Penugasan Khusus	• The geographical condition of remote and very remote public health centers experiencing isolation at 54.8%
Analisis Kondisi Geografis dan Ketersediaan Peralatan di Puskesmas Terpencil/Sangat Terpencil di Indonesia	193 public health centers in 25 provinces that are the proposed locus for Penugasan Khusus with Nusantara a Sehat Team	• Some public health center lack a minimum standard equipment set of 80% • Lack of availability of essential medicines and vaccines which can hinder emergency cases
Noya, F.C., Carr, S.E. and Thompson, S.C. (2022) ²⁸	Interpretative phenomenological analysis Penugasan Khusus	• The district health office relies on the Nusantara Sehat program with temporary assignments to cover remote areas • The district government recruits doctors with poor management due to a lack of
Commitments, conditions,		

Author (Year) Title	Methods	Results
	Program	
	Study Locus	
and corruption: An interpretative phenomenological analysis of physician recruitment and retention experiences in Indonesia	Provinsi Maluku	transparency, so doctors are less interested in working in remote health centers through local government recruitment.
Idaiani, S. and Waris, L. (2022) ²⁹ Depression and Psychological Stress Among Health Workers in Remote Areas in Indonesia	Cross-sectional	<ul style="list-style-type: none"> Proportion of Team-based Nusantara Sehat experiencing depression at 7.1% and psychological stress at 10% in 2018 Work motivation is related to psychological stress. Work motivation is influenced by leadership, job satisfaction, income, social support, and job skills
	Penugasan Khusus	
Noya, F.C., Carr, S.E. and Thompson, S.C. (2023) ³⁰	Qualitative	<ul style="list-style-type: none"> The local government has provided additional incentives but has not improved working and living situations. Local governments in remote areas struggle to offer incentives, housing, and vehicles Doctors are from outside Maluku Province and not retained to serve in remote areas
Attracting, Recruiting, and Retaining Medical Workforce: A Case Study in a Remote Province of Indonesia	Penugasan Khusus	
	Maluku Province	

This systematic review of 21 research articles identified challenges faced in the implementation of the doctor deployment program by the Ministry of Health through PTT doctors and Penugasan Khusus.

DISCUSSION

Effectiveness of Doctors Distribution Program

The deployment of public health care doctors by the government through the Ministry of Health is still carried out today in the era of decentralization to fulfill public health center services³¹. Various strategies for the deployment of public health center doctors from compulsory to voluntary mechanisms with incentives are quite effective efforts to improve the accessibility of doctor services in remote areas³². Even local governments tend to rely on the recruitment of doctors in public health centers by the Ministry of Health to meet the needs of doctors in their areas both during the PTT doctor period^{15,33}, as well as the Penugasan Khusus period with Nusantara Sehat³². This is due to the limited fiscal capacity of local

governments to recruit and provide incentives for doctors³⁴.

The assignment period for doctors through the deployment program is temporary^{16,32}. A two-year assignment period can result in improvements in the public health index with innovations in health programs carried out at public health centers³⁵. Research by Soewondo et al. (2019) found that indicators of Program Indonesia Sehat dengan Pendekatan Keluarga (PIS-PK) improved with the deployment of temporary health workers³⁶.

Challenges Distribution Doctors Program

Distributing doctors in remote and very remote public health centers is a continuous effort by the government. Attracting and recruiting doctors to work in remote areas is a challenge. Doctors are unwilling and uninterested in being placed in remote areas due to several factors, namely:

- Individual factors
Temporary assignment contracts limit career development and further education for doctors²⁰.

WHO recommends providing continuing education to healthcare workers in rural³⁷. The Ministry of Health offers educational assistance in the form of awards to those who have participated in *Penugasan Khusus* to increase recruitment³¹.

Access to education for children in remote areas is still insufficient²⁰. This discourages doctors from working in rural and remote areas³⁸, causing doctors already to leave³⁹. A study in the Asia-Pacific region found that adequate schooling facilities are crucial for attracting doctors to work in rural areas⁴⁰.

- **Job factors**

The condition of health workers in remote health centers has a high workload²⁰; and limited access to health equipment and medicines²⁷. Deploying doctors to remote areas causes depression and psychological stress²⁹, a study shows that inadequate accommodations, limited growth opportunities, a lack of medical staff, insufficient healthcare infrastructure, and restricted access to public amenities^{27,41}.

A study by Mohammadiaghdam et al. (2020) has shown that the lack of medicines and health equipment is important in encouraging doctors to stay in rural areas⁴². This is consistent with a study in Senegal that the availability of equipment in health facilities impacts the probability of health professionals staying in a rural⁴³.

The PTT program has been criticized for inadequate salary provision^{10,11,44}, but the *Penugasan Khusus* Program provides incentive compensation from the government and additional incentives from local governments³⁰. Providing attractive incentive packages is recommended by WHO to encourage health workers to work in rural or remote areas³⁷. A study in Mozambique found that combination incentive packets encourage work in rural or remote areas⁴⁵.

- **Living circumstances factors**

Remote public health centers struggle to reach their work areas due to geographical conditions and poor road infrastructure^{22,27}. This is particularly problematic for poor people in rural or remote areas⁴⁶. A study by Putri et al. (2022) found that transportation facilities are important for doctors to work in

rural for support personal dan professional⁴⁰.

- **Health system factors**

Temporary deployment of doctors doesn't guarantee the continuity of doctors at public health centers²⁶. Another distribution of doctors is through the recruitment of State Civil Apparatus (ASN) lacks interest in doctors to work in remote areas⁴⁷. Local governments must provide housing and transportation but remote areas are struggling to do these responsibilities (11,30,48). The literature review found that local governments are still not fully able to fulfill this obligation. A study by Honda et al. (2019) found that improving health system functioning improves retention in rural posts⁴³.

CONCLUSIONS

The program distributes public health center doctors through temporary mechanisms with incentives, which is still effective in meeting the need for doctors in remote areas. However, there is a need for longitudinal studies to assess the long-term impact of this program. Various challenges in implementing this program such as the lack of interest in deploying doctors to remote health centers due to individual, work, living environment, and health system factors. To address this issue, further research is needed to develop a combination of attractive incentives that can increase the effectiveness of recruiting doctors in remote areas. The government and local government can provide support by improving living conditions in remote areas, including road infrastructure, housing, transportation, communication, and security. This support will optimize life in remote areas and encourage more doctors to deploy to these regions. Policy support is required to deploy doctors in low fiscal capacity regions, which requires further research.

REFERENCES

1. Database Peraturan | JDIH BPK [Internet]. [cited 2024 Feb 5]. Law No 17/2023 about Health. Available from: <http://peraturan.bpk.go.id/Details/258028/uu-no-17-tahun-2023>
2. Idris H. Equity of Access to Health Care: Theory & Application in Research.

- Jurnal Ilmu Kesehatan Masyarakat. 2016 Jul 15;7(2):73–80.
3. Ramadina N, Ardisasmita MN, Sujatmiko B. Geographic accessibility towards primary health care in Karawang district. *Kesmas: Jurnal Kesehatan Masyarakat Nasional (National Public Health Journal)*. 2021;16(3).
4. Leosari Y, Uelmen JA, Carney RM. Spatial Evaluation of Healthcare Accessibility Across Archipelagic Communities of Maluku Province, Indonesia. *PLOS Glob Public Health*. 2023 Mar 9;3(3):e0001600.
5. Ikrar T. *Konsil Kedokteran Indonesia.html*. 2022 [cited 2023 Oct 18]; Available from: <https://kki.go.id/blog/read/mengurai-benang-kusut-dokter-indonesia>
6. Romadhona YS, Siregar KN. Analisis Sebaran Tenaga Kesehatan Puskesmas di Indonesia berdasarkan Peraturan Menteri Kesehatan Nomor 75 Tahun 2014 tentang Puskesmas. *JKM*. 2018 Dec 30;4(2):114.
7. Attriani AN. Tantangan dan Isu Strategis Sumber Daya Kesehatan Manusia Kesehatan pada Puskesmas di Indonesia. *JKT*. 2022 Aug 25;3(3):363–8.
8. Hikmah B N, Rahman H, Puspitasari A. Membandingkan Ketimpangan Ketersediaan Tenaga Kesehatan Puskesmas di Wilayah Indonesia Timur. 2020;
9. DalGLISH SL, Khalid H, McMahon SA. Document analysis in health policy research: the READ approach. *Health Policy and Planning*. 2021 Feb 16;35(10):1424–31.
10. Sulistyawati H, Bachroen C, Prayoga P, Sopacua E, Ajik S, Indrasanto D, et al. Studi Tentang Faktor-faktor yang Mempengaruhi Penampilan Kerja Dokter PTT di Indonesia. *Buletin Penelitian Sistem Kesehatan*. 1997;1(1):20987.
11. Suwandono A, Setijadi G, Sumantri S. Hasil Awal Angket Dokter PTT. *Media Penelitian dan Pengembangan Kesehatan*. 2002;12(4):160073.
12. Nugraha Wendy F, Nita A. Pengetahuan, Sikap Dan Persepsi Koasisten Tentang Kebijakan Dokter Pegawai Tidak Tetap Dokter PTT) di Tiga Fakultas Kedokteran di Jawa Barat. *Jurnal Manajemen Pelayanan Kesehatan*. 2004;7.
13. Herman H, Mubasysyr H. Evaluasi kebijakan penempatan tenaga kesehatan di puskesmas sangat terpencil di Kabupaten Buton. *Jurnal Manajemen Pelayanan Kesehatan*. 2008;11(3):103–11.
14. Gondodiputro S, Djuhaeni H, Wiwaha G. Ekspektasi Rencana Masa Depan Mahasiswa Program Pendidikan Kepaniteraan Dokter (P3D) Tahap Dua Fakultas Kedokteran Universitas Padjadjaran Angkatan 2000–2001. *Majalah Kedokteran Bandung*. 2009;41(1).
15. Laksmiarti T. Sinkronisasi Peraturan Perundangan Dalam Penempatan Tenaga Medis Di Daerah Terpencil, Perbatasan Dan Kepulauan. *Buletin Penelitian Sistem Kesehatan*. 2013;16(4).
16. Erlan A. Condition of Health Problems in The District Health Office Parigi Moutong Central Sulawesi Province, Efforts in Response of Health Problem. *Buletin Penelitian Sistem Kesehatan*. 2016 Jan 28;18(3):239–45.
17. Indahyani R. Analisis Implementasi Kebijakan Dalam Penggunaan Dana APBN Dan DAK Di Kabupaten Jayawijaya Tahun Anggaran 2012 – 2014. *Jurnal Kajian Ekonomi dan Studi Pembangunan [Internet]*. 2015 Apr 1 [cited 2024 Jan 30];2(1). Available from: <https://ejournal.uncen.ac.id/index.php/JKESP/article/view/2053>
18. Palembang P, Rantetampang A, Pongtiku A. Factors Affecting the Performance of Non-Permanent Medical Health Employees in the Bintang Mountains, Papua. *International Journal of Sciences*. 2015;24(5).
19. Syahmar I, Putera I, Istatik Y, Furqon M, Findyartini A. Indonesian medical students' preferences associated with the intention toward rural practice. *Rural and Remote Health [Internet]*. 2015 Dec 2 [cited 2024 Jan 30]; Available from: <https://www.rrh.org.au/journal/article/>

- 3526
20. Arifandi A, Meliala A. Faktor yang Mempengaruhi Rekrutmen Dokter di Puskesmas Wilayah Kerja Dinas Kesehatan Kabupaten Buol Tahun 2016. *Jurnal Kebijakan Kesehatan Indonesia*. 2017 Sep 1;6(3):103.
 21. Nurcahyo H, Suryoputro A, Jati SP. Analisis Proses Rekrutmen Dan Seleksi Tenaga Kesehatan Tim Nusantara Sehat Dalam Program Nusantara Sehat Kementerian Kesehatan Republik Indonesia. *Jurnal Kesehatan Masyarakat*. 2016;4.
 22. Soewondo P, Johar M, Pujisubekti R, Halimah H, Irawati DO. Inspecting Primary Healthcare Centers in Remote Areas: Facilities, Activities, and Finances. *Jurnal Administrasi Kesehatan Indonesia*. 2019 Jun 13;7(1):89.
 23. Laing E. Pelaksanaan Pembangunan Bidang Kesehatan Di Kecamatan Kayan Selatan Kabupaten Malinau. *Jurnal Administrative Reform*. 2020 Jan 9;7(2):86.
 24. Nurlinawati I, Putranto RH. Faktor-Faktor Terkait Penempatan Tenaga Kesehatan di Fasilitas Pelayanan Kesehatan Tingkat Pertama Daerah Terpencil/Sangat Terpencil. *Jurnal Penelitian dan Pengembangan Pelayanan Kesehatan*. 2020 May 7;31–8.
 25. Akbar MI, Ahmad LOAI. Analysis of the Needs of General Practitioners in Public Health Centers Using Health Workload Method. *Public Health of Indonesia*. 2020 May 20;6(2):63–9.
 26. Noya F, Carr S, Thompson S, Clifford R, Playford D. Factors associated with the rural and remote practice of medical workforce in Maluku Islands of Indonesia: a cross-sectional study. *Human Resources for Health*. 2021 Dec;19(1):126.
 27. Su'udi A, Putranto RH, Harna H, Irawan AMA, Fatmawati I. Analisis Kondisi Geografis dan Ketersediaan Peralatan di Puskesmas Terpencil/Sangat Terpencil di Indonesia. *JIK*. 2022 Aug 29;16(2):132–8.
 28. Noya FC, Carr SE, Thompson SC. Commitments, Conditions, and Corruption: An Interpretative Phenomenological Analysis of Physician Recruitment and Retention Experiences in Indonesia. *International Journal of Environmental Research and Public Health*. 2022 May 2;19(9):5518.
 29. Idaiani S, Waris L. Depression and Psychological Stress Among Health Workers in Remote Areas in Indonesia. *Frontiers in Public Health*. 2022 Apr 27;10:743053.
 30. Noya FC, Carr SE, Thompson SC. Attracting, Recruiting, and Retaining Medical Workforce: A Case Study in a Remote Province of Indonesia. *International Journal of Environmental Research and Public Health*. 2023;1(1):1–2.
 31. Minister of Health Regulation No. 33/2018 on Penugasan Khusus Tenaga Kesehatan dalam Mendukung Program Nusantara Sehat Program [Internet]. 33 2018. Available from: <http://peraturan.bpk.go.id/Details/111947/permenkes-no-33-tahun-2018>
 32. Noya FC, Carr SE, Thompson SC. Commitments, conditions, and corruption: An interpretative phenomenological analysis of physician recruitment and retention experiences in Indonesia. *International Journal of Environmental Research and Public Health*. 2022;19(9):5518.
 33. Herman H, Mubasysyr H. Evaluasi kebijakan penempatan tenaga kesehatan di puskesmas sangat terpencil di Kabupaten Buton. *Jurnal Manajemen Pelayanan Kesehatan*. 2008;11(3):103–11.
 34. Nugraha SM, Manik CG, Su'udi A. Analisis Keberadaan Tenaga Kesehatan Non-PNS Di Puskesmas Indonesia. *Jurnal Penelitian dan Pengembangan Pelayanan Kesehatan*. 2020 May 7;51–63.
 35. Sari ID, Hendarwan H, Halim R. Penggunaan indeks kesehatan masyarakat Nusantara Sehat dalam mengukur kinerja tim Nusantara Sehat. *Berita Kedokteran Masyarakat*. 34(11):11–3.
 36. Soewondo P, Pujisubekti R, Febriady A, Dwi Oktiana DO, Sumartono AHI, Rahmayanti NM. Improving Health of the Left-Behinds: The Case of

- Indonesia's Nusantara Sehat A Quantitative Evaluation Study. 2019.
37. WHO W. WHO guideline on health workforce development, attraction, recruitment, and retention in rural and remote areas. Update. Geneva: World Health Organization; 2021.
 38. Malau-Aduli BS, Smith AM, Young L, Sen Gupta T, Hays R. To stay or go? Unpacking the decision-making process and coping strategies of International Medical Graduates practicing in rural, remote, and regional Queensland, Australia. *PLoS One*. 2020;15(6):e0234620.
 39. Handoyo NE, Prabandari YS, Rahayu GR. Identifying motivations and personality of rural doctors: A study in Nusa Tenggara Timur, Indonesia. *Education for Health (Abingdon, England)*. 2018;31(3):174–7.
 40. Putri LP, Russell DJ, O'Sullivan BG, Meliala A, Kippen R. A critical review of definitions of rural areas in Indonesia and implications for health workforce policy and research. *Health Research Policy and Systems*. 2022;20(1):1–15.
 41. Hetharia DVI. Strategi Coping Stress Tenaga Kesehatan Nusalaut. *Pameri: Pattimura Medical Review*. 2023;5(2):66–75.
 42. Mohammadiaghdam N, Doshmangir L, Babaie J, Khabiri R, Ponnet K. Determining factors in the retention of physicians in rural and underdeveloped areas: a systematic review. *BMC Fam Pract*. 2020 Dec;21(1):216.
 43. Honda A, Krucien N, Ryan M, Diouf ISN, Salla M, Nagai M, et al. For more than money: the willingness of health professionals to stay in remote Senegal. *Human Resources for Health*. 2019 Apr 25;17(1):28.
 44. Freely NW. Pengetahuan, Sikap dan Persepsi Koasisten tentang Kebijakan Dokter Pegawai Tidak Tetap (Dokter PTT) di Tiga Fakultas Kedokteran di Jawa Barat. *Jurnal Manajemen Pelayanan Kesehatan*. 2004;7(04).
 45. Honda A, Vio F. Incentives for non-physician health professionals to work in the rural and remote areas of Mozambique—a discrete choice experiment for eliciting job preferences. *Hum Resour Health*. 2015 Dec;13(1):23.
 46. Wulandari RD, Laksono AD, Rohmah N, Latifah L, Ashar H. Determine the Target to Increase Primary Healthcare Utilization in Indonesia's Disadvantaged Areas. *JAKI*. 2023 Dec 3;11(2):299–310.
 47. Amin S. rri.co.id - Portal berita terpercaya. 2024 [cited 2024 Feb 20]. Penempatan Wilayah Terpencil, Formasi PPPK Dokter Tidak Diminati. Available from: <https://www.rri.co.id/daerah-3t/526106/penempatan-wilayah-terpencil-formasi-pppk-dokter-tidak-diminati>
 48. Nurlinawati I, Putranto RH. Faktor-Faktor Terkait Penempatan Tenaga Kesehatan di Fasilitas Pelayanan Kesehatan Tingkat Pertama Daerah Terpencil/Sangat Terpencil. *Jurnal Penelitian dan Pengembangan Pelayanan Kesehatan*. 2020;31–8.

Original Article

Effect of Avocado Seed Flour Nugget on Organoleptic Tests

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ABSTRACT

Avocado seeds contain a lot of starch and can be processed into foods such as avocado seed flour (TBA). TBA is classified as low-protein flour but has a lot of nutritional content, so it can be made into noodles or other food products. This research aimed to determine the acceptability of avocado seed flour nuggets with chicken, catfish, and shrimp variants. The research design in this study is a pure experiment with a simple experimental design. A simple experimental design is also called a posttest-only control group design. This research design was a nugget design with 25% avocado seed flour and 25% tapioca flour with three treatments (three flavor variants), chicken, catfish, and shrimp (50%). The results of this study showed that there were significant differences in the chicken, catfish, and shrimp nugget variants based on color categories because the results were $p < 0.05$. In terms of texture, the test shows a p -value of > 0.05 , which means that there is no real difference between the three variants of avocado seed nuggets. In conclusion, this research is based on the results of the ANOVA test on avocado seed nuggets with chicken, catfish, and shrimp variants. The results obtained were that there were real differences in the chicken, catfish, and shrimp nugget variants based on the color, taste, and aroma categories. Meanwhile, in the texture category, the test results obtained were that there were no real differences between the three avocado seed nugget variants.

Keywords: Avocado Seeds, Avocado Seed Flour, Nugget, Organoleptic Test, Stunting.

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PENDAHULUAN

Avocado (*Persea Americana* Mill) is a tree that grows in the highlands of Central America, and its types are widely distributed throughout the country. Avocado (*Persea Americana* Mill) is a tree that grows widely in tropical areas such as Indonesia. Avocado is a fruit that many people like. Avocados are delicious and nutritious. However, people only use avocados for the pulp, and the seeds become waste¹.

Based on BPS (Central Statistics Agency) data in 2019, Indonesian avocado

production was 461,613 tons, especially in North Sumatra province at 18,525 tons. But unfortunately, only the flesh is consumed and the skin and seeds are thrown away and become trash. In fact, avocado seeds can be processed into various alternative foods, including avocado seed flour².

The content of avocado seeds has high potential as a main food ingredient. Avocado seeds contain a lot of starch and can be processed into foods such as avocado seed flour (TBA). TBA is classified as low-protein flour but has a lot of nutritional content, so it can be made into noodles or other food products³.

Apart from carbohydrates, protein, and fat, avocados are also rich in various vitamins such as vitamins A, C, and E, as well as various minerals such as calcium, magnesium, phosphorus, potassium, zinc, iron, copper, and sodium⁴.

The characteristic of avocado seed flour which is high in starch is a great opportunity to be used as an alternative to wheat flour. In general, various foods are made from wheat flour, as we know, wheat flour is made from wheat which is rich in gluten. Gluten is a natural protein found in cereals or grains that is insoluble in water and is chewy. Gluten can interfere with health, namely celiac disease. Therefore, avocado seed flour is an alternative basic ingredient for food products to replace wheat flour⁵.

Wheat flour or wheat flour is one of the main ingredients for making nuggets. Wheat cannot be grown in Indonesia because it is a plant that can grow in subtropical climates. This incident prompted the government to import flour from abroad. Wheat flour contains a protein called gluten. Consuming it in large quantities may have negative effects on the body. This means that the body cannot absorb nutrients optimally⁶.

Dependence on the use of wheat flour in food processing, including nuggets, can be a burden for the country because it has to import wheat from other countries. The increase in population causes an increase in flour consumption. Therefore, in Indonesia it is important to look for alternative food ingredients that are easy to grow in Indonesia and can be converted into flour for a longer shelf life⁷.

Alternatives include turning avocado seed waste into flour and making processed food in the form of nuggets. Nuggets are a food made from wheat flour and are very popular among children, teenagers and even adults⁸.

Nugget is a type of processed food made from minced meat molded in a square shape and coated with spiced flour⁹. Nuggets are a fast food that is very popular among people today, especially among the millennial generation. This product is included in the processed food category which can be found in various supermarkets with various brands, packaging and prices¹⁰.

The nuggets that are popular today are usually made from minced chicken (broiler)

meat mixed with additional ingredients and spices, then steamed, shaped, coated with egg white and breadcrumbs, then fried¹¹.

Nuggets generally have various kinds of fillers. Generally, the filler used is high in protein, such as chicken (broiler). However, in this study the fillers used were chicken, shrimp and catfish as sources of animal protein¹².

Using avocado seed flour as a base for nuggets is an effort to reduce avocado seed waste as well as an effort to reduce the use of wheat flour in Indonesia. Filler with chicken, shrimp, catfish to add variety of flavors so that the nuggets made from avocado seed flour are delicious when eaten.

Based on the description above, researchers are interested in conducting organoleptic testing on avocado seed flour nuggets with three flavor variations, namely chicken, catfish and shrimp.

METHOD

The research design in this research is a pure experiment with a simple experimental design. A simple experimental design is also called a posttest only control group design. This research design was a nugget design with 25% avocado seed flour and 25% tapioca flour with three treatments (three flavor variants), namely chicken, catfish and shrimp (50%). The research is used to analyze data by explaining or illustrating the data collected.

The organoleptic test for avocado seed flour nuggets used a hedonic test which assessed the taste level of test participants in terms of color, aroma, texture and taste, using a five-point scale, namely dislike, like, really like and really like. The research was conducted at the Faculty of Public Health, North Sumatra State Islamic University, Medan. The panelists used were untrained panelists, namely students from the Faculty of Public Health, UIN North Sumatra and consisted of semesters I and VII. The tools used for the process of making avocado seed nuggets are (1) Container for mixing avocado seed nuggets, (2) Knife for cutting nugget ingredients, (3) Spoon for scooping avocado seed mixture, (4) Blender for smoothing nugget ingredients avocado seeds, (5) Oven for drying avocado seeds, (6) Scales for weighing avocado seed nugget ingredients, (7) Baking pan used as a container for avocado seed when dried in the oven.

The ingredients used for the process of making avocado seed nuggets are (1) Tapioca flour 100 gr, (2) avocado seed flour, (3) Sliced carrots 45 gr, (4) Sliced soup leaves 15 gr, (5) 2 eggs, (6) Pepper and salt, (7) Chicken, catfish and shrimp 500 gr each, (8) White bottom 5 cloves and (9) Wheat flour.

The process for making avocado seed nugget is 91) Weigh out 25 gr of avocado seed flour, 100 gr of tapioca flour, 500 gr of chicken, catfish and shrimp each, 40 gr of carrot slices, 15 gr of soup leaf slices, and 5 fine garlic cloves, (2) Prepare a large contrainer, put into the contrainer avocado seed flour, tapioca flour, chicken/catfish/shrimp, sliced carrot, sliced soup leaves, crushed garlic and beat well 2 eggs, (3) Mix. Mix the mixture evenly and make sure the texture is soft but still sticky, (4) After the mixture is evenly mixed, add salt and pepper to adjust throughly then stri again, (5) Put the mixture into a heat-resistant container and steam for about 10 minutes, (6) Leave the mixture until cold.

When it is cold, cut the nuggets and separate each flavor, then coat the nuggets in dry wheat flour, water and breadcrumbs, repeat until the nugget are finished. Next, the nuggets are stored in the freezer so they last longer.

RESULTS

The results of organoleptic tests on

avocado seed nuggets using a hedonic scale (level of liking) can be seen in the table below:

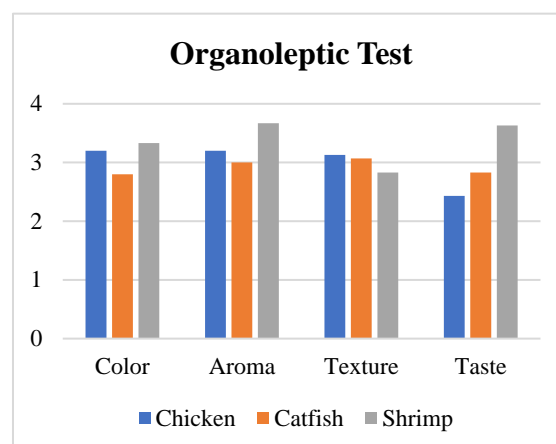


Figure 1. Organolaptic Test Results for Three Variants

Based on the results of subjective research carried out using organoleptic/hedonic tests on 3 variants in terms of color, aroma, texture and taste, it can be seen in Figure 1. The range of average values for the organoleptic test results for avocado seed flour nuggets in terms of color, aroma, texture, and taste, namely 2,43 to 3,67. The highest average value was shown by the shrimp variant in terms of aroma and taste, namely 3,67 and 3,63. So the organoleptic test with a hedonic scale that was really liked by the panelists was the aroma and taste of the shrimp variant.

Table 1. Avocado Seedd Nugget Anova Test

Color					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	4,622	2	2,311	3,336	0,040
Within Groups	60,267	87	,693		
Total	64,889	89			
Aroma					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	7,022	2	3,511	3,574	0,032
Within Groups	85,467	87	,982		
Total	92,489	89			
Texture					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	1,489	2	0,744	0,906	0,408
Within Groups	71,500	87	0,822		
Total	72,989	89			
Taste					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	22,400	2	11,200	12,104	0,000
Within Groups	80,500	87	0,925		
Total	102,900	89			

Based on table 1, the panelists' assessments were analyzed using the SPSS 21.0 program using one way ANOVA to determine the differences between the three variants of avocado seed flour nuggets. Based on the table 1, the results of the ANOVA test show a sig (P) value $< 0,05$, meaning that there are significant

differences between the three variants, namely chicken, catfish and shrimp in terms of color, aroma and taste. Furthermore, the ANOVA test table obtained a sig (P) value $> 0,05$, meaning there was no significant difference in terms of texture between the three variants of avocado seed flour nuggets.

Table 2. Duncan Nugget Test for Avocado Seed Flour

Variants	Color	Aroma	Texture	Taste
Chicken	3,20ab	3,20ab	3,13a	2,43a
Catfish	2,80a	3,00a	3,07a	2,83a
Shrimp	3,33b	3,67b	2,83a	3,63b

Next, after carrying out the ANOVA test, Duncan's further test was carried out to provide information on formulas that were significantly different. Based on table 2, the results of the Duncan color and aroma test show that the proportion of wheat flour and avocado seed flour has an effect on giving different colors and aromas to fried nuggets.

DISCUSSION

Panelists' Level of Likeness for Taste, Color, Texture and Aroma of Avocado Seed Flour Nuggets

The taste produced in food is produced by the human sense of taste, namely the tongue because the tongue has red papillae. Taste is generally influenced by several factors, namely chemical compounds, temperature, the combination of food and other food additives and time in the cooking process.

Based on table 1, the results of the ANOVA test show a sig (P) value < 0.05 , meaning that there are significant differences between the three variants, namely chicken, catfish and shrimp in terms of color, aroma and taste. In this research, it was found that there was an effect of adding avocado seed flour with chicken, catfish and shrimp flavors on the resulting color.

Furthermore, the ANOVA test table shows a sig (P) value > 0.05 . This means that there is no significant difference in texture between the three variations of avocado seed flour nuggets. The texture of a food can be seen from the pressure felt when touched with the mouth or fingers, namely when bitten, chewed, swallowed or held, and can also be recognized from the shape of the nugget.

This is in accordance with Winisiatri's research (2021) where researchers used the Anova test to determine the antioxidant content

in snackbar products. The results obtained show $p = 0.000$. This results in an average difference ($p < 0.05$) in the anti-oxidant activity content of snackbar products with five different formulation treatments¹³.

To find out the real differences in the three variants of avocado seed flour nuggets. A follow-up test to the ANOVA test, namely the Duncan test, must be carried out. From the tests that have been carried out, the results of the Duncan color and aroma test show that the proportion of wheat flour and avocado seed flour has an effect on giving fried nuggets a different color and aroma.

In the chicken variant there are two symbols, namely ab, this indicates that the color and aroma of the chicken variant has no real difference from the catfish and shrimp variants. In the catfish and shrimp variants there are 2 different symbols, namely the catfish variant with the symbol a and the shrimp variant with the symbol b, this shows that the color and aroma of the catfish and shrimp variants have a real difference from the color of the chicken.

Based on table 2, the results of the Duncan texture test show that the proportion of wheat flour and avocado seed flour has no effect on providing a different texture to fried nuggets. In the chicken, catfish and shrimp variants, they are on the same symbol, namely symbol a, with the same texture, and are less popular with the panelists because the texture is hard and hard to bite.

Based on table 2, the results of the Duncan taste test show that the proportion of wheat flour and avocado seed flour has an effect on giving a different taste to fried nuggets. The chicken and catfish variants have the same symbol, namely symbol a, this means that the taste of the chicken and catfish variants has no real difference to the shrimp variant. The

shrimp variant has a different symbol from the symbols for the chicken and catfish variants, namely the symbol b, this shows that the taste of the shrimp variant has a real difference from the taste of the chicken and catfish variants.

CONCLUSION

Based on the results of the ANOVA test on avocado seed nuggets with chicken, catfish and shrimp variants. The results obtained were that there were real differences in the chicken, catfish and shrimp nugget variants based on the color, taste and aroma categories. Meanwhile, in the texture category, the test results obtained were that there were no real differences between the three avocado seed nugget variants.

At this time, researchers have not yet carried out a comparison with a control group between traditional nuggets and avocado seed flour nuggets. And there are no trained panelists in this study, so the accuracy of the findings cannot be recognized outside the research site. For this reason, further research is needed to generalize the findings beyond the research site.

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REFERENCES

1. Malangngi LP, Sangi MS, Paendong JJE. Penentuan Kandungan Tanin dan Uji Aktivitas Antioksidan Ekstrak Biji Buah Alpukat (*Persea americana* Mill). 2012;1(1):5–10.
2. Violita, Lady, Purba R, Emilia E, Damanik M, Juliarti J. Uji Organoleptik Dan Analisis Kandungan Gizi Cookies Substitusi Tepung Biji Alpukat. *J Gizi dan Kuliner (Journal Nutr Culinary)*. 2021;1(2):1.
3. Azalia A. Pemanfaatan Limbah Biji Alpukat Sebagai Bahan Dasar Pembuatan Mie Dengan Tekstur Lembut Berdasarkan Uji Organoleptik. 2021.
4. Harahap KMN, Erwan E, Misrianti R. Pemanfaatan Tepung Biji Alpukat (*Persea americana* Mill .) dalam Ransum terhadap Performa Ayam Ras Pedaging Utilization of Avocado Seed Flour (*Persea americana* Mill .) in Feed on Broiler Performance. *J Peternak Sriwij.* 2019;8(2):45–57.
5. Nurul Yasmina Hilmianti. Perbandingan Tepung Sorgum (*Sorghum bicolor* L. Moench) Dengan Tepung Edamame (*Glycin max* (L) Merrill) Dan Konsentrasi Tepung Porang (*Armorphophalus muelleri*) Terhadap Karakteristik Mie Basah Bebas Gluten). Universitas Pasundan; 2022.
6. Sari PP. Uji Organoleptik Dan Analisis Kandungan Gizi Cookies Substitusi Tepung Biji Alpukat. In: *Pengolahan Bahan Pangan Lokal Untuk Mengatasi Masalah Gizi*. 2022. p. 187.
7. Yuniarthu A. Pengaruh Substitusi Tepung Terigu Dengan Tepung Biji Alpukat Terhadap Karakteristik Kue Pukis. 2023.
8. Agusta FK, Ayu DF, Rahmayuni. Nilai Gizi Dan Karakteristik Organoleptik Nugget Ikan Gabus Dengan Penambahan Kacang Merah. *J Teknol Pangan*. 2020;14(1).
9. Triyadi KM. Studi Pembuatan Nugget Ikan Gluten Free Dari Tepung Ubi Jalar Oranye (*Ipomoea Batatas* L.). Universitas Politeknik Kesehatan Kemenkes Denpasar; 2018.
10. Rotinsulu M., Tangkere E., Ratulangi F. Kualitas Organoleptik Naget Ayam Menggunakan Tepung Pisang Kepok (*Musa paradisiacal formatypica*). *Zootec*. 2022;42(1):124–30.
11. Yuniartini NLPS, Nugrahani R. Pengaruh Kombinasi Tepung Terigu Dan Jamur Tiram (*Pleurotus ostreatus*) Terhadap Sifat Organoleptik Nugget. *J Agritechnology Food Process*. 2022;2(1).
12. Muchtar F. Analisis Kandungan Protein Dan Sifat Organoleptik Nugget Ikan Cakalang Dengan Jenis Tepung Yang Berbeda. *Koloni J Multidisiplin*. 2022;1(1).
13. Winiastri D. Formulasi Snack Bar Tepung Sorgum (*Sorghum Bicolor* (L.) Moench) Dan Labu Kuning (*Cucurbita Moschata*) Ditinjau Dari Uji Organoleptik Dan Uji Aktivitas Antioksidan. *J Inov Penelit*. 2021;2(2):751–64.

Original Article

Android-based Application for Depression, Anxiety, and Stress Screening

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ABSTRACT

The escalating issue of emotional and mental disorders, such as stress, anxiety, and depression, necessitates proactive measures to anticipate adverse effects on individuals experiencing them. One of the ways is by implementing a screening method. An android-based screening application can offer immediate feedback about an individual's mental health condition. This study employs a research and development approach encompassing the preliminary study, model development, and model validation. The outcome of this study was an initial design for an Android-based screening application, DeAs Care, which aims to measure the levels of depression, anxiety, and stress in individuals. The DeAs Care application underwent evaluation by a group of 15 adolescent participants, all between the ages of 18 and 20. The assessment employed a Likert scale with a range of 1 to 5. The results indicated an overall satisfaction rate of 85%, corresponding to a 'Very Good' rating. The application was utilized on 216 adolescent participants to evaluate their levels of depression, anxiety, and stress. The assessment results indicate that the subsequent proportions of participants received a diagnosis of depression: 21% of the participants reported experiencing mild depression, while 20% showed moderate depression. Additionally, 8% had severe depression, and 6% had extremely severe depression. The other 45% of participants indicated they were in normal conditions. As for the participants' anxiety levels, the results of the assessments showed that 15% of them had mild anxiety, 31% had moderate anxiety, 23% had severe anxiety, 16% had extremely severe anxiety, and 15% of them were in a normal state. Furthermore, concerning stress levels, the study found that 20% of individuals had mild stress, 24% experienced moderate stress, 6% experienced severe stress, and 1% experienced extremely high stress levels. In comparison, the remaining 50% reported normal stress levels. The findings indicate that utilizing the DeAs Care Android application for screening adolescent mental health is an effective method for preventing issues related to mental and emotional disorders through self-assessment.

Keywords: Screening, Android-Based Application, Stress, Anxiety, Depression.

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INTRODUCTION

Anxiety and depression, as suggested by the World Health Organization (WHO), are global mental disorders. Approximately 300 million individuals, or 4.4 percent of the worldwide population, have been diagnosed with depression. Additionally, up to 264 people are reported to be suffering from anxiety disorders. According to survey results gathered

by the World Health Organization (WHO), around 10 to 20 percent of adolescents suffer from mental health problems. Furthermore, adolescence is a period when mental problems such as depression, anxiety, and stress frequently emerge. As of 2016, the World Health Organization estimates that approximately 35 million adolescents experienced depression¹.

In Indonesia, there is a population of

706,689 individuals who are over the age of 15 suffer from depression. Among this group, there are a total of 157,6592 cases of depression, particularly among individuals aged 15 to 24 years². Nurtant and Handayan (2021) conducted a study at vocational schools in Wonogiri, revealing that 48.1% of adolescents experience stress, 39.8% experience anxiety, and 12.1% experience depression³. A study conducted by the Department of Child and Adolescent Psychiatry, Faculty of Health Sciences, University of Indonesia, involving adolescents aged 16-24 years in Indonesia, revealed that 88% of those surveyed reported experiencing symptoms of depression as they dealt with problems at that age, and 95.4% reported suffering from symptoms of anxiety at this age⁴.

Adolescents who suffer from depression show symptoms such as an overwhelming feeling of self-pity (82%), difficulty in concentrating (65%), lack of interest in activities (41%), and significant changes in body weight (35%)⁵. *Depression* is a psychological condition characterized by feelings of melancholy, distress, despair, or dissatisfaction, as well as a lack of motivation and excitement for life⁶. Furthermore, depression is characterized by feelings and emotions that are ambiguous, disoriented, hopeless, indifferent, and lacking desire and motivation⁷.

Depression can lead to a range of issues for individuals, encompassing physical, psychological, and social challenges. If not promptly and appropriately treated, depression can give rise to various complications for the affected individual. Untreated depression can escalate into a severe mental illness that profoundly impacts one's mental well-being. It is crucial for those experiencing depression to get early medical and psychological treatment. Moreover, individuals with depression are also susceptible to engaging in suicidal behaviours⁶. Hence, it is crucial to prioritize initiatives aimed at averting depression in adolescents, one of which involves using screening method. Screening is a proactive measure taken to identify the existence of emotional or mental issues at an early stage in an individual⁸.

Within the adolescent group, screening can be conducted by leveraging technological advancements that provide individual access for each teenager while ensuring participant confidentiality⁹. Adolescents extensively utilize

digital media and possess the ability to comprehend mental health-related material¹⁰. Multiple research papers have conducted mental health screening through applications. A study by Eanggarsita Auliasin et al. created an app to identify symptoms of depression in adolescents¹¹. Further research and various prototypes have led to developing a teenage mental health screening application that can generate real-time feedback and offer insights into mental health⁸.

The objective of this study is to assess the levels of depression, anxiety, and stress among adolescents by utilizing an Android application for screening. The aim is to mitigate the adverse effects of mental health issues in adolescents and offer health education to those affected by these disorders.

The significance of this research lies in its contribution to providing a comprehensive understanding for parents and other individuals in addressing the behavioural indicators of depression in adolescents, both ones who have already experienced depression and those who are at risk of developing depression. By familiarizing themselves with these signs and symptoms, it is expected that parents and individuals in their vicinity might mitigate more severe psychological issues in adolescents by enacting suitable interventions.

METHOD

This study employs research and development (R&D) approach. Development research is the systematic process of designing and validating products for education¹². The approach utilized is level I research and development, which includes preliminary study, model development, and model validation¹³. In this research, the Depression Anxiety Stress Scales (DASS)-42 questionnaire was used to develop an Android-based depression, anxiety, and stress screening application, DeAs Care. The DASS-42 questionnaire is a reliable and valid means for identifying anxiety, stress, and depression disorders¹⁴.

The research has received ethical approval under reference No. 1160/KEKP/Adm2/VIII/2021. This research was conducted in three distinct phases, specifically:

1. Preliminary study
Researchers conduct analyses to investigate the underlying causes of problems or phenomena. The issues related to mental disorders, specifically stress, anxiety, and depression that can affect adolescents, were examined along with several potential contributing factors.
2. Model development
Relevant theoretical frameworks are reviewed in pursuit of resolving issues or phenomena. Comprehensive examinations of various concepts, theories, and research findings are conducted to serve as a foundation for further research. Furthermore, investigated potential solutions could be adopted to promote and preserve mental health in adolescents.
3. Model validation
The final part of the research involves assessing the model's validity by quantitative, qualitative, or mixed methods. This evaluation provides assessments and feedback on the generated model or product. Subsequently, enhancements are implemented until the product/model reaches a state of readiness and validity. In this study, an internal evaluation of application usage was conducted among application users.

RESULTS

This study produced an Android application, DeAs Care, which is used for screening levels of depression, anxiety, and stress. This application facilitates the assessment of an individual's emotional and mental state by answering the provided questionnaire. The system presents multiple primary menus, including the Depression, Anxiety, and Stress Questionnaire (Dass 42), mental health information, and strategies for managing depression, anxiety, and stress. These menus serve as a valuable resource for users to get information and understanding about the signs and symptoms of emotional and mental problems commonly experienced, especially among adolescents.

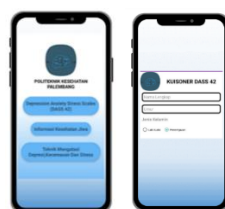


Figure 1. Main Menu



Figure 2. Start Screening



Figure 3. Examination Result



Figure 4. Information and techniques to overcome the problem.

Table 1. Application Usage Evaluation Results (N=15)

No	Questions	Mean	Max Score	Median	Std. Dev.
1.	The App is easy to use	4,26	5	4	0,593
2.	The App display is attracting	3,93	5	4	0,798
3.	The App features are useful	4,33	5	4	0,617
4.	The App language is understandable	4,26	5	4	0,457
5.	Examination results are understandable	4,2	5	4	0,560
6.	Information displayed is beneficial	4,46	5	4	0,516
7.	Tips given are easy to implement	4,2	5	4	0,560

The frequency of 105 was derived from the evaluation responses of 15 participants who completed 7 questions of the application evaluation questionnaire. Moreover, the mean score derived from the evaluation results was

calculated using the following equation (arikinro): $P = \frac{\sum R}{N} \times 100\%$. P stands for percentage of answers, $\sum R$ for total frequency of answers, and N for maximum score.

According to this formula, the maximum score

on the scale can be calculated by multiplying the highest score (5) by the number of question items and the number of respondents. Therefore, the maximum score (N) is 525, and the total frequency of answers is 445 ($\sum R$). The final percentage was 85%, placing it in the 'Very Good' category.

Direct feedbacks from the participants indicated that while easily accessible screening results were valuable knowledge for

adolescents, a consultation function for users linked to mental health professionals such as psychiatrists and psychologists was also required. This feature would serve as an internet-based consultation platform that might be utilized based on the specific requirements and circumstances of users seeking solutions, particularly those facing severe and extremely severe levels of depression, anxiety, and stress.

Table 2. The Overview of Depression, Anxiety, and Stress Levels in Adolescents (N=216)

	Depression, Anxiety, and Stress Levels				
	Normal	Mild	Moderate	Severe	Very Severe
Depression	98 (45%)	45 (21%)	44 (20%)	17 (8%)	12 (6%)
Anxiety	32 (15%)	33 (15%)	67 (31%)	50 (23%)	34 (16%)
Stress	107 (50%)	43 (20%)	51 (24%)	13 (6%)	2(1%)

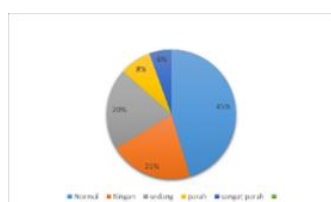


Figure 5. Adolescents' Depression Level



Figure 6. Adolescents' Anxiety Level



Figure 7. Adolescents' Stress Level

The findings of screening on the DeAs Care application revealed the levels of depression, anxiety, and stress among 216 adolescent responders. In regard to the severity of depression, the study showed that 21% of participants had mild depression, 20% had moderate depression, 8% had severe depression, and 6% had extremely severe depression. The remaining 45% of participants were in a normal condition. In terms of anxiety levels, 15% of the participants experienced light anxiety, 31% experienced moderate anxiety, 23% experienced severe anxiety, 16% experienced extremely severe anxiety, and 15% were in normal category. Regarding stress levels, the study revealed that 20% of participants reported light stress, 24% reported moderate stress, 6% reported severe stress, and 1% reported extremely severe stress. Additionally, 50% of participants appeared to be under normal conditions.

DISCUSSION

According to data from Basic Health Research in 2013, the prevalence of significant mental disorders in Indonesia was 1.7 per million, meaning that 1-2 out of every 1000 Indonesians experienced severe mental problems¹⁵. In 2018, a study revealed a notable rise in the incidence of severe mental diseases, reaching a rate of 7 per million. It indicates that 7 out of every 1000 Indonesians were affected by significant mental problems¹⁶. Based on these findings, it can be inferred that the prevalence of severe mental diseases in Indonesia had a 5.3% rise between 2013 and 2018².

Depression, anxiety, and stress are three prevalent mental diseases in Indonesia, with a significant increase of 312% since 2013 (17 The rising prevalence of severe mental disorders in Indonesia indicates the criticality of assessing the risk for mental health issues within the community through mental health screening¹⁸.

Screening is a diagnostic process to identify potential abnormalities or issues in individuals without complaints or symptoms related to a specific condition⁸. The study

utilized the DeAs Care mental health screening application to conduct mental health screening. The application offers three primary menu options: the Dass 42 questionnaire, mental health information, and strategies for managing depression, anxiety, and stress.

On the Dass 42 questionnaire menu, participants are requested to respond to a series of inquiries that relate to prevalent symptoms associated with stress, anxiety, and depression. This strategy enables program users to choose symptoms that align with their recent experiences within the past 30 days. Subsequently, the system will examine each chosen symptom individually by following the database's flow and considering the user's submitted information. Upon finishing all the questions, responders will receive depression, anxiety, and stress results automatically.

The DeAs Care Application's second section provides mental health information, including coping mechanisms for stress, anxiety, and depression. An essential aspect of promoting the mental well-being of adolescents using this application is deep breathing relaxation techniques and five-finger hypnosis. These techniques can be independently practiced alleviating symptoms of depression, anxiety, and stress effectively. Adolescents can utilize accessible relaxation practices as a proactive measure to ward off depression, anxiety, and stress from a very early stage.

The results obtained from the mental health screening conducted using the Deas Care application on 216 adolescents revealed that 55% of respondents showed symptoms of depression, while the remaining 45% were in a normal mental state. Additionally, 85% of adolescents experienced symptoms of anxiety, with only 15% being in a normal state. Furthermore, 51% of respondents experienced symptoms of stress, while the remaining 49% were in a normal mental state. Based on these findings, it is evident that over 50% of adolescents encounter depression and stress, while 85% of the total suffer from anxiety.

This study demonstrates that adolescents undergo unnoticed anxiety, depression, and stress despite engaging in typical activities like their peers in regular circumstances. This phenomenon arises due to the prevalent perception among adolescents that they impose a significant strain on their parents, particularly in terms of financial obligations, and they believe they are incapable of bringing

joy to their parents. In addition to that, this phenomenon can also result from insufficient communication, emotional connection, and intimacy with their parents or other family members inside the household. Despite everyone's efforts to contribute their utmost to the family, there is a lack of emotional intimacy and openness among them. This situation leads to adolescents lacking a trustworthy friend with whom they can communicate and express their growing ambitions and difficulties.

Furthermore, adolescents encounter challenges that they need help resolving and clarity about appropriate courses of action. Besides, in addition to academic responsibilities that demand concentration and effort, they may also face stress, anxiety, and even depression due to personal and social challenges within their school or community.

Adolescents experiencing pressure struggle to employ effective problem-solving strategies¹⁹. If adolescents do not receive intervention to address the challenges they are facing, they are susceptible to developing mental disorders⁹. To mitigate the occurrence of mental disorders in adolescents, it is essential to prioritize the preservation of their mental well-being through the implementation of screening.

Multiple studies indicate that mental health screening applications are highly beneficial in the prevention of emotional and mental disorders throughout society. An example of such an application is the Android Screening Mental Health application, designed to identify mental health issues in individuals. Additionally, it can be utilized to monitor the mental well-being of adolescents in real-time. Android-based mental health applications can efficiently and effortlessly facilitate mental health screening while gathering information about an individual's mental well-being²¹. The BAPER application, accessible on the Google Play store, is an Android-based self-screening tool designed to identify mental health issues early and mitigate the likelihood of mental disorders in adolescents⁷.

Websites have also incorporated numerous mental health assessments employing the Depression Anxiety Stress Scales (DASS)-42 questionnaire instrument for analysis. The study included a total of 324 individuals who completed the website survey designed for youths, adults, and the elderly²². The utilization of the Dass-42 questionnaire in this study aligns with the DeAs care program, which employs the

Dass-42 instrument. Therefore, the DeAs care application is suitable for conducting extensive public health screening across many age groups, including adolescents, adults, and elders.

To enhance individuals' mental well-being, particularly among adolescents, it is fundamental for all stakeholders to actively pursue a range of initiatives that align with the latest advancements in science and technology. Thus, to address the diverse range of conditions and issues related to mental and emotional disorders faced by adolescents, it is vital to provide support and intervention aimed at enhancing their mental well-being. This proactive approach is crucial in preventing the onset and consequences of mental and emotional disorders in adolescents²³. Efforts to mitigate the incidence of emotional and mental health problems can be directed toward enhancing the overall mental well-being of the community and safeguarding individuals who are susceptible or in jeopardy of developing mental illnesses²⁴.

Various strategies can be implemented to enhance the mental well-being of adolescents. These include raising awareness about mental health in the community and educational settings, establishing mental health units (UKS) in schools, providing integrated mental health services (Posyandu) for adolescents, organizing youth support groups, utilizing social media and health education websites to promote adolescent mental health, and utilizing readily available mental health screening applications as an early detection tool.

CONCLUSION

Considering the research findings, utilizing the Android-based Deas Care application to screen for emotional and mental issues in adolescents is effective in preventing the development of mental disorders in this age group. The application enables adolescents to conduct self-assessments to detect mental health disorders at an early stage. Additionally, users can access knowledge regarding mental health and methods for preserving their well-being via this application. Integrating mental health screening with applications might facilitate the promotion of mental well-being by promptly identifying indications and symptoms of emotional and mental disorders, hence

averting the onset of such problems in society. This application will continue to be updated under user demands, feedback, and recommendations, ultimately improving the community's optimal mental health.

REFERENCES

1. WHO. Depression and Other Common Mental Disorder. Depression. 2017. 24 pages.
2. Kemenkes. Riskesdas 2018 [Internet]. Badan Penelitian dan Pengembangan Kesehatan. 2019. Retrieved from http://labdata.litbang.kemkes.go.id/images/download/laporan/RKD/2018/Laporan_Nasional_RKD2018_FINAL.pdf
3. Susana Nurtanti SH. Analisis Tingkat Depresi, Ansietas Dan Stress Saat Menghadapi Penilaian Akhir Semester Pada Siswi Smk Muhammadiyah. *J Chem Inf Model*. 2021;4(2):351–60.
4. Kaligis F, Ismail RI, Wiguna T, Prasetyo S, Indriatmi W, Gunardi H, et al. Mental health problems and needs among transitional-age youth in Indonesia. *Int J Environ Res Public Health*. 2021;18(8).
5. Dianovinina K. Depresi pada Remaja : Gejala dan Permasalahannya Depression in Adolescent : Symptoms and the Problems. 2018;6(1):69–78.
6. Sulistyorini W, Sabarisman M. Depresi : Suatu Tinjauan Psikologis. *Sosio Inf*. 2017;3(2):153–64.
7. Yani A. Layanan Berbasis Android Untuk Melakukan Deteksi Dini Depresi Pada Remaja. *J Chem Inf Model*. 2013;53(9):1689–99.
8. Sutanto S, Amiruddin D, Nugraha G. Rancang Bangun Aplikasi Skrining Kesehatan Mental Remaja Berbasis Web Di Rsud Dr.Dradjat Prawiranegara Dengan Menggunakan Metode Analytic Hierarchy Process (AHP). *J Innov Futur Technol*. 2022;4(1):29–38.
9. Azzahro EA, Dian J, Sari E, Masyarakat FK, Epidemiologi D, Kesehatan F, et al. Faktor Psikososial Dengan Kejadian Depresi Pada Remaja (Studi pada Siswa Kelas 12 SMA XY Jember) Psychosocial Factors with The Incidence of Depression in Adolescents (Study at 12th Grade XY High Schools Students in Jember). 2021;2655:69–77.

10. Janitra PA, Prihandini P, Aristi N. Pemanfaatan Media Digital Dalam Pengelolaan Kesehatan Mental Remaja Di Era Pandemi. *Bul Udayana Mengabdi*. 2021;20(1):18.
11. Auliasin E, Rusdianto DS, Soebroto AA. Pengembangan Aplikasi Diagnosis Gejala Depresi pada Mahasiswa Fakultas Ilmu Komputer Studi Kasus Fakultas Ilmu Komputer Universitas Brawijaya. *J Pengemb Teknol Inf Dan Ilmu Komput* [Internet]. 2019;3(9):8823–30. Retrieved from: <http://j-ptiik.ub.ac.id>
12. Hanafi. Konsep Penelitian R&D Dalam Bidang Pendidikan. *J Kaji Keislaman* [Internet]. 2017;4(2):129–50. Retrieved from: <http://www.aftanalisis.com>
13. Sugiono. Metode Penelitian Kuantitatif, Kualitatif, dan R&D. 2016.
14. Basha E, Kaya M. Depression, Anxiety and Stress Scale (DASS): The Study of Validity and Reliability. *Univers J Educ Res*. 2016;4(12):2701–5.
15. Depkes R. Riskesdas 2013. DEPKES RI. 2013.
16. Kemenkes. Situasi kesehatan jiwa di Indonesia. InfoDATIN [Internet]. 2019;12. Retrieved from: <https://pusdatin.kemkes.go.id/resources/download/pusdatin/infodatin/InfoDatin-Kesehatan-Jiwa.pdf>
17. Duriana Wijaya Y, Psi M, Puskesmas P, Baru K, Dki J. Kesehatan Mental di Indonesia : Kini dan Nanti. *Bul Jagadhdhita* [Internet]. 2019;1(1):1–4. Retrieved from: <https://www.neliti.com/publications/276147/>
18. Hakim MA, Aristawati NV. Mengukur depresi, kecemasan, dan stres pada kelompok dewasa awal di Indonesia: Uji validitas dan reliabilitas konstruk DASS-21. *J Psikol Ulayat*. 2023;10(2):232–50.
19. Suratmini D, Afriani T. Pemanfaatan Deteksi Stres Remaja Yang Efektif Dan Efisien Melalui Aplikasi: Systematic Review. *J Keperawatan Respati Yogyakarta*. 2019;6(1):542.
20. Hamenda TF, Moo S, Hunowu R, Soeli YM. Pengembangan Deteksi Dini Gangguan Kesehatan Jiwa Dengan Mental Health Screening Berbasis Aplikasi Android Untuk Masyarakat Pesisir Pantai Desa Ponelo. *Jambura Nurs J*. 2022;4(1):16–21.
21. Khoiri M imron. Perancangan Aplikasi Kesehatan Mental Online Menggunakan Metode Rapid Application Development(Rad). *JEKIN - J Tek Inform*. 2023;1(3):26–32.
22. Rizqi J, Widayati RW, Fitriawan AS, Indriani A. Skrining Kesehatan Mental Menggunakan Skala Depresi, Kecemasan, dan Stres (Dass-42): A Cross-Sectional Study Pada Website “PEDULIJIWA. COM.” *Pros Semin Nas Multidisiplin Ilmu*. 2022;4(1):380–5.
23. Endriyani S, Lestari D, Lestari E, Napitu IC. Gangguan Ment Emosional Dan Depresi Pada Remaja [Internet]. 2022;4(2):429–34. Retrieved from: <https://journal.umtas.ac.id/index.php/healtcare/article/view/2346>
24. Ayuningtyas D, Rayhani M. Analisis Situasi Kesehatan Mental pada Masyarakat DI Indonesia dan Strategi Penanggulangannya. 2018;9(1):1–10.

Article Review

Effectiveness of Nursing Interventions and Nurses' Competencies in the Use of Chemoport in Cancer Patients: A Systematic Review

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ABSTRACT

Chemoport is an implanted device, placed in the central venous system especially for infusion of chemotherapy drugs in oncological diseases that can reduce vascular inflammation during chemotherapy because this device is implanted under the skin, making IV (intravenous) drug administration easier and reducing pain. Nurses as officers must be able to provide more specific care and therapy based on patient needs, and must understand the lives of cancer patients and their families. The purpose of this study was to determine the effectiveness of nursing interventions and nurse competence in the use of chemoport in cancer patients. The research method used a systematic review with article searches on five trusted journal databases, such as EBSCOhost, ClinicalKey Nursing, Sage Journal and Science direct. Article analysis using the PRISMA method. The results showed that there were ten articles that fit the criteria for articles related to nursing interventions and nurse competence in the use of chemoport in cancer patients. All articles used quantitative research methods with a randomized control trial design. The conclusion is that nursing interventions and nurse competence in the use of chemoport in cancer patients, among others, are divided into nursing interventions to reduce pain, namely virtual reality interventions, giving Valsalva maneuvers, skin stimulation, and giving local anesthesia. While nursing interventions to reduce anxiety include virtual reality interventions, visual blocking information interventions and patient education and nurse competence through increasing nurse knowledge and providing training.

Keywords: Chemoport, Nursing Interventions, Nurse Competency.

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INTRODUCTION

Cancer is a global health issue that affects people from all walks of life regardless of their social status. In 2020, an increase in cancer cases was observed, with 25% of the world's population being diagnosed with cancer and expected to suffer from the disease throughout their lives. Cancer treatment is not evenly distributed worldwide, especially in developing countries, which often struggle to control and treat cancer due to limited resources¹.

Cancer is a disease that psychologically devastates patients from the moment of diagnosis. Furthermore, the treatment process itself can exacerbate the discomfort experienced by cancer patients. Currently, there are various cancer treatment methods such as surgery, radiotherapy, and chemotherapy, each of which has its own complications. Patients undergoing radiotherapy and chemotherapy may experience skin problems, loss of appetite, nausea, fatigue, hair loss, and many other side effects during the process. Therefore, similar to

cancer itself, its treatment has the potential to traumatize patients².

A study evaluating the effects of chemotherapy on muscle strength, quality of life, fatigue, and anxiety in 37 breast cancer patients conducted in Brazil showed that three cycles of chemotherapy treatment could disrupt isometric handgrip strength and quality of life in breast cancer patients³. Another study indicated that chemotherapy not only affects physical strength but can also impact the memory of cancer patients who have undergone chemotherapy. Chemotherapy treatment can disrupt and damage brain structures related to memory, leading to slow synaptic consolidation in the brain and memory deficits in patients undergoing chemotherapy⁴.

One of the safest methods of chemotherapy delivery is chemoport, which minimizes pain from repeated venous punctures during each chemotherapy cycle consisting of multiple cycles. Patients receiving chemotherapy via the peripheral IV route experience multiple punctures, discomfort, pain, redness, or swelling of the arm⁵. In addition to providing benefits, chemoport can also lead to complications. Research results show that some complications that may arise from the use of chemoport include pneumothorax, infection, thrombosis, hemothorax, drug extravasation, and chemoport malfunction⁶.

Chemotherapy management is a collaborative nursing intervention, within the authority of Post Basic Register Nurses or oncology specialist nurses, and nursing interventions are provided based on clinical assessment and knowledge where nurses act with the goal of effective patient recovery. In the field of collaborative intervention, nurses have expertise in a number of limited interventions that reflect their expertise, but the overall classification may represent nursing expertise⁷.

Nurses as caregivers must be able to provide more specific care and therapy based on patient needs, and must understand the lives of cancer patients and their families. The goal of cancer care is to improve the quality of life of cancer patients, through nursing care, both independent and collaborative interventions. In a study related to the effects of evidence-based nursing intervention improvement on treatment compliance, quality of life, and self-efficacy of lung carcinoma (LC) patients undergoing

radiotherapy and chemotherapy, it was found that evidence-based nursing interventions can improve treatment compliance, lung function, self-efficacy, and quality of life of chemotherapy patients⁸.

The results of research on oncology nursing certification training show that there are significant differences in pre-test and post-test scores of nurse staff. Where knowledge and clinical skills have proven effective in enabling nurses to provide high-quality care. chemotherapy management⁹.

Based on the above explanation, it is deemed important to investigate the effectiveness of nursing interventions and nurse competency in the use of chemoport in cancer patients.

METHOD

This study employed a systematic review design using the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) method. The search strategy for articles/journals utilized relevant data sources related to the research topic, such as EBSCOhost, ClinicalKey Nursing, Sage Journal, and ScienceDirect, with keywords: "Cancer patient undergoing Chemotherapy" OR "Chemotherapy" OR "Use of chemoport" AND "Nursing interventions" OR "Nurse Competencies".

The researchers retrieved several journal articles through online databases that met the predetermined criteria, namely full-text articles published between 2014 and 2023 with a quantitative research method of Randomized Controlled Trials, describing nursing interventions and nurse competency in the use of chemoport in cancer patients of all ages. The researchers eliminated research journals that did not discuss nursing interventions and nurse competency in the use of chemoport in cancer patients. They collected all relevant journals and analyzed each journal according to the predefined criteria by reading and summarizing them. Subsequently, the results of the analysis were concluded into the topic of discussion, which is the spiritual needs of advanced-stage cancer patients.

Based on the analysis results from four databases, 12,280 references related to the topic were obtained. Figure 1 displays the article selection process for inclusion in this study. The articles were screened by rereading for title

similarity (duplicates), inclusion criteria, full-text availability, specific material suitability to the research title, and material congruence in the abstract. Afterward, all identified articles underwent critical appraisal using the Critical Appraisal Skills Programme checklist specifically for Randomized Controlled Trial Standard research types. In each critical assessment process, two reviewers discussed, and if there were differences of opinion, a third reviewer was involved to reinforce the analysis and provide reviews of the filtered articles. In the final selection stage, 10 journal articles were chosen for review.

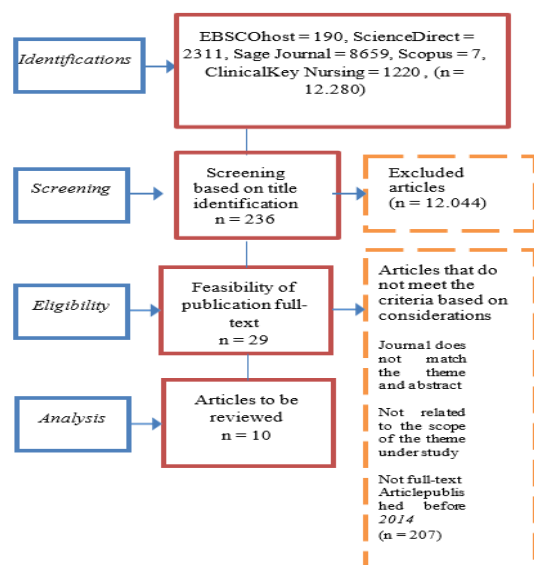


Figure 1. PRISMA

Table 1. Summary of Literature Analysis

N	Journal Title	Aim	Design	Result Can be Expanded	Notes
1	Effect of lidocaine spray on relieving non-coring needle puncture-related pain in patients with totally implantable venous access port: a randomized controlled trial	To explore the effectiveness, acceptability, and safety of lidocaine spray in reducing pain from non-coring needle puncture in patients with TIVAP	Randomized controlled trial	The pain scores in the intervention and control groups were 15.12 ± 6.61 mm and 36.50 ± 18.79 mm respectively ($P < 0.05$), 33 patients (78.6%) in the intervention group and 12 patients (28.6%) in the control group reported that they would choose the same spray for future interventions ($P < 0.001$).	The use of local lidocaine spray in TIVAP patients is effective, acceptable, and safe to reduce pain from chemoport non-scoring needle puncture.
2	The Effects of Nursing Intervention on Pain Control during	To determine the effect of Lidocaine Cream, cryotherapy, and	Randomized controlled trial	All anesthetic methods (i.e., application of Lidocaine Cream, cryotherapy, and skin stimulation) applied prior	All three interventional measures (use of Lidocaine Cream, cryotherapy, and skin stimulation) may contribute to effective pain

RESULTS

The results of the analysis of ten articles where eight articles discuss nursing interventions and two articles discuss the competence of nurses in patients attached to chemoport. A summary of the literature analysis can be seen in table 1.

	Chemoport Needle Insertion	skin stimulation on Pain Control due to Chemoport Needle Insertion.		to Chemoport needle insertion were effective in reducing patients' pain levels. In summary, all three anesthetic methods evaluated in this study reduced cancer patients' pain levels during Chemoport needle insertion.	and anxiety management during Chemoport needle insertion in the clinical environment (but remain subject-specific and subject to other hospital factors).
3	Improving the Knowledge of Port-A-Cath Care For Nurses	To evaluate a program to improve knowledge of port-a-cath care for nursing staff. To assess nursing staff knowledge of the port-a-cath care process before the training program and measure knowledge of the device and procedures related to device use and maintenance after the training.	Randomized controlled trial	Nurses caring for port-a-cath patients were as follows: never (58.89%), one to five times (31.11%), 6-10 times (2.22%) and >10 times (7.78%). The study intervention significantly improved nurses' knowledge regarding port-a-cath care. Nurses achieved an average of 12.5 points at pretest (40.4%) and the score increased by an average of 27 points posttest (88.1%).	These findings relating to the low level of pretest knowledge by nurses provide strong evidence of the need for hospital-based education/training related to chemoport care.
4	Effects of Virtual Reality on Pain During Venous Port Access in Pediatric Patients: A Randomized Controlled Study	To evaluate the effect of Virtual Reality method on pain during venous port access in pediatric oncology patients aged 7 to 18 years.	Randomized controlled trial	Descriptive characteristics of the children (n = 71) showed a homogeneous distribution between groups. During the procedure, children in the control group (n = 36; 5.03 ± 3.35) experienced more pain than children in the VR group (n = 35; 2.34 ± 2.76; p < .001). Parental proxy reports in the experimental group (1.77 ± 2.46) were found to be lower than in the control group (4.67 ± 2.56; p < .001)	The VR method is effective for reducing pain during venous port access in pediatric oncology patients. VR should be used as a distraction method during venous port access.
5	Comparison of the effects of Valsalva maneuver, EMLA cream, and the combination of both in relieving pain of needle	To compare the effectiveness of Valsalva maneuver, eutectic cream mixed local anesthetic (EMLA), and the combination of both in	Randomized controlled trial	Group E and Group EV had the least pain scores at needle insertion, which was significantly lower than Group V and Group C.	EMLA cream is a safe and effective way to reduce pain during non-coring needle insertion in TIAP and improve overall patient comfort. We recommend using EMLA cream 1 hour before TIAP needle insertion, especially in patients who have needle

	insertion on totally implantable access port: A randomized controlled stud	relieving cannulation pain in chemoport.			phobia or high pain scores from previous non-coring needle insertion.
6	Setting the stage: innovation in port access education for pediatric emergency nurses	To describe the knowledge and self-efficacy gained after receiving training on sterile access techniques for chemoport and see the effect of training on nurses in accessing chemoport sterile.	Randomized controlled trial	Thirty-four pediatric emergency nurses participating in the study demonstrated an overall increase in knowledge and self-efficacy with port access maintained throughout the 3-month follow-up. Data revealed positive responses regarding the simulation experience of the study participants	Effective sterile chemoport access training for nurses requires a comprehensive curriculum that integrates procedural aspects and situational techniques to address components of the actual chemoport access experience involving pediatric patients and families. The curriculum in this training combines skill-based practice with situational management, and promotes self-efficacy and nursing competence with port access in the pediatric population.
7	Improving cancer patients' knowledge about totally implantable access port: a randomized controlled trial	To evaluate the effectiveness of educational methods related to chemoport on increasing patient knowledge and reducing anxiety in patients with chemoport.	Randomized controlled trial	Results after 3 months, pairwise comparisons showed a significant increase in chemoport knowledge in each group. ($p < 0.001$), significant difference in group C compared to group A ($p < 0.001$) and Group B ($p < 0.001$). Anxiety decreased in the intervention group and control group after receiving information related to chemoport.	Educational interventions related to chemoport in cancer patients are effective in increasing knowledge about chemoport in 3 months and effective in reducing anxiety in patients who are placed on chemoport.
8	The Effect of Virtual Reality Distraction Intervention on Pain, Anxiety, and Vital Signs of Oncology Patients Undergoing Port Catheter Implantation: A Randomized Controlled Study	To determine the effect of virtual reality (VR) distraction intervention on pain, anxiety, and vital signs of oncology patients undergoing port catheter implantation.	Randomized controlled trial	There was an increase in pain scores in both groups after chemoport implantation however, pain scores in the intervention group were lower and there was a statistically significant difference between the two groups after implantation. In the intervention group there was a decrease in anxiety, systolic blood pressure, diastolic blood pressure, heart rate, and respiratory rate, and an increase in SpO ₂ . The use of VR had a large effect on pain scores (Cohen's $d = 3.023$) and a large effect on SAI scores (Cohen's $d = 8.770$).	VR distraction intervention was found to be an effective way to reduce pain, anxiety, , blood pressure, blood pressure (systolic diastolic), heart rate, and respiratory rate and improve SpO ₂ of patients undergoing port catheter implantation.

9	The Effect of Visual Information Blocking Nursing Intervention on Stress and Anxiety during Chemoport Insertion in Adult Cancer Patients of Operation Rooms	To examine the effect of visual information blocking (VIBNI) nursing intervention on stress and anxiety of patients undergoing chemoport insertion in the operating room.	Quasi Eksperi men	The difference in cortisol levels between the two groups was statistically significant after the VIBNI intervention ($p=0.007$). In terms of systolic blood pressure ($p=0.005$) and pulse rate ($p<0.001$), the interaction between the two groups was significant over time.	Participants who received VIBNI reported lower stress responses (cortisol level, systolic blood pressure, and pulse rate) during chemoport insertion. Based on the results of this study, further evaluation in a larger sample and objective anxiety is needed.
10	Effect of Educational Guidelines on Nurses' Performance regarding Prevention of Port-A-Catheter complications among Patients Undergoing Chemotherap	To evaluate the effect of educational guidelines on nurse performance regarding the prevention of port-A-catheter complications in patients undergoing chemotherapy.	Quasi Eksperi men	There was a correlation between the knowledge and practice of the studied nurses regarding Port-A catheter guidelines before and after education. There was a statistically significant positive correlation between total knowledge and practice before and after the implementation of educational guidelines ($p=0.00003^*$ and 0.00067^* , respectively).	Nurses are the backbone of the oncology team, so nurses must be continuously educated to implement new developments in their practice. As nurses are responsible for identifying patients who will benefit from port-A-catheters, performing teaching, accessing the port, administering medications, completing on-site care and preventing complications. Therefore, continuing education is essential to provide optimal care to patients with A-port catheters.

DISCUSSION

A chemoport is an implanted device placed in the central venous system, primarily for the infusion of chemotherapy drugs in oncological diseases. Chemoport, mediport, cancer port, or portacath can reduce inflammation of blood vessels during chemotherapy because this device is implanted under the skin, making intravenous drug administration easier and reducing pain. It facilitates healthcare workers in locating patients' blood vessels¹⁰.

Regarding Patricia Benner's nursing theory on the interrelation between knowledge and practice, where nurses have a role in developing knowledge in practice in line with the research findings by Navin Rajendra in 2021 conducted in India concluded that the chemotherapy method through chemoport access needs to be offered to patients requiring long-term venous access, and its use can be controlled by a trained team. Chemoport is safe

for children requiring long-term chemotherapy. Studies have shown that the use of Port-A-Cath in the treatment and management of cancer patients results in shorter hospital stays¹¹.

The use of chemoport in developing countries is increasingly common. In Indonesia, the use of chemoport is on the rise, with breast cancer patients typically choosing to use chemoport after receiving education about the low and mild complications that may occur¹². However, in other studies, several complications arising from the use of chemoport are mentioned, including pneumothorax, infection, thrombosis, hemothorax, drug extravasation, and chemoport malfunction⁶.

In a quantitative observational study conducted by Madabhavi in 2017 in India involving 100 patients requiring port catheter placement, the research findings showed that the most disturbing aspect of treatment for patients is repeated venous punctures for the administration of cytotoxic agents, antibiotics,

blood products, and nutritional supplements, which can cause pain and discomfort to patients¹³.

The Nursing Interventions Classification (NIC) standard classification encompasses independent, collaborative interventions, and direct or indirect care. Chemotherapy management is a collaborative nursing intervention that can be performed by oncology nurse specialists after basic nursing registration. Nursing interventions involve handling or treatment based on assessment and clinical knowledge where nurses take action with the aim of improving patient outcomes⁷.

Based on Patricia Benner's Nursing Theory on caring, clinical wisdom, and ethics in nursing practice, Benner states that nursing practice is an effort toward the interconnection between knowledge and nursing practice. Nursing knowledge in practice is acquired over time and developed through experimental learning, situational thinking, and reflection in specific practices. Patricia Benner describes the mastery of skills and development in nursing practice divided into levels starting from novice, advanced beginner, competent, proficient, and expert. Nurses as caregivers must be able to provide more specific care and therapy according to the needs of patients because the life journey of cancer patients and their families must be understood.

The goal of cancer patient care is to improve the quality of life of cancer patients through both independent and collaborative nursing interventions. The choice of cancer treatment through chemotherapy, as described above, has an impact on cancer patients, both from the chemotherapy regimen and the method of drug administration¹⁴.

Based on the systematic review conducted, several nursing interventions and nurse competencies in the use of chemoport in cancer patients include interventions for reducing pain such as virtual reality intervention, Valsalva maneuver, skin stimulation, and local anesthesia administration. Meanwhile, nursing interventions to reduce anxiety include virtual reality intervention, visual blocking information intervention, patient education, and nurse competency through knowledge enhancement and training.

Nursing Interventions to Reduce Pain

Inadequate pain management can

negatively impact children, parents, and healthcare providers. Distraction is an active coping strategy where patients divert their attention from nociceptive stimuli to reduce pain awareness. Virtual reality intervention is one intervention that can effectively reduce pain during chemoport access. Virtual Reality is a distraction method that helps patients actively participate in a task with cognitive or behavioral functions.

The effect of Virtual reality on pain scores was obtained from the research findings of Semerci (2021) where pain evaluation was obtained through self-reports of children and proxy reports of parents, using the Wong-Baker FACES Pain Rating Scale. It was found that when procedural pain during chemoport access in children was evaluated using the Wong-Baker Faces Pain Rating Scale (control group = 5.02 ± 3.35 ; VR group = 2.34 ± 3.27), there was a significant difference between the control group and the VR group ($p = 0.001$)¹⁵. The average pain scores of children in the control group were significantly higher than in the Virtual reality group. Parent proxy reports in the experimental group (1.77 ± 2.46) were found to be lower than in the control group (4.67 ± 2.56 ; $p (<0.001)$). Virtual Reality is useful for reducing procedural pain in children. VR can be used in pediatric clinics during painful procedures such as chemoport access and also to improve procedure success. Additionally, it is suggested that VR be combined with proven methods such as topical anesthesia and parental presence to reduce needle pain¹⁵.

In line with this, research conducted by Shi, et al., (2023) found that the Valsalva Maneuver intervention is also effective in reducing pain during chemoport access¹⁶. Modified Valsalva Maneuver can alleviate pain during non-injury needle insertion on TIVAP, which may benefit from increased chest wall stiffness as they hold their breath. Simultaneously, applying the Valsalva Maneuver during coring needle insertion into the port allows patients to focus on their breathing, diverting attention and maintaining emotional stability through breathing control and ultimately resulting in pain relief. The research findings indicate that pain scores in patients with the Valsalva Maneuver are smaller compared to the control group¹⁶.

Another nursing intervention to reduce pain during chemoport access is the administration of local anesthesia such as

lidocaine spray, cryotherapy, and the use of EMLA cream, which has been proven to reduce pain during chemoport access. The research findings of Zhu (2023) regarding the effect of lidocaine spray in relieving pain caused by non-coring needle insertion in patients with total implantable venous access port showed that the pain scores in the intervention and control groups were 15.12 ± 6.61 mm and 36.50 ± 18.79 mm, respectively ($P < 0.001$). There were 2 (4.8%) patients with moderate pain in the intervention group and 18 (42.9%) patients with moderate pain in the control group ($P < 0.001$). In the control group, (7.1%) patients reported severe pain. This study concluded that the use of local lidocaine spray in TIVAP patients is effective, acceptable, and safe for reducing pain caused by non-coring needle insertion¹⁷.

In another study by Menekli (2022), nursing interventions such as the administration of local anesthesia with lidocaine cream, cryotherapy, and skin stimulation were effective in reducing pain during chemoport needle insertion. The research results showed a significant difference in pain scores between the experimental groups (lidocaine cream group, cryotherapy group, and skin stimulation group) and the control group (without anesthesia) validated by statistical analysis of subjective pain scores: $F=26.76$, $p < 0.000$. Pain scores (subjective and objective scores) in the intervention groups were significantly lower than scores from the control group¹⁸.

Nursing Interventions to Reduce Anxiety

Chemoport has many beneficial effects on the quality of life of patients. It is reported in the literature that besides patients experiencing pain in the incision area after implantation, patients may also experience anxiety before, during, or after implantation. Due to pain and anxiety, changes in patients' vital signs may occur. Distraction is effective in managing anxiety, such as active distraction techniques like toy provision, virtual reality, integrated imagination breathing control, and relaxation.

In a study conducted by Menekli (2022), Virtual reality intervention was proven effective in reducing anxiety in cancer patients with chemoport placement. In the intervention group, there was a decrease in the level of patient anxiety while there was an increase in the control group. The use of virtual reality has a significant effect on the State Anxiety Inventory score (Cohen's $d = 8.770$) in patients

undergoing chemoport implantation¹⁸.

The findings of this study, reporting that most studies report positive findings supporting the use of VR for anxiety-related disorders. In this regard, the literature review findings regarding nursing interventions in patients with chemoport placement also indicate that virtual reality is effective in reducing anxiety.

Another intervention to reduce anxiety is visual blocking information intervention. To test the effect of nursing intervention of visual information blocking (VIBNI) on stress and anxiety levels of patients undergoing chemoport placement in the operating room. VIBNI intervention is a nursing intervention for visual information blocking where nursing actions provided by nurses to block information by covering the eyes using gauze with attention to thickness, size, and weight of the gauze and illumination measured with a light meter (CENTER-337, Center Technology, Taiwan) and 330 Lux illumination provided, and the spatio-temporal process measured during the chemoport placement procedure in the operating room.

The level of patient anxiety in this study was assessed by examining serum cortisol levels taken during the operation. The research findings showed a significant difference in cortisol levels between the two groups statistically after the VIBNI intervention ($p=0.007$). In terms of systolic blood pressure ($p=0.005$) and heart rate ($p < 0.001$), the interaction between the two groups appeared significant over time. Participants receiving VIBNI reported lower stress responses (cortisol levels, systolic blood pressure, and heart rate) during chemoport placement¹⁹.

Patient education intervention is an intervention that is much needed by cancer patients related to the need for important and specific information which, if addressed, can reduce anxiety and mood disturbances and result in a better quality of life. Most cancer patients want to receive as much information as possible, but at least half are not at all or slightly satisfied with the amount of information received. Nurses can be very effective as providers of cancer patient information and can play this role with several strategies. In addition to oral communication, written education, especially in brochure format, personalized and reviewed with healthcare professionals, is highly appreciated by cancer patients²⁰.

The findings of this literature review are in line with this. In a study conducted by Piredda (2016) to evaluate the effectiveness of an information booklet on patient knowledge about chemoport in a short time and after 3 months and in reducing physiological indicators of patient anxiety immediately after chemoport implantation. The research findings showed a significant difference in knowledge in group C compared to group A ($p < 0.001$) and group B ($p < 0.001$) from each other. Physiological indicators of anxiety decreased in the intervention group compared to the control group immediately after chemoport implantation²¹.

Nurse Competencies in Providing Interventions for Patients with Chemoport

The care and rehabilitation of cancer patients are interdisciplinary work. Optimal care and complication avoidance require collaborative efforts from all specialists involved, not only doctors who perform port system implants but also oncologists, nutritionists, and especially nurses. Continuing education also plays a role in improving outcomes²⁰.

All individuals caring for cancer patients with port systems must take responsibility for the care of these special systems. Nurses are the basic element of the oncology team. Nurses are primarily responsible for ensuring that patients receive chemotherapy safely and providing effective self-care support needed for patients to cope with their treatment. Nursing care and catheter management are complex, and many controversial practice issues pose challenges for nursing specialists²².

In this regard, the results of this systematic review found research findings by Hoa (2019) showing that the study intervention significantly improved nurses' knowledge of port-a-cath care, where nurses' knowledge reached an average of 12.5 points on the pretest (40.4%) but increased scores averaged 27 points posttest (88.1%). It is important to realize that nursing staff play a significant role in reducing port-a-cath complications and are directly responsible for ensuring patient safety and improving hospital service quality²³.

In another study, the results of this literature search also stated that improving nurses' knowledge about effective chemoport access requires a comprehensive curriculum

that integrates procedural aspects and situational techniques to address the actual chemoport access experience involving pediatric patients and families. The research findings indicate that providing skills-based practice education is effective in increasing self-efficacy and nursing competence in accessing chemoport in children²⁴.

Competent nurses with broad knowledge in key aspects of chemoport care and maintenance can ensure that the specific needs of patients are met and optimal health outcomes are achieved. However, nurses working in oncology require a higher level of knowledge and skills in managing port-a-catheters.

The findings of this literature search also show research results that are consistent with the research conducted by Mersal (2012) showing nurses' knowledge of complications related to pre- and post-chemoport education guidelines, less than a quarter of nurses (20%) had a satisfactory level of knowledge regarding chemoport complications such as catheter cutting and pre-education guidelines for lung collapse while more than three-quarters of nurses (76.66%) had a satisfactory level of knowledge regarding the same items after education guidelines. Additionally, one-third (33.33%) of nurses had a satisfactory level of knowledge regarding chemoport complications such as site infection, bleeding, clot formation, and nerve damage, while most nurses (80%) had a satisfactory level of knowledge regarding the same items post-education guidelines. Moreover, this study illustrated that there was a statistically significant difference between nurses' knowledge before and after education guidelines about chemoport complications with $p < 0.005$ ²⁵.

CONCLUSION

The results of a systematic review that have been carried out, obtained several nursing interventions and nurse competencies in the use of chemoports in cancer patients, among others, are divided into nursing interventions to reduce pain, namely virtual reality interventions, giving Valsalva maneuvers, skin stimulation, and giving local anesthesia. While nursing interventions to reduce anxiety include virtual reality interventions, visual blocking information interventions and patient education and nurse competence through increasing nurse

knowledge and providing training. meaning/purpose, and transcendence.

For further research, it is recommended to conduct research related to complications and causes of complications in patients with chemoport.

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REFERENCES

1. World Health Organization. WHO Report on Cancer Setting Priorities, Investing Wisely And Providing Care For All. 2020. <https://www.who.int/publications/i/item/9789240001299>
2. Akif, M., Fatma, E., & Yılmaz, Ö. Perbandingan pemberian pengobatan kemoterapi melalui port vena dan akses vaskular perifer dalam hal kualitas hidup dan biaya. 1897–1908. 2023.
3. Marques VA, Ferreira-Junior JB, Lemos TV, Moraes RF, Junior JR, Alves RR, Silva MS, Freitas-Junior RD, Vieira CA. Effects of chemotherapy treatment on muscle strength, quality of life, fatigue, and anxiety in women with breast cancer. *International journal of environmental research and public health*. 2020 Oct;17(19):7289.
4. Lindner OC, Mayes A, McCabe MG, Talmi D. Acute memory deficits in chemotherapy-treated adults. *Memory*. 2017 Nov 26;25(10):1327-39.
5. Samiksha, S., Patil, R. T., Surgery, G., Medical, G., & Corresponding, C. Oncology a comparative study of chemoport versus peripheral venous access in breast cancer patients in goa medical, 2023.
6. Puri G, Kumar N, Jayaram J, Kataria K, Dhar A, Srivastava A. Rare Complications of Chemoport. *Indian Journal of Surgery*. 2023 May 18:1-3.
7. Butcher, H. K., Bulechek, G. M., Dochterman, J. M., & Wagner, C. M. *Nursing intervention classification (NIC)*. Elsevier Ltd, 2018.
8. Zhang T, Lu J, Fan Y, Wang L. Evidence-based nursing intervention can improve the treatment compliance, quality of life and self-efficacy of patients with lung cancer undergoing radiotherapy and chemotherapy. *American Journal of Translational Research*. 2022;14(1):396.
9. Group, A. H. Effectiveness of Certificate Program on Oncology Nursing, 2019, 19(2).
10. Mcorkle, R., Grant, M., Stromborg, M. F., & Baird, S. B. *Cancer nursing a comprehensive textbook (Second Edi)*. W.B. Saunders Company, 1996.
11. Case, A., & Raghuraman, M. Port-a Cath - A friendly partner in the care of child with cancer, 2021. <http://www.iosrjournals.org/>
12. Jahya, AN. Evaluasi Penggunaan Totally Implantable Venous . *Jurnal Medika Udayana*, 2016. <https://ojs.unud.ac.id/index.php/eum>
13. Madabhavi I, Patel A, Sarkar M, Anand A, Panchal H, Parikh S. A study of use of “PORT” catheter in patients with cancer: a single-center experience. *Clinical Medicine Insights: Oncology*. 2017 Feb 22;11:1179554917691031.
14. Alligood, M. R. *Nursing theorists and their work*. Mosby Elsevier, 2014. inc. www.elviesier.com
15. Semerci R, Akgün Kostak M, Eren T, Avci G. Effects of virtual reality on pain during venous port access in pediatric oncology patients: a randomized controlled study. *Journal of pediatric oncology nursing*. 2021 Mar;38(2):142-51.
16. Shi S, Zhu R, Huang X, Qu Y, Liang Q, Lin Q, Chen Y, Li Q, Liao T, Xin M. Comparison of the effects of Valsalva maneuver, EMLA cream, and the combination of both in relieving pain of needle insertion on totally implantable access port: A randomized controlled study. *The Journal of Vascular Access*. 2023 Jun 19:11297298231169155.
17. Zhu Y, Niu S, Zhang Y, Zhang H, Chang J, Ye L. Effect of lidocaine spray on relieving non-coring needle

- puncture-related pain in patients with totally implantable venous access port: a randomized controlled trial. *Supportive Care in Cancer*. 2023 Aug;31(8):452.
18. Menekli T, Yaprak B, Doğan R. The effect of virtual reality distraction intervention on pain, anxiety, and vital signs of oncology patients undergoing port catheter implantation: a randomized controlled study. *Pain Management Nursing*. 2022 Oct 1;23(5):585-90.
 19. Lee M, Park W. The effect of visual information blocking nursing intervention on stress and anxiety during chemoport insertion in adult cancer patients of operation rooms. *Korean Journal of Adult Nursing*. 2018 Apr 1;30(2):194-205.
 20. Teichgräber UK, Pfitzmann R, Hofmann HA. Central venous port systems as an integral part of chemotherapy. *Deutsches Ärzteblatt International*. 2011 Mar;108(9):147.
 21. Piredda M, Biagioli V, Giannarelli D, Incletoli D, Grieco F, Carassiti M, De Marinis MG. Improving cancer patients' knowledge about totally implantable access port: a randomized controlled trial. *Supportive Care in Cancer*. 2016 Feb;24:833-41.
 22. Özden D, Çalışkan N. Turkish nurses' level of knowledge regarding implantable port catheter care. *Japan Journal of Nursing Science*. 2012 Jun;9(1):1-8.
 23. Hoa NT. Improving the knowledge of port-a-cath care for nurses; 2019.
 24. Downey D, Graber K, Lajoie D, Newman L, Weinstock P. Setting the Stage: Innovation in Port Access Education for Pediatric Emergency Nurses. *Journal of Emergency Nursing*. 2023 Jul 1;49(4):631-9.
 25. Mersal NA, Sofar SM, Elnakshabandy E. Effect of educational guidelines on nurses' performance regarding prevention of port-a-catheter complications among patients undergoing chemotherapy. *International Journal of Novel Research in Healthcare and Nursing*. 2019;6(2):1296-310.

Original Article

The Local Tradition of Gorontalo and Health Anthropology: Gorontalo's Experience in Addressing the COVID-19 Pandemic

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ABSTRACT

This paper explores the overlapping consensus between indigenous kinship practices and the spread of diseases. The COVID-19 pandemic has altered the community's way of life and behaviour, yet Gorontalo's indigenous kinship-based traditions contradict the implemented health protocols. Due to their foundation in the kinship system (ngala'a), these traditions necessitate everyday interactions among individuals. The clash between local traditions and health procedures leads to the widespread transmission of Covid-19. This research argues that relying on Gorontalo's traditions would increase the likelihood of community exposure to COVID-19, as shown by descriptive analysis. Therefore, it is fundamental to reassess the significance of traditions during the Covid-19 pandemic.

Keywords: Local Tradition, COVID-19, Culture, Pandemic, Gorontalo.

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INTRODUCTION

The Indonesian government reported the first confirmed cases of COVID-19 on March 2, 2020, two months after the World Health Organization (WHO) declared the epidemic a global concern on January 30, 2020. The rising number of cases has become alarming, with a daily increase reaching 2000¹. The data indicate that the pandemic is a health concern as it can spread to individuals of all age groups, with older individuals and those with preexisting health concerns being most vulnerable. In 2022, the Indonesian Ministry of Health declared that there were 6.04 million confirmed cases of COVID-19, resulting in 156,000 deaths, and the numbers continue to be rising. COVID-19 was declared to be eradicated between 2023 and 2024.

Tedros Adhanoaik Ghebreyesus, the Director-General of the WHO, states that while the pandemic has ended, its humanitarian impacts continue to affect all sectors of humankind². Therefore, the pandemic cannot be viewed solely as a health issue but encompasses political, economic, cultural, and societal concerns. Widisuseno and Sudarsih (2021) contend that this argument underpins their findings that disease outbreaks and socio-cultural aspects are interconnected³. They believe that the emergence of epidemics arises due to particular human activities, which in turn impact the socio-cultural life of the community. For instance, cholera results from unsanitary living conditions, while H5N1 (avian flu) is linked to inadequate farm management^{3,4}. Furthermore, in the 17th century, disease outbreaks led to thousands of deaths in Italy due

to issues with sanitation laws and personal hygiene⁵. These facts indicate that pandemics are complex issues involving health concerns and cultural or human behavioural factors prevalent at the time.

These patterns are akin to the Covid-19 pandemic that occurred in recent years. Initially, people perceived it as a health issue, necessitating using masks, frequent handwashing, and avoiding close contact with others as preventive measures. However, the virus has since become uncontrollable and mutated into various forms. Žižek (2020), a Slovenian philosopher and Marxist, argues that the Covid-19 pandemic, initially considered to be a health issue, quickly generates worldwide panic and dread, resulting in widespread scepticism and the growth of conspiracy theories⁶. It demonstrates that the epidemic has not only impacted health but has also adversely affected economics, cultures, politics, and the traditional values of indigenous tribes globally, which have existed for a long time.

Understanding these interrelated phenomena is anchored by linking them to human culture and society life. Pillay (2021) asserts that human civilisation is defined by institutionalised communal activities rather than individual ones⁷. Pillay acknowledges that more than focusing on personal objectives and achievements is needed to meet the wider requirements of the community. He emphasises group efforts by referring to the African proverb "*umuntu ngumuntu ngabantu*", which means 'I am because we are.' This proverb emphasises that human culture is defined by common ideals and connected through kinship systems, where individuals are assigned in particular circumstances and locations. It applies to everyday tasks and their interpretation and contemplation of specific occurrences, such as politics, economics, and society. Human culture influences every facet of human existence.

METHOD

This research method use a mixed-method approach combining qualitative and quantitative techniques. This approach allows for a comprehensive understanding of the cultural, social, economic, and political factors influencing the spread and management of COVID-19, particularly within the context of the Gorontalo community in Indonesia.

Qualitative methods such as ethnography, participant observation, and in-depth interviews would be essential for understanding the cultural norms, traditions, and practices within the Gorontalo community. Quantitative methods such as surveys and statistical analysis would complement qualitative findings by providing empirical data on the prevalence and impact of COVID-19 within the community. Comparative analysis could provide insights into how cultural traditions influence pandemic responses across different communities and regions

RESULT AND DISCUSSION

The Phrase of Corona Anthropology: An Approach to Understanding the Covid-19 Pandemic

However, in the earlier COVID-19 pandemic, customs that we thought were harmless contributed to the rise in case numbers. Therefore, since anthropology is about context, the author uses the phrase "Corona Anthropology" as terminology related to the relevance of anthropology in public health to explain the context of traditions during the pandemic⁸. This argument will be demonstrated inherently by examining the facts of the indigenous Gorontalo community, which heavily relies on communalism as its social principle. This principle is called *ungala'a* or "togetherness". Pateda (1977) claims that Ungala'a was originally interpreted as a "whole family" or a kinship structure centred on kinship, indicating that this concept was exclusive to individual families⁹. As the population of Gorontalo grew, *ungala'a* expanded to encompass the entire community. Ungala'a manifests in communal practices such as conversations, sharing feelings, and evolving towards cooperation. These activities involve gatherings that could potentially worsen the spread of the epidemic, as previously stated. Consequently, it is worth reflecting on to what extent traditions are worth preserving in times of crisis. This paper is presented to reflect on the journey of the pandemic and its connection to Gorontalo's local traditions.

Covid-19 first emerged in Wuhan, China, when someone consumed a certain food from a seafood restaurant. However, Covid-19 has precedence throughout history. It pertains to the history of humanity, both social and biological, ancient and modern times¹⁰.

Throughout history, the evolution of viruses has been closely linked to human interactions, spanning from the Justinian Plague (541-543) to the Black Death (1347-1351), the Spanish and Asian Flu (1918-1959), and the ongoing pandemic in 2019¹¹. The transmission of infectious diseases originated during the shift from hunter-gatherer communities to agrarian societies approximately 12,000 years ago¹¹. The Proximal Origin of SARS-CoV-2, state that the virus came from animals and was passed to humans due to the widespread domestication of animals. Thus, in this process, there is a strong connection between the mode of production and the spread of the pandemic¹².

Communities' responses also play a role in influencing the cause of outbreaks. Communities' response to pandemics at this stage is influenced by the specific culture and traditions they adhere to. Humans are inherently sociable creatures. They engage in social interactions, forming groups, exchanging emotions, physical contact, and establishing relationships in daily activities. Socialising is currently viewed as advantageous. However, as Fuentes (2020) acknowledges, during the COVID-19 outbreak, "our sociality becomes the perfect pathway for virus invasion"¹⁰. The COVID-19 pandemic is influenced by the level of human contact in a particular moment and context. Global and national advisors prioritise policies aimed at 'flattening the curve' by enhancing the implementation of public health measures to prevent and control infections. In doing so, the governments propose measures such as vaccinations, isolation, quarantine, and lockdowns to restrict non-essential commercial activities.

However, traditions might present difficulties as well. In Gorontalo, traditions like *ungala'a* symbolise a traditional value of the community. *Ungala'a* refers to a system of familial relationships that establish kinship, as described by Pateda in 1977. This practice has not only been acknowledged but has been there since the beginning of Gorontalo's history. Its originality is derived from male and female ancestry, resulting in individuals being affiliated with multiple descent groups rather than one lineage or clan¹³. Once they discover common ground, these families construct ngala'a, or close-knit families, to build ties and sustain livelihoods¹⁴. Each ngala'a is headed by a male family leader who resides in traditional dwellings known as layihe. The family head is

called *Polulayihe*.

Over time, Ngala'a gradually transformed into lembo'o, which were neighbourhood associations referred to as Linula or little kingdoms, as documented^{13,15,16}. Each Linula is governed by an olongia, the leader, linked to bigger kingdoms known as lipu¹⁷. Nur (1979) stated that the creation of lipu was not a result of conquest but rather stemmed from each clan's realisation of the need to join and move away from tribalism¹³. Levi-Strauss (1969) argues that this awareness is a fundamental aspect of indigenous communities and existed before the field of anthropology¹⁸. Malinowski (1922) suggests that domestic institutions can adopt kinship if it helps meet the needs of society and govern social rights¹⁹.

Ungala'a as a Challenge in Pandemic Prevention: Gorontalo's Experience

In practice, Ungala'a as a cultural practice is carried out in two types of interactions that require physical and social contact since its inception. Firstly, Ungala'a serves as the foundation for personal interaction among individuals. This entails every time two people meet in daily life through actions such as teteyapuwa (showing concern), titiliya (being close), tata'apa (patting), kukubinga (gentle pinching). These interactions can occur in everyday life, even within very small communities. Secondly, Ungala'a extends to communal practices within the community. In this sense, Ungala'a becomes a form of social interaction conducted through activities such as dedepita (sharing food), bilohe (visiting, especially to the sick), huyula (collaboration), tayade (sharing), and so forth²⁰.

However, the kinship-based system during this pandemic may need to be reevaluated. There is an overlapping consensus between ungala'a traditions and the recommendations of protocols in pandemic management. Although physical contact is required for ungala'a, this contradicts the primary recommendations of global and national guidelines regarding the pandemic: avoiding physical gatherings. Referring to data from the UNG COVID-19 Crisis Centre during the Large-Scale Social Restrictions, there are three districts and cities with positive COVID-19 cases: Gorontalo Regency, Bone Bolango, and Gorontalo City²¹. When viewed from an epidemiological perspective at the village level, large local clusters formed in three areas:

Tumbihe, Padebuolo, and Bu'a.

These three areas are kambungu (villages), which, in Gorontalo's context, are administrative regions and socio-cultural spaces. In this sense, these three areas are snapshots of the pandemic spread caused by the practice of ungala'a, manifested in the form of despise (food sharing) and love (visiting), which are the main characteristics of the communities in these areas. This is compared to other areas, such as Tomolobutao, Libuo, and Dulalowo, which are categorized administratively as villages but cannot be considered kambungu. The main reason is that the cultural practices of ngala'a and mohuyula are less applied due to urbanization altering the social landscape of these areas. Therefore, these areas have lower social interactions. However, in Tumbihe, Padebuolo, and Bu'a, where ngala'a and mohuyula are practiced well, it tends to create higher social interactions, ultimately leading to a larger pandemic spread.

It is argued that the community's limited understanding and awareness of pandemic protocols still challenges the government. Therefore, how the country handles the pandemic faces significant threats from economic and political turmoil and the socio-cultural practices of the Gorontalo community that still maintain ungala'a. In this regard, ungala'a as the traditional basis of Gorontalo society will likely accelerate the spread to become massive. In line with this, Novry Susan argues that the responsiveness system in dealing with the pandemic relies on the workings of the state system and the reciprocity with the community^{3,22}. Therefore, it is also necessary to consider how the community responds to these regulations compared to implementing them unilaterally.

Another issue arises when the government implements the Large-Scale Social Restrictions (PSBB) policy to slow the outbreak through Governor Regulation Number 15 of 2020, dated May 5, 2021. The government's policy through the village is to provide direct cash assistance (BLT) to rural communities to cope with the economic crisis at the village level while also disciplining residents to comply with protocols. However, this does not reduce the activities and mobility of residents. Even though the government provides them with food assistance for several days, some of their problems still need to be solved. The government should have better interpreted the

assistance by distributing food in urban centres, causing crowds. This happened on April 7, 2020, when the Gorontalo Government tried to help drivers by distributing food in the city centre. However, they violated health protocols because the event caused crowds.

Compared to similar incidents in West Java, the distribution went very well because the government utilized online drivers to deliver assistance to those entitled to receive it²³. From this reality, the Gorontalo government faced limitations in managing how food supplies should be distributed. Ultimately, the government then apologized even though many criticized its inconsistency. However, on the other hand, even though we consider it an achievement in times of crisis, food assistance is temporary, so they still have to work and go to fields, gardens, seas, or lakes to meet their daily needs. In other words, no matter how sensible the government's regulations regarding pandemic prevention may seem, they will only be beneficial when considering the socioeconomic conditions of the community.

Rethinking Ungala'a: The Need for Local Solidarity

Zizek (2020) argues that only by strengthening global solidarity and increasing communal awareness can humanity confront the current threat⁶. He views global solidarity as the consciousness of being "together" by overcoming individualism, as individuals cannot face this pandemic alone. While Zizek's idea may seem utopian, as there is currently little concern for global cooperation, he cites America as a supposedly sovereign nation that still relies on China for various protective equipment such as masks and test kits. Therefore, the task is to ensure this solidarity network expands and reaches the most marginalized countries on earth struggling against this pandemic. Zizek's "global solidarity" notion can be extracted and elaborated into "regional solidarity" and even in a local context. In this regard, there is a need for cooperation and the fostering of solidarity among governments at every level through concrete steps to ensure the successful implementation of this idea.

Ungala'a and Mohuyula can be maintained if our trust in the government remains intact. This is certainly not easy, but it is also not utopian. The need for cultural engineering should be considered as one

alternative to instill in the community the understanding that COVID-19 is a pandemic and, as such, can only be addressed by maintaining the people's trust. Many economic and political issues can also be addressed as long as this cooperation (huyula) is strengthened by giving opportunities to every authority figure in the community, especially at the village level, to function effectively. Therefore, it does not mean that intervention against Covid-19 cannot be done. There is a way to reinterpret ngala'a to be adaptive in everyday community life. The government can make ngala'a a local mitigation strategy by conducting various studies and analyses.

First, it is advisable to offer an alternative understanding of ngala'a during crises. Everyone should now believe that because we are in a pandemic, health advice must be trusted for the sake of humanity. This advice should be consistent with Islam and Gorontalo customs because both have advocated for everyone to continue their lives. Ngala'a, built for hundreds of years, stands on the same boat. Secondly, Gorontalo has many influential figures (both in Islam and custom/bate), such as Qadhi, bate, and Imamu Kambungu (local preachers). These actors have a special position in society based on the knowledge and institutions that are listened to and obeyed by the community. In a pandemic situation, they are needed to support the government's advice regarding the pandemic. These actors need to be empowered and even given special authority in the village to increase awareness of the pandemic. This is the only way to survive this pandemic without disrupting cultural practices but reinterpreting them. Thirdly, customary institutions need to reconsider formulating ad hoc regulations for situations like pandemics requiring social interactions to be reduced or even restricted so that transformative formulations like these can be prepared for conditions such as during future pandemics.

CONCLUSION

In summary, the global pandemic in recent years transcends mere health concerns, entwining itself with society's political, economic, social, and cultural fabric. Despite concerted efforts, particularly in addressing mitigation challenges, navigating these

complexities is hindered by overlapping policies emanating from governmental and communal spheres. It is imperative to acknowledge that the fundamental issue lies in sustained cooperation. Hence, a pressing need arises to bolster solidarity and channel it towards local initiatives as the primary endeavour in confronting this pandemic.

REFERENCES

1. Nugraha B, Wahyuni LK, Laswati H, Kusumastuti P, Tulaar AB, Gutenbrunner C. COVID-19 pandemic in Indonesia: Situation and challenges of rehabilitation medicine in Indonesia. *Acta Med Indones.* 2020 Jul 1;52(3):299-305.
2. Mansoury, F. *The Socio-cultural Impact of COVID-19*. Paris, France: United Nations Educational, Scientific and Cultural Organization. 2020.
3. Widisuseno I, Sudarsih S. Responding to Cultural Challenges during the Covid-19 Pandemic as a Strategy to Build New Traditional Norms towards a Green Indonesia. In *E3S Web of Conferences 2021*, 317, p. 01053). EDP Sciences.
4. Clinic, M. *Bird Flu (Avian Influenza)*. 2015. Retrieved from <https://www.mayoclinic.org/diseases-conditions/bird-flu/symptoms-causes/syc-20368455#:~:text=Bird%20flu%20occurs%20naturally%20in,its%20nose%2C%20mouth%20or%20eyes.>
5. Roos, D. *How One 17th-Century Italian City Fended Off the Plague*. 2020. Retrieved from <https://www.history.com/news/plague-italy-public-health-ferrara#:~:text=The%20plague%20ravaged%20large%20cities,strikingly%2C%20some%20communities%20were%20spared.>
6. Žižek, S. *Pandemic! COVID-19 Shakes the World*. New York: OR Books. 2020.
7. Pillay I. Culture, politics and being more equal than others in COVID-19: some psychological anthropology perspectives. *South African Journal of Psychology.* 2021 Jun 1;51(2):325-35.

8. Hahn RA, Schoch-Spana M. Anthropological foundations of public health; the case of COVID 19. *Preventive Medicine Reports*. 2021 Jun 1;22:101331.
9. Pateda, M. *Kamus Bahasa Gorontalo - Indonesia*. Jakarta: Pusat Pembinaan dan Pengembangan Bahasa. 1977.
10. Fuentes A. A (bio) anthropological view of the COVID-19 era midstream: Beyond the infection. *Anthropology Now*. 2020 Jan 2;12(1):24-32.
11. Piret J, Boivin G. Pandemics throughout history. *Frontiers in microbiology*. 2021 Jan 15;11:631736.
12. Batubara B. *Teman Rebahan Kapitalisme dan COVID-19*. Yogyakarta: Penerbit Gading. 2020.
13. Nur, S. R. *Beberapa Aspek Hukum Adat Tatanegara Kerajaan Gorontalo Pada Masa Pemerintahan Eato (1673-1679)*. Makassar: Ph.D Thesis at Hasanuddin University. 1979.
14. Hunowu, M. A. *Linula Molalahu: Sejarah, Tradisi dan Kearifan*. Sumatera Barat: Kapalok. 2020.
15. Niode, A. M., & Elnino, M. H. *Abad Besar Gorontalo*. Gorontalo: The Pressnas Center. 2003.
16. Henley, D. *Fertility, Food and Fever: Population, Economy, and Environment in North and Central Sulawesi, 1600-1930*. Leiden: KITLV Press. 2005.
17. Amin B. Islam, budaya dan lokalitas Gorontalo. *Jurnal Sejarah Dan Budaya*, VII. 2012;7:1-6.
18. Levy-Strauss, C. *The Elementary Structures of Kinship*. London: Beacon Press. 1969.
19. Malinowski, B. *Agronauts of the Western Pacific*. New York: Routledge & Sons. 1922.
20. Tanipu, F. COVID-19, Penjarakan Sosial dan Perilaku Orang Sakit Gorontalo. In e. a. Funco Tanipu, *UNG Merespons Pandemi: Diskursus Tradisi, Pengetahuan dan Realitas Sosial Masyarakat Gorontalo* (pp. 56-62). Yogyakarta: Buku Litera. 2020.
21. Tanipu, F. PSBB, Tapi Kok Kasus Bertambah. In e. a. Funco Tanipu, *UNG Merespons Pandemi: Diskursus Tradisi, Pengetahuan dan Realitas Sosial Masyarakat Gorontalo* (pp. 109-114). Yogyakarta: Buku Litera. 2020.
22. Agung. *New Normal, Momentum Transformasi Sosial Budaya*. 2020. Retrieved from Universitas Gadjah Mada: <https://ugm.ac.id/id/berita/19479-new-normal-momentum-transformasi-sosial-budaya>
23. Dharmastuty, H., & Khalid, A. *Bagi-bagi Sembako Berujung Pelaporan*. 2021. Retrieved from News Detik: news.detik.com/berita/d-4982439/bagi-bagi-sembako-berujung-pelaporan-gubernur-gorontalo

Original Article

Impact of Media Stimulus Health Promotion Videos on Adolescents Risk of Smoking

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ABSTRACT

Adolescence is a transitional period, which causes physical, psychological, and social changes. Such changes tend to lead to susceptibility to delinquency in adolescents. One of delinquency begins with smoking behavior, the impact of nicotine on cigarettes can reduce the concentration and memory of adolescents, make someone become an addict or dependent on cigarettes, and can be a gateway to drug entry. Efforts to prevent smoking behavior can be carried out promotive actions through health education using Video Media, to improve good behavior towards preventing adolescent smoking risks. Basic Health Research in 2018 shows a high number of Indonesians who smoke. The number of active smokers of the population aged more than 15 years is 33.8%. Of these, 62.9% of men and 4.8% of women, meaning that two in three men are active smokers. The prevalence of smoking cases in adolescents of school aged 10 to 19 years has increased by 9.1%. In Talaud Islands District the data of daily smokers is 18.40%, smokers not every day 3.63%, do not smoke 77.78%, do not know about cigarettes 0.18%. This study aims to determine the effect of health promotion media stimulus, and smoking risk videos on adolescent behavior. The research method uses a quasi-experimental research design with Pretest and Posttest design with a Control Group Design. The study respondents were adolescents at risk of smoking with a category of 13 to 21 years with a sample of 80 respondents. Data analysis using statistical Wilcoxon signed rank test and significance level $p < 0.05$. 95% confidence level. The results of this study showed a significant value (2-tailed) of < 0.000 which means there is a significant effect of stimulus interventions media promotion health video smoking risk on adolescent behavior. The conclusion of this study shows that health promotion video media has an effect as a stimulus on the risk and dangers of smoking in adolescents.

Keywords: Stimulus-Response, Media Health Promotion video, Adolescent Behavior, Risk of Smoking.

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INTRODUCTION

Adolescence is a transitional period where it causes physical, psychological, and social changes. Such changes tend to cause delinquency in adolescents. One of delinquency begins with smoking behavior, the impact of nicotine on cigarettes can reduce the concentration and memory of adolescents, make someone become an addict or dependent on cigarettes, and can be a gateway to drug

entry. Smoking behavior is one of the complex health problems that occur in the World health environment¹.

Based on data from the World Health Organization, World Health Organization states that Indonesia ranks third among countries with the highest aggregate level of tobacco consumption in the world, then ranks first in ASEAN countries. ASEAN countries are a region with 10% of all world smokers and 20% of global causes of death due to smoking. The

percentage of smokers in the population in the largest ASEAN countries is Indonesia 46.16%, Philippines 16.64%, Vietnam 14.11%, Myanmar 8.72%, Thailand 7.74%, Malaysia 2.9%, Cambodia 2.07%, Laos 1.23%, Singapore 0.39%, and Brunei 0.04%. The increase in cigarette consumption has an impact on the increasing burden of disease caused by smoking and the increase in mortality due to smoking².

Basic Health Research in 2018 shows a high number of Indonesians who smoke. The number of active smokers of the population aged more than 15 years is 33.8%. Of these, 62.9% of men and 4.8% of women, meaning that two in three men are active smokers. The prevalence of smoking cases in adolescents of school age 10 to 19 years has increased by 9.1%. This is related to the nature of adolescents who are more likely to take risks, higher curiosity, and environmental influences³.

Based on data from the Central Statistics Agency of North Sulawesi (BPS) in 2020, it shows that data on smokers in Manado, North Sulawesi in 2020, who stated every day 18.44%, who stated not every day 3.18%, and those who did not smoke 73.53%, did not know about cigarettes 4.85%. In 2021, it shows that data on smokers in Manado, North Sulawesi, namely daily smokers 19.79%, smokers not every day 3.45%, do not smoke 73.75%, do not know about cigarettes 3.01%. The results showed an increase in smokers in North Sulawesi at the age of 15 years and over according to districts and cities. In Talaud Islands Regency, the data on daily smokers is 18.40%, smokers not every day 3.63%, do not smoke 77.78%, do not know about cigarettes 0.18%^{3,18}.

The category of adolescents is individuals aged 13 years to 21 years. This transition phase has an impact on the vulnerability of adolescent health status. Related to how a teenager can go through the transition period and stay healthy and live a quality life, of course, health services are needed that are oriented towards the process of controlling juvenile delinquency and controlling diseases caused by environmental factors such as smoking, so that there is an improvement in adolescent health.

Smoking is a lifestyle of adolescents that can cause psychological changes into addiction that causes diseases of the respiratory system where nicotine levels and carbon levels increase in the blood resulting in decreased oxygen levels in the blood so that smoking can cause shortness

of breath, the risk of lung cancer and coronary heart disease

The concept of stimulus response (S-R) is an effort to change knowledge and attitudes to overcome the problem of juvenile delinquency smokers. Researchers use stimulus response theory as a Health Education program related to knowledge and attitudes of adolescents to overcome smoking problems in transitional age. By using stimulus response theory, there will be an increase in awareness and attitude and behavior in overcoming the problem of smoking^{4,19,33}.

There are various kinds of health promotion media that can be used, but not all of them can be applied to all ages. Need a medium to facilitate the understanding of the information provided and used as a reminder even though it is not in the process of providing health education.

Video is a media that can present factual and fictitious messages that are informative, educative and instructional. Videos are excellent learning aids, videos can overcome the lack of skills in reading and language acquisition, overcome visual limitations, videos are also very good for explaining a process by using slow repetition of movements to clarify descriptions and illustrations, attract attention, stimulate and motivate target groups, videos are excellent for presenting theory and practice, saving time for explanations.⁵ This research hypothesis analyzes the impact of health promotion video media stimulus on adolescent smoking behavior.

METHOD

The research design used in this study was using the *Quasi Experiment method with the design of "Pretest-posttest control group design"* The research method is quasi-experimental because the research sample used is a non-random technique and it is not possible for researchers to place research subjects in a pure laboratory situation that is free from the influence of other factors and uses class groups of school children.

The population in this study is each subject studied. The population in this study was 392 male students. Sampling technique by *means of simple random sampling* with the number of samples in the study taken using the slovin formula, which is as many as 80 respondents. The research sample that meets the

inclusion criteria requirements is male adolescents who are at risk of smoking aged 13-21 years, class X and XI. Exclusion criteria for sick teenage students, permission and unwillingness to be respondents

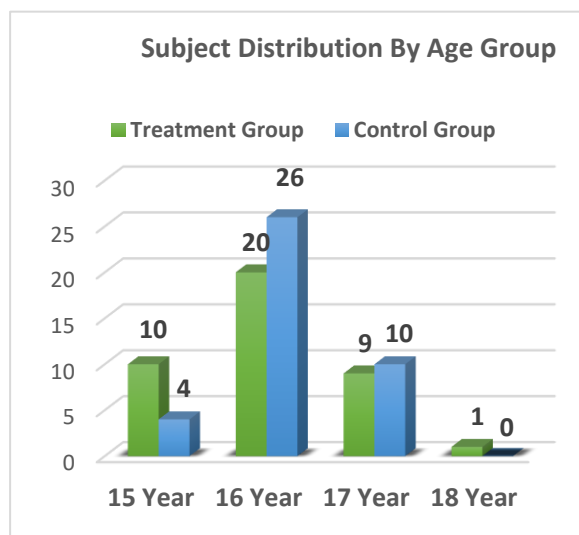
The content of the health promotion video media message is the dangers of smoking for teenagers as a stimulus that can influence teenagers' behavior to change their non-smoking behavior

The instrument in this study is the Health Promotion Media Stimulus Video. The video in this study is a set of projections that are easy for a group of teenagers to understand. The health promotion media video used in this study has a duration of 3 minutes 40 seconds. The first minute opens with a projection video describing the origin of the research institution, then the next minute explains the definition of smoking, the dangers of smoking and the impact of smoking. The questionnaire in this study consisted of 2 (two), namely about adolescent behavior and video media stimuli containing.

Before conducting the research, the researcher proposed a research ethics protocol to the health research ethics commission (KEPK) of the Manado Ministry of Health Polytechnic and received a letter of research approval. During the research, the researcher explained the purpose of the research and asked for consent from the teenagers' willingness to act as respondents by distributing an informed consent form.

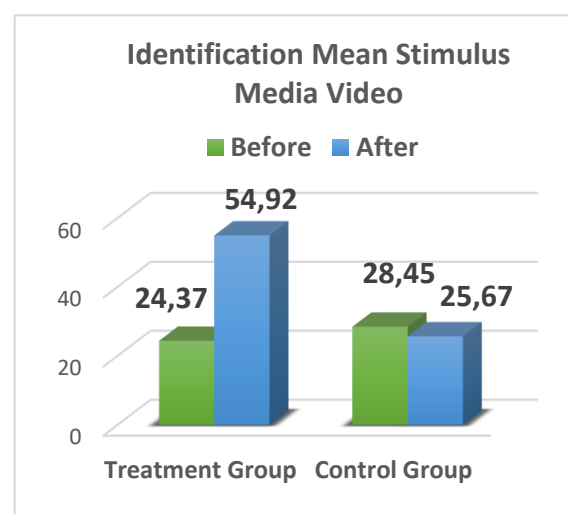
RESULT AND DISCUSSION

Grafik 1. Distribution of Respondents according to Age in Groups of Treatment and Control



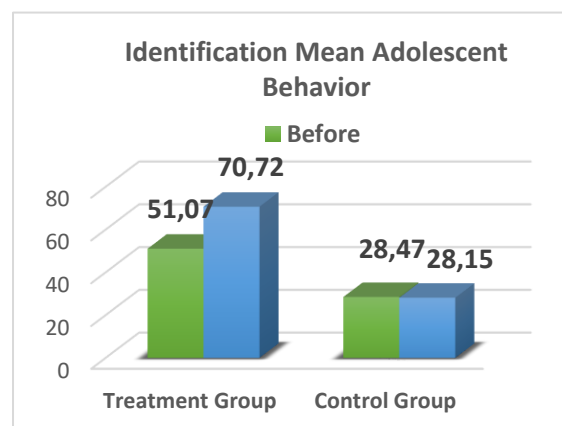
Graph 1. Explain about the distribution of age group respondents. The most age characteristics in the treatment group were 16 years with a percentage of 60.0% (n = 20) and the least age was 18 years with a percentage of 2.0% (n = 1). In the control group, the highest age was 16 years with a percentage of 65.0% (n = 26) and at least 15 years old with a percentage of 10.0% (n = 4).

Graph 2. Average Distribution of Video Health Promotion Media Stimulus in Treatment and Control Groups.



Graph 2. Displays the average stimulus score of Health promotion media videos before and after. In the treatment group, there was an increase in reara score from 24.37 to 54.92 with a mean difference of 30.55. Then the average score in the control group from 28.45 to 25.67 with a mean difference of 2.78 showed that the average score in the control group decreased with a mean difference of 2.78.

Graph 3. Identifying Average Adolescent Behavior in the treatment and corolls



Graph 3. Describes the average behavior score before and after the increase and decrease. In the treatment group, the average value was 51.07 to 70.72 with a mean difference of 19.65. Then the average media score in the control group from 28.47 to 28.15 with a mean difference of 0.32.

Table 1. Results of Statistical Test of Differences in Media Stimulus, Health Promotion, Video and Adolescent Behavior Before and After in the Treatment Group.

Treatment Group			
Stimulus Media Video		Adolescent Behavior	
<i>z</i>	<i>Asymp. Sig. (2-tailed)</i>	<i>z</i>	<i>Asymp. Sig. (2-tailed)</i>
-5,520 ^b	,000	-5,251 ^b	,000

Table 1. It shows that both the treatment group and the control group have very significant results where the (p value = 0.00<0.05). This research uses the Wilcoxon signed rank test statistic

Table 2. Results of Statistical Test of Differences in Media Stimulus, Health Promotion, Video and Adolescent Behavior Before and After in the Control Group.

Control Group			
Stimulus Media video		Adolescent Behavior	
<i>z</i>	<i>Asymp. Sig. (2-tailed)</i>	<i>z</i>	<i>Asymp. Sig. (2-tailed)</i>
-,816 ^c	,414	-,231 ^c	,817

The results of table 2 show that both the treatment group and the control group showed insignificant results where the (p value >0.05). This research uses the Wilcoxon signed rank test statistic

RESULTS AND DISCUSSION

Adolescence is a phase that can allow significant changes, not only in physical form, but also in thought and action. In adolescence they have a tendency to be exposed to cigarettes. In this study, both the treatment group and the control group were generally at the age of 16 years. The older enough, the influence of changes in attitudes and behavior towards

individuals will experience a level of maturity in thinking and acting. This is in line with previous research by in their research it was explained that the higher a person's age, the easier they are to receive information and in the end the more knowledge they have. The more knowledge a person will influence in determining his behavior. According to Hurlock, adolescence is divided into three phases of age limitation, namely: Early adolescence phase in the age range from 12-15 years, middle adolescent phase in the age range of 15-18 years and late adolescent phase in the age range of 18-21 years^{6,22,30}

Media is a tool to channel messages from sender to receiver so that it can stimulate students' thoughts, feelings, attention and interests in such a way that a process of change occurs. In this study, the average stimulus of health promotion media video of smoking risk before and after treatment in the treatment group increased. Then the average stimulus score of health promotion media video smoking risk in the control group decreased. The concept of stimulus response (S-R) is an effort to change behavior to overcome the problem of juvenile delinquency smokers. Researchers use stimulus response theory as a behavior-related health education program to overcome smoking problems in adolescents in transitional age. The use of stimulus response theory in this study, can increase awareness in behaving and behaving to overcome the problem of smoking in adolescents. Health promotion is a process that can improve a person's health status. Health promotion can be given to all targets, but must use appropriate methods so that the information provided can be received properly. Video is an excellent medium to overcome the lack of reading skills and language acquisition, overcome visual limitations, video is very good for explaining a process by using slow repetition of movements to clarify descriptions and illustrations, attract attention, stimulate and motivate the target group, videos are excellent for presenting theory and practice, saving time for explanation. This result is in line with previous research by^{7,20} Suggesting that video health promotion is a very effective medium with significant results.

Human behavior is an individual reaction manifested by action or activity to a certain stimuli. In this case the stimulus is cigarettes. The average behavior score in the intervention group, there was an increase and the average

behavior score in the control group decreased. The control group decreased because at the time of data collection the condition of respondents was less conducive because the time of data collection by researchers was quite short, so the control group respondents rushed to fill out questionnaires. This is supported by the test anxiety theory: This theory states that high levels of anxiety during testing can impair cognitive performance, including knowledge and understanding. Respondents who were rushed and anxious when collecting data in the control group could experience a decrease in knowledge due to anxiety that interfered with their thought processes. This is also in line with previous research.⁸ Found that time constraints can affect the quality of assessments, and the presence of perceived time pressures can worsen assessment results.

Health promotion media stimulus videos are media that rely on the sense of hearing and the sense of sight. Video media is one of the media that can increase the interest of teenagers in learning because they can listen as well as see pictures. The results of statistical tests in this study show that there is a difference. This also agrees with⁹, which shows an increase in behavior in extension activities using audio-visual media. Researchers argue that behavior change is caused by a learning process with the aim of behavior change. Exposure to video media risks of smoking can affect adolescents by changing their perceptions and attitudes towards smoking habits. Through the use of powerful messages and evocative visuals, video media can influence teens to consider quitting or reducing their smoking habit.

Education influences human behavior, if the acceptance of new behavior is based on knowledge, awareness, positive attitude, then the behavior will be lasting^{10,23,28} Video media health promotion stimuli have a significant influence on adolescent smoking-related behavior. Exposure to video media that illustrates the risks of smoking can increase interest, desire, and positive attitudes towards smoking in adolescents. The results of statistical tests in this study show that there is a difference. This is in line with previous research^{11,21} which argues that After the intervention completion, there was a significant positive effect of the community-based health promotion intervention program in improving adolescents tobacco smoking knowledge, attitude, intention and behavior.

In the control group, the video media stimulus did not have significant results due to the absence of health promotion interventions. The results of statistical tests in this study were no different. This is in line with a study conducted^{12,25,26} examining the influence of video media on the risk of smoking on adolescent behavior in a control group. The results showed that there was no significant effect between exposure to video media and smoking behavior in the control group. The findings support the argument that video media had no effect on adolescent smoking behavior in the control group.

In the process of behavior change, it appears that behavior can change if the stimulus given exceeds the original. In examining the new behavior there are three important variables, namely attention, understanding and acceptance. The results of this study showed no difference in adolescent behavior before and after in the control group. This is because the control group was not given a video health promotion media stimulus. The response or change depends on the process to the individual. The stimulus that is the message conveyed to the communicant can be accepted or rejected. Furthermore, this theory says that behavior can change only if the stimulus (stimulus) given really exceeds the original stimulus^{13,29}

Behavior is an action or response that can be observed and measured in an individual or group. Behavior includes actions, attitudes, or responses that can be seen, heard, or observed tangibly by others. The control group did not improve behavior because the control group did not receive the stimulus intervention given. This is in line with previous research^{14,20}, researchers argue that there is no influence of audio-visual media on the control group.

This shows that currently there are still many adolescents who are not informed about the risks of smoking at a transitional age. Because Talaud District is in the category of underdeveloped, outermost and deepest areas where in certain villages telecommunication access, information is difficult to reach and there are almost no healthy behavior promotion personnel, therefore health information related to adolescent health is still a taboo. Based on the results of statistical tests of health promotion media stimulus, video before and after media in the treatment and control groups showed a difference. There was a difference in the two groups because the treatment group was given a

video health promotion media stimulus, and the control group was not given treatment, therefore there was a difference between the treatment and control groups. Where there was a significant influence on the treatment group, while in the control group there was no influence. This is in line with previous research by ^{15,27,31} where the intervention group had an effect on increasing knowledge in the intervention group and there was no significant increase in the control group.

Behavior is an individual's response or reaction to stimuli and the environment. Behavior change is caused by a learning process with the aim that behavior changes occur, namely from not knowing to knowing, from not understanding to understanding and unable to become capable. Education influences human behavior, if the acceptance of new behavior is based on knowledge, awareness, positive attitude, then the behavior will be lasting. Thus, the higher a person's level of knowledge, the more precise it is in determining behavior and the faster it will be to achieve the goal of improving the degree of health. To determine the behavior of respondents need knowledge which is the result of knowing that occurs after people sense a certain object. Sensing occurs through the senses of sight, smell, taste, touch, and most human knowledge is taken through the eyes and ears ^{16,24} The results of statistical tests of adolescent behavior before and media after in the treatment and control groups showed a difference. There was a difference in the two groups because State 1 Beo senior high school was given a health promotion media stimulus video, and the state 1 Melongguane senior high school group was not given treatment, therefore there was a difference between the treatment and control groups. There was a significant influence on the treatment group, while in the control group there was no significant effect. This is supported by research conducted ^{17,32,35} where statistical test results show a significant influence. So it can be concluded that H_{a1} is accepted and H_{o1} is rejected which means that there is an effect of health promotion media stimulus smoking risk videos on adolescent behavior in the treatment group, and these media can be categorized as effective. This is because the information obtained after counseling can be well received and equipped with interesting stories and pictures so that respondents more clearly receive information.

Based on the research results, it shows that the group of teenagers who were treated showed a significant influence compared to the control group. Health promotion video media as a stimulus response for adolescents who smoke who can change their behavior after watching and listening to health promotion video media. adolescents can know the dangers of smoking for health. The results of this research require a policy from the school to program socialization using health promotion video media as a stimulus or stimulate teenagers to pay attention and motivate themselves not to smoke because it is very dangerous for health and for schools to create healthy school programs.

CONCLUSION

Based on the results of the discussion of the effect of stimulus, health promotion media, videos, the risk of smoking on adolescent behavior, conclusions were drawn about the age characteristics of respondents in this study, both the treatment group and the control group, generally at the age of 16 years. There was an increase in the average video health promotion media stimulus in the treatment group and there was a decrease in the average video health promotion media stimulus in the control group. There was an increase in the average behavior of adolescents after being given the stimulus of video health promotion media in the treatment group and there was a decrease in the average behavior of adolescents in the control group. There were significant differences in the health promotion stimulus of video media before and after in the intervention group. There were significant differences in adolescent behavior after being given the health promotion stimulus of video media before and after in the intervention group. There were no significant differences in health promotion media before and after videos in the control group. There were no significant differences in smoking risk behavior in the control group. There was a significant effect of video media health stimulus on adolescent smoking risk behavior after the intervention. There was no significant effect of health media promotion media video stimuli on adolescent smoking risk behavior in the control group.

Health promotion video media as a stimulus response for teenagers who smoke who can change their behavior after watching

and listening to health promotion video media. adolescent can know the dangers of smoking for health. The results of this research require a policy from the school to program socialization using health promotion video media as a stimulus or stimulate adolescents to pay attention and motivate themselves not to smoke because it is very dangerous for health and for schools to create healthy school programs.

REFERENCES

1. Suluge NW. Hubungan Fungsi Afektif Keluarga Dengan Perilaku Merokok Pada Remaja Di Desa Kalongan Utara Kecamatan Kalongan Kabupaten Talaud Sulawesi Utara. *Jurnal Ilmiah Kesehatan Manado*. 2022;1(3).
2. World Health Organization (WHO) tahun 2019.
3. Kementerian Kesehatan Republik Indonesia, 2018. <https://www.kemendes.go.id/article/view/210601000002/peringati-hari-tampa-tembakau-sedunia-kemendes-targetkan-5-juta-masyarakat-berhenti-merokok.html>
4. Zulham M. Pengaruh Metode Stimulus Respon terhadap Daya Serap pada Pembelajaran Keterampilan Berbicara. *Jurnal Onoma: Pendidikan, Bahasa, dan Sastra*. 2021 May 20;7(1):203-12.
5. Gunawan D. Pengaruh Promosi Kesehatan Dengan Media Video Terhadap Pengetahuan Hipertensi Pada Masyarakat Di Wilayah Kerja Puskesmas Telaga Dewa Kota Bengkulu: Promosi Kesehatan. *Jurnal Prosehatku*. 2023 Jan 31;2(1):38-44.
6. Dharmawati IG. Hubungan tingkat pendidikan, umur, dan masa kerja dengan tingkat pengetahuan kesehatan gigi dan mulut pada guru penjas kes di Kecamatan Tampak Siring Gianyar. *Jurnal Kesehatan Gigi (Dental Health Journal)*. 2016;4(1):1-5.
7. Widiyansyah M. Faktor-faktor penyebab perilaku remaja perokok di desa sidorejo kabupaten penajam paser utara. *Journal Sosiologi*. 2014;2(4):1-2.
8. Kang, S, dkk. Impact of time constraints on judgment quality: The moderating role of perceived time pressure. *The Journal of Applied Business Research*, 2014, 30(3), 869-886.
9. [https://www.google.com/search?sca_esv=586734894&sxsrf=AM9HkKIFWiH3ktjUKm8TzY4q7rR4Sgyw:1701387839706&q=10.+Kang,+S,+dkk+\(2014\).+Impact+time+constraints](https://www.google.com/search?sca_esv=586734894&sxsrf=AM9HkKIFWiH3ktjUKm8TzY4q7rR4Sgyw:1701387839706&q=10.+Kang,+S,+dkk+(2014).+Impact+time+constraints)
10. Amir A, Sipahutar RA, Putri FE, Hubaybah H. The Effect of Health Promotion Media on Knowledge of Work Safety and Health of Students of 3 State Vocational School, Jambi City. *International Journal Of Health Science*. 2023 Jun 16;3(2):45-53.
11. Notoatmodjo, S. Promosi Kesehatan dan Ilmu Perilaku. Jakarta : Rineka Cipta. 2007. <https://fik.um.ac.id/wpcontent/uploads/2020/10/2.->
12. Tahlil T. The Effects of A Community-based Health Program on Adolescents' Smoking Prevention-A Quasi-Experimental Study. *International Journal of Nursing Education*. 2023 Jan 1;15(1).
13. Siregar S, Sandika TW. Pengaruh Media Audio Visual pada Sikap Remaja tentang Bahaya Merokok. In *SINTAKS (Seminar Nasional Teknologi Informasi Komputer dan Sains 2019)* 2019 Dec 30 (Vol. 1, No. 1, pp. 557-563).
14. Notoatmodjo, S. Promosi Kesehatan dan Perilaku Kesehatan. Jakarta : Rineka Cipta. 2014. <https://inlislite.lebakkab.go.id/opac/detail-opac?id=6782>
15. Sinundeng OM, Engkeng S, Ratag BT. Pengaruh Media Audio Visual terhadap Pengetahuan dan Sikap Peserta Didik tentang Bahaya Merokok di SMA dan SMK Lirung Talaud. *KESMAS: Jurnal Kesehatan Masyarakat Universitas Sam Ratulangi*. 2020;9(7).
16. Aeni N, Yuhandini DS. Pengaruh Pendidikan Kesehatan dengan media video dan metode demonstrasi terhadap pengetahuan sadari. *Jurnal care*. 2018;6(2).
17. Notoatmodjo, S. Metodologi Penelitian Kesehatan. Jakarta : Rineka Cipta. 2010. <https://opac.perpusnas.go.id/DetailOpac.aspx?id=197163>
18. Kurniawati, D. Pengaruh Penyuluhan Kesehatan Dengan Media Audio Visual Terhadap Perilaku Merokok Pada Remaja di SMPN 1 Sawoo, Engineering, 1516

- Construction and Architectural Management, 2020. <http://eprints.umpo.ac.id/8376/>,
19. Badan Pusat Statistik Provinsi Sulawesi Utara, 2020. <http://sulut.bps.go.id>, Sulawesi Utara (2022).
 20. Cookson, M.D. and Stirk, P.M.R. Strategi Komunikasi Stimulus Respon, Ilmu Komunikasi, 2019, 2651 <https://jurnal.usk.ac.id/JPSI/issue/download/2018/356>
 21. Edison RE, Anisa YH, Fauzy FR. Analysis Of Visual Attention Among Smoker And Non-Smoker By Using Human Eye Tracker Of Health Graphic Warning On Tobacco Package. Jurnal Kesehatan Masyarakat Andalas. 2021 Nov 14;15(2):3-7.
 22. Giskes K, Kunst AE, Benach J, Borrell C, Costa G, Dahl E, Dalstra JA, Federico B, Helmert U, Judge K, Lahelma E. Trends in smoking behaviour between 1985 and 2000 in nine European countries by education. Journal of Epidemiology & Community Health. 2005 May 1;59(5):395-401.
 23. Hurlock, B. E. Perkembangan anak jilid 1. Jakarta: Erlangga. 1991. <https://onesearch.id/Author/Home?author=Elizabeth+B.+Hurlock>
 24. Jennie dkk. Foundations For Health Promotion, Fourth Edition, ISBN 9780702054426, Elsever Ltd. 2009. https://books.google.com/books/about/Foundations_for_Health_Promotion.html?id=edYFogEACAAJ
 25. Komar F. Pengaruh Komunikasi Interpersonal Orangtua dengan Anak Terhadap Kenakalan Remaja Pada Siswa: Studi Kasus SMP Negeri 2 Salapian. Cendikia: Media Jurnal Ilmiah Pendidikan. 2020 Sep 30;11(1):20-38.
 26. Mamat M, Mujiburrahman M. Pengaruh Media Audio Visual Terhadap Sikap Kecanduan Merokok Pada Siswa Kelas X Di Smk Negeri 1 Jonggat Tahun Pelajaran 2021/2022. Transformasi: Jurnal Penelitian dan Pengembangan Pendidikan Non Formal Informal. 2023 Jan 18;8(2):94-101.
 27. Mobley LR, Finkelstein EA, Khavjou OA, Will JC. Spatial analysis of body mass index and smoking behavior among WISEWOMAN participants. Journal of women's health. 2004 Jun 1;13(5):519-28.
 28. Nabihah, L. *Factors Causing Student'S Anxiety Theory To Face National Exami-Nation*. Prespektif Ilmu Pendidikn, 2012. 25,16–32.
 29. Nasution, IK. Perilaku Merokok Pada Remaja. Tesis. Medan : Fakultas Kedokteran Universitas Sumatera Utara Program Studi Psikologi. 2007.
 30. Pohan ZA, Siregar MF, Sembiring NS. Strategi masyarakat menghadapi perilaku buruk remaja. Khazanah: Journal of Islamic Studies. 2022 Feb 5:1-5.
 31. Porcellato L, Dugdill L, Springett J, Sanderson FH. Primary schoolchildren's perceptions of smoking: implications for health education. Health Education Research. 1999 Feb 1;14(1):71-83.
 32. Puspandhani, M, E, S. Metode Penelitian Kesehatan. 2020.
 33. Surabaya, U.M. Perilaku Individual. 2022.
 34. Wicaksono RR, Aniriani GW, Nasihah M. Penggunaan stimulus response theory dalam sosialisasi budaya kesehatan dan keselamatan kerja di perusahaan. Jurnal EnviScience (Environment Science). 2017;1(1).
 35. Widiensyah M. Faktor-faktor penyebab perilaku remaja perokok di desa sidorejo kabupaten penajam paser utara. Journal Sosiologi. 2014;2(4):1-2.
 36. Yarmaliza Y, Fitriani F, Farisni TN, Syahputri VN, Zakiyuddin Z, Reynaldi F. Edukasi Pemberdayaan Peran Remaja dalam Menjaga Kesehatan Lingkungan di Wilayah Pesisir. JPAI: Jurnal Perempuan Dan Anak Indonesia. 2020 Sep 1;2(2):10-5.

Original Article

The Potential of Kalelo Yogurt as Supplementary Foods to Prevent Stunting

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ABSTRACT

This study aims to determine the potential of kalelo yogurt as supplementary feeding to prevent stunting. This type of research was pre-experimental with the Post-test only design method with the yogurt formula treatment. The statistical analysis used was Complete Randomized Design (CRD) 3 X 2 followed by Duncan test to see the difference in each formulation. And the organoleptic test of kalelo yogurt was processed using the Analysis Of Variant (ANOVA) test and Duncan test to see the level of difference significant at a level of 0.05. Results: The best formula of kalelo yogurt based on nutrient content was F1, which was consumed simultaneously with other foods to increase its nutritional value. While organoleptic tests showed F3 as the best product, with a rating level of (somewhat dislike-neutral). Based on the test results, the panelists still did not like kalelo yogurt very much, as it can be seen from the results of panelist evaluations ranging from somewhat dislike to neutral (4-5). This could be due to the aroma, taste and texture that were different from a solid yogurt. With increasing incubation time, microbial activity increases and the number of microbes increases, resulting in the pH of the medium decreasing. The best kalelo yogurt product from organoleptic and nutrient content was F3 and F1, respectively. The nutritional, energy and micronutrient content of the three formulas were not significantly different. To fulfill the nutritional needs of sufficient numbers requirements, pregnant women are advised to consume several times a day accompanied by other foods.

Keywords: PMT (supplementary feeding), Yogurt, Pregnant Women, Breastfeeding Mother, Jackfruit Seeds (*Arthocarpus heterophilus*), Soybeans (*Glycine max L. Mer*), Daun kelor (*Moringa oleifera*).

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INTRODUCTION

Stunting is a condition that is caused by lack of nutritional intake and not in accordance with the needs in a long time, causing chronic malnutrition. Malnutrition at an early age increases infant and child mortality, causing sufferers to easily get sick and have a posture that is not optimal when they are adults. Mothers were advised to increase food intake during pregnancy, by paying attention to the food consumed such as enriching the diversity of nutrients which can improve the outcomes of mothers and babies ^{1,2,3-10,11}. In addition, in the

process after pregnancy, namely the breastfeeding stage, Exclusive breastfeeding (EBF) is critical to a newborn's survival, development, and growth ¹²⁻¹⁶.

Indonesia is one of the developing countries that still faces the problem of stunting. Based on the results of the Indonesian Nutritional Status Survey 2022, 35% of Indonesian toddlers were in the short category, with the highest percentage in the provinces of West Sulawesi ¹⁷. The government seeks to improve nutritional status to prevent stunting through various activities under the Provision of

Supplementary Foods for Pregnant Women, by meeting the needs through additional food or drinks that are high in macronutrients and micronutrients. Material selection for the supplementary food should be based on community interest. Food that will be processed into additional food for pregnant women should be the same as the food habits of pregnant women every day.

Indonesia is rich in micronutrient sources that are still not maximally processed. Local foods that can be developed into Supplementary Feeding products include jackfruit seeds (*Artocarpus heterophilus*), soybeans (*Glycine max* L. Mer), and Moringa oleifera leaves. These indigenous ingredients offer significant potential for enhancing nutritional intake and addressing dietary deficiencies in various communities. Given the critical role of nutrition in preventing stunting among children, it's essential to explore innovative ways to incorporate these nutrient-rich foods into daily diets. One such approach is through the production of yogurt, which can serve as an accessible and nutritious option for young children. By harnessing the benefits of yogurt fortified with ingredients like jackfruit seeds, soybeans, and Moringa oleifera leaves, communities can proactively combat stunting and promote healthy growth and development among children. Soybeans have a high protein content which can be processed into various types of processed products, one of which is soy milk. In 100g of soybeans, it contains energy of 286 kcal, protein 30.2g, fat 15.6g and carbohydrates 30.1g¹⁸. Soy milk is currently being used as an alternative substitute for cow's milk. In addition to containing calcium, soybeans also contain phytoestrogens which are almost the same as estrogen which serves to help absorption of calcium in the blood although when substituting fortified soy-based alternatives, the nutrients already added to commercially available goods can effectively make up for the lack of milk and dairy products¹⁹. Jackfruit seeds are beneficial for growth and provide other benefits for humans²⁰⁻²². Soybeans²³, moringa oleifera²⁴⁻²⁸ and yoghurt²⁴ is believed to be effective in preventing stunting.

Moringa is known throughout the world as a nutritious plant and WHO has introduced moringa as an alternative food to overcome malnutrition. Herbal medicine has employed moringa oleifera for it is anti-

bacterial, anti-inflammatory, antioxidant, anticancer, and antidiabetic properties²⁹. Protein and minerals are found in moringa oleifera leaves. All parts of the moringa plant have nutritional value, efficacious for health and benefits in the industrial sector. The high nutritional value, efficacy and benefits caused the moringa to be nicknamed as the Mother's Best. Moringa leaves are rich in amino acids, minerals and antioxidant content.

The micronutrients content of moringa is 7 times vitamin C of orange, 4 times vitamin A of carrots, equal to 4 glasses of calcium from milk, 3 times potassium of bananas, and equal to protein content in 2 servings of yoghurts. Therefore, moringa has the potential as a probiotic drink for health drinks, or added to its nutritional food while iron-containing moringa leaves can be used as an alternate food source to address the issue of malnutrition³⁰.

Based on the information above, researchers felt that further research was needed to see the potential of local food ingredients to be processed into beverage formulas with the purpose of determining the potential of kalelo yogurt as supplementary foods to prevent stunting.

METHOD

This was a pre-experimental research with the Posttest only design method. The treatment used in this study was yogurt formula. The resulting yogurt will be seen as having an effect on the nutritional content of carbohydrates, proteins, fats and minerals Calcium (Ca) and Phosphorus (P) and organoleptic levels. The design of the main raw material formulations for instant functional drinks is as shown in Table 1.

Table 1. Yogurt formulas in 100% kalelo

Ingredients	Formula		
	F1	F2	F3
Sari Soybean (1:6)	40	35	50
Sari Jackfruit (1:6)	40	50	35
Moringa extract	20	15	15
Skim Milk	10	10	10
Sugar	10	10	10
Stater	10	10	10

The level of preference / organoleptic test was carried out by 30 panelists. Laboratory test results on nutrition were tested statistically

using a Completely Randomized Design (CRD) 3 X 2 followed by Duncan test to see the difference in mineral content of each formulation significantly at the level of α 0.05. Data on the level of preference / organoleptic results from instant functional drinks were processed statistically using the Analysis of Variant (ANOVA) test and continued with the Duncan test to see the different levels of organoleptic tests from each formulation significantly at the α level of 0.05.

RESULTS

Table 2. Average carbohydrate, protein, fat, calcium, phosphorus content in three types of kalelo yogurt formulas

Nutritional content	F1	F2	F3
Carbohydrate (%)	6.91 ^a	5.685 ^b	5.265 ^c
Protein (%)	3.85 ^a	3.65 ^a	2.68 ^b
Fat (%)	2.095 ^a	2.08 ^a	2.08 ^a
Calcium (mg/kg)	269.91 ^a	262.72 ^a	267.44 ^a
Phosphorus (%)	0.0885 ^a	0.083 ^b	0.0885 ^a

Footnote description:

Carbohydrate (F1=a, F2=b, F3=c)

Protein (F1=a, F2=a, F3=b)

Fat (F1=a, F2=a, F3=b)

Calcium (F1=a, F2=a, F3=b)

Phosphorus (F1=a, F2=b, F3=a)

Table 3. The average level of preference of panelists (flavour, taste, texture and acidity) of three types of kalelo yogurt formulas

	F1	F2	F3
Flavour	3.61 ^a	4.48 ^a	5.26 ^b
Taste	4.13 ^a	4.77 ^a	4.68 ^a
Texture	5.29 ^a	5.29 ^a	5.55 ^a
Acidity level	3.90 ^a	4.68 ^a	4.77 ^a

Footnote description:

Average level of preference of panelists (flavour, taste, texture and acidity)

F1=a, F2=a, F3=c

Table 4. The total energy of three kalelo yogurt formulas in 100 ml / serving

For mula	Energy sources	Content (%)	Energy (kcal/g)
F1	Carbohydrate	6.91	27.64
	Protein	3.85	15.4
	Fat	2.095	18.855
Total Energy			61.895
F2	Carbohydrate	5.685	22.74

	Protein	3.65	14.6
	Fat	2.08	18.72
Total Energy			56.06
F3	Carbohydrate	5,265	21.06
	Protein	2,68	10.72
	Fat	0,09	0.81
Total Energy			32.59

Table 5. Percentage of nutrition adequacy standard of the kalelo yogurt formula based on the snack needs of pregnant women

For mula	Energy sources	Product Content	Nutrition adequacy standard number first trimester pregnant women (19-29th)	30% Nutrition adequacy standard number first trimester pregnant women(19-29th)
F1	Energy	61.895 kcal	2430 kcal	729
	Carbohydrate	6.91 g	334 g	100.2
	Protein	3.85	76 g	22.6
	Fat	2.095	81 g	24.3
	Calcium	26.991	1300 mg	390
	Phosphorus	0.0885 g	0 mg	0
F2	Energy	56.06 kcal	2430 kcal	729
	Carbohydrate	5.685 g	334 g	100.2
	Protein	3.65 g	76 g	22.6 g
	Fat	2.08 g	81 g	24.3
	Calcium	26.272 mg	1300 mg	390
	Phosphorus	0.083 g	0 mg	0
F3	Energy	32.59 kcal	2430 kcal	729
	Carbohydrate	5.265 g	334 g	100.2
	Protein	2.68 g	76 g	22.6
	Fat	0.09 g	81 g	24.3
	Calcium	26.744 mg	1300 mg	390
	Phosphorus	0.0885 g	0 mg	0

DISCUSSION

Based on the data obtained it is known that in terms of the nutritional content of Formula 1 (F1) is the best formula because it has the highest nutrient content compared to Formula 2 (F2) and Formula 3 (F3). This could be due to the composition of the F1 formula which was greater than the other 2 formulas.

Based on the test results, the kalelo yogurt formulas were not well-received by the panelists, as seen from the results of panelist evaluations ranging from somewhat dislike-neutral⁴⁻⁵. This could be due to the aroma, taste, texture that were not similar to normal yogurt which is usually much denser. The texture of kalelo yogurt was not dense but thick, which could be attributed by the bioactive compounds found in moringa which accelerated yogurt fermentation by promoting growth of lactic acid

bacteria³⁹. Besides, the aroma and taste of the yogurt may be different due to a mixture of jackfruit seeds, soybeans, and moringa that give different flavor and aroma from pure milk yogurt, which may not be familiar among the panelist. However, a study conducted in South Korea showed that moringa extract-supplemented yogurt was well received and exerted positive health benefit³⁹.

Lactic acid is produced from the lactose fermentation process by lactic acid bacteria which gives a distinctive sour taste to yogurt. Additionally, the majority of yogurt's texture depends on the type of bacteria that makes it and its content. Yogurt combines the health benefits of raw materials with the beneficial effects of its culture starter and numerous other active bacterias. The bacteria in this yogurt must remain active throughout the fermentation process to effectively break down the sugars present in the milk. This breakdown process not only contributes to the texture and taste of the yogurt but also enhances its nutritional value by increasing the availability of beneficial nutrients and probiotics. Therefore, ensuring the continued activity of these bacteria is essential for producing high-quality yogurt with optimal flavor and health benefits³¹⁻³⁷. With increasing incubation time, microbial activity increases and the number of microbes increases, resulting in the pH of the medium decreasing. This proves the occurrence of chemical changes in the sugar component into an acid component.

The use of yogurt as to Supplementary Foods or Supplementary Feeding Product to prevent stunting is calculated as an additional menu (snack) for pregnant women so that it is expected to meet the needs of 30% daily RDA of pregnant women. Analysis of RDA percentage of kalelo yogurt showed that the taste of kalelo yogurt is influenced by the amount of acid produced during the fermentation process. The longer the fermentation process will produce more acid. The lactic acid was produced from the fermentation process through the breakdown of sugar, so that the higher acidity level, the sweetness of the product will decrease. The 48-hour fermentation produced high enough lactic acid content so that the sour taste was more dominant than the sweetness which caused the panelists to be somewhat not favoring the product.

The texture of kalelo yogurt was not too creamy, but thick. This was influenced by the

composition of the ingredients used and the amount of skim milk added. Addition of Moringa leaf extract, jackfruit seed juice and soybean juice and incubation time affected the viscosity of the yogurt. The degree of acidity of milk decreases causing milk protein, namely casein, to coagulate. The best formula that approached the needs of 30% of daily RDA of pregnant women was F1 formula. However, since it still not reaching the target of 30% daily RDA of pregnant women, other sources of nutrition will still need to be added. Based on regulation of the Minister of Health of the Republic of Indonesia number 28 of 2019, trimester 1 pregnant women in the age range of 19-29 years will require additional energy of 180 kcal from 2250 kcal, additional protein of 1g of 60g, total fat of 2.3g of 65g, and additional carbohydrates of 25g from 360g, 200mg calcium from 1000 mg and. To meet these additional needs, it is recommended for pregnant mothers to consume kalelo yogurt as a daily snack together with other foods.

One practical recommendation to implement the findings in dietary interventions is to develop educational programs targeting pregnant and breastfeeding mothers. These programs can focus on promoting the consumption of kalelo yogurt as a nutritious snack option. Additionally, healthcare providers can offer personalized dietary counseling sessions to pregnant women, emphasizing the importance of incorporating kalelo yogurt into their daily diet to meet their nutritional needs. Furthermore, collaborations with local community organizations can be established to distribute kalelo yogurt samples and organize cooking demonstrations to encourage its consumption. By integrating these strategies, stakeholders can effectively promote the adoption of kalelo yogurt as a dietary intervention to prevent stunting among vulnerable populations.

CONCLUSION

The best formula which contains the highest amount of nutrient content is Formula F1, with the nutrient content, energy and micronutrients of the three formulas not too different. The best preference of kalelo yogurt product is F3 formula with ratings ranging from 4-5 (somewhat non-neutral). It was concluded that the acid produced was too high which affects the final results of the organoleptic test.

The suggestion is to address the identified shortcomings in the research design, proposed measures include the implementation of stricter designs, such as randomized controlled trials (RCTs), as well as an improvement in sample size and more adequate representation. Consequently, future research can yield results that are more trustworthy and relevant to informing sustainable policy and clinical practices.

REFERENCES

1. Chasekwa B, Ntozini R, Church JA, Majo FD, Tavengwa N, Mutasa B, et al. Prevalence, risk factors and short-term consequences of adverse birth outcomes in Zimbabwean pregnant women: a secondary analysis of a cluster-randomized trial. *Int J Epidemiol* [Internet]. 2022 Dec 13;51(6):1785–99. Available from: <https://academic.oup.com/ije/article/51/6/1785/6454750>
2. Farid Lewa A, Muliani M. Effect of video-based intervention of nutritional knowledge of pregnant women in the first 1000 days of life in Banggai Regency. *Gac Med Caracas* [Internet]. 2022 Jul 11;130(2):350–6. Available from: http://saber.ucv.ve/ojs/index.php/rev_gmc/article/view/24056
3. Fahmida U, Pramesthi IL, Kusuma S, Wurjandaru G, Izwardy D. Problem Nutrients and Food-Based Recommendations for Pregnant Women and Under-Five Children in High-Stunting Districts in Indonesia. *Curr Dev Nutr* [Internet]. 2022 May;6(5):nzac028. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S247529912200049X>
4. Ropitasari, Yunita FA, Hutomo CS, Kartikasari MND, Parwatiningsih SA, Hardiningsih, et al. The effect of peer counseling on knowledge and motivation of pregnant women in stunting prevention. In: *Improving Health for Better Future Life: Strengthening from Basic Science to Clinical Research* [Internet]. London: CRC Press; 2023. p. 295–9. Available from: <https://www.taylorfrancis.com/books/9781032693408/chapters/10.1201/9781032693408-48>
5. Isdiany N, Rahmat M, Pramintarto Eko Mulyo G, Judiono. Two Eggs A Day Can Increase Choline Intake and Size of Mid Upper Arm Circumference (MUAC) in Pregnant Women in Indonesia. *Curr Nutr Food Sci* [Internet]. 2024 Feb;20(2):198–204. Available from: <https://www.eurekaselect.com/216012/article>
6. Muhamad Z, Mahmudiono T, Abihail CT, Sahila N, Wangi MP, Suyanto B, et al. Preliminary Study: The Effectiveness of Nutrition Education Intervention Targeting Short-Statured Pregnant Women to Prevent Gestational Stunting. *Nutrients* [Internet]. 2023 Oct 9;15(19):4305. Available from: <https://www.mdpi.com/2072-6643/15/19/4305>
7. Ciulei MA, Smith ER, Perumal N, Jakazi CS, Sudfeld CR, Gernand AD. Nutritious Supplemental Foods for Pregnant Women from Food Insecure Settings: Types, Nutritional Composition, and Relationships to Health Outcomes. *Curr Dev Nutr* [Internet]. 2023 Jun;7(6):100094. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S2475299123247678>
8. Sudaryati E, Zuska F, Masthalina H. Strengthening Food Security Reduces The Anemic Status of Pregnant Women and Encourages Breastfeeding Immediately after Delivery in the Coastal Area of Central Tapanuli. *Curr Res Nutr Food Sci J* [Internet]. 2023 Apr 25;11(1):445–55. Available from: <https://www.foodandnutritionjournal.org/volume11number1/strengthening-food-security-reduces-the-anemic-status-of-pregnant-women-in-the-coastal-area-of-central-tapanuli/>
9. Sudarmi. Integrated antenatal care services with breastfeeding counseling practices to improve pregnant women's knowledge, skills and readiness for exclusive breastfeeding. *Bali Med J* [Internet]. 2023;12(1):1147–51. Available from: <https://api.elsevier.com/content/abstract>

10. t/scopus_id/85153876736
Arero G. Undernutrition and associated factors among pregnant women in East Borena Zone, Liban District, Oromia regional state, Ethiopia. *Front Nutr* [Internet]. 2022 Dec 16;9. Available from: <https://www.frontiersin.org/articles/10.3389/fnut.2022.1008701/full>
11. Musaidah M, Syam A, Wahyu A, Hadju V, Sudargo T, Abdullah AZ, et al. The Influence of Giving Biscuits of Yellow Pumpkin Seed and Capsule of Moringa Leaves on the Level of C-Reactive Protein on Pregnant Women. *Int J Des Nat Ecodynamics* [Internet]. 2022 Aug 31;17(4):627–32. Available from: <https://www.iieta.org/journals/ijдне/paper/10.18280/ijдне.170419>
12. Yilak G, Gebretsadik W, Tadesse H, Debalkie M, Bante A. Prevalence of ineffective breastfeeding technique and associated factors among lactating mothers attending public health facilities of South Ari district, Southern Ethiopia. Young MF, editor. *PLoS One* [Internet]. 2020 Feb 11;15(2):e0228863. Available from: <https://dx.plos.org/10.1371/journal.pone.0228863>
13. Hasan M, Hassan M, Khan MS, Tareq M, Afroj M. Prevalence, knowledge, attitudes and factors associated with exclusive breastfeeding among mothers in Dhaka, Bangladesh: A cross-sectional study. *Popul Med* [Internet]. 2021 Sep 7;3(September):1–7. Available from: <http://www.populationmedicine.eu/Prevalence-knowledge-attitudes-and-factors-associated-with-exclusive-breastfeeding,140132,0,2.html>
14. Shofiya D, Sumarmi S, Sulistyono A, Suyanto B. Determinants of successful exclusive breastfeeding on primiparas mothers. *J Public Health Africa* [Internet]. 2023 May 25;14. Available from: <https://www.publichealthinafrica.org/jphia/article/view/2614>
15. Kaiza R, Joho AA. The effect of low-fidelity simulation training on breastfeeding knowledge, practice, and self-efficacy among young lactating mothers in Tanzania: A quasi-experimental study. Cheptum JJ, editor. *PLoS One* [Internet]. 2023 Nov 28;18(11):e0285392. Available from: <https://dx.plos.org/10.1371/journal.pone.0285392>
16. Kasmita K, Tasrif N, Darlis Santi T. Stunting in Toddlers (6-60 Months): Parenting Pattern, Mother's Education Level, Infectious Diseases, and Breastfeeding. *J Kesehat Masy* [Internet]. 2023 Apr 30;18(4):564–70. Available from: <https://journal.unnes.ac.id/nju/index.php/kemas/article/view/41433>
17. Kemenkes. Buku Saku Hasil Survey Status Gizi Indonesia (SSGI) Tahun 2022. Kemenkes [Internet]. 2022;1–7. Available from: <https://www.litbang.kemkes.go.id/buku-saku-hasil-studi-status-gizi-indonesia-ssgi-tahun-2021/>
18. Kesehatan K. Food Composition Table—Indonesia (Daftar Komposisi Bahan Makanan) [Internet]. 2018. 135 p. Available from: https://repository.stikespersadanabire.ac.id/assets/upload/files/docs_1634523137.pdf
19. Taeger M, Thiele S. Replacement of Milk and Dairy Products with Soy-Based Alternatives—How to Avoid Nutrient Deficiencies in a Milk-Free Diet? *J Nutr* [Internet]. 2024 Jan;154(1):163–73. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S0022316623727211>
20. Anh Ngoc Le T, Jie Lin Lee J, Ning Chen W. Stimulation of lactic acid production and *Lactobacillus plantarum* growth in the coculture with *Bacillus subtilis* using jackfruit seed starch. *J Funct Foods* [Internet]. 2023 May;104:105535. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S1756464623001354>
21. Kumari A, Gupta A, Chauhan AK. Optimization of the iron-enriched extruded snack containing jackfruit seed flour, mung bean flour and ferrous ammonium phosphate by using response surface methodology. *Food Prod Process Nutr* [Internet]. 2022 Nov 28;4(1):31. Available from: <https://fppn.biomedcentral.com/articles>

22. /10.1186/s43014-022-00108-x
Nantongo JS, Mudondo S, Oluk R, Agaba H, Gwali S. Variation in seed and seedling traits of the different ethno-varieties of jackfruit, a potential fruit tree species for food security. *Trees, For People* [Internet]. 2022 Sep;9:100303. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S2666719322001108>
23. Helmizar, Sakinah R. Characteristics of Nutrients on Functional Bread with Additional Red Bean, Soy Bean, and Corn as Food Supplementation for Stunting Children Under Five. *IOP Conf Ser Earth Environ Sci* [Internet]. 2022 Apr 1;1018(1):012029. Available from: <https://iopscience.iop.org/article/10.1088/1755-1315/1018/1/012029>
24. Ponka R, Zhung PM, Zomegni G, Tchouape CG, Fokou E. Organoleptic and Physicochemical Properties of Soy-Milk Yoghurt Enriched with Moringa Oleifera Root Powder. *Glob Challenges* [Internet]. 2022 May 23;6(5). Available from: <https://onlinelibrary.wiley.com/doi/10.1002/gch2.202100097>
25. Wardana Ms, Jufri M, Mun'im A. Physicochemical Properties And Nutrition Of Moringa Oleifera Lam. Leaf Extract: A Preliminary Study On Preparation Phytosomes As Herbal Supplement For Children. *Int J Appl Pharm* [Internet]. 2022 Jan 7;14(1):281–7. Available from: <https://innovareacademics.in/journals/index.php/ijap/article/view/43477>
26. Zakaria, Sirajuddin, Veni H, Burhanuddin B, Rosmini, Suryani A, et al. Linear growth of infants aged 0-6 months in breastfeeding mothers who consume Moringa oleifera leaf extract capsules: randomized controlled doubleblind design. *Food Res* [Internet]. 2022 Sep 16;6(5):135–43. Available from: https://www.myfoodresearch.com/uploads/8/4/8/5/84855864/_15__fr-2021-720_zakaria.pdf
27. Arwansyah A, Lewa AF, Muliani M, Warnasih S, Mustopa AZ, Arif AR. Molecular Recognition of Moringa oleifera Active Compounds for Stunted Growth Prevention Using Network Pharmacology and Molecular Modeling Approach. *ACS Omega* [Internet]. 2023 Nov 21;8(46):44121–38. Available from: <https://pubs.acs.org/doi/10.1021/acsomega.3c06379>
28. Singh SK, Vemana K, Reddy MG, Rawat K, Sharma NK, Yadav JK, et al. First Report of Association of ‘Candidatus Phytoplasma asteris’ with Moringa oleifera Leaf Yellowing and Stunting Disease in India. *Plant Dis* [Internet]. 2023 Jun 1;107(6):1934. Available from: <https://apsjournals.apsnet.org/doi/10.1094/PDIS-09-22-2173-PDN>
29. Safrida S, Noviasyah N, Khairil K. Effects of Moringa oleifera Leaves Powder in Fish Feed Toward Growth Rate and Health of Colossoma macropomum. *Biosaintifika J Biol Biol Educ* [Internet]. 2020 Aug 1;12(2):186–91. Available from: <https://journal.unnes.ac.id/nju/index.php/biosaintifika/article/view/22655>
30. Arviyani TN, Afifah DN, Noer ER, Rahfiludin MZ, Mahati E. Sorbet Made from Moringa Leaves and Red Guava as an Alternative for the Management of Iron Deficiency Anemia in Adolescent Girls. *J Appl Food Technol* [Internet]. 2022 Dec 31;9(2):41–6. Available from: <https://ejournal2.undip.ac.id/index.php/jaft/article/view/15782>
31. Harper AR, Dobson RCJ, Morris VK, Moggré G. Fermentation of plant-based dairy alternatives by lactic acid bacteria. *Microb Biotechnol* [Internet]. 2022 May 8;15(5):1404–21. Available from: <https://sfamjournals.onlinelibrary.wiley.com/doi/10.1111/1751-7915.14008>
32. Ayivi RD, Ibrahim SA. Lactic acid bacteria: an essential probiotic and starter culture for the production of yoghurt. *Int J Food Sci Technol* [Internet]. 2022 Nov 27;57(11):7008–25. Available from: <https://ifst.onlinelibrary.wiley.com/doi/10.1111/ijfs.16076>
33. Fawzi NY, Abdelghani DY, Abdelazim MA, Shokier CG, Youssef MW, Gad El-Rab MK, et al. The ability of

- probiotic lactic acid bacteria to ferment Egyptian broken rice milk and produce rice-based yoghurt. *Ann Agric Sci* [Internet]. 2022 Jun;67(1):107–18. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S0570178322000136>
34. Huang W, Dong A, Pham HT, Zhou C, Huo Z, Wätjen AP, et al. Evaluation of the fermentation potential of lactic acid bacteria isolated from herbs, fruits and vegetables as starter cultures in nut-based milk alternatives. *Food Microbiol* [Internet]. 2023 Jun;112:104243. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S0740002023000308>
 35. Kılıç EE, Halil Kılıç İ, Koç B. Yoghurt Production Potential of Lactic Acid Bacteria Isolated from Leguminous Seeds and Effects of Encapsulated Lactic Acid Bacteria on Bacterial Viability and Physicochemical and Sensory Properties of Yoghurt. Memon SQ, editor. *J Chem* [Internet]. 2022 Jan 11;2022:1–10. Available from: <https://www.hindawi.com/journals/jchem/2022/2683126/>
 36. Tavşanlı H, Güner TE, Altundal B, Ektik N, İlhak Oİ. The effect of ultrasound process on lactic acid bacteria, physicochemical and sensory properties of yoghurt, before and after inoculation of starter cultures into milk. *Int J Dairy Technol* [Internet]. 2024 Feb 19;77(1):105–13. Available from: <https://onlinelibrary.wiley.com/doi/10.1111/1471-0307.13013>
 37. Kang YJ, Kim TJ, Kim MJ, Yoo JY, Kim JH. Isolation of Exopolysaccharide-Producing Lactic Acid Bacteria from Pa-Kimchi and Characterization of Exopolysaccharides. *Microbiol Biotechnol Lett* [Internet]. 2023 Jun 28;51(2):157–66. Available from: <http://www.mbl.or.kr/journal/view.html?doi=10.48022/mbl.2305.05004>
 38. RI KK. Angka Kecukupan Gizi (AKG) 2019. 2019; Available from: <https://stunting.go.id/kemenkes-permenkes-no-28-tahun-2019-angka-kecukupan-gizi-yang-dianjurkan/>
 39. Zhang T, Jeong CH, Cheng WN, Bae H, Seo HG, Petriello MC, Han SG. Moringa extract enhances the fermentative, textural, and bioactive properties of yogurt. *LWT - Food Sci. Technol.* 101 (2019): 276-284, Available from 10.1016/j.lwt.2018.11.010

Article Review

Innovative Strategies to Increase Public Awareness of the Importance of Physical Fitness to Health: Systematic literature review

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ABSTRACT

In this modern era, unhealthy living habits and lack of physical activity have led to increasing health problems related to physical fitness. Therefore, it is important to inspire people to be more aware of the importance of maintaining health and fitness. The purpose of this study discuss innovative strategies in increasing public awareness of the importance of physical fitness through the magic of motivation. This research uses a qualitative descriptive research model that is a literature study that uses various literature reviews to strengthen research analysis. This research began by collecting some literature, then conducted a review and the collected literature was analyzed with a critical Appraisal table of 10 literature. This study explores new and innovative motivational approaches to influence people to increase their awareness of physical fitness. Various motivational strategies, such as technology use, gamification, support communities, and promotion through social media, were analyzed in the context of increasing active participation in physical activity. The results of this study show that the implementation of innovative motivation strategies can have a significant effect in increasing public awareness of the importance of physical fitness. Technology can be used to track progress and provide motivation through apps and wearable devices. The use of game or gamification elements in fitness programs also helps increase community participation and engagement. The study concludes that innovative motivational strategies can work wonders in raising public awareness of the importance of physical fitness. With a creative and integrated approach, we can encourage behaviour change and help people to adopt healthier lifestyles, and maintain their health and fitness.

Keywords: Motivation, Innovative Strategy, Public Awareness, Physical Fitness, Public Health

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INTRODUCTION

Physical health is an integral aspect of the general well-being of individuals and society ¹⁻⁴. In this modern era, lifestyle changes and increased urbanization have led to an

increase in the number of lifestyle-related diseases, such as heart disease, diabetes, and obesity ⁵⁻⁷. Although information about the importance of physical fitness is available, public awareness of this is still not optimal. This lack of awareness results in high levels of

physical inactivity and unhealthy living habits, which in turn can have a negative impact on people's overall quality of life and health⁸⁻¹⁰.

In this context, innovative strategies are needed to increase public awareness of the importance of physical fitness to health^{11,12}. Engaging communities in these efforts is key, leveraging technology and creative approaches to achieve these goals. In addition, a holistic approach that not only highlights physical benefits but also mental and social well-being can have a greater positive impact. Therefore, the implementation of innovative programs, public campaigns, and the use of digital platforms can be a solution to change paradigms and shape people's behavior towards a more active and healthy lifestyle¹³⁻¹⁶.

In today's modern society, a sedentary lifestyle and unhealthy habits have become a serious challenge in maintaining physical health and fitness. Increasingly advanced technology, jobs that require a lot of time in front of the computer, and the tendency to rely on personal transportation have resulted in a significant decrease in physical activity. As a result, there has been an increase in health problems such as obesity, cardiovascular disease, and mental disorders¹⁷⁻¹⁹.

Public awareness of the importance of physical fitness is the key to overcoming this problem. However, it is often difficult to inspire people to prioritize health and increase participation in physical activity^{20,21}. Therefore, innovative strategies are needed that are able to motivate people to increase their awareness of the importance of physical fitness. With a creative and integrated approach, it is expected to create significant behavior changes and healthier lifestyles in society as a whole²²⁻²⁴.

In an effort to increase public awareness of the importance of physical fitness, various research and development of innovative motivational strategies have been carried out. One recent trend is the use of wearable technology, such as activity-tracking devices and heart rate monitors, which allow individuals to monitor and track their progress in real-time. In addition, the gamification approach, where game elements are applied in fitness programs to increase engagement and motivation, has shown promising results^{25,26}.

The use of social media is also an important factor, where promotion and support through online platforms can help build a community that supports each other in achieving fitness goals²⁷⁻²⁹. Nevertheless, there is still room for further research in exploring more effective and affordable motivational strategies, as well as to understand the psychological and social factors that influence people's motivation in raising awareness of the importance of physical fitness³⁰⁻³².

This research has a very sharp and powerful novelty and contribution in the context of people's motivation to raise awareness of the importance of physical fitness. The main novelty of this research is the integration of innovative motivational approaches in helping to overcome the challenges faced by modern society in maintaining health and physical fitness^{33,34}. This approach includes the use of wearable technology, gamification, and social media as integrated strategies to increase awareness and participation in physical activity. This integration creates a comprehensive and sustainable framework to motivate people to adopt healthier lifestyles³⁵⁻³⁷.

A significant contribution of this research is to provide deep insight into innovative motivational strategies that can be used in raising public awareness of the importance of physical fitness. Through a sharp evaluation, this study was able to identify the advantages and weaknesses of each motivation strategy applied^{38,39}. In addition, this study also analyzes psychological and social factors that influence people's motivation, thus providing a deeper understanding of how to influence individuals' behavior and mindset in adopting a healthy lifestyle. As such, this research provides a solid foundation for the planning and development of interventions that are more effective in raising public awareness and participation in physical fitness, with the potential to reduce the burden of physical inactivity-related diseases⁴⁰⁻⁴².

The in-depth interpretation of this study shows that innovative motivational strategies implemented have great potential to change people's behavior and mindset in recognizing the importance of physical fitness. The use of wearable technology, such as

activity-tracking devices, provides accurate information about an individual's physical activity in real-time^{43,44}. It allows individuals to see their own development, measure achievements, and motivate themselves to achieve set fitness goals. In addition, the gamification approach transforms fitness activities into more fun and challenging experiences by rewarding and recognizing individual achievements^{45,46}. In this regard, the study presents an in-depth interpretation of how the combination of technology and game elements can motivate people to be more active and participate in physical activity^{47,48}.

In addition, this study also reveals the importance of social support and interaction in increasing public awareness of the importance of physical fitness^{49,50}. The use of social media as a platform to share achievements, get inspired, and give support to each other has proven effective in building mutually supportive communities^{51,52}. Individuals can feel motivated by the success and commitment of others in achieving their fitness goals. This in-depth interpretation highlights the importance of building positive and supportive online communities in fostering behavior change and healthy lifestyles^{53,54}.

Furthermore, the interpretation of this study underscores the need for a holistic and integrated approach in increasing public awareness of physical fitness^{55,56}. An approach that brings together technology, gamification, and social media provides a comprehensive framework for influencing individual motivation on an ongoing basis. In this regard, a deep interpretation shows that only by adopting an integrated and holistic approach, can significant changes be created in people's behavior and mindset regarding physical fitness. Through this interpretation, the study provides a deeper understanding of the complexity of community motivation and provides practical guidance for stakeholders in designing effective and sustainable interventions to raise awareness of the importance of physical fitness.

The main objective of this review was to compile a systematic literature review that investigates innovative-strategies to raise public awareness of the importance of physical fitness for health. By digging into the latest scientific literature, the study aims to detail the

most effective approaches and methods in promoting awareness of the close relationship between physical fitness and well-being. Through a thorough analysis of research findings, we aim to identify recent trends, successes, and barriers that may be associated with raising public awareness of the importance of physical activity.

In addition, the study will look for innovative elements that can be used in developing new strategies or improving existing strategies to achieve better results in educating the public. Thus, the main objective of this study is to compile detailed guidelines that can guide health practitioners, policy makers, and other relevant parties in designing effective awareness campaigns to motivate people in adopting a healthy lifestyle with a focus on physical fitness.

METHOD

This research uses a qualitative descriptive research model that is a literature study that uses various literature reviews in strengthening research analysis. This research begins with collecting some literature, then reviewing some important terms in the research, then collecting relevant research literature, then conducting an analysis based on all the literature that has been obtained by compiling a discussion, then formulating conclusions based on the results that have been analyzed and submitting suggestions based on the conclusions obtained.

The data used in this study was using secondary data.⁵⁷ states that secondary data is data taken indirectly that can provide information to data collectors. The source of the data obtained is in the form of original scientific reports derived from published scientific articles and journals that have been accredited and indexed, both printed and non-print which are interrelated in the model of application of blended learning in physical education and sports.

The data collection method used in this study is the documentation method. The documentation method is a method of collecting data by digging and searching for data from the literature related to what is in the problem statement. Data that has been obtained from various literature is then collected as a

unified document that will be used in answering the problems that have been formulated.

Article search techniques in this study are through web access mendeley, google scholar, and science direct as well as on other journal search access with keywords learning models, blended learning, and physical education health sports. Articles or journals that match the criteria are then taken for further analysis and journal summary including the name of the researcher, year of publication of the journal, study design, research objectives, samples, instruments, and a summary of results or findings. The summary of the research journal is entered into a table sorted according to the alphabet and year of publication of the journal and in accordance with the format mentioned above. This literature review uses literature that can be accessed fulltext in pdf format and scholarly (peer reviewed Journal). To further clarify the abstract and full text, the journal is read and examined. The summary of the journal is analyzed on the contents contained in the research objectives and research results / findings. The analysis method used is journal content analysis.

RESULTS

This literature review was conducted to determine innovative strategies to increase public awareness of the importance of physical fitness to health. The collected literature was analyzed with critical appraisal tables to answer the measurement objectives compared to simple measurement results. There are as many as 10 literatures that discuss innovative strategies to increase public awareness of the importance of physical fitness to health, all of these journals are nationally accredited journals and international journals that are searched on the Google Scholar, Mendeley, Science direct.com portal by typing the keyword "innovative strategies to increase public awareness of the importance of physical fitness to health" which is then analyzed using critical appraisal analysis to analyze from the core of the journal, as well as the results or findings of these journals. The following is a table of critical appraisal analysis from 10 journals:

Researchers	Article Title	Research Results
58	Reflections on physical activity intervention research in young people – dos, don'ts, and critical thoughts	This paper critically evaluates, amongst others, current research practice regarding intervention development, targeting, active involvement of the target population, challenge of recruitment and retention, measurement and evaluation protocols, long-term follow-up, economic evaluation, process evaluation, and publication. It argues that funders and researchers should collaborate to ensure high quality long-term evaluations are prioritised and that a trial's success should be defined by its quality, not its achieved effect. Summary: The conduct and publication of well-designed evaluations of well-defined interventions is crucial to advance the field of youth physical activity promotion and make us better understand which intervention strategies may or may not work, why, and for whom.
59	The Use of Wearable Activity Trackers Among Older Adults: Focus Group Study of Tracker Perceptions, Motivators, and Barriers in the	The results suggest that activity trackers may be an effective technology to encourage physical activity among older adults, especially those who have never tried it. However, initial positive response to tracker use does not guarantee tracker use maintenance. Maintenance depends on recognizing the long-term benefits of tracker use, social support, and internal motivation. Nonadoption and relapse may occur because of technology's limitations and gaining

60	Maintenance Stage of Behavior Change Physical Activity and Healthy Lifestyle of the Community as an Effort to Maintain Health during the Covid-19 Pandemic	<p>awareness of one's physical activity without changing the physical activity level itself.</p> <p>The results of this study show that to prevent the spread of the COVID-19 virus, people have carried out physical activities such as gymnastics, leisurely walking, jogging, and cycling and carried out a healthy lifestyle by consuming nutritious foods, exercising regularly, wearing masks, and diligently washing hands. So it can be concluded that Physical Activity and Healthy Lifestyle of the Community as an Effort to Maintain Health during the Covid-19 Pandemic are quite effective with a percentage rate (78%).</p>
61	Efforts to Improve Physical Fitness Using Jigsaw-Type Cooperative Learning Model	<p>The application of the jigsaw-type cooperative learning model has a positive influence on increasing students' willingness to exercise.</p>
62	School Principal's Strategy in Implementing Clean and Healthy Living Behavior Program (PHBS) in Early Childhood	<p>The results of this study show that the principal's strategy in implementing clean and healthy living behavior programs that; First, the principal's efforts by conducting the situation analysis stage, understanding the values of clean and healthy living behavior, meeting program indicators, and conducting short and long term evaluations. Second, the role of the principal by implementing innovative policies and the role of the principal as a motivator. Third, the supporting factor is the enthusiasm of teachers and existing stakeholders and the inhibiting factor is the character of early childhood who is still a child. The implications of implementing the principal's strategy can protect students from various diseases and the like.</p>
63	Efforts to Improve Physical Fitness in Students of the Faculty of Teacher Education at the Indonesian Community Development University	<p>Based on the results of this learning, it can be concluded that there is an increase in physical fitness training in students of the Faculty of Teacher Training in Education (FKIP) through floor gymnastics at the Indonesian Community Development University.</p>
64	The behavior of sports activities towards improving physical fitness in the community	<p>The results obtained are to keep the body healthy and productive doing daily activities. So people must know what are the benefits and how to maintain physical fitness to stay fit and not experience fatigue.</p>
65	Socialization of Aerobic Gymnastics to Improve Physical Fitness of the Pamoyanan Community	<p>The results of the physical fitness test measurement, it was found that 65% of participants were in the category of moderate physical fitness level. This socialization helps people's understanding of well-programmed aerobic exercise will be able to improve physical fitness. So that people are motivated to do sports well and the desired results can be obtained optimally.</p>

66	Results of Community Service Aerobic Gymnastics Training to Improve Physical Fitness	The output results achieved in this activity are. (1) MTs AL Qodir and MA AL Qodir students have better physical fitness. (2) Knowing the science of sports, especially aerobic gymnastics, in addition to the religious knowledge studied has a healthy physique and physique. (3) Have a routine agenda every week of aerobic gymnastics activities so that the physical is better prepared to face the routine agenda of championships such as POPDA (Regional Student Sports Week), O2SN (National Student Sports Olympiad), POSPEDA (Regional Level Inter-Ponpes Art Sports Week), AXIOM (Madrasah Art and Sports Competition) which is the Friday morning gymnastics agenda. (4) National seminar presenters. (5) Seminars and publications of national journals.
67	Sports development in terms of the Sport Development Index: Aspects of Community Participation and Physical Fitness to Improve the Quality of Physical Education in Magelang City	The results of the index value in the participation index research in Magelang City are 0.0212324 and the physical fitness index in Magelang City is 0.2283, with the results of the index value of both aspects Magelang City in terms of the Sport Development Index is included in the low category due to the community does not have awareness about the importance of exercise and less attractive public sports facilities.

DISCUSSION

From the results of a literature study of 10 articles that have been reviewed and presented previously there are several related discussions that are mutually sustainable, this study discusses the magic of motivation and innovative strategies in increasing public awareness of the importance of physical fitness. In line with some of the results of previous research by ^{68,69} In the modern era dominated by a less active lifestyle, it is important to inspire and motivate people to be more caring and proactive in maintaining a healthy body through physical activity. The magic of motivation refers to the positive changes that can occur in people's behavior and mindset when they are strongly motivated. In the context of physical fitness, the magic of motivation includes a change from a sedentary lifestyle to regular exercise, driven by awareness of the health benefits gained ^{69,70}.

Innovative strategies include new and creative approaches in influencing people's motivations. This can include the use of wearable technology, such as activity-tracking

devices, that help individuals monitor and measure their progress in achieving fitness goals. In raising public awareness about the importance of physical fitness, a change in mindset is essential. Innovative strategies should pay attention to psychological factors and build positive beliefs that each individual is capable of achieving the desired changes in their lifestyle.

The use of wearable technology, such as smartwatches or activity-tracking devices, provides tangible benefits in raising public awareness about physical fitness. By tracking physical activity, heart rate, and sleep, individuals can understand their lifestyle and motivate themselves to improve their quality of life through exercise and fitness ^{71,72}. The gamification approach is an innovative method that involves the use of game elements in a

fitness program. Through awarding points, achievement levels, and rewards, individuals are incentivized to actively participate in physical activity and keep their motivation high⁷³⁻⁷⁵.

The use of social media as a tool to increase public awareness about physical fitness has proven effective. In this platform, individuals can share experiences, seek support, and get inspired by communities that share the same interest in fitness^{76,77}. Education and the provision of accurate and easy-to-understand information are key factors in raising public awareness of the importance of physical fitness^{78,79}.

By providing proper knowledge about the benefits of physical fitness, individuals can make better decisions in Physical Fitness for Optimal Health. Physical fitness has an important role in achieving optimal health. Increasing public awareness about the importance of physical fitness brings significant benefits, such as improving cardiovascular function, reducing the risk of heart disease, increasing muscle strength, boosting the immune system, and improving mental balance. With this increased awareness, people will be more motivated to take active steps in improving their physical fitness^{80,80,81}.

The Influence of Technology in Community Motivation, Technology has become a key factor in increasing people's motivation towards physical fitness. The use of wearable technology, such as activity-tracking devices and heart rate monitors, allows individuals to track their progress in real-time⁸²⁻⁸⁴. Features such as notifications and reminders also help boost motivation by reminding individuals to stay active and reach their daily activity goals^{85,85}. In this digital age, technology has great potential to be an effective tool in increasing public awareness and participation in physical fitness^{86,87}.

Gamification as an Attractive Motivational Approach, The gamification approach has shown its effectiveness in increasing people's motivation towards physical fitness. By combining game elements such as points, achievement levels, and rewards, gamification creates a fun and challenging experience in physical activity^{88,89}. This not only increases participation, but also helps change an individual's perception of

physical exercise into something more enjoyable and rewarding^{90,91,91}.

Social media has become a powerful platform in building a support community to raise awareness of physical fitness⁹¹⁻⁹³. Through social media, individuals can share their achievements, seek inspiration, and get support from others who share similar interests. These online communities provide a sense of mutual support and accountability, which motivates individuals to remain committed to their fitness goals^{94,95}.

Support from Interested Parties and the Physical Environment, To increase public awareness about the importance of physical fitness, support from interested parties and the physical environment also plays an important role. Education and promotion organized by government agencies, health institutions, schools, and community organizations can provide the necessary information and knowledge about the benefits of physical fitness^{96,96,97}. In addition, the construction of supportive physical environments, such as parks, bike paths, and affordable gyms, can also facilitate community participation in regular physical activity.

Through a systematic literature review, we can identify innovative strategies that have proven effective in raising public awareness. A key implication is the potential for the development of more focused disease prevention and health promotion programs, leveraging the latest findings and emerging trends. This research provides an in-depth look at successes and possible barriers in communicating the importance of physical activity. Stakeholders, including health practitioners and policymakers, can use these results to devise more effective information strategies, triggering positive behavior change in society.

In addition, the research provides a basis for the development of more innovative and engaging extension campaigns, ensuring health messages reach different demographic groups. Thus, the implications of this research create a solid foundation for the transformation of society towards healthier lifestyles, reducing the risk of disease, and promoting general well-being.

CONCLUSION

In an effort to raise public awareness of the importance of physical fitness, motivational miracles and innovative strategies play a crucial role. Through creative approaches, such as the use of wearable technology, gamification, and the use of social media, individuals can be encouraged to adopt an active lifestyle and maintain their body health. Support from interested parties, a supportive physical environment, as well as proper education about the benefits of physical fitness are also important factors in raising public awareness and participation. With this increased awareness, it is expected that there will be positive changes in lifestyle and overall public health.

REFERENCES

1. Riedel D, Lorke N, Mierau A, et al. The relationship between interhemispheric transfer time and physical activity as well as cardiorespiratory fitness in healthy older adults. *Exp Gerontol.* 2023;176:112167. doi:10.1016/j.exger.2023.112167
2. Muntaner-Mas A, Mora-Gonzalez J, Cabanas-Sánchez V, et al. Prospective associations between physical fitness and executive function in adolescents: The UP&DOWN study. *Psychol Sport Exerc.* 2022;61:102203. doi:10.1016/j.psychsport.2022.102203
3. Marcos-Pardo PJ, Espeso-García A, Abelleira-Lamela T, Machado DRL. Optimizing outdoor fitness equipment training for older adults: Benefits and future directions for healthy aging. *Exp Gerontol.* 2023;181:112279. doi:10.1016/j.exger.2023.112279
4. CAUWENBERGHS N, HADDAD F, DAUBERT MA, et al. Clinical and Echocardiographic Diversity Associated With Physical Fitness in the Project Baseline Health Study: Implications for Heart Failure Staging. *J Card Fail.* 2023;29(11):1477-1489. doi:10.1016/j.cardfail.2023.04.008
5. Rand M, Goyder E, Norman P, Womack R. Why do new members stop attending health and fitness venues? The importance of developing frequent and stable attendance behaviour. *Psychol Sport Exerc.* 2020;51:101771. doi:10.1016/j.psychsport.2020.101771
6. Franklin BA, Wedig IJ, Sallis RE, Lavie CJ, Elmer SJ. Physical Activity and Cardiorespiratory Fitness as Modulators of Health Outcomes: A Compelling Research-Based Case Presented to the Medical Community. *Mayo Clin Proc.* 2023;98(2):316-331. doi:10.1016/j.mayocp.2022.09.011
7. Haverkamp BF, Hartman E, Oosterlaan J. Physical fitness and psychosocial health in a sample of Dutch adolescents. *Prev Med Reports.* 2022;25:101689. doi:10.1016/j.pmedr.2021.101689
8. Allesøe K, Lau CJ, Buhelt LP, Aadahl M. Physical activity, self-rated fitness and stress among 55,185 men and women in the Danish Capital Region Health survey 2017. *Prev Med Reports.* 2021;22:101373. doi:10.1016/j.pmedr.2021.101373
9. Lindgren M, Börjesson M. The importance of physical activity and cardiorespiratory fitness for patients with heart failure. *Diabetes Res Clin Pract.* 2021;176:108833. doi:10.1016/j.diabres.2021.108833
10. Franklin BA, Eijsvogels TMH, Pandey A, Quindry J, Toth PP. Physical activity, cardiorespiratory fitness, and cardiovascular health: A clinical practice statement of the American Society for Preventive Cardiology Part I: Bioenergetics, contemporary physical activity recommendations, benefits, risks, extreme exerci. *Am J Prev Cardiol.* 2022;12:100424. doi:10.1016/j.ajpc.2022.100424
11. Franklin BA, Eijsvogels TMH, Pandey A, Quindry J, Toth PP. Physical activity, cardiorespiratory fitness, and cardiovascular health: A clinical practice statement of the American Society for Preventive Cardiology Part II: Physical activity, cardiorespiratory fitness, minimum and goal intensities for exercise train. *Am J Prev Cardiol.* 2022;12:100425. doi:10.1016/j.ajpc.2022.100425
12. Razaghizad A, McKee T, Malhamé I, et

- al. Mobile Health Fitness Interventions: Impact of Features on Routine Use and Data Sharing Acceptability. *JACC Adv.* 2023;2(8):100613. doi:10.1016/j.jaccadv.2023.100613
13. Gråstén A, Kolunsarka I, Huhtiniemi M, Jaakkola T. Developmental associations of actual motor competence and perceived physical competence with health-related fitness in schoolchildren over a four-year follow-up. *Psychol Sport Exerc.* 2022;63:102279. doi:10.1016/j.psychsport.2022.102279
14. Fraser BJ, Blizzard L, Rovio SP, et al. Tracking of Cardiorespiratory Fitness and Physical Activity from Youth to Young Adulthood: Findings from the Prospective Special Turku Coronary Risk Factor Intervention Project (STRIP). *J Pediatr X.* 2023;9:100085. doi:10.1016/j.ympx.2023.100085
15. Felin Fochesatto C, Cristi-Montero C, Ribeiro Bandeira PF, et al. A network analysis involving mental difficulties, cognition, physical fitness, 24-hour movement components, fatness, and sociodemographic factors in children. *J Exerc Sci Fit.* 2023;21(4):416-423. doi:10.1016/j.jesf.2023.10.001
16. Morgan KA, Heeb R, Flynn A, et al. An observational study of personal and environmental factors associated with attendance at a community-based adaptive fitness center for adults with physical disabilities. *Disabil Health J.* 2022;15(4):101342. doi:10.1016/j.dhjo.2022.101342
17. Pranata D. Pengaruh Olahraga Dan Model Latihan Fisik Terhadap Kebugaran Jasmani Remaja: Literature Review. *J Kesehatan Olahraga.* 2022;10(02):107-116.
18. Agus A. Olahraga Kebugaran Jasmani: Sebagai Suatu Pengantar. Published online 2012.
19. Mulyadi A, Rifki MS. Pengaruh Senam Terhadap Kebugaran Jasmani Lansia. *J Stamina.* 2021;4(3):113-124.
20. Hartanti D, Mawarni DRM. Hubungan konsumsi buah dan sayur serta aktivitas sedentari terhadap kebugaran jasmani kelompok usia dewasa muda. *Sport Nutr J.* 2020;2(1):1-9. doi:10.15294/spnj.v2i1.38073
21. Sinuraya JF, Barus JBNB. Tingkat kebugaran jasmani mahasiswa pendidikan olahraga tahun akademik 2019/2020 Universitas Quality Berastagi. *Kinestetik J Ilm Pendidik Jasm.* 2020;4(1):23-32. doi:10.33369/jk.v4i1.10359
22. Chaeroni A, Ma'mun A, Budiana D. Aktivitas Fisik: Apakah Memberikan Dampak Bagi Kebugaran Jasmani dan Kesehatan Mental? *Sport Saintika.* 2021;6(1):54-62. doi:10.24036/sporta.v6i1.163
23. Oktaviani NA, Wibowo S. Survei tingkat kebugaran jasmani siswa smp negeri di Madiun. *J Pendidik Olahraga Dan Kesehat.* 2021;9(1):7-18.
24. Yudho FHP, Aryani M, Rahadian A, Afriyandi AR, Pratama AK. Tingkat Persepsi dan Ketertarikan Masyarakat Dalam Aktivitas Fisik Berirama Dalam Menjaga Kebugaran Fisik. *JTIKOR (Jurnal Terap Ilmu Keolahragaan).* 2020;5(2):125-133. doi:10.17509/jtikor.v5i2.28160
25. Siregar YI. Peranan Kebugaran Jasmani Dalam Meningkatkan Kinerja. *J Pengabdian Kpd Masy.* 2010;16(60):77-83.
26. Rizka M, Agus A. Pengaruh latihan jalan kaki terhadap kebugaran jasmani lansia di Puskesmas Sungai Aur Kabupaten Pasaman Barat. *J Stamina.* 2018;1(1):206-218.
27. Efendi VP, Widodo A. Literature Review Hubungan Penggunaan Gawai Terhadap Aktivitas Fisik Remaja. *J Kesehatan Olahraga.* 2021;9:17-26.
28. Ølnes S, Ubacht J, Janssen M. Blockchain in government: Benefits and implications of distributed ledger technology for information sharing. *Gov Inf Q.* 2017;34(3):355-364.
29. Van den Bosch M, Sang AO. Urban natural environments as nature-based solutions for improved public health—A systematic review of reviews. *Environ Res.* 2017;158:373-384.
30. Utomo AW. Upaya bersepeda sebagai

- moda transportasi serta gaya hidup baru menjaga kebugaran jasmani. In: *Prosiding Seminar Nasional Fakultas Ilmu Kesehatan Dan Sains*. Vol 1. ; 2020.
31. Oktriani S, Kusmaedi N, Daniel Ray HR, Setiawan A. Perbedaan Jenis Kelamin, Usia, dan Body Mass Index (BMI) Hubungannya dengan Kebugaran Jasmani Lanjut Usia. *J Terap Ilmu Keolahragaan*. 2020;5(1):28-40.
 32. Syahputra R, Saifuddin S, Ifwandi I. Pengaruh Latihan Olahraga Hadang Terhadap Peningkatan Kebugaran Jasmani Pada Siswa Kelas V SD Negeri 1 Pagar Air. *Pendidik Jasmani, Kesehat dan Rekreasi*. 2017;3(3).
 33. Warburton DER, Bredin SSD. Health benefits of physical activity: a systematic review of current systematic reviews. *Curr Opin Cardiol*. 2017;32(5):541-556.
 34. Bull FC, Al-Ansari SS, Biddle S, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *Br J Sports Med*. 2020;54(24):1451-1462.
 35. Mcphee JS, French DP, Jackson DN, James D, Hans NP. Physical Activity In Older Age: Perspectives For Healthy Ageing And Frailty. *J Natl Cent Biotechnol Inf Biogerontology*. 2016;17:567–580,. doi:10.1007/S10522-016-964-0
 36. Thomas JR, Martin P, Etnier JL, Silverman SJ. *Research Methods in Physical Activity*. Human kinetics; 2022.
 37. Ferrel MN, Ryan JJ. The impact of COVID-19 on medical education. *Cureus*. 2020;12(3).
 38. Dishman RK, Heath GW, Schmidt MD, Lee I-M. *Physical Activity Epidemiology*. Human Kinetics; 2022.
 39. Tremblay MS, Carson V, Chaput J-P, et al. Canadian 24-hour movement guidelines for children and youth: an integration of physical activity, sedentary behaviour, and sleep. *Appl Physiol Nutr Metab*. 2016;41(6):S311-S327. doi:10.1139/apnm-2016-0151
 40. Dyrbye L, Shanafelt T. A narrative review on burnout experienced by medical students and residents. *Med Educ*. 2016;50(1):132-149.
 41. Sallis JF, Bull F, Guthold R, et al. Progress in physical activity over the Olympic quadrennium. *Lancet*. 2016;388(10051):1325-1336.
 42. Bonney R, Phillips TB, Ballard HL, Enck JW. Can citizen science enhance public understanding of science? *Public Underst Sci*. 2016;25(1):2-16.
 43. Aubert S, Barnes JD, Abdeta C, et al. Global matrix 3.0 physical activity report card grades for children and youth: results and analysis from 49 countries. *J Phys Act Heal*. 2018;15(s2):S251-S273.
 44. Piercy KL, Troiano RP, Ballard RM, et al. The physical activity guidelines for Americans. *Jama*. 2018;320(19):2020-2028.
 45. Organization WH. *Global Action Plan on Physical Activity 2018-2030: More Active People for a Healthier World*. World Health Organization; 2019.
 46. Pangrazi RP, Beighle A. *Dynamic Physical Education for Elementary School Children*. Human Kinetics Publishers; 2019.
 47. Franco MR, Tong A, Howard K, et al. Older people's perspectives on participation in physical activity: a systematic review and thematic synthesis of qualitative literature. *Br J Sports Med*. 2015;49(19):1268-1276.
 48. Bauman A, Merom D, Bull FC, Buchner DM, Fiatarone Singh MA. Updating the evidence for physical activity: summative reviews of the epidemiological evidence, prevalence, and interventions to promote "active aging." *Gerontologist*. 2016;56(Suppl_2):S268-S280.
 49. Suharjana F, Purwanto H. Kebugaran Jasmani Mahasiswa D Ii Pgsd Penjas Fik Uny. *J Pendidik Jasm Indones*. 2008;5(2):65-66.
 50. Wardani D, Nurudin A. Pengaruh Senam Bugar Muhammadiyah Terhadap Kebugaran Jasmani Siswa SMP. *Phys Act J*. 2020;2(1):100-108.
 51. Haerens L, Aelterman N, Vansteenkiste M, Soenens B, Van

- Petegem S. Do perceived autonomy-supportive and controlling teaching relate to physical education students' motivational experiences through unique pathways? Distinguishing between the bright and dark side of motivation. *Psychol Sport Exerc.* 2015;16:26-36.
52. Williamson B, Eynon R, Potter J. Pandemic politics, pedagogies and practices: digital technologies and distance education during the coronavirus emergency. *Learn Media Technol.* 2020;45(2):107-114.
 53. Bangun SY, Zaluku JS. Survey analisis tingkat kebugaran jasmani pelajar SMP di pondok pesantren Ta'dib Asyakirin Medan. *J Publ Pendidik.* 2019;9(3):273-279.
 54. Prastyawan RR, Pulungan KA. Signifikansi Kebugaran Jasmani Terhadap Prestasi Belajar Siswa Sekolah Dasar. *J Pendidik Jasm Indones.* 2022;18(2):185-193.
 55. Kezar A, Chambers AC, Burkhardt JC. *Higher Education for the Public Good: Emerging Voices from a National Movement.* John Wiley & Sons; 2015.
 56. Witkowski K. Internet of things, big data, industry 4.0—innovative solutions in logistics and supply chains management. *Procedia Eng.* 2017;182:763-769.
 57. Sugiyono. *Metode Pendidikan Pendekatan Kuantitatif, Kualitatif, Dan R&D.* Alfabeta; 2015.
 58. Van Sluijs EMF, Kriemler S. Reflections on physical activity intervention research in young people—dos, don'ts, and critical thoughts. *Int J Behav Nutr Phys Act.* 2016;13(1):1-6. doi:10.1186/s12966-016-0348-z
 59. Kononova A, Li L, Kamp K, et al. The use of wearable activity trackers among older adults: focus group study of tracker perceptions, motivators, and barriers in the maintenance stage of behavior change. *JMIR mHealth uHealth.* 2019;7(4):e9832. doi:10.2196/mhealth.9832
 60. Atmaja PMYR, Astra IKB, Suwiwa IG. Aktivitas Fisik Serta Pola Hidup Sehat Masyarakat Sebagai Upaya Menjaga Kesehatan pada Masa Pandemi Covid-19. *J Ilmu Keolahraagaan Undiksha.* 2021;9(2):128-135. doi:10.23887/jiku.v9i2.31409
 61. Wulandari W, Jariono G. Upaya Meningkatkan Kebugaran Jasmani Menggunakan Model Pembelajaran Kooperatif Tipe Jigsaw. *J Porkes.* 2022;5(1):245-259. doi:10.29408/porkes.v5i1
 62. Rozi F, Zubaidi A, Masykuroh M. Strategi Kepala Sekolah dalam Menerapkan Program Perilaku Hidup Bersih dan Sehat (PHBS) pada Anak Usia Dini. *J Pendidik Anak.* 2021;10(1):59-68. doi:10.21831/jpa.v10i1.39788
 63. Nasution AF, Tarigan FN. Upaya Meningkatkan Kebugaran Jasmani Pada Mahasiswa Fakultas Keguruan Ilmu Pendidikan Universitas Pembinaan Masyarakat Indonesia. *AFoSJ-LAS (All Fields Sci J Liaison Acad Soc.* 2021;1(1):27-41. doi:10.58939/afosj-las.v1i1.311
 64. Majid W. Perilaku aktivitas olahraga terhadap peningkatan kebugaran jasmani pada masyarakat. In: *Seminar Nasional Keolahraagaan.* Vol 1. ; 2020.
 65. Supriady A, Schiff NT. Sosialisai Olahraga Senam Aerobik Untuk Meningkatkan Kebugaran Jasmani Masyarakat Pamoyanan. *aksararaga.* 2021;3(1):33-41. doi:10.37742/aksaraga.v3i1.7
 66. Nugraheningsih G, Saputro YA. Hasil Pengabdian pada Masyarakat Pelatihan Senam Aerobik untuk Meningkatkan Kebugaran Jasmani. *KoPeN Konf Pendidik Nas.* 2020;2(1):109-111.
 67. Arizaldi AZ. Pembangunan Olahraga Ditinjau Dari Sport Development Index: Aspek Partisipasi Dan Kebugaran Jasmani Masyarakat Guna Peningkatan Kualitas Pendidikan Jasmani Di Kota Magelang. *Indones J Phys Educ Sport.* 2020;1(1):12-24. doi:10.15294/inapes.v1i1.38901
 68. Rochester CL, Vogiatzis I, Holland AE, et al. An official American Thoracic Society/European Respiratory Society policy statement: enhancing implementation, use, and

- delivery of pulmonary rehabilitation. *Am J Respir Crit Care Med*. 2015;192(11):1373-1386.
69. Horesh D, Brown AD. Traumatic stress in the age of COVID-19: A call to close critical gaps and adapt to new realities. *Psychol Trauma Theory, Res Pract Policy*. 2020;12(4):331.
70. Jeong H-C, So W-Y. Difficulties of online physical education classes in middle and high school and an efficient operation plan to address them. *Int J Environ Res Public Health*. 2020;17(19):7279. doi:10.3390/ijerph17197279
71. Jarrett C, Wilson R, O'Leary M, Eckersberger E, Larson HJ. Strategies for addressing vaccine hesitancy—A systematic review. *Vaccine*. 2015;33(34):4180-4190.
72. Keesstra SD, Bouma J, Wallinga J, et al. The significance of soils and soil science towards realization of the United Nations Sustainable Development Goals. *Soil*. Published online 2016.
73. Andreas S. *International Summit on the Teaching Profession Valuing Our Teachers and Raising Their Status How Communities Can Help: How Communities Can Help*. oecd Publishing; 2018.
74. Lee TM, Markowitz EM, Howe PD, Ko C-Y, Leiserowitz AA. Predictors of public climate change awareness and risk perception around the world. *Nat Clim Chang*. 2015;5(11):1014-1020.
75. Hahn RA, Truman BI. Education improves public health and promotes health equity. *Int J Heal Serv*. 2015;45(4):657-678.
76. Porter ME, Kramer MR. Creating shared value: How to reinvent capitalism—And unleash a wave of innovation and growth. In: *Managing Sustainable Business: An Executive Education Case and Textbook*. Springer; 2018:323-346.
77. Khan KM, Thompson AM, Blair SN, et al. Sport and exercise as contributors to the health of nations. *Lancet*. 2012;380(9836):59-64.
78. Das P, Horton R. Physical activity—time to take it seriously and regularly. *Lancet*. 2016;388(10051):1254-1255.
79. Hallal PC, Andersen LB, Bull FC, Guthold R, Haskell W, Ekelund U. Global physical activity levels: surveillance progress, pitfalls, and prospects. *Lancet*. 2012;380(9838):247-257.
80. Guthold R, Stevens GA, Riley LM, Bull FC. Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1· 9 million participants. *lancet Glob Heal*. 2018;6(10):e1077-e1086.
81. Andersen LB, Mota J, Di Pietro L. Update on the global pandemic of physical inactivity. *Lancet*. 2016;388(10051):1255-1256.
82. Sallis JF, Cerin E, Conway TL, et al. Physical activity in relation to urban environments in 14 cities worldwide: a cross-sectional study. *Lancet*. 2016;387(10034):2207-2217.
83. Kohl HW, Craig CL, Lambert EV, et al. The pandemic of physical inactivity: global action for public health. *Lancet*. 2012;380(9838):294-305.
84. Bauman AE, Kamada M, Reis RS, et al. An evidence-based assessment of the impact of the Olympic Games on population levels of physical activity. *Lancet*. 2021;398(10298):456-464.
85. Rodriguez-Ayllon M, Cadenas-Sánchez C, Estévez-López F, et al. Role of physical activity and sedentary behavior in the mental health of preschoolers, children and adolescents: a systematic review and meta-analysis. *Sport Med*. 2019;49(9):1383-1410.
86. Julie G-N. A model of teacher professional knowledge and skill including PCK: Results of the thinking from the PCK Summit. In: *Re-Examining Pedagogical Content Knowledge in Science Education*. Routledge; 2015:28-42.
87. Ting DSW, Cheung GCM, Wong TY. Diabetic retinopathy: global prevalence, major risk factors, screening practices and public health challenges: a review. *Clin Experiment Ophthalmol*. 2016;44(4):260-277.

88. Moore SA, Faulkner G, Rhodes RE, et al. Impact of the COVID-19 virus outbreak on movement and play behaviours of Canadian children and youth: a national survey. *Int J Behav Nutr Phys Act.* 2020;17(1):1-11.
89. Organization WH. Global action plan on the public health response to dementia 2017–2025. Published online 2017.
90. Siedentop D, Hastie P, Van der Mars H. *Complete Guide to Sport Education.* Human Kinetics; 2019.
91. Sørensen K. Health Literacy: A Key Attribute for Urban Settings. *Optim Heal Lit Improv Clin Pract.* Published online 2018:1-16.
92. Stockwell S, Trott M, Tully M, et al. Changes in physical activity and sedentary behaviours from before to during the COVID-19 pandemic lockdown: a systematic review. *BMJ open Sport Exerc Med.* 2021;7(1):e000960.
93. Glanz K, Rimer BK, Viswanath K. *Health Behavior: Theory, Research, and Practice.* John Wiley & Sons; 2015.
94. Lesser IA, Nienhuis CP. The impact of COVID-19 on physical activity behavior and well-being of Canadians. *Int J Environ Res Public Health.* 2020;17(11):3899.
95. Metzler M. *Instructional Models in Physical Education.* Taylor & Francis; 2017.
96. Althoff T, Sosič R, Hicks JL, King AC, Delp SL, Leskovec J. Large-scale physical activity data reveal worldwide activity inequality. *Nature.* 2017;547(7663):336-339.
97. Stanton R, To QG, Khalesi S, et al. Depression, anxiety and stress during COVID-19: associations with changes in physical activity, sleep, tobacco and alcohol use in Australian adults. *Int J Environ Res Public Health.* 2020;17(11):4065.

***“ATemp”, A Tempe-based product with High Nutritional Value and Low Glycemic Index
(Alternative Plant-Based Protein Sources for Diabetic Patients)***

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ABSTRACT

Diabetes Mellitus (DM) is a metabolic endocrine disease with the identical symptom of hyperglycemia. One of the main pillars in DM management is nutrition therapy through limiting the intake of carbohydrates and high simple sugar (monosaccharides). The availability of foods with low glucose levels has become one of the crucial needs of DM patients in controlling blood glucose levels. Tempeh is a soy-fermented local food that has been known widely by Indonesian Society. Tempeh-based food products with high nutritional value and low sugar are still scarcely found in society. Thus, this research aims to develop a tempeh-based product with high nutrition value (protein), low Glycemic Index (GI) level and adequate fibre content. Research and Development Design method was used in this research with the selecting, sorting and processing done with respecting the standard of food processing. The yield product was tested on 40 panellists for organoleptic tests, analyzed in the laboratory to measure the nutrient content, and calculated for glycemic index. The results show that “ATemp” (a tempeh floss) has a result of organoleptic test with the panellist who stated like and very like for colour of the product 65%, for the aroma 67,5%, for the texture 58% and for the taste of the product 50%. Laboratory analysis has shown that 100 g of ATemp contains 23 g of fat, 19 g of protein, 45 g of carbohydrate, 1 g of sugar, 257 mg of sodium, 12 g of fibre and 465 kcal of total energy. The result of GI test shows that ATemp has a GI level of 12 (low) and GL level of 2,7 (low). ATempt has a high potential to be an alternative food for diabetes or for those who are doing low-sugar diet.

Keywords: ATemp, Floss, Tempeh, Glycemic Index, Diabetes Mellitus

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INTRODUCTION

Diabetes Mellitus (DM) is a metabolic endocrine disease with the identical symptom of hyperglycemia¹. One of the main pillars in DM management is nutrition therapy through limiting the intake of carbohydrates and high simple sugar (monosaccharides)². Increased levels of blood glucose or hyperglycemia are a major sign of diabetes accompanied by polyuria, polydipsy and polyphagia³.

Medical nutrition therapy (MNT) is one of the main interventions in treating DM². In MNT planning for DM patients, it is crucial to consider glycemic index (GI) and glycemic load (GL) of the food in controlling blood glucose level^{4,5}. The food glycemic index indicates the speed of a food increases blood glucose levels. Whilst glycemic load is a value that shows how much carbohydrates in a portion of food can increase blood glucose levels^{6,7}. Thus, food with high GI and or GL will increase the occurrence of hyperglycemia⁸.

In addition to GI and GL, MNT planning for DM patients should also be developed with the consideration of protein content. It is because food with high protein content could bring benefit for glycemic control⁹. Therefore, it is important to provide food with high protein content for DM patients.

One of the local foods in Indonesia that can provide the aforementioned properties in MNT planning for DM patients is tempeh. A hundred gram of tempeh contains 201 kcal, 20.8 g protein, 8.8 g fat, and 13.5 g carbohydrate¹⁰. Hence, it is most likely that tempeh can be utilized in making food for DM patients.

Various research had studied about the utilization of tempeh for DM patients. There was a study found that, tempeh could contributed to the making of nugget with low IG dan GL which would be suitable for DM patients¹¹. There was also a study that used tempeh to develop a low GI biscuit. Besides, its high fiber content also contributed to gastric emptying which eventually lead to low GI level¹². Furthermore, there were studies that found that interventions with tempeh-based product resulting in improvement of hyperglycemic control and wound healing^{13,14}.

Even though there had been some development of tempeh-based products for DM patients, most of them are still in *in vivo* study or in product development phase. Another point to consider is, the forms of the developed

product were deemed not attractive enough for Indonesian people. Therefore, it is still a challenge to form a tempeh-based product that is more familiar to society.

Various types of animal floss are widely known in society and are relatively preferred by many people such as cow meat floss, chicken floss, fish floss, and so forth. Thus, a tempeh-based floss could be a promising product for DM patients. In addition to that, there is also another local food, which is oyster mushroom that will be added to tempeh-based floss to increase its hedonic score. Therefore, this study aimed to develop a tempeh floss. The product was named Atemp to reflect the main ingredient of it, which is tempeh.

METHOD

Research and Development Design method was used in this research with the selecting, sorting, and processing were done with respecting the standard of food processing.

Atemp product was made with the main ingredient of high quality of tempeh (100 g) and Oyster Mushroom (*Pleurotus ostreatus*) (100 g). Those two main ingredients were then added with spices and seasonings to obtain the desired mixture. The well mixed pre-cooked Atemp then cooked by deep-frying method. After the frying process, the oil spinner was used to extract the excessive oil from the cooked Atemp.

An organoleptic test was performed to determine the assessment of the panel against the Atemp. The test covered the colors, aroma, texture, and taste. The 7-point hedonic scale was used by the panelists to indicate their preferences start from dislike very much (point 1) to like very much (point 7). The evaluation was given by 40 panelists with the inclusion criteria: healthy with normal BMI (20-24) and normal blood glucose, as well as no history of DM in family¹⁵. Those healthy young adults were selected to reduce the bias due to impairment in blood glucose which eventually could alter the results. To test the content and nutritional value of atemp performed testing by the same laboratory with sni method 01-2891-1992 section 8.1.

Glycemic index tests and glycemic load are performed with methods explained by Brouns et al¹⁵. All responders who will follow glychemic index testing protocols are required to fast for 8-10 hours before the blood sugar

check begins. After performing the fasting, a sample is measured in blood sugar before it consumes an Atemp or sugar solution as a reference. The sugar solution consumed was 25 g of sugar along with 200 millimetres of water and the tempeh-based product consumed was 56 g to fill the load of 25 g carbs to be the same. There was six days prior to the exchange of consumption of tested materials. After consuming product or sugar solution, blood sugar was measured every 15 minutes for the first hour and then every 30 minutes until it reaches 2 hours. Following the interval of the blood sample taken in minutes: 0, 15, 30, 45, 60, 90, 120.

RESULTS

Organoleptic Test

The Atemp product have been tested for the level of preference among 40 panelists who comprised of 75% women and 25% men, aged range between 18 to 80 years and 48% work as students; 25% private employees; housewives 20% and workers 7%. The results of the organoleptic test shown that most of the panelist chose like and very like for all the parameter. The presentation of those values are displayed in table 1.

Table 1. Organoleptic Test Results

Parameter	Like Moderately	Like Very Much	Total
Color	45.0	25.0	70.0
Aroma	35.0	32.5	67.5
Texture	42.5	15.0	57.5
Taste	17.5	32.5	50.0
Overall	42.5	20.0	62.5

As shown on table 1, there were 70.0% and 67.5% of 40 panelists that stated like moderately and like very much for the color and the aroma of Atemp, respectively. There were also 57.5% and 50.0% of the panelists who stated like moderately and like very much for the texture and taste of Atemp. Moreover, after calculated the total collected organoleptic data, we managed to identify the overall value of the product and the data shown that there were 42.5% and 20.0% who stated like moderately and like very much for overall Atemp with the total percentage of acceptance at 62.5%.

Nutrition Value Analysis

Nutrition value analysis was done in proximate analysis of food. The results of this

analysis are shown on table 2.

Table 2. Nutrition Value Analysis of Atemp

Nutrition Value	Result
Total Energy	465 kcal
Fat	23 g
Protein	19 g
Carbohydrate	45 g
Sugar	1 g
Sodium	257 mg
Fiber	12 g

As shown in table 2, the nutrition value was displayed according to 100 g of Atemp. The findings confirm that the total calories of Atemp is 465 kcal, with the macronutrients value are 23 g, 19 g, and 45 g for fat, protein and carbohydrate, respectively. There were also 1 g and 12 g of sugar and fiber content, with 257 mg of sodium.

Glycemic Index and Glycemic Load

Glycemic index of Atemp was analyzed based on the blood sample of 10 healthy young adults. The results of the blood glucose increment after consuming Atemp and Sugar (Reference) are shown in figure 1.

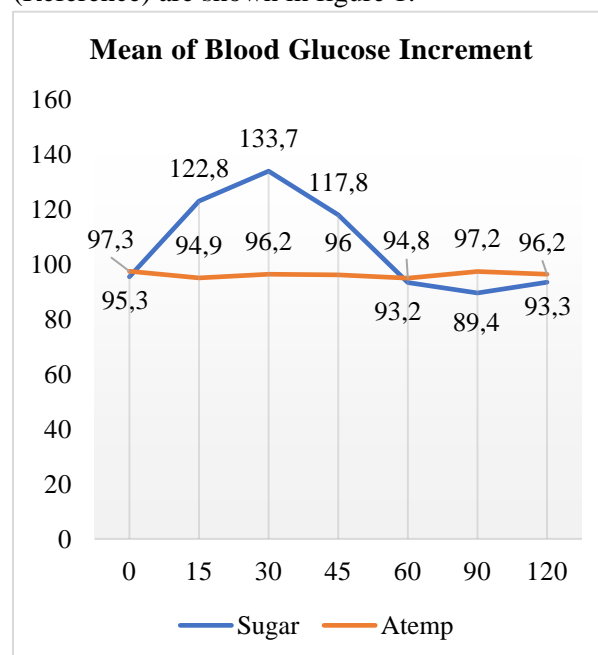


Figure 1. The Differences of Blood Glucose Increment in consuming Atemp and sugar.

As displayed in figure 1, the mean blood glucose level at 0 minutes (fasting plasma glucose) were 95.3 mg/dL for sugar and 97.3% for Atemp. Fifteen minutes after the consumption, the mean blood glucose level when the respondents consuming sugar was exponentially increased to 122.8 mg/dL. The

mean blood glucose level for consuming sugar was at its peak after 30 minutes with the blood glucose level of 133.7 mg/dL. Contradictively, the results of consuming Atemp shown that there were mild changes in mean blood glucose level. We can hardly even point out the peak level of mean blood glucose after consuming Atemp.

These results of mean blood glucose increment then used in calculation to decide the glycemic index (GI) of Atemp. The GI level was obtained after comparing the AUC for Atemp against the AUC for Atemp. The obtained GI level was then used to calculate the Glycemic Level (GL) of Atemp. The results of GI and GL analysis are shown in table 3.

Table 3. The GI and GL of Atemp

Item	AUC	GI (Category)	GL (Category)
Atemp	125.8	12	2,7
Sugar	1087.7	(Low)	(Low)

Based on the table above, it can be seen that the glycemic index (GI) of Atemp products is still relatively low (<55) as well as the glycemic load (GL) which is also low (<10)(15).

DISCUSSION

The findings in the organoleptic test as shown in table 1 indicate that most of the panelists stated like moderately and like very much in all parameters, except in taste which was still 50:50. Moreover, this study used oyster mushroom to enhance the texture and the taste of the product. This also confirmed that oyster mushroom could be utilised as the additional ingredient in making floss. This also could add the alternatives that had been mentioned elsewhere for plant-based ingredients with similar texture to the animal based such as unripe jackfruit¹⁶, unripe sukun¹⁷, and banana blossom¹⁸.

The overall results confirmed that Atemp can be well accepted by the panelists. Even though the overall value is not as high as similar product but different form elsewhere¹⁹, this result still can be a supportive finding if this product was about to be given to the targeted population.

The results in the organoleptic test was in alignment with the results in nutrition value analysis which was shown in table 2. This proves that, beside acceptable, Atemp also can

offer a good nutrients content, especially protein. Protein content in Atemp even higher than plant-based high protein snack which was done elsewhere, with the protein content of the product ranging from 12-14 g per 100 g²⁰.

The result from nutrition value analysis also confirms that this product can be utilized as a nutritional support in certain diseases such as those with pulmonary TB patients or DM patients. There was a study that found that giving two nutritional support products with a protein content of 8.5 g per serving (17 g per day) could affect the healing of post-surgical wounds in patients¹⁴. The provision of nutritional support products like this is based on the standard provision of nutritional support in hospitals by providing 2 x 40 g of extra egg white which contains 8 g of protein (16 g of total protein)²¹.

In addition to its high protein content, Atemp also possesses a predominantly low GI compared to its classification²². With the GI of 12, Atemp can even provide better GI compared to other tempeh-based products which were also low GI^{12,11}. This GI of Atemp also lower than tuber-based snack bar developed for DM patients in other study⁴.

The soybean as the only main ingredient in tempeh contain the starch that could contribute to higher GI^{23,24}. Nevertheless, fermentation process in making tempeh makes the rapidly digestible starch (RDS) decrease while increases the resistance starch (RS)²⁵. For this reason, tempeh used in Atemp could contribute to the yield product with low GI.

Potential limitations of this product are the sources of the main ingredients. The way that tempeh was fermented could not be controlled, yet it still can influence the end product²⁵. Nevertheless, in this study, the used tempeh was obtained from a reputable vendor which marked by its brand awareness.

CONCLUSION

The overall acceptance according to the organoleptic test indicates that the Atemp product can be well accepted by society. The nutrition value, GI level, as well as GL level can confirm that Atemp is a potential product for those who need high protein food with low GI and GL level. Therefore, Atemp could be utilized in MNT planning for DM patients. For further research in product development, it is important to put more concern regarding the taste of the product.

REFERENCES

1. IDF. IDF Diabetes Atlas. Ninth edition. Brussels: International Diabetes Federation. 2019.
2. Perkeni. Pedoman Pengelolaan dan Pencegahan Diabetes Melitus Tipe 2 Dewasa di Indonesia. Jakarta: PB Perkeni; 2021.
3. Kesehatan K. Pedoman Nasional Pelayanan Kedokteran Tata Laksana Diabetes Melitus Tipe 2 Dewasa. Jakarta: Kemenkes RI; 2020.
4. Avianty S, Ayustaningwarno F. Indeks Glikemik Snack Bar Ubi Jalar Kedelai Hitam sebagai Alternatif Makanan Selingan Penderita Diabetes Melitus Tipe 2. *J Apl Teknol Pangan*. 2014;3(3):98–102.
5. Abbie E, Francois ME, Chang CR, Barry JC, Little JP. A low-carbohydrate protein-rich bedtime snack to control fasting and nocturnal glucose in type 2 diabetes: A randomized trial. *Clin Nutr* [Internet]. 2020;39(12):3601–6. Available from: <https://doi.org/10.1016/j.clnu.2020.03.008>
6. Yang YX, Wang HW, Cui HM, Wang Y, Yu L Da, Xiang SX, et al. Glycemic index of cereals and tubers produced in China. *World J Gastroenterol*. 2006;12(21):3430–3.
7. Susanti A, Wijanarka A, Nareswara AS. Penentuan indeks glikemiks dan beban glikemik pada cookies tepung beras merah (*Oryza nivara*) dan biji kecipir (*Psophocarpus tetragonolobus* L). *Ilmu Gizi Indones*. 2018;2(1):69.
8. Evert AB, Dennison M, Gardner CD, Garvey WT, Hei K, Lau K, et al. Nutrition Therapy for Adults With Diabetes or Prediabetes: A Consensus Report. *Diabetes Care*. 2019;42(May):731–54.
9. Dong J, Zhang Z, Wang P, Qin L. Effects of high-protein diets on body weight , glycaemic control , blood lipids and blood pressure in type 2 diabetes: meta-analysis of randomised controlled trials. *Br J Nutr*. 2013;110:781–9.
10. Kementerian Kesehatan RI. Tabel Komposisi Pangan Indonesia. Jakarta; 2020.
11. Widianny FL. Indeks glikemik nugget berbahan campuran tepung belut (*Monopterus albus*) dan tepung tempe untuk dukungan gizi pasien emodialisis diabetik. *Ilmu Gizi Indones*. 2019;03(01):35–44.
12. Kustanti IH, Rimbawan, Furqon LA. Formulasi Biskuit Rendah Indeks Glikemik (Batik) Dengan Substitusi Tepung Pisang Klutuk (*Musa Balbisiana Colla*) Dan Tepung Tempe. *J Apl Teknol Pangan*. 2017;6(1):12–8.
13. L. W, Nuryanto, A. R, Y. FD, F. DF, G. A, et al. Analysis of glycemic index, glycemic load and acceptability of enteral formulas based on tempeh flour and jicama flour as innovations for hyperglycemic patients. *Food Res*. 2020;4:46–53.
14. Widianny FL. Pemberian Dukungan Gizi Puding Tepung Tempe. *J Nurisia*. 2016;18:1–6.
15. Brouns F, Bjorck I, Frayn KN, Gibbs AL, Lang V, Slama G, et al. Glycaemic index methodology. *Nutr Res Rev*. 2005;18(1):145–71.
16. Jannah UQAN, Hidayati D, Jakfar AA. Karakteristik Sensoris dan Kimia pada Abon Nangka Muda (*Artocarpus heterophyllus* LMK) dengan Penambahan Tempe. *AGROINTEK*. 2012;10(1):48–54.
17. Rohmawati N. Pengaruh Penambahan Sukun Muda (*Artocarpus communis*) terhadap Mutu Fisik, Kadar Protein, dan Kadar Air Abon Lele Dumbo (*Clarias gariepinus*). *J Nurisia*. 2016;18(1):65–9.
18. Aida Y, Mamuaja CF, Agustin AT. Pemanfaatan Jantung Pisang (*Musa paradisiaca*) dengan Penambahan Daging Ikan Layang (*Decapterus sp.*) pada Pembuatan Abon. *J Ilmu dan Teknol Pangan*. 2014;2(1):20–6.
19. Aziz A, Adjie WLP, Estofany F, Siti E. Formulasi Makanan Cair Alternatif Berbasis Tepung Pegagan Dan Buah Naga Merah Untuk Diet Pasien Dengan Diabetes mellitus. *J Jur Keperawatan Poltekkes Jakarta III*. 2022;7(1):67–80.
20. Gupta S, Liu C, Sathe SK. Quality of a Chickpea-Based High Protein Snack. *J Food Sci*. 2019;84(6):1621–30.
21. Suharyati. Penuntun Diet dan Terapi

- Gizi. Persatuan Ahli Gizi Indonesia dan Asosiasi Dietisien Indonesia; 2019.
22. Monro JA, Shaw M. Glycemic impact, glycemic glucose equivalents, glycemic index, and glycemic load: Definitions, distinctions, and implications. *Am J Clin Nutr* [Internet]. 2008;87(1):237S-243S. Available from: <https://doi.org/10.1093/ajcn/87.1.237S>
 23. Lal MK, Singh B, Sharma S, Singh MP, Kumar A. Glycemic index of starchy crops and factors affecting its digestibility: A review. *Trends Food Sci Technol* [Internet]. 2021;111(February):741–55. Available from: <https://doi.org/10.1016/j.tifs.2021.02.067>
 24. Atkinson FS, Brand-Miller JC, Foster-Powell K, Buyken AE, Goletzke J. International tables of glycemic index and glycemic load values 2021: a systematic review. *Am J Clin Nutr*. 2021;114(5):1625–32.
 25. Demirkesen-Bicak H, Arici M, Yaman M, Karasu S, Sagdic O. Effect of different fermentation condition on estimated glycemic index, in vitro starch digestibility, and textural and sensory properties of sourdough bread. *Foods*. 2021;10(3).

Original Article

The Effectiveness of Exclusive Breastfeeding on the Nutritional Status of Infants in Efforts to Prevent Stunting in PMB Bogor Regency

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ABSTRACT

Breast milk contains all the nutrients needed by the body, evidenced by the results of scientific evidence about the benefits of breast milk for the baby's immune system, growth and development, babies who are not exclusively breastfed have a higher risk of disease. The purpose of the researcher is to discuss further about the effect of exclusive breastfeeding on the nutritional status of infants aged 6 months at PMB Dian Dwi Anggraini, Bogor Regency 2022. The observational research design is analytical, cross-sectional with purposive sample sampling, data analysis comparison of independent variables with dependent variables, with independent T-Test statistical tests. Based on the results of independent T-test analysis in the study, the average body weight of exclusively breastfed infants (6.03 kg) and non-exclusive breastfeeding (5.57 kg) was obtained, while the average body length was obtained from exclusively breastfed infants (59.0 cm) and in non-exclusively breastfed infants (57.92 cm), for nutritional status in exclusively breastfed infants obtained 0.14 (Z score) and Non-exclusive breastfeeding 0.97 (Z score). This shows that exclusive breastfeeding affects the nutritional status of infants who are exclusively breastfed and those who are not exclusively breastfed very significantly with a p-value of > 0.01 .

Keywords: Exclusive Breastfeeding, Nutritional Status, Baby

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INTRODUCTION

Stunting is an indicator of chronic malnutrition due to inadequate food intake for a long time, poor food quality, increased morbidity, and increased height that is not appropriate for age (TB/U)^{1,2}. In general, linear growth problems in toddlers are often ignored because they are still considered normal as long as the child's weight has met the standard. According to several studies, stunting is associated with an increased risk of illness and death as well as stunted growth of motor and mental abilities^{3,4,5}.

Early and exclusively breastfeeding is

essential for a child's survival, and to protect the child from various diseases that can be fatal⁶. Children who receive breast milk are proven to have higher intelligence test results and have a lower likelihood of being overweight so as to prevent stunting^{7,8}.

According to Basic Health Research data, 52.5% or only half of the 2.3 million infants aged less than 6 months are exclusively breastfed in Indonesia, or a decrease of 12% from the figure in 2019^{9,10}. The early breastfeeding initiation rate (IMD) also fell from 58.2% in 2019 to 48.6% in 2021. Meanwhile, in Bogor District, the coverage rate for exclusive breastfeeding was only 53.12% in

2020¹⁰.

The causes of low breastfeeding are predisposing factors, lack of knowledge of mothers, health workers who do not understand the importance of providing counseling on exclusive breastfeeding, the many promotions of formula milk, and lack of support from the community¹¹. One of the factors that inhibit the occurrence of breast milk expenditure is psychological factors, the emergence of stressors in nursing mothers^{12,13}.

Breast milk is an ideal food for babies, especially in the first months of life. Breast milk contains all the building blocks of nutrients and the necessary energy supply¹⁴. Breast milk does not burden the work of the function of the digestive system and kidneys that have not functioned in newborns, and produces optimal growth and development¹⁵.

Based on research by the World Health Organization (WHO), in six developing countries the risk of infant death between 9-12 months increases by 40% if the baby is not breastfed. For infants under 2 months, mortality increases to 40% (4). UNICEF says babies fed formula are 25 times more likely to die in the first month of birth than babies breastfed exclusively¹⁶.

Exclusive breastfeeding is breastfeeding for 6 months without other additional foods such as formula, fruit, biscuits or baby porridge from birth to 6 months old (12). The composition of breast milk is divided into 3 parts, namely colostrum comes out on the first day to day 4-7, transitional breast milk, comes out on days 4-7 to days 10-14 and mature breast milk after day 14¹⁷.

Exclusively breastfeeding will ensure the achievement of optimal development of children's intelligence potential. Breast milk apart from being an ideal nutrient, with the right composition and tailored to the needs of the baby, also contains special nutrients such as taurine, lactose, arachidonic acid (AA), docosahexaenoic acid (DHA), omega 3, omega 6, choline, and tryptophan which the baby's brain needs to grow optimally to help synaptogenesis and myelination processes².

Breast milk contains all the nutrients needed by the body, evidenced by the results of scientific evidence about the benefits of breast milk for the baby's immune system, growth, and development, babies who are not exclusively breastfed have a higher risk of disease.

Research that monitors the growth and

development of exclusively breastfed infants has been carried out in developed countries, The results of the study found that babies with sufficient birth weight who are exclusively breastfed grow in accordance with growth standards according to WHO¹⁴.

In contrast to the results of the study, Mukhlis stated that there was no effect of exclusive breastfeeding on the baby's weight, p-value ($p = 0.680$), baby length ($p = 0.786$) and baby's head circumference ($p = 0.657$)¹⁸.

Based on the description above, the purpose of the researcher is to discuss further about the effect of exclusive breastfeeding on the nutritional status of infants aged 6 months at PMB Dian Dwi Anggraini, Bogor Regency 2022.

METHOD

The design carried out in this research is an observational study that is analytical, namely observations on the effect of exclusive breastfeeding on nutritional status in infants aged 6 months. The research design uses a cross sectional design because in this study independent and dependent variables will be observed in the same period.

This research was carried out at PMB Dian Dwi Anggraeni Bogor Regency starting from January to July 2020, the selection of research locations was carried out based on the consideration that it was possible to meet the number of samples in accordance with inclusion criteria, besides that the research location was affordable and facilitated access for researchers in completing administrative needs needed during the research process.

Parametric test is an unpaired t-test totaling 30 infants aged 6 months, how to take samples using purposive sampling where this technique is the method used if the determination of the sample is recommended on certain criteria whose purpose is to get baby respondents with exclusive breastfeeding. With the inclusion criteria set, namely: 1) babies born with a body weight of 2500 – 3000 grams, 2) babies born spontaneously without complicating or born section caesaria, 3) healthy, 4) mothers of infants willing to be respondents to the study by signing informed consent. Exclusion criteria: 1) infants with partial breastfeeding, 2) experiencing impairment during the study process (diarrhea or other disorders), 3) the respondent's residence is

difficult to reach.

Good research must be accompanied by ethics, in this study applied the principles of research ethics: 1) This research provides goodness and benefits for respondents, 2) provides freedom to refuse to be a respondent, 3) the identity of respondents is kept secret during the research, 4) informed consent. And this research has gone through the consideration and approval of the ethics committee

Characteristic data collection was carried out after respondents signed a letter of consent willing to be involved in the study. Primary data is the baby's body development including weight, height and head circumference of the baby and exclusive breastfeeding. The data collection instruments used were eutionary, fill-in sheets, digital scales of weight and height and the use of KMS to see the nutritional status of infants with BB / U.

Data analysis was carried out quantitatively, then univariate and bivariate analysis was carried out. To see the comparison of the independent variable with the dependent variable, with an independent statistical test T Test. If $p > 0.05$ then H_0 is accepted meaning that there is no significant difference between the independent and dependent variables, if $p < 0.05$ then H_a is accepted meaning that there is a significant influence between the independent variable and the dependent variable.

RESULTS

Table 1. Frequency Distribution of Respondent Characteristics

Characteristic	Group		Value	
	Breast Milk		Non breast milk	
	N=15	%	N=15	%
Age				
17-35	13	86,6%	12	80
36-45	2	13,4%	3	20
Paritas				
Primipara	7	46,7%	7	46,7
Multipara	8	53,3%	8	53,3
IMD				
Yes	10	66,7%	11	73,3
No	5	33,3%	4	26,7
Work				0,448
Yes	8	53,3%	9	60%
No	7	46,7%	6	40%
Spousal/Family Support				
Yes	9	60%	10	66,7%
No	6	40%	5	33,3%

Based on table 1, it can be seen that the characteristics of respondents show no significant difference between the Exclusive Breastfeeding group and the Non-Exclusive Breastfeeding group with a p value of > 0.05 , which is 0.448, so that the two groups are said to be homogeneous and worthy of comparison

Table 2. Shapiro-Wilk Test Result

Variable	p-value
Weight	0,110
Body length	0,086
Nutritional Status	0,069

Table 2 data shows the existence of a normal distributed data population with a value of ($p > 0.05$) so that using a parametric test, namely an unpaired t-test.

Table 3. Effects of Exclusive Breastfeeding on Infant Nutritional Status

Variable	Breast-feeding	N	Mean	95% CI	p-value
Weight (kg)	Exclusive	15	6,03	5,86-6,20	< 0,001
	Non-exclusive	15	5,57	5,42-5,71	
Body Length (cm)	Exclusive	15	59,0	58,48-59,51	0,003
	Non-exclusive	15	57,92	57,49-58,36	
Nutritional Status Z score < -2 SD (BB/U)	Exclusive	15	-0,41	-0,66-0,17	0,01
	Non-exclusive	15	0,97	1,18-0,76	

Based on the results of independent T-test analysis in the study, the average body weight of exclusively breastfed infants (6.03 kg) and non-exclusive breastfeeding (5.57 kg) was obtained, while the average body length was obtained exclusively breastfed infants (59.0 cm) and in non-exclusively breastfed infants (57.92 cm), for nutritional status in exclusively breastfed infants obtained 0.14 (Z score) and Non-exclusive breastfeeding 0.97 (Z score). This shows that exclusive breastfeeding affects the nutritional status of infants who are exclusively breastfed and those who are not exclusively breastfed very significantly with a p value of > 0.01 .

DISCUSSION

The effect of exclusive breastfeeding on the nutritional status of infants

The results of this study obtained the effect of exclusive breastfeeding on infant nutritional status showed from 30 respondents, the exclusive breastfeeding group as many as 15 respondents, and non-exclusive breastfeeding 15 respondents. Based on statistical tests, the T test obtained exclusive breastfeeding statistically and clinically meaningful with a p-value of < 0.01 . So it can be stated based on the results of this study that there is a significant effect of exclusive breastfeeding on the nutritional status of infants with BB / U indicators.

Infants at the age of 6 months who are exclusively breastfed are proven to have length and weight according to WHO growth standards and the risk of stunting will be lower than those in the non-exclusive breastfeeding group. It can be seen from the results of the analysis of infant nutritional status using BB / U.

This is supported by the results of research conducted by Riyanti on the relationship of exclusive breastfeeding to infant growth and development, the results of the Chi-square test obtained a significance level of 0.05 so that it can be concluded that there is a relationship between exclusive breastfeeding and the growth and development of infants aged 6-12 months¹⁹.

Child growth and development does not begin after the child is born but has begun since the child is in the mother's womb. Maternal weight gain during pregnancy represents a nutritional state that plays an important role in the growth and development of the fetus whose results can be seen from the parameters of body weight and body length¹⁶.

The advantage of exclusive breastfeeding is that at any time it can be given directly with proportions and compositions that adjust to the baby's needs. The content of breast milk cannot be replicated by formula milk. Breast milk contains antioxidants has a major role in inhibiting oxidative stress which is a condition of imbalance between oxidants and anti-oxidants so as to form free radicals that will underlie the process of occurrence of a certain disease in infants¹².

Introducing liquids or foods other than

breast milk, especially before the age of 4 months, has a risk level of gastrointestinal disease which can cause growth disorders, micronutrient deficiencies and susceptibility to infections in children under 2 years²⁰.

The nutritional status of infants has a significant relationship with exclusive breastfeeding, this is based on nutritional status indicators, namely weight per age¹⁴. There is a relationship between improving the nutritional status of infants and the practice of giving complementary foods to infants. Not doing IMD, colostrum deficiency at birth and improper administration of complementary foods are risk factors that affect nutritional status in infancy. Socialization of exclusive breastfeeding and proper complementary food is important to be given to mothers²¹.

Different things were stated by the results of Mukhlis's research stating that the growth and development of babies who were given exclusive breastfeeding was different from the growth and development of babies who were not given exclusive breastfeeding. In Exclusive breastfeeding infants obtained the average body weight of the baby (9.83 kg) while in Exclusive Breastfeeding (10.06 kg), with test results obtained $p (0.689) > 0.05$ it can be concluded that there is no effect of exclusive breastfeeding on the baby's weight.

Based on the results of Widayati's research entitled the effect of Exclusive Breastfeeding on infant growth and development, it was found that there was a significant influence on the nutritional status and development of infants aged 6-12 months in the Gamping Health Center kerka area in 2015²². Other factors that affect the nutritional status and development of babies aged 6 months are certainly differences from the nutritional status of the baby's mother, as well as the food consumed and others but have not been included in the study so further research needs to be needed.

CONCLUSION

Based on the results of research that has been conducted on infants aged 6 months at PMB Dian Bogor City in 2020, it can be concluded that the nutritional status of infants who are given exclusive breastfeeding is different from the nutritional status of non-exclusively breastfed babies. The result of the T

Test was obtained with a p value of > 0.01 .

In this study there are limitations, including: 1) the design of this study cross-sectionally examines variables at one time so that it cannot see causal relationships, 2) Collection of research data in a short time, 3) When measuring weight and body length takes place there are difficulties because babies move a lot and fuss, so it takes longer.

Based on this research, similar research is needed using cohort methods, in order to obtain more accurate results. And further research can use tools for distraction, so that babies are not fussy when measurements are taken so that more accurate results are obtained.

REFERENCES

1. Ford ND, Behrman JR, Hoddinott JF, Maluccio JA, Martorell R, Ramirez-Zea M, et al. Exposure to improved nutrition from conception to age 2 years and adult cardiometabolic disease risk: a modelling study. *Lancet Glob Heal*. 2018 Aug 1;6(8):e875–84.
2. Akombi BJ, Agho KE, Hall JJ, Wali N, Renzaho AMN, Merom D. Stunting, wasting and underweight in Sub-Saharan Africa: A systematic review. Vol. 14, *International Journal of Environmental Research and Public Health*. MDPI AG; 2017.
3. Rahayu A, Yulidasari F, Putri AO, Anggraini L. Study Guide - Stunting dan Upaya Pencegahannya. Buku stunting dan upaya pencegahannya. 2018. 88 p.
4. Aguayo VM, Menon P. Stop stunting: Improving child feeding, women's nutrition and household sanitation in South Asia. *Matern Child Nutr*. 2016 May 1;12:3–11.
5. de Onis M, Branca F. Childhood stunting: A global perspective. *Matern Child Nutr*. 2016;12:12–26.
6. Umiyah A, Hamidiyah A. Exclusive Breastfeeding With Stunting. *Str J Ilm Kesehat*. 2020;9(2):471–7.
7. Assaf S, Juan C. Stunting and Anemia in Children from Urban Poor Environments in 28 Low and Middle-Income Countries. *Nutrients*. 2020;12(3539):5–8.
8. Rusmil VK, Prahastuti TO, Erlangga Luftimas D, Hafsa T. Exclusive and Non-Exclusive Breastfeeding among Stunted and Normal 6–9 Month-Old-Children in Jatinangor Subdistrict, Indonesia. *Althea Med J*. 2019;6(1):35–41.
9. NASIONAL R. Laporan_Nasional_RKD2018_FINAL.pdf [Internet]. Badan Penelitian dan Pengembangan Kesehatan. 2018. p. 674. Available from: http://labdata.litbang.kemkes.go.id/images/download/laporan/RKD/2018/Laporan_Nasional_RKD2018_FINAL.pdf
10. Litbangkes H. Tiga Aspek Pelaksanaan SSGI 2021. Badan Penelitian dan Pengembangan Kesehatan. 2021;
11. Nugraheni SD, Prabamurti PN, Riyanti E. Pemberian Mp-Asi Dini Sebagai Salah Satu Faktor Kegagalan Asi Eksklusif Pada Ibu Priimipara. *J Kesehat Masy* [Internet]. 2018;6(5):804–13. Available from: <http://ejournal3.undip.ac.id/index.php/jkm>
12. Putri, Octavia A, Rahman F, Laily N, Rahayu A, Noor, Syahadatina M, Yulindasari F, et al. Air Susu Ibu (ASI) dan Upaya Keberhasilan Menyusui. 2020. 1–154 p.
13. Lydiani D, Darmayanti, Ruslinawati. Pengaruh Hypnobreastfeeding Terhadap Peningkatan Pengeluaran ASI di Wilayah Kerja Puskesmas 09 November Banjarmasin. *Caring Nurs J*. 2020;4(2):0–6.
14. Saputra AR. Peran Pemberian ASI Eksklusif terhadap Status Gizi dan Tumbuh Kembang pada Anak Usia Dini Exclusive Breastfeeding Role in Nutritional Status and Growth of Childhood. *J Agromed Unila*. 2016;3(1):30–4.
15. Hadi H, Fatimatasari F, Irwanti W, Kusuma C, Alfiana RD, Ischaq Nabil Asshiddiqi M, et al. Exclusive breastfeeding protects young children from stunting in a low-income population: A study from eastern indonesia. *Nutrients*. 2021;13(12):1–14.
16. Wasting and stunting—similarities and differences.
17. Sundari SW, Imaniar MS. Effect of hypnobreastfeeding on the success of

- exclusive breastfeeding in pregnant women trimester III in Puskesmas Bungursari Tasikmalaya. *JNKI (Jurnal Ners dan Kebidanan Indonesia) (Indonesian J Nurs Midwifery)*. 2021;9(2):128.
18. Mukhlis H. Pengaruh Pemberian Asi Eksklusif Terhadap Tumbuh Kembang Bayi Umur 6-24 Bulan Di Nagari Sariak Laweh Kec. Akabiluru. *Sainstek J Sains dan Teknol*. 2019;11(1):37.
 19. Marlina Yunita. Pengaruh Pemberian Asi Eksklusif Terhadap Perkembangan Bayi Di Desa Kekait Kecamatan Gunung Sari. *J Kesehat Prima*. 2017;11(1):50–6.
 20. Nur Azzah RZ, Ermiati E, Nur Asriyani Maryam N. Gambaran Budaya Pemberian MP-ASI di Desa Mundu Pesisir Kabupaten Cirebon. *J Sehat Masada*. 2018;12(2):113–22.
 21. Som SV, Prak S, Laillou A, Gauthier L, Berger J, Poirot E, et al. Diets and Feeding Practices during the First 1000 Days Window in the Phnom Penh and North Eastern Districts of Cambodia. *Nutrients* [Internet]. 2018 Apr 18;10(4):500. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/29670006>
 22. Widayati W, Nurdianti DS. Pengaruh Pemberian Asi Eksklusif Terhadap Status Gizi Dan Perkembangan Bayi Di Puskesmas Trucuk I. *J Kebidanan dan Keperawatan*. 2016;12(1):60–8.

The Effect of Soy Milk Consumption on the Duration of Perineal Wound Healing in Postpartum Mothers

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ABSTRACT

Perineal wounds in postpartum mothers that do not heal promptly within several days can lead to infections. Nutritional status is also considered a crucial factor in the wound healing process. Mothers with good nutritional status tend to experience faster healing of perineal wounds, including those with protein intake from processed soy milk. This research aims to determine the impact of soy milk consumption on the duration of perineal wound healing in postpartum mothers at the Independent Midwife Practice (IMP) Sriwati Palu. The study design employed a pre-experimental design with an Intact Group Comparison approach. The sample consisted of 16 postpartum mothers with second-degree perineal wounds at the IMP Sriwati Palu, selected through quota sampling. Univariate and bivariate analyses using the Mann-Whitney U test were conducted. The research findings indicate that respondents who consumed soy milk were four times more likely to experience faster healing compared to those who did not consume soy milk. The Mann-Whitney U test yielded a p-value of 0.000 (<0.05), suggesting a statistically significant influence of soy milk consumption on the duration of perineal wound healing in postpartum mothers at the IMP Sriwati Palu. In conclusion, soy milk consumption has a significant impact on the duration of perineal wound healing in postpartum mothers at the IMP Sriwati Palu.

Keywords: Perineal Wound, Soy Milk

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INTRODUCTION

During the childbirth process, the vulva and vagina undergo changes, particularly in the perineum, resulting from tears in the birth canal, either spontaneously or due to episiotomy with specific indications¹. As a result of perineal wounds, postpartum mothers experience pain, leading to discomfort and a fear of engaging in early mobilization², however, early mobilization is crucial to facilitate the expulsion of lochia, prevent infection in the wound, ensure a smooth involution process, improve blood circulation,

prevent thrombophlebitis, and expedite wound healing³⁻⁵.

Based on the data from the Palu City Health Office in 2023, the number of mothers delivering pervaginam was 7,206, and there were cases of postpartum infections⁶. Direct interviews with midwives in several health facilities revealed that a majority of mothers delivering pervaginam experienced perineal wounds and discomfort during the healing process, especially in the case of second-degree perineal tears, resulting in pain. The research findings confirmed that a significant number of mothers experienced second-degree perineal

wounds, thereby affecting postpartum perineal pain⁷.

Perineal wound healing if there is no infection will heal within 6-7 days⁸. Perineal wounds in postpartum mothers that do not heal promptly can lead to infections⁹, influenced by various related factors. This process may be disrupted or delayed recovery due to factors such as age, nutrition¹⁰, pain, poor hygiene¹¹, cultural practices, and hereditary factors¹². The nutritional needs during the postpartum period, especially during breastfeeding, increase by 25%, benefiting the post-delivery healing process¹. One crucial source of nutrition in perineal wound healing is protein intake¹³. Research results indicate that the quantity of consumed protein has the most significant impact on the condition of second-degree perineal wound healing¹⁴. Another study shows that postpartum mothers with birth canal (perineum) injuries on days 1-42 have a sufficient protein intake rate in the category of "adequate" (53.3%), with perineal wound healing time falling into the "primary" category (53.3%). Based on statistical tests, there is a correlation between postpartum mothers' protein intake and the duration of perineal wound healing¹⁵.

Many sources of protein are available, such as animal and plant-based proteins. Plant-based protein sources include legumes, tofu, tempeh, and so on. One of these sources is soybeans, which are frequently used as food ingredients and can be processed into various forms, including the use of soy milk, a product rich in zinc. This mineral is beneficial for maintaining and enhancing immune function, aiding in the wound healing process by increasing the number of connective tissue cells¹⁶. This study aimed to investigate the influence of soy milk consumption on the duration of perineal wound healing in postpartum mothers at the Independent Midwife Practice (IMP) Sriwati Palu.

METHOD

The research design employed in this

study was Pre-Experimental research with an Intact Group Comparison design, where the researcher compared two existing groups without randomizing them. The researcher applied treatment to one group, providing an intervention, while the other group received no treatment.

The study was conducted from July 23 to August 23, 2020, at the Independent Midwife Practice (IMP) Sriwati Palu. The population for this research comprised all postpartum mothers with perineal wounds at the IMP Sriwati Palu. The sample for this study included some postpartum mothers with second-degree perineal wounds at the IMP Sriwati Palu, obtained through sample size calculations using the Lemeshow formula, as the population estimate was unknown. The sample size for this study was 16 respondents, divided into two groups: 8 respondents in the control group and 8 respondents in the intervention group.

This study utilized quota sampling with inclusion criteria being postpartum mothers with second-degree perineal rupture, having a healthy body condition, receiving care at the IMP on the first day after 2 hours postpartum, and willing to participate as respondents. Exclusion criteria included mothers with psychological disorders, anemia, diabetes mellitus, and a history of nut allergies. The dropout criterion was if a respondent could not continue as a study sample. Data collection techniques for this study only involved primary data. The instrument used in this study was in the form of an observation sheet. The analysis used in this study included univariate and bivariate analyses. Univariate analysis generated the distribution and percentage of each variable, including the independent variable (soy milk consumption) and the dependent variable (duration of perineal wound healing). Bivariate analysis first conducted a normality test using Shapiro-Wilk. As the data did not follow a normal distribution, the Mann-Whitney U-test was employed in this study

RESULTS

Based on sample characteristics, the research found the following data.

Table 1. Respondent Characteristics

Characteristics	Category	f	%
Age (years)	< 20 and > 35 years	0	0
	20 – 35 years	16	100
Education	Junior High School	3	19
	Senior High School	5	31
	College	8	50
Parity	Primipara	9	56
	Multipara	7	44
	Grandemulipara	0	0
Occupation	Employed	7	44
	Unemployed	9	56

Based on Table 1, it is known that all respondents fall within the age range of 20 – 35 years, comprising 100%. The majority have a college-level education, accounting for 50%.

The most common parity is primipara, constituting 56%. The predominant occupation among the respondents is unemployed, making up 56%.

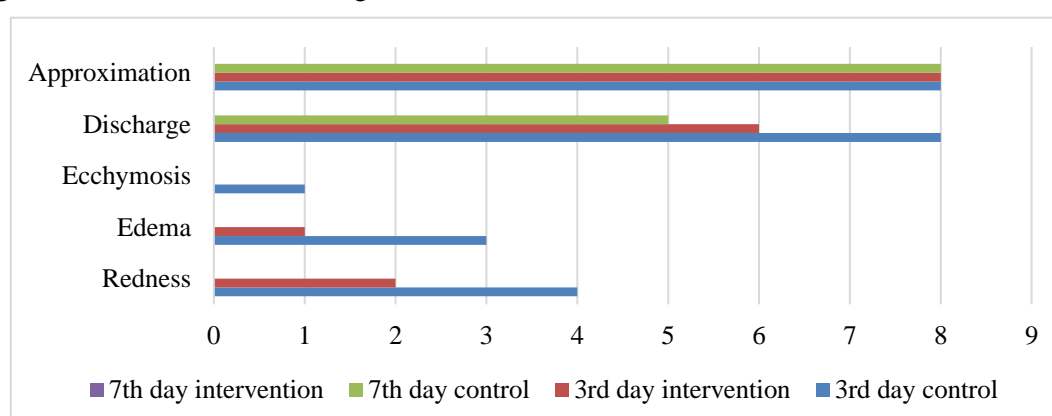


Figure 1. Duration of Perineal Wound Healing in Postpartum Mothers

Based on the REEDA scale assessment on day 3, observations of 8 respondents in the intervention group still showed signs of REEDA, with the majority (100%) experiencing Approximation (wound closure). Meanwhile, observations of 8 respondents in the control group showed that the majority

(100%) still experienced Discharge and Approximation.

Observations continued on day 7 using the REEDA scale. In the intervention group, none of the respondents exhibited signs of REEDA. However, in the control group, the majority (100%) showed signs of Approximation

Table 3. Bivariate Analysis of the Effect of Soy Milk on the Duration of Perineal Wound Healing in Postpartum Mothers

Soy Milk Consumption	Perineal Wound Healing Duration				Z-Score	P Value
	Fast		Slow			
	f	%	f	%		
Intervention	8	100	0	0	-3,633	0,000
Control	0	0	8	100		

Based on Table 3, the Z-score value of -3.633 indicates that mothers who were given soy milk have approximately 3.633 times (rounded to 4 times) higher chances of faster perineal wound healing compared to mothers who did not consume soy milk. The Mann-Whitney U test results show a p value of 0.000. Since this value is less than the significance level of 0.05, statistically, the null hypothesis (H_0) is rejected. Therefore, the hypothesis in this study is accepted, indicating that there is an influence of soy milk consumption on the duration of perineal wound healing in mothers.

DISCUSSION

Based on the research conducted at the Independent Midwife Practice (IMP) Sriwati Palu on 16 postpartum mothers, it was found that the perineal wounds experienced by the respondents were still influenced by several external factors, as observed through the characteristics of each respondent. Risk factors for perineal tear or injury, as indicated in various theories, include the age of the mother being either too young or too old, and being a first-time mother^{17,18}. In Table 1, the factor influencing the duration of wound healing was the age of the respondents, particularly those in the productive age group or the non-risk age, which includes individuals below 20 years or over 35 years. This age range was identified as a risk factor for complications. The prevalence of postpartum mothers experiencing perineal rupture was highest in the age range of 32-39 years, accounting for 62%¹⁹. This phenomenon is attributed to the underdeveloped reproductive function below the age of 20, while above the age of 35, there is a decline in reproductive function. Respondents in the productive age group resulted in a faster body function in repairing damaged tissues, leading to a quicker healing process of perineal wounds compared to the non-productive age group²⁰.

It is evident that respondents with higher education are more easily educated about clean and healthy living behaviors, as well as vulva hygiene²¹ resulting in lower REEDA scale scores compared to respondents with lower education who have higher REEDA scores. Other research findings state that there is a correlation between the postpartum mothers' knowledge of perineal wound care and the prevention of infection. Respondents who consumed soy milk, whether primiparous or

multiparous, showed no significant difference in the healing process²². Similarly, the respondents' occupations did not affect the duration of perineal wound healing, as all respondents avoided heavy work during the 7-day postpartum period.

In Figure 1, it is outlined that the two groups of respondents were observed using the REEDA scale assessment. On the 3rd day, the overall condition of the intervention group still showed signs of REEDA, with the majority experiencing Approximation (wound closure). Conversely, the control group also still exhibited signs of REEDA overall, with the most commonly observed criteria being Approximation and Discharge. The wound exudate for the respondents included serum and serosanguinous discharge. Upon comparison, although both groups of respondents still showed overall signs of REEDA, those in the intervention group had fewer instances of REEDA compared to the control group.

On the 7th day, all respondents in the intervention group showed no signs of REEDA and were declared to have healed within ≤ 7 days. In contrast, the control group still had respondents experiencing REEDA signs, with an average healing time on days 10 to 11. The research results indicate that respondents who consumed soy milk had approximately 3.633 times higher chances of faster healing of perineal wounds compared to respondents who did not consume soy milk. Soybean milk is a common drink prepared from soybeans and is rich in soy protein, soy isoflavones, and other bioactive components^{23,24}. Soy milk can have potential benefits for postpartum mothers, as it has a relatively low cost and contains more protein than most other dairy alternatives. Soy milk also contains fat, carbohydrates, calcium, phosphorus, iron, provitamin A, B-complex vitamins (except B12), and water²⁵⁻²⁷.

Wound healing with the assessment of perineal suture quality during the postpartum period is expected to protect postpartum mothers from the dangers of infection or physiological complaints by increasing the intake or consumption of a high-protein diet in daily life²⁸. The supply of nutrients to postpartum mothers, including macronutrients (e.g., omega-3) and micronutrients (zinc, magnesium, vitamin D, vitamin E, and probiotics), plays a crucial role in the wound healing process. These macro and micronutrients are essential for modulating cell

proliferation, collagen metabolism, inflammation, oxidation stages, and omega-3, zinc, magnesium, vitamin D, vitamin E, and probiotics play a vital role in enhancing collagen production, protein synthesis, bacteria, and removal of necrotic cells^{29,30}.

Other research suggests the influence of high plant protein consumption on the quality of perineal wound healing in postpartum mothers^{12,31}. Additional studies state that the wound healing process of perineal wounds is influenced by the nutrition of postpartum mothers, particularly high-calorie intake, protein, fluid and mineral intake, as well as vitamins that aid in the regeneration of new cells, facilitating rapid perineal wound healing^{32,33}. Proper wound healing can reduce pain, analgesia use, and dyspareunia at three months postpartum^{34,35}.

CONCLUSION

The research concludes that soy milk consumption has a significant impact on the duration of perineal wound healing in postpartum mothers with second-degree injuries. Respondents who consumed soy milk exhibited a faster rate of healing compared to the control group that did not consume soy milk. The importance of the healthcare professional's role, especially midwives, in providing education to postpartum mothers about the necessary nutrition during the postpartum period, including soy milk consumption, is emphasized. It is also crucial to integrate information on soy milk consumption into postpartum care programs at healthcare facilities, particularly in Independent Midwife Practices (IMP).

REFERENCES

1. Pitriani R, Andriyani R. Asuhan Kebidanan Ibu Nifas Normal (Askeb III). I. Pitriani R, Andriyani R, editors. Yogyakarta: Deepublish; 2014.
2. Suciani Pujiningrum AR. Pengaruh Senam Nifas terhadap Intensitas Nyeri Perineum dan Kecemasan Postpartum di RSIA Pertiwi Makassar. UMI Med J [Internet]. 2019 Dec 31;4(2):11–9. Available from: <http://jurnal.fk.umi.ac.id/index.php/umimedicaljournal/article/view/64>
3. Rottie J, Saragih RE. Pengaruh Mobilisasi Dini Terhadap Penyembuhan Luka Post Sectio Caesarea Di Irina D Bawah RSUP PROF DR. R. D. Kandou Manado. J Community Emerg [Internet]. 2019;7(3):431–40. Available from: <https://www.ejournal.unpi.ac.id/index.php/JOCE/article/view/238>
4. Zhou W, Shi B, Fan Y, Zhu J. Effect of early activity combined with early nutrition on acquired weakness in ICU patients. Medicine (Baltimore) [Internet]. 2020 Jul 17;99(29):e21282. Available from: <https://journals.lww.com/10.1097/MD.00000000000021282>
5. Susanti S, Sari IN. Early Mobilization Behavior Of Mother Post Section Caesarea At Embung Fatimah Hospital Batam City. Int J Of Nurs Midwifery Sci [Internet]. 2022 Apr 25;6(1):82–7. Available from: <https://ijnms.net/index.php/ijnms/article/view/382>
6. Dinas Kesehatan Kota Palu. Angka Kematian Ibu Tahun 2018. Palu; 2018.
7. Mulati TS, Susilowati D. Pengaruh Derajat Robekan Perineum Terhadap Skala Nyeri Perineum Pada Ibu Nifas Di Kabupaten Wonogiri. J Kebidanan dan Kesehat Tradis [Internet]. 2018 Mar 13;3(1):51–6. Available from: <http://jurnalbidankestrad.com/index.php/jkk/article/view/67>
8. Tanjung MRH. Relationship of Postpartum Mother ' s Knowledge about Perineal Care with Belief in Healing Perineal Sutures in Lima Puluh Village , Lima Puluh Subdistrict , Batu Bara Regency in 2021. Sci Midwifery [Internet]. 2021;10(1):410–6. Available from: <https://midwifery.iocspublisher.org/index.php/midwifery/article/view/230%0Ahttps://midwifery.iocspublisher.org/index.php/midwifery/article/download/230/192>
9. Fauziah EN, Widowati R, Novelia S. Factors Related to Perineal Wound Healing in Postpartum Mothers at Jawilan Public Health Center. Nurs Heal Sci J [Internet]. 2022 Apr 1;2(1):41–6. Available from: <https://nhs-journal.com/index.php/nhs/article/view>

- w/72
10. Althumairi AA, Canner JK, Gearhart SL, Safar B, Sacks J, Efron JE. Predictors of Perineal Wound Complications and Prolonged Time to Perineal Wound Healing After Abdominoperineal Resection. *World J Surg* [Internet]. 2016 Jul 23;40(7):1755–62. Available from: <http://link.springer.com/10.1007/s00268-016-3450-0>
11. Triyani Y, Wittiarika ID, Hardianto G. Factors Influencing the Process of Perineal Wound Healing in Postpartum Women in Serui Hospital, Papua. *Indones Midwifery Heal Sci J* [Internet]. 2021 Oct 28;5(4):398–405. Available from: <https://e-journal.unair.ac.id/IMHSJ/article/view/28153>
12. Yeni K, Sulistyoningtyas S. Pengaruh Konsumsi Tinggi Protein Nabati Terhadap Kualitas Penyembuhan Luka Perineum Pada Ibu Nifas Di Puskesmas Mlati II Kabupaten Sleman [Internet]. Universitas 'Aisyiyah Yogyakarta; 2017. Available from: <http://digilib.unisayogya.ac.id/2564/>
13. Sebayang WB, Ritonga F. Nutrisi Efektif Mempercepat Penyembuhan Luka Perineum pada Ibu Post Partum (Systematic Review). *J Kesehat* [Internet]. 2021 Aug 24;12(2):330–6. Available from: <http://ejurnal.poltekkes-tjk.ac.id/index.php/JK/article/view/1790>
14. Rahmawati E, Triatmaja NT. Hubungan Pemenuhan Gizi Ibu Nifas Dengan Pemulihan Luka Perineum. *J Wiyata Peneliti Sains Kesehat* [Internet]. 2017;2(1):19–24. Available from: <https://ojs.iik.ac.id/index.php/wiyata/article/view/30>
15. Hestianingrum PR, Djarot HS, Purwanti IA. Hubungan Tingkat Kecukupan Protein Dengan Lama Penyembuhan Luka Perineum Ibu Nifas Di Wilayah Kerja Puskesmas Tawangharjo Kabupaten Grobogan. *J Kebidanan* [Internet]. 2015;4(2):12–23. Available from: https://jurnal.unimus.ac.id/index.php/jur_bid/article/view/1684
16. Novianti Y. Inilah 3 Makanan dari Kedelai yang Kaya Nutrisi dan Manfaat Untuk Anak. Ibu dan Balita. 2022.
17. Pangastuti N. Robekan Perineum pada Persalinan Vaginal di Bidan Praktik Swasta (BPS) Daerah Istimewa Yogyakarta Indonesia Tahun 2014-2016. *J Kesehat Reproduksi* [Internet]. 2016 Dec 21;3(3):179. Available from: <https://jurnal.ugm.ac.id/jkr/article/view/36184>
18. Subriah S, Agustina A, Puspita EW, Rahmawati N, Nurfatimah N. Hubungan Paritas dengan Kejadian Rupture Perineum pada Persalinan Normal. *J Bidan Cerdas* [Internet]. 2021 Dec 7;3(4):176–82. Available from: <http://jurnal.poltekkespalu.ac.id/index.php/JBC/article/view/369>
19. Kurniawan F, Jingsung J, Baeda AG, Anam A, Siagian HJ. The Risk Factor of Pregnant Gymnam on The Incidence of Ruptur Perineum in Aliyah Hospital Kendari. *J KEBIDANAN* [Internet]. 2020 Oct 28;10(2):138–42. Available from: <http://ejournal.poltekkes-smg.ac.id/ojs/index.php/jurkeb/article/view/6326>
20. Rohmin A, Octariani B, Jania M. Faktor Risiko yang Mempengaruhi Lama Penyembuhan Luka Perineum pada Ibu Post Partum. *J Kesehat* [Internet]. 2017 Nov 30;8(3):449. Available from: <http://ejurnal.poltekkes-tjk.ac.id/index.php/JK/article/view/660>
21. Mole M, DwiAnggraeni M, Sumeru A. The Relationship Between Level of Knowledge About Vulva Hygiene and The Restrictions During Childbirth With The Perineal Wound Healing Among Postpartum Mothers. *Ann Trop Med Public Heal* [Internet]. 2019;22(11):356–62. Available from: https://www.journal.atmph-specialissues.org/uploads/179/6996_pdf.pdf
22. Rumini R, Julita T. Pengetahuan Ibu Post Partum tentang Perawatan Luka Perineum dengan Pencegahan Infeksi. *J Bidan Cerdas* [Internet]. 2020 May 27;2(2):60–5. Available from: <http://jurnal.poltekkespalu.ac.id/index.php/JBC/article/view/66>

23. Jochum F, Altheld B, Meinardus P, Dahlinger N, Nomayo A, Stehle P. Mothers' Consumption of Soy Drink But Not Black Tea Increases the Flavonoid Content of Term Breast Milk: A Pilot Randomized, Controlled Intervention Study. *Ann Nutr Metab* [Internet]. 2017;70(2):147–53. Available from: <https://www.karger.com/Article/FullText/471857>
24. Xin P, Han S, Huang J, You X, Wu J. Natural Soybean Milk-Derived Bioactive Coatings for Enhanced Wound Healing. *ACS Appl Mater Interfaces* [Internet]. 2022 Aug 3;14(30):34480–7. Available from: <https://pubs.acs.org/doi/10.1021/acsam.2c09689>
25. Vieira AM, de Almeida Brasiel PG, Ferreira MS, Mateus K, Figueiredo MS, Lisboa PC, et al. Maternal soybean diet during lactation alters breast milk composition and programs the lipid profile in adult male rat offspring. *Endocrine* [Internet]. 2018 May 8;60(2):272–81. Available from: <http://link.springer.com/10.1007/s12020-018-1572-x>
26. Lane M. Review of Plant Based Milks for Breastfeeding Moms. *The Lactation Nutritionist* [Internet]. 2019 Jan; Available from: <https://www.thelactationnutritionist.com/post/2019/01/16/the-best-plant-based-milks-for-breastfeeding-moms-a-dietitians-review>
27. Budimarwanti C. Komposisi dan Nutrisi pada Susu Kedelai. In: *Competition Nutrition*. 2017. p. 1–7.
28. Sulistyoningtyas S, Komala Y. Effect of high consumption the phyto-protein on quality of wound healing perineal on the postpartum at Primary Health Center Mlati II District Sleman. *Int J Heal Sci Technol* [Internet]. 2020 Mar 28;1(3):75–9. Available from: <https://ejournal.unisayogya.ac.id/ejournal/index.php/ijhst/article/view/1275>
29. Lestari MP, Kusumaningrum NSD. Gizi untuk Proses Penyembuhan Luka pada Pasien dengan Diabetic Foot Ulcer (DFU): Literature Review. *J Nutr Coll* [Internet]. 2021 May 28;10(1):39–46. Available from: <https://ejournal3.undip.ac.id/index.php/jnc/article/view/29825>
30. Ibrahim N, Wong S, Mohamed I, Mohamed N, Chin K-Y, Ima-Nirwana S, et al. Wound Healing Properties of Selected Natural Products. *Int J Environ Res Public Health* [Internet]. 2018 Oct 25;15(11):2360. Available from: <http://www.mdpi.com/1660-4601/15/11/2360>
31. Asti EJ. Penerapan Konsumsi Tinggi Protein Pada Ibu Nifas Dalam Proses Penyembuhan Luka Perineum [Internet]. Universitas Muhammadiyah Purwokerto; 2019.
32. Frilasari H, Saudah N, Prameswari VE, Azizah YN, Suhita BM. Nutritional Pattern And Healing Of Perineum Wound On Postpartum Period. *J Nurs Pract* [Internet]. 2020 Apr 28;3(2):172–80. Available from: <https://thejnp.org/index.php/jnp/article/view/85>
33. Puji Rahayu Y, Saputri R, Rahmadaniah N. Analysis Of Knowledge And Attitudes On Perineal Wound Healing In Postpartum Mother In The Area Of Pekauman Public Health Center In South Banjarmasin. In: *Proceedings of the 2nd Sari Mulia International Conference on Health and Sciences 2017 (SMICHS 2017)* [Internet]. Paris, France: Atlantis Press; 2017. p. 309–16. Available from: <http://www.atlantispress.com/php/paper-details.php?id=25886815>
34. Patel A, Makwana A, Tiwari A. Effect of Topical Application of Breast Milk on Episiotomy Wound Healing- a Literature Review. *Int J Biol Pharm Allied Sci* [Internet]. 2023 Jun 1;12(6).
35. Festy P, Wulandari Y, Syawaliyah M. The Relationship of Nutritional Status and Perineal Wound Healing Among Post-Partum Women. In: *4th International Conference on Sustainable Innovation 2020–Health Science and Nursing (ICoSIHSN 2020)* [Internet]. 2021.

Original Article

Oryza Sativa L. Indica Ointment Effect on Histopathological Skin and Collagen Features in Ultraviolet B-Exposed Rattus norvegicus

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ABSTRACT

Outdoorsy folks get UV radiation. Acute UVB decreases hyaluronic acid. Antioxidants can prevent photoaging by delaying, stopping, or eliminating oxidation-induced molecular damage. Black rice extract ointment (Oryza sativa l. indica) was tested on the histological features of skin and collagen in Wistar rats (Rattus norvegicus) subjected to ultraviolet B radiation. This study is lab-based. The research samples were Wistar strain white mice (Rattus norvegicus). Research with treatment groups is Precondition variables (UVB rays), independent factors (10%, 20%, and 30% black rice extract ointment), and fixed variables (dermis collagen and histological picture of mice exposed to UVB rays) were the research variables. The research procedures included the accreditation of test animals, black rice extract, ointment, phytochemical screening, treatment, histopathological skin tissue preparations, and histopathological observation. All the data was examined with SPSS. The investigation revealed that 30% black rice extract ointment had the highest collagen density (mean and SD = 55,959 ± 2.5). All groups K-, K+, P1, P2, and P3 had significant data normality tests of 0.200 > 0.05. The homogeneity p-value is 0.06 > 0.05, and the sig (2-tailed) value is 0.000 < 0.05 in the t-test. The alkaloids, flavonoids, tannins, and steroids in black rice extract increase glutathione peroxidase levels in mice, which helps collagen density when exposed to UVB light at 125 mg/kg BW.

Keywords: Collagen, Black Rice Ointment, UVB Radiation, Histopathological Skin

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INTRODUCTION

Aging is an unquestionably natural phenomenon characterized by biological processes that result in the steady build-up of harm, ultimately culminating in illness and eventual death^{1,2}. With advancing age, the skin changes, such as increased dryness, paleness, translucency, and fragility³.

Human skin protects the body^{4,5}. The epidermis and dermis are thin and flattened with age, leaving the skin less firm and smooth. Old age generates fine lines, pigment spots, sagging, and wrinkles. Due to intrinsic and extrinsic aging causes, the complex physiology,

biochemistry, and structural integrity of the dermis in aged skin changes rapidly⁶.

Time and genetics cause intrinsic or chronological skin aging. Extrinsic skin aging is mainly induced by UV radiation or photoaging⁷. Both aging processes are linked to sun-exposed skin and cause wrinkles, sagging, and skin brittleness due to dermal matrix changes⁸.

Solar ultraviolet (UV) activates MMPs, which degrade collagen, fibronectin, and elastin, causing skin aging⁹. After acute UV exposure, the activation of significant cell transcription factors enhanced MMPs 1, 2, 3, and 9 synthesis and other cellular processes linked with decreased type I procollagen

synthesis¹⁰. Mutations and skin cancer result from UV radiation-induced DNA damage^{11,12}. UV radiation stresses epidermal tissue and enters the dermis. Basal cell carcinoma, malignant melanoma, and squamous cell carcinoma are linked to cumulative UV radiation exposure¹³.

UVB-induced soluble mediators from keratinocytes, such as specific cytokines and matrix Metalloproteinases (MMPs), penetrate lower into the dermis and impact the extracellular matrix (ECM)^{14,15,16}. Aging promotes skin moisture and epidermal Hyaluronic Acid (HA) loss, which stores water¹⁵.

Photoaging causes uneven epidermal thickness and shape, unlike intrinsic aging^{15,16,17}. Photodamaged skin is thicker than organically aged skin. Melanogenesis is increased and neutralizes UV-induced free radicals, which may protect against photodamage⁸.

As humans age, natural (intrinsic) and environmental (extrinsic) factors reduce the production of these essential components, causing skin deterioration, wrinkles, and sagging¹⁸. The loss of collagen I in elderly skin makes collagen seem disordered and increases the collagen III-collagen I ratio³.

In healthy skin, the extracellular matrix mainly consists of glycoproteins such as collagen, elastin, fibronectin, laminin, and proteoglycans/glycosaminoglycans¹⁹. The dermis' primary components—collagen, elastin, and hyaluronic acid—make skin soft and elastic. Collagen strengthens and firms skin^{20,21,22}. Elastin keeps skin stretchy. Hyaluronic acid plumps the skin matrix with water, making it fuller, firmer, and more youthful²⁰.

Outdoor activities can expose people to UV radiation, which can accelerate aging, especially during peak sun hours from 10 am to 4 pm, and wear UV-blocking garments, hats, sunglasses, and sunscreen³.

Antioxidants can also prevent photoaging by slowing, stopping, or eliminating molecular damage from oxidation processes. Endogenous enzymatic antioxidants like Glutathione peroxidase, SOD, catalase, and low molecular weight non-enzymatic antioxidants, including GSH, uric acid, and ubiquinol, protect the skin. Extreme UV exposure can deplete the skin's antioxidant reserves. Hence, external antioxidants are needed, such as antioxidant-rich natural products. Antioxidants are found in

black rice (*Oryza sativa l. indica*)^{23,24,25}

Black rice (*Oryza sativa l. indica*) is nutritious and antioxidant. Black rice contains antioxidants such as phenolic acids, flavonoids, anthocyanins, proanthocyanidins, tocopherols, tocotrienols, γ -oryzanol, and phytic acid²⁶.

Beneficial black rice is colored. Essential amino acids, functional lipids, dietary fiber, vitamins, minerals, anthocyanins, phenolic compounds, tocopherols, tocotrienols, phytosterols, and phytic acid are found in this rice^{27,28}. This plant's substance can inhibit photoaging-causing free radicals.

Several previous studies have discussed the effects of black rice (*Oryza Sativa L. Indica*), such as research on the impact of applying black rice extract to lipid-based food products, where the research results show the quality and safety of applying natural antioxidants to food products²⁹. Then, research was conducted into black rice as an active chemical that is an antioxidant and protects against UV radiation³⁰, as well as research on black rice bran, which can be used as a skin-lightening agent³¹. In this study, black rice extract will look at its effect on collagen and the histopathological features of the skin of obese mice exposed to UVB Rays.

METHOD

This is true experimental research using Post Test Only Control Group Design, which only observes the control and treatment groups after an action³². Inclusion criteria were male Wistar strain (*Rattus norvegicus*) rats weighing 200-300 grams, 2-3 months old, healthy physical condition, no anatomical abnormalities, and never used as research samples before. The exclusion criteria were white mice that died or were disabled during the experiment³³. Samples were calculated using the Federer formula $(n-1) \times (t-1) \geq 15$ ³⁴. Federer's sample calculations showed that each group needed 5 test animals. Each experimental group had 6 Wistar mice, totaling 30 mice. Since rats (*Rattus norvegicus*) share so many physiological and behavioral traits with humans and are among the most popular research animals in the biomedical sciences, scientists have found them to be an ideal model for human subjects. Mice of the white variety also do well when housed in a controlled laboratory setting³⁵.

The precondition variable, Ultraviolet-

B light; the independent variable, Black Rice (*Oryza sativa l. indica*) Extract Ointment at 10%, 20%, and 30% concentrations; and the fixed variables, dermis collagen and histopathological skin tissue, were the variables in this study.

The research includes water baths, rotary evaporators, filters, rat drums, drinking containers, shavers, digital scales, surgical instruments, microscopes, rulers, cameras, and maceration tools. We will need the following items for in vitro testing: 10 ml, 25 ml, and 100 ml measuring flasks; test tubes; test tube racks; BioHit 1000 μ L micropipettes; measuring pipettes; spatulas; vials; incubators; pH meters; cuvettes; centrifuges; centrifuge tubes; UV-spectrophotometers Vis; beaker glass; and an ultraviolet lamp B PL-S9W/01/2P. Brand Philips. Trichloroacetic Acid (TCA), ethanol propionate (Brataco), Aquades, Sirius red, and black rice extract simplicia (*Oryza sativa l. indica*) are some of the compounds utilized in the research.

The research procedure was to acclimate test animals for seven days at the Animal House, Faculty of Mathematics and Natural Sciences, University of North Sumatra. Then, the extract is made by preparing black rice (*Oryza sativa l. indica*) from Medan farmers, separating bad rice, washing, and drying it in a 50°C oven. The simplicial powder is blended and sieved with a 40-mesh sieve. Macerate and filter 96%: HCl (9:1), 1 part bran: 10 parts solvent to make black rice extract ointment at 10%, 20%, and 30%. The filtrate was evaporated in a rotary evaporator at 40°C, 50 mBar vacuum pressure, and 100 rpm to provide a crude extract for phytochemical analysis. Mix the extract and base ointment until homogenous.

Then, make two ointments: one without extract and one with black rice extract (*Oryza sativa l. indica*). The basic or control ointment contains 170 gr soft paraffin, 10 gr hard paraffin, 10 gr cetostrearyl alcohol, and 10 gr wool fat—an ointment containing 10%, 20%, and 30% black rice extract. Then, test the secondary metabolites for the content of tannins, flavonoids, alkaloids, steroids/terpenoids, and saponins in black rice extract ointment (*Oryza sativa l. indica*).

Add 1 gram of extract to a test tube, add 10 mL of hot water, boil for 5 minutes, then add 3-4 drops of FeCl₃ to the filtrate for the Tannin Content Test. It is positive for catechol tannins

if it is blue-green (green-black) or blue-black. pirogalo tannin. In the Flavonoid Content Test, 1 gram of sample extract was added to a test tube, concentrated HCl was added, and the tube was heated for 15 minutes in a water bath Red or yellow indicates flavonoids (flavone, chalcone, aurone). The Alkaloid Content Test involved dripping 5 mL of 2 N HCl over 2 grams of sample extract, heating, cooling, and dividing into 3 1 mL test tubes. Reagents are added to each tube. If Mayer's reagent precipitates white or yellow, alkaloids are present. Wagner's reagent detects alkaloids if a brown precipitate appears. The Dragendrof reagent contains alkaloids and gives an orange precipitate. In the Steroid/Terpenoid Content Test, 2 grams of sample extract were shaken in a test tube with 2 mL of ethyl acetate. The ethyl acetate layer was dropped onto a drop plate to dry. After drying, 2 drops of acetic acid and 1 drop of concentrated sulfuric acid were added. Terpenoids are present if they become red or yellow. Steroids are present if they turn green. In the Saponin Content Test, 1 gram of sample extract is added to a test tube, 10 ml of hot water is added, cooled, and shaken violently for 10 seconds. Saponin is present if the foam is 1-10 cm high in 10 minutes and does not dissolve after adding 1 drop of 2 N HCl.

Male Wistar rats acclimated and fed pellet food were randomly divided into five groups. All 30 mice were exposed to ultraviolet-B light daily for 28 days in 5 groups. The Negative Control Group (K-1) exposed mice only to ultraviolet-B light, the Positive Control Group (K-2) treated mice with basic ointment, the Treatment Group-3 (K-3) treated mice with 10% black rice extract ointment, the Treatment Group-4 (K-4) treated mice with 20%, and the Treatment Group-5 (K-5) treated mice with 30% black rice extract (*Oryza sativa l. indica*).

Then, proceed with making Histopathological Skin Tissue Preparations; Melanin appears as tiny black dots when viewed via a microscope. After taking pictures of the parts that came up positive, we ran the images through Image J for analysis. The Histopathological Observation Process using a scoring system viewed using a light microscope with 400x magnification.

Histopathological tissue metrics will include skin collagen density and melanin pigment. After all treatments, the researchers took a biopsy of the mice's back skin (2 cm x 2 cm x 2 mm). They stained it with Picro Sirius

Red to measure dermis collagen density and Fontana-Masson to measure melanin.

The scoring system used is based on collagen density from the study as follows: 0 = normal, 1 = mild increase, 2 = moderate increase, and 3 = significant increase³⁶. The amount of collagen is calculated as the percentage of red collagen area pixels compared to the entire tissue's pixel area³⁷. Here are three categories for melanin pigment that will be counted: little (<40 melanin pigments), moderate (40-80 melanin pigments), and a lot (>80 melanin pigments). The melanin pigment visible under a microscope with interpretation will be used³⁸.

Data in this study was normalized using the Kolmogorov-Smirnov test. $P > 0.05$ indicates normal distribution. After normalizing the data, use Levene's test for homogeneity. $P > 0.05$ indicates homogeneity³⁹. The SPSS analysis test tool uses the t-test to compare groups after normality and homogeneity testing.

RESULTS

The test animals mainly were male Wistar rats (*Rattus norvegicus*) of the Wistar strain. They were averaging 200-300g and 2-3 months old. Black rice extract ointment (*Oryza sativa l. indica*) is applied after the disinfected rat's back is shaved. Each rat was shaved with a 4x4 cm hair shaver. Treat each group. Each ointment concentration was administered at 0.1 ml/cm² to the backs of shaved mice subjected to ultraviolet B light. In ultraviolet B light, the ointment was applied twice daily for four weeks, 20 minutes after exposure. Violet B was applied four hours later at 09.40 AM, 10.00 AM, and 2.00 PM. On radiation-free days, ointment is used.



Figure 1. Process for Making Black Rice Extract

From selecting the best black rice to

manufacturing black rice extract, Figure 1 demonstrates the process. Put black rice flour in a glass bottle after grinding to 60 mesh. The extraction was done in a light-tight glass bottle at room temperature ($\pm 27^\circ\text{C}$) for 24 hours. After filtering the crude extract, a rotary vacuum evaporator at 60°C evaporated the filtrate. The final thick extract ($\pm 10\%$ of total solvent) was kept at 4°C for further analysis.

Making Black Rice Extract Ointment with mixtures of extracts of 10%, 20%, and 30% are prepared by levigationally mixing accurately weighed extracts into the base ointment to make a fine paste with 2 or 3 times the base weight, gradually adding more base ointment until it forms a homogeneous ointment, and finally packaging the mixture. In the organoleptic test (blank, F1, F2, F3), the black rice ointment extract was odorless, white, light brown, brown, homogeneous, solid, and pH 5.37 - 6.33, suitable for human skin. The ointment spreadability test showed a 5.0 – 5.9 cm diameter in 0 – 125 gr packages. Thus, the ointment is safe for experimentation.

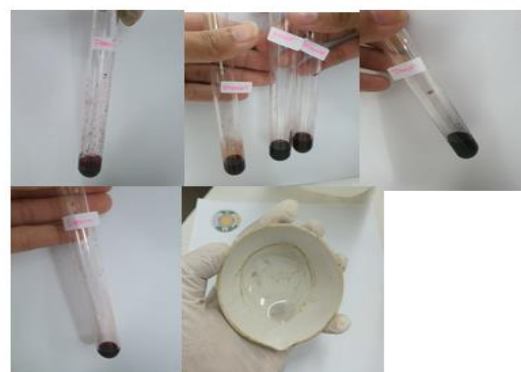


Figure 2: Phytochemical test results

Phytochemical studies have shown that the alkaloids, flavonoids, tannins, and steroids found in black rice extract (*Oryza sativa L. indica*) increase glutathione peroxidase levels in mice, suggesting that this extract may have antioxidant properties.

Based on the information in Table 1, we can observe that the control group (K-) of mice that did not receive any treatment other than exposure to UVB light for 28 days had an average percentage of collagen density of 36.37 ± 0.8 . In the treatment group (K+), mice were exposed to UVB light and given basic ointment without black rice extract, resulting in an average result of 42.25 ± 1.3 . In treatment group 1 (P1), mice were exposed to UVB light and

given a 10% concentration of black rice extract ointment daily for 28 days. In this group, the average percentage of collagen density was 45.59 ± 2.8 . Lastly, in treatment group 2 (P2), mice were exposed to UVB light and given a 10% black rice extract ointment concentration. For treatment group 3 (P3), the average result with a standard deviation was 50.30 ± 1.2 . Mice in this group were subjected to UVB and daily applications of a 30% concentration of black rice extract ointment for one month. A standard deviation accompanied the 55.96 ± 2.5 average result.

Our results suggest that the P3 group received a 30% concentration of black rice extract ointment as treatment and had the highest average percentage area of collagen density. The negative control group has the lowest average collagen density percentage area if that's true. Specifically, the group that underwent treatment with UVB rays but did not get any black rice extract ointment.

Table 1. Collagen Density Test Results in Mice Skin Tissue

Repetition	Treatment Group				
	K-	K+	P1	P2	P3
1	37.26	42.61	48.93	51.06	58.03
2	35.38	39.87	42.42	48.99	53.96
3	37.37	43.17	46.27	50.47	57.31
4	36.33	43.79	42.94	48.93	52.36
5	35.56	41.68	44.26	50.22	55.33
6	36.77	42.33	48.72	52.14	58.76
Score	0	1	2	3	3
Mean	36.37	42.25	45.59	50.30	55.96
SD	0.8	1.3	2.8	1.2	2.5

Note Score: 0 = normal, 1 = mild increase, 2 = moderate increase, and 3 = significant increase.

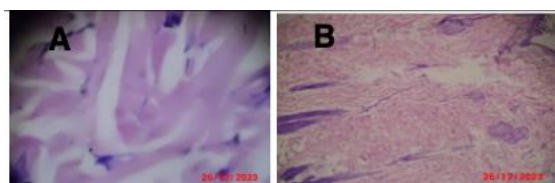


Figure 3. Histopathological Features of Collagen (A) and Melanin (B) in the Negative Control Group (K-).

With a collagen density (A) of 0, the negative control group (K-) exhibited a thick, typical look and a purplish-blue hue (Figure 3).

Because these mice were solely exposed to UV-B radiation for 28 days and received no therapy, their collagen density is higher, and their fibers are not disseminated. The mouse epidermis also found many damaged skin melanin pigment (B) patches. Radiation intensity influences melanin pigment treatment.

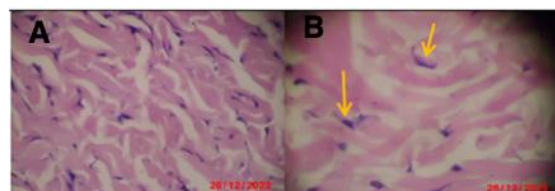


Figure 4. Histopathological Features of Collagen (A) and Melanin (B) in the Positive Control Group (K+).

Histology images of collagen density (A) in the positive control group (K+) indicated a little elevation of 1 point, a thick, purplish-blue appearance, and fibers started to scatter in the same direction (Figure 4). UVB rays were utilized on this subset of ointment without black rice extract. Granules formed in the mice's epidermis, indicating that the damaged melanin pigment (B) was working. The results show that base ointment melanin pigment production depends on exposure.

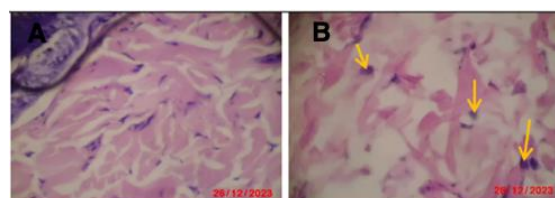


Figure 5. Histopathological Features of Collagen (A) and Melanin (B) in the Treatment Group 1 (P1).

In the initial treatment group 1 (P1), collagen density (A) had a score of 2 considerable increases, a dense and purplish-blue appearance, and distributed fibers (Figure 5). This group of mice received 10% black rice extract ointment and ultraviolet B light for 28 days. In mice, damaged skin melanin pigment (B) in the epidermis fades and has fewer granules—exposure to 10% black rice extract ointment daily for 28 days impacts melanin formation.

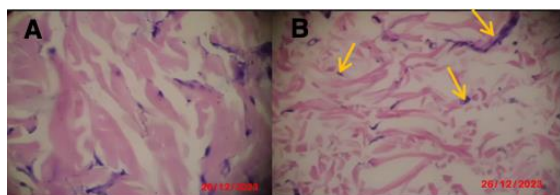


Figure 6. Histopathological Features of Collagen (A) and Melanin (B) in the Treatment Group 2 (P2).

On histopathological imaging, the second treatment group of mice (P2) had a statistically significant increase in collagen density (A) of 3 compared to the light-exposed control group (Figure 6). The image was predominantly purplish blue, and collagen density was high. Ointments with 20% UVB and black rice extract were applied daily for 28 days. Melanin pigment was found in wounded skin's smaller, fewer-granule epidermis. Daily application of 20% black rice extract ointment for 28 days shows that exposure influences melanin pigment production.

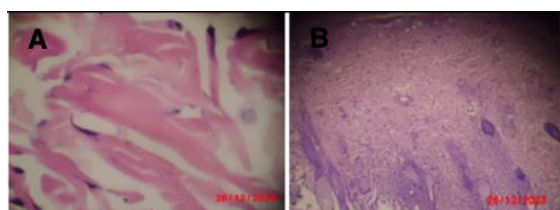


Figure 7. Histopathological Features of Collagen (A) and Melanin (B) in the Treatment Group 3 (P3).

In Figure 7, treatment group 3 (P3)'s histological collagen density (A) image resembles treatment 2, with a score of 3, suggesting a significant rise. Purple-blue picture dominates results. These mice were exposed to UVB rays and treated with 30% black rice extract ointment daily for 28 days. Microgranules of damaged skin melanin pigment (B) were found in the mouse epidermis. Applying 30% black rice extract ointment daily for 28 days shows that exposure influences melanin formation.

Table 2. Normality Test Result

Groups	Kolmogorov-Smirnov ^a		
	Statistic	df	Sig.
Control -	.184	6	.200*
Control +	.191	6	.200*
P1	.198	6	.200*
P2	.189	6	.200*
P3	.205	6	.200*

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

The results demonstrate that all groups K -, K+, P1, P2, and P3 exhibit a significant value of 0.200, according to the image in Table 2 that has been normality checked using SPSS. If the p-value in the Kolmogorov-Smirnov Test is more significant than the standard margin of 0.05, then the data is considered regularly distributed.

Table 3. Homogeneity Test Results

<i>Levene static</i>	df1	df2	Sig
4.665	4	25	.006

The significant statistics in Table 3 indicate a p-value of 0.06. There is a statistically significant difference in the mean percentage of collagen density between the four groups, as H_0 is rejected at the fundamental level = 0.05.

Table 4. T-test results

t	df	One-Sample Test			
		Sig.	Mean	95% Confidence	
		(2-tailed)	Difference	Interval of the	
			nce	Lower	Upper
Result	35.98	29	.000	46.11	43.4911 48.734

Table 4, the t-test results show that each group has an average t-value of 46.11. Since the sig (2-tailed) value is $0.000 < 0.05$, it may be inferred that there is a significant difference between the pairs of groups.

DISCUSSION

Due to its alkaloids, flavonoids, tannins, and steroids, black rice (*Oryza sativa L. indica*) extract increases glutathione peroxidase in mice, according to phytochemical research. Antioxidant glutathione fights free radicals, slows aging, and boosts the immune system. According to Haryanto, black rice (*Oryza sativa l. indica*) is nutritious and antioxidant-rich⁴⁰.

Ointments of black rice extract are checked before testing samples. The organoleptic tests (Blanko, F1, F2, F3) showed that the black rice ointment extract was odorless, white, light brown, brown, homogeneous, solid, and pH 5.37–6.33, suitable for human skin. The ointment spreadability test showed a 5.0–5.9 cm diameter

in 0–125 gr packages. Thus, the ointment is safe for experimentation.

CONCLUSION

Based on the research findings, it can be concluded that using 125g of black rice (*Oryza sativa l. indica*) extract ointment daily for 28 days at a 30% concentration yields average results with a standard deviation of $55,959 \pm 2.5$. This ointment is effective in healing skin wounds exposed to UVB light due to its superior melanin pigment synthesis and high collagen density. This is because antioxidants such as steroids, alkaloids, flavonoids, and tannins found in black rice extract help the body fight free radicals, delay aging, and keep the immune system strong.

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CONFLICTS OF INTEREST

All writers have stated no conflicts of interest in this publication.

REFERENCES

1. Bielach-Bazyluk A, Zbroch E, Mysliwiec H, Rydzewska-Rosolowska A, Kakareko K, Flisiak I, Hryszko T. Sirtuin 1 and skin: implications in intrinsic and extrinsic aging—a systematic review. *Cells*. 2021 Apr 6;10(4):813.
2. Vaiserman A, Koliada A, Lushchak O. Phyto-nanotechnology in anti-aging medicine. *Aging (Albany NY)*. 2021 Apr 4;13(8):10818.
3. Zouboulis CC, Makrantonaki E, Nikolakis G. When the skin is in the center of interest: An aging issue. *Clinics in dermatology*. 2019 Jul 1;37(4):296-305.
4. Egambaram OP, Kesavan Pillai S, Ray SS. Materials science challenges in skin UV protection: a review. *Photochemistry and Photobiology*. 2020 Jul;96(4):779-97.
5. Lim HW, Kohli I, Ruvalo E, Kolbe L, Hamzavi IH. Impact of visible light on skin health: The role of antioxidants and free radical quenchers in skin protection. *Journal of the American Academy of Dermatology*. 2022 Mar 1;86(3):S27-37.
6. Choi EH. Aging of the skin barrier. *Clinics in dermatology*. 2019 Jul 1;37(4):336-45.
7. Pham TL, Thi TT, Nguyen HT, Lao TD, Binh NT, Nguyen QD. Anti-aging effects of a serum based on coconut oil combined with deer antler stem cell extract on a mouse model of skin aging. *Cells*. 2022 Feb 9;11(4):597.
8. Kim M, Park HJ. Molecular mechanisms of skin aging and rejuvenation. *Molecular mechanisms of the aging process and rejuvenation*. 2016 Aug 31;450.
9. Kruglikov IL, Zhang Z, Scherer PE. Caveolin-1 in skin aging—From innocent bystander to major contributor. *Ageing Research Reviews*. 2019 Nov 1;55:100959.
10. Limbert G, Masen MA, Pond D, Graham HK, Sherratt MJ, Jobanputra R, McBride A. Biotribology of the ageing skin—Why we should care. *Biotribology*. 2019 Mar 1;17:75-90.
11. Pfeifer GP. Mechanisms of UV-induced mutations and skin cancer. *Genome instability & disease*. 2020 May;1(3):99-113.
12. Giglia-Mari G, Sarasin A. TP53 mutations in human skin cancers. *Human mutation*. 2003 Mar;21(3):217-28.
13. Strnadova K, Sandera V, Dvorankova B, Kodet O, Duskova M, Smetana K, Lacina L. Skin aging: The dermal perspective. *Clinics in dermatology*. 2019 Jul 1;37(4):326-35.
14. Guan LL, Lim HW, Mohammad TF. Sunscreens and photoaging: a review of current literature. *American journal of clinical dermatology*. 2021 Nov;22(6):819-28.
15. Krutmann J, Schalka S, Watson RE, Wei L, Morita A. Daily photoprotection to prevent photoaging. *Photodermatology, photoimmunology & photomedicine*. 2021 Nov;37(6):482-9.
16. Gromkowska-Kęпка KJ, Puścion-Jakubik A, Markiewicz-Żukowska R,

- Socha K. The impact of ultraviolet radiation on skin photoaging—review of in vitro studies. *Journal of cosmetic dermatology*. 2021 Nov;20(11):3427-31.
17. She JM, Yuan HH, Zhang J, Si ZN, Lan MB. Protective effect of the *Rubus chingii* Hu. fruit extract on ultraviolet B-induced photoaging via suppression of mitogen-activated protein kinases (MAPKs) in vitro. *Archives of Biological Sciences*. 2019;71(3):541-50.
 18. Farage MA, Miller KW, Elsner P, Maibach HI. Intrinsic and extrinsic factors in skin ageing: a review. *International journal of cosmetic science*. 2008 Apr;30(2):87-95.
 19. Humbert P, Louvrier L, Saas P, Viennet C. Vitamin c, aged skin, skin health. In *Vitamin C-an Update on Current Uses and Functions* 2018 Nov 5. IntechOpen.
 20. Reilly DM, Lozano J. Skin collagen through the lifestages: Importance for skin health and beauty. *Plast Aesthet Res*. 2021 Jan;8(2):10-20517.
 21. Mathew-Steiner SS, Roy S, Sen CK. Collagen in wound healing. *Bioengineering*. 2021 May 11;8(5):63.
 22. Lister IN, Amiruddin HL, Fachrial E, Girsang E. Anti-aging effectiveness of avocado peel extract ointment (*persea americana* mill.) against hydration, collagen, and elasticity levels in wistar rat. *Journal of Pharmaceutical Research International*. 2021;173-84.
 23. Moeini R, Memariani Z, Asadi F, Bozorgi M, Gorji N. Pistacia genus as a potential source of neuroprotective natural products. *Planta medica*. 2019 Nov;85(17):1326-50.
 24. Shishir MR, Karim N, Gowd V, Zheng X, Chen W. Liposomal delivery of natural product: A promising approach in health research. *Trends in food science & technology*. 2019 Mar 1;85:177-200.
 25. Kowalska H, Czajkowska K, Cichowska J, Lenart A. What's new in biopotential of fruit and vegetable by-products applied in the food processing industry. *Trends in Food Science & Technology*. 2017 Sep 1;67:150-9.
 26. Ito VC, Lacerda LG. Black rice (*Oryza sativa* L.): A review of its historical aspects, chemical composition, nutritional and functional properties, and applications and processing technologies. *Food chemistry*. 2019 Dec 15;301:125304.
 27. Kraithong S, Lee S, Rawdkuen S. Physicochemical and functional properties of Thai organic rice flour. *Journal of Cereal Science*. 2018 Jan 1;79:259-66.
 28. Callcott ET, Santhakumar AB, Luo J, Blanchard CL. Therapeutic potential of rice-derived polyphenols on obesity-related oxidative stress and inflammation. *Journal of Applied Biomedicine*. 2018 Nov 1;16(4):255-62.
 29. Tanghiranrat J, Itsarasook K, Prompamorn P, Imsathian N, Sriburin N, Bangsiri N, Chantree K. Antioxidant Efficiency of Black Glutinous Rice (*Oryza sativa* L.(indica)) Extracts: Application in Lipid-Based Food Products. *Burapha Science Journal*. 2021 Jun 1:1345-63.
 30. Farhamzah F, Kusumawati AH, Alkandahri MY, Hidayah H, Sujana D, Gunarti NS, Yuniarsih N, Apriana SD, Agustina LS. Sun Protection factor activity of black glutinous rice emulgel extract (*Oryza sativa* var glutinosa). *Indian Journal of Pharmaceutical Education and Research*. 2022;56(1):302-10.
 31. Jufri M, Vardhani A, Purwaningsih E. Evaluating the efficacy of lotion containing black rice bran (*Oryza sativa* L. indica) extract as skin brightening agent: A clinical trial. *Jundishapur Journal of Natural Pharmaceutical Products*. 2021 Nov 30;16(4).
 32. Notoatmodjo, S. *Metodologi Penelitian Kesehatan*, 3rd ed. Jakarta: Rineka Cipta, 2022.
 33. O'Rourke DP, Cox JD, Baumann DP, Weichbrod RH, Thompson GA, Norton JN. *Management of Animal Care and Use Programs in Research, Education, and Testing*. Boca Raton: CRC Press Taylor & Francis Group, 2018.
 34. Federer WT. Randomization and sample size in experimentation.," *Cornell University Biometrics Unit Technical*, vol. Number BU-236-M, pp. 1–15, Sep. 1966, Accessed: Feb. 07, 2024. [Online]. Available:

- <https://hdl.handle.net/1813/32334>
35. N.- NRC. *Guide for the Care and Use of Laboratory Animals*, 8th ed., vol. 39, no. 4. Washington, D.C.: National Academy Press, 2011.
 36. Swaim SF, Gillette RL, Sartin EA, Hinkle SH, Coolman SL. Effects of a hydrolyzed collagen dressing on the healing of open wounds in dogs. *American journal of veterinary research*. 2000 Dec 1;61(12):1574-8.
 37. Kiernan JA. Sirius Red for collagen staining protocol. Department of Anatomy and Cell Biology, The University of Western Ontario, London, Canada N6A 5C1. 2011.
 38. Zeise L, Murr BL, Chedekel MR. Melanin standard method: particle description. *Pigment cell research*. 1992 Sep;5(3):132-42.
 39. Ghozali I. Aplikasi analisis multivariete dengan program IBM SPSS 25. Semarang, 2018.
 40. Haryanto A, Pangkahila W, Wiraguna AA. Black rice bran (*oryza sativa* L. indica) extract cream prevented the increase of dermal matrix metalloproteinase-1 and dermal collagen reduction of male Wistar rats (*rattus norvegicus*) exposed to ultraviolet-B rays. *IJAAM (Indonesian Journal of Anti-Aging Medicine)*. 2020 Jan;4(1):16-9.

Original Article

Effectiveness of Mango Mistletoe on Lung Superoxide Dismutase in Hypertensive Rats Exposed to DOCA-Salt

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ABSTRACT

Vascular disease, caused by oxidative stress and endothelial cell inflammation during hypertension's development, produces substantial mortality and morbidity. Mango mistletoe was tested for its effect on pulmonary superoxide dismutase (SOD) in hypertensive rats exposed to DOCA-salt in a preventative model. This study involves experimental quantitative research. SPSS was used for one-way ANOVA and post-hoc LSD testing. The population used was male Wistar rats (*Rattus norvegicus*). The samples used were 25 male Wistar rats divided into five treatment groups because of the Shapiro-Wilk test for normality analysis. The treatment group included a negative control group, a positive control group, and a group given different doses of mango mistletoe methanol extract: P1 at 75 mg/kgBW, P2 and P3 at 150 mg/kgBW, and P3 at 250 mg/kgBW. The study indicated that 250 mg/kg BW mango mistletoe extract increased SOD levels in DOCA-Garam-exposed Wistar white rats (*Rattus norvegicus*). Enhanced superoxide dismutase, malondialdehyde (MDA), ureum, creatinine, and renal histology see this. The normality of study data in the complete group assessing SOD, MDA, ureum, and creatinine levels showed a significance value larger than 0.05. The significance probability and one-way ANOVA test values are more than 0.05. The study found that mango mistletoe extract contains saponins, tannins, flavonoids, and triterpenoids that increase SOD levels and repair kidney cells damaged by hypertension in Wistar white rats. The study examined how mango mistletoe extract affects mouse hypertension. However, its conclusions should not be applied to humans. Clinical trials are needed to determine mango mistletoe extract's safety and efficacy for humans.

Keywords: Mango Mistletoe, Superoxide Dismutase, Malondialdehyde, Ureum, Creatinine

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INTRODUCTION

Humans have used plant-derived medications for thousands of years ¹. Many around the globe rely on plant-based medicine due to its accessibility and lack of other healthcare options. Many countries, including China, Indonesia, and most African nations, use plant-based or herbal medications to treat various disorders ². Many countries treat multiple diseases with plant extracts, mixtures, poultices, decoctions, or pastes. Since antiquity, several medicinal plants and plant-based

techniques have been known for their therapeutic effects on healing ³.

The oxidative stress and inflammation of endothelial cells that occur throughout the development of hypertension contribute to the high mortality and morbidity associated with vascular disease, which is one of the causes of hypertension ⁴. Hypertension and other cardiovascular disease problems are greatly amplified in response to oxidative stress ⁵⁻⁷. Hence, it can alleviate hypertension by reducing inflammation and oxidative stress in endothelial

cells. Genetic and environmental variables combine in intricate ways to cause hypertension, a multifactorial disease in and of itself. Hypertension can be caused or worsened by reactive oxygen species (ROS) that are present in excess. Artery occlusion (atherosclerosis) is caused by LDL oxidation. Untreated oxidized LDL has the potential to cause hypertension⁸⁻¹⁰.

Oxidative stress happens when reactive oxygen species (ROS) rise above what the body's natural defenses can handle. High amounts of malondialdehyde and reduced superoxide dismutase activity are indicators of oxidative stress caused by excess lipid peroxidation in cells. Intracellular antioxidant enzymes are the body's natural defense against reactive oxygen species (ROS) processing¹¹. Enzymes like catalase, glutathione peroxidase, and superoxide dismutase are found inside cells and work to neutralize free radicals¹². These three enzymes have distinct distributions in various bodily tissues and organs, including the liver, kidneys, heart, and spleen¹³.

Scavenging superoxide anions produced in the early phases of oxidative stress and delaying aging are significant functions of superoxide dismutase (SOD)¹². Superoxide anions can be converted into oxygen and hydrogen peroxide, two more stable molecules, using antioxidant initiators^{12,14}. An external source of oxygen is required to compensate for the absence of antioxidants within cells and to neutralize the resulting radicals¹⁵.

Huang et al. (2018) found that several elements impact the physiological system that controls blood pressure and involve intricate interactions between environmental and genetic components¹⁶. A condition known as hypertension or high blood pressure occurs when either the systolic or diastolic blood pressure is equal to or greater than 140 mmHg or 90 mmHg, respectively. Many people refer to hypertension as "the silent killer" because the condition rarely causes any noticeable symptoms; as a result, many people with hypertension are unaware that they have it until they develop a problem from it. Healthcare providers diagnose hypertension in just 36.8% of patients, and treatment adherence is low at only 0.7%¹⁷.

Despite being a semi-parasitic plant, the bioactivities of mango mistletoe may be host plant-dependent¹⁸. According to research reports, mango mistletoe may have many

medical uses, including as an antioxidant¹⁹, anti-inflammatory²⁰, cytotoxic¹⁹⁻²¹, hepatoprotective²², immunomodulatory²³, anti-aging agent²⁴, and against cancer²⁵, anti-bacterial²⁶, anti-cancer²⁵, hyperglycemia, and proliferative diseases. According to phytochemical research, mango mistletoe contains alkaloids, phenolics, flavonoids, saponins, and terpenoids²⁷.

Manganese mistletoe (*Dendrophthoe pentandra*) has several uses in human medicine, including the treatment of hypertension, according to several scientific research¹⁸⁻¹⁹. The parasite of the mango plant, often known as mango mistletoe, has been shown in studies to have antihypertensive and anticancer properties¹⁹⁻²⁰. Results from studies evaluating the safety and toxicity of mango mistletoe as a phytopharmaceutical preparation in female Wistar rats have shown that it is not hazardous to their kidneys or lipid profiles²¹⁻²².

Previous work by Aini et al. (2021) utilizing a curative model demonstrated that a methanol extract from mango mistletoe can enhance lung SOD levels in rats with DOCA-Salt-induced hypertension³². Mango mistletoe methanol extract is an antioxidant that can relieve oxidative stress by increasing superoxide dismutase (SOD) and lowering malondialdehyde (MDA). To find out if mistletoe manga extract affected serum SOD activity in a preventative model of hypertension in rats induced by DOCA-Garam, this study took a different tack. To avoid hypertension, the preventive model is implemented.

Several phytochemical components have been isolated from mango mistletoe by employing extraction methods like maceration and reflux. This research aims to fill gaps in our knowledge of the phytomorphology, phytochemistry, and extraction methods of mango mistletoe in animals with hypertension and to explore its potential future uses.

METHOD

Laboratory research utilizing a genuine experiment or experimental design is what this study employs as its method of experimental quantitative research³⁴. This study used 25 male Wistar rats (*Rattus norvegicus*). Two months old, 150-200 grams, healthy, and without anatomical anomalies, divided into five groups of five animals and treated for 28 days. The control group (male white rats) received no

treatment. They receive basic food and water. Experimental mice are induced to become hypertensive by administering 1.5 ml/kg prednisone and 25% NaCl for 14 days. Mango mistletoe extract was skipped for 28 days. The mice in Group 1 (P1) were provided standard food and water during adaption. After adaption, this group received mango mistletoe extract 75 mg/kg BW/rat/day for 28 days. The mice in Group 2 (P2) were provided standard food and water during adaption. After adaption, this group received 150 mg/kg BW/rat/day mango mistletoe extract for 28 days. The mice in Group 3 (P3) were provided standard food and water during adaption. After adaption, this group received mango mistletoe extract 250 mg/kg BW/rat/day for 28 days.

Male Wistar rats (*Rattus norvegicus*) weighing 160-200 grams and 2-3 months old were used in this sample study. Male Wistar rats, one of the most often used biomedical research species, were chosen as test subjects because they have traits and physiologies similar to humans. Inclusion and exclusion criteria determined the sample. Male Wistar rats (*Rattus norvegicus*), two months old, 150-200 grams, healthy, not physically malformed, and hypertensive are included. Excluded mice did not develop sickness during adaption or perish during treatment.

The one-way ANOVA test was used for data analysis, and the Post Hoc LSD test was used for follow-up testing. ANOVA (Analysis of variances) is the tool for comparing variables across several variables. Only with two variables can the "t" test, a method of comparative analysis that involves comparing two means, be practical. When looking for statistically significant differences between groups, the LSD Post Hoc Test is an excellent tool to use. An asterisk (*) indicates that all groups in this study had significant differences from other groups according to the results of the Post Hoc LSD test analysis[35]. After applying the Kolmogorov-Smirnov test to the data, we found it normally distributed ($p > 0.05$). A one-way analysis of variance technique, also known as One-way ANOVA, was used to examine the significance between groups at a 95% confidence level ($p < 0.05$). Using the Post Hoc Test with the LSD procedure, additional analysis or testing was conducted. If the ANOVA test finds significant differences (Ho is rejected), multiple comparison analysis (Post Hoc Test) attempts to determine further which

groups have different averages.

October 2023 to December 2023 is the start of the research period. The research sites were the University of North Sumatra's Anatomical Pathology Laboratory and the Department of Pharmaceutical Pharmacology's Laboratory.

Research procedures carried out mango mistletoe extract (*Dendrophthoe pentandra*), phytochemical screening, examination of lung SOD levels, assessment of MDA levels, kidney histopathological examination, and administration of treatment doses to experimental subjects. Next, the data results were analyzed using SPSS.

This study examined the Independent Variable (Mango Mistletoe Extract) and the Dependent Variable (SOD, MDA, Ureum, and Creatinine levels in doc-salt-exposed hypertensive rats). Mango mistletoe was macerated and administered at 75 mg/kgBW, 150 mg/kgBW, and 250mg/kgBW for 28 days in the significant variable.

Blood pressure was measured without anesthesia using the tail-cuff auto-pickup method on experimental animals. A CODA® non-invasive blood pressure monitor was used twice a week. A tail cuff with a Volume Pressure Recorder (VPR) and occlusion cuff measures blood pressure non-invasively. Rats with systolic or diastolic blood pressures over 129 or 90 mmHg are hypertensive.

Plasma is utilized to measure SOD activity. Start by gathering tools and materials at 18-25°C room temperature. Place 50uL of standard and sample in each tube. Inject 50uL of sample diluent into each control well immediately. Add 100 uL HRP conjugate to each well and incubate at 37°C for 60 minutes. Then, wash the microtiter four times. Add 50 uL of chromogen solutions A and B to each well. Mix for light protection and incubate at 37°C for 15 minutes. Add stop solution to each tube and immediately take 450 nm readings for 15 minutes to determine plasma SOD levels.

White mice's orbital plexus vein blood was drawn into a tiny capillary tube, 2 ml per animal, and spun at 3000 rpm for 20 minutes at 4 °C to measure MDA levels. MDA is measured in red blood cell-separated serum. The exam is done on the same day as the blood draw. A spectrophotometric examination at 532 nm measured Thio Barbituric Acid Reactive Substance (TBARS) levels based on the red color change caused by the reaction generating

the thiobarbituric acid-MDA complex. The histopathological study uses paraffin to examine tissue cell morphology.

After treatment on the 28th day, animals were fixed with 10% formalin buffer and processed histologically with Hematoxylin Eosin (HE) staining. Each organ, the left and right kidney, was prepared and examined under a 400x microscope in five fields of view: the four corners and the center. The kidney's closing proximal tubule lumen is read. Testing materials can measure ureum from plasma, serum, or urine. After the experiment, a syringe drew five cc of blood through the heart. To collect serum for urea and creatinine measurement, the blood was centrifuged at 10,000 rpm for 10 minutes (Eppendorf 543R). A Hitachi UV/Vis® mouse instrument spectrophotometer read Randox® Kit ureum and creatinine results.

Rattus norvegicus, or male Wistar rats, were the subjects of the study. Aged two months, with a healthy weight of 150-200 grams and no visible abnormalities. Along with rabbits and monkeys, rats are commonly utilized as experimental animals. This is because, anatomically speaking, mice and humans are very similar. Wistar male white rats were employed in this study because their results are less affected by the menstrual cycle and pregnancy, making them a more reliable research subject. Additionally, researchers can more easily regulate rats' feeding and activity levels, reducing the possibility of bias ³⁶.

With *n* being the sample size and *t* the sample group size, the Federer formula $(n-1)(t-1) > 15$ is used to find the sample size ³⁷. According to the results, at least six animals were in each treatment group. So, 24 people is the bare minimum for the sample size. Each treatment group included five animals, for a total of twenty-five used in the study. Each treatment group—P1, P2, and P3—received different amounts of EMBM (methanol extract of mango mistletoe). P1 received 75 mg/kgBW, P2 and P3 received 150 mg/kgBW, and P3 received 250 mg/kgBW, respectively. The control groups were negative and positive.

The tools used in this research are test animal cages measuring 40x30 cm, cage covers with woven wire, digital scales, sondes, rat drink bottles, digital scales, funnels, bottles, Petri dishes, beakers, blenders, ovens, freezers, rotary evaporator, paraffin block, surgical tools or 38 tattoos, mask, one med syringe, heating

set, Eppendorf tube, tweezers and tissue hook, hand scoop, trash can (cracked), scissors, tweezers, needle for rat fixation, microcentrifuge, velvet satin fabric. The materials used in the research were male Wistar rats (*Rattus norvegicus*), test animal feed, rat drinking water and husks, mango mistletoe leaves (*Dendrophthoe pentandra*), 70% methanol, and label paper.

RESULTS

Male Wistar white rats (*Rattus norvegicus*) were separated into five groups for this study. The negative control group received no therapy or healthy mice. Positive control rats were given 1.5ml/kg prednisone and 25% NaCl to induce hypertension. The third group, treatment group 1, received conventional feed, water, and mango mistletoe extract 75mg/KgBW for 28 days. Fourth was treatment group 2, which received 150mg/KgBW mango mistletoe extract. Fifth, 250mg/KgBW mango mistletoe extract was given to group 3 (See Table 1).

Table 1. Characteristics Test Animals

Component	Treatment Group				
	K-	K+	P1	P2	P3
Types Rats	<i>Rattus norvegicus</i>				
Gender	Male				
General Condition	White fur, healthy and active				
Avg Initial BW (gram)	191	187	193	189	186
Avg Final BW (gram)	193	181	191	185	183

According to the data in Table 2, which shows that the average SOD levels varied, the highest rise in SOD levels was observed in treatment group 3, which consisted of mice exposed to DOCA-Salt and administered 250 mg/kg body weight of mango mistletoe extract (*Dendrophthoe pentandra*). In contrast, the treatment group saw a significant rise in SOD and MDA levels, while the positive control group—mice exposed to DOCA-Salt but only given distilled water—had the opposite effect.

By protecting cells from oxidative stress, SOD plays a key role. The antioxidant superoxide dismutase (SOD) has several roles in the body, according to research ^{28,30}. It protects cells from oxygen radical damage, reduces the production of inflammatory chemicals like prostaglandins, thromboxane,

and leukotriene, and inhibits DNA chain damage caused by superoxide. Plasma SOD activity measurements reveal this²⁸⁻²⁹.

This study found that hypertensive rats significantly increased their SOD levels after receiving a dosage of mistletoe mango extract. Hypertension research needs to focus on increasing endogenous SOD levels as a potential treatment method.

Mounting MDA causes DNA mutations, exacerbating existing diseases³⁰⁻³¹. Researchers found that administering mango mistletoe extract to hypertensive rats reduced their MDA levels. Researchers found that measuring levels of malondialdehyde (MDA) in hypertensive rats both before and after administering mango mistletoe extract was an excellent way to gauge the extent to which the treatment affected the animals' cell membranes.

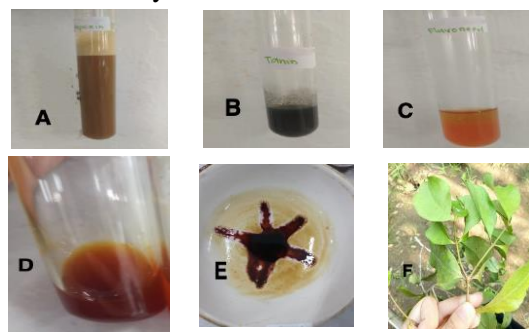
After comparing the average Ureum and Creatinine levels in Table 2, the researchers discovered that the third treatment group, which consisted of mice exposed to DOCA-salt and given 250 mg/kg body weight of mango mistletoe extract, had the most significant decrease in both markers, coming close to matching the control group. On the other hand, urea levels were least affected or improved in the positive control group, consisting of mice exposed to DOCA-salt but only given distilled water.

In breaking down proteins, urea is the primary by-product⁴². Blood contains ureum, a nitrogen molecule that is not a protein. The buildup of urea in the blood is a symptom of renal disease. When plasma urea levels rise, the kidneys aren't effectively filtering blood. Hemodialysis or kidney transplantation may be necessary for this potentially life-threatening condition³²⁻³³. This study showed that hypertensive rats given mango mistletoe extract had lower blood urea levels. Since the kidneys' ability to excrete urea is determined by the protein diet, it can be concluded that the treatment with mango mistletoe extract was effective.

Creatinine phosphate (protein), the result of muscle keratin metabolism, is produced in the liver, blood, and skeletal muscle⁴². The kidneys react with it to form urine. Unless a person has a significant physical injury or a degenerative condition that damages their muscles significantly, their daily creatinine formation should remain consistent⁴⁴. The kidneys are responsible for filtering out

creatinine, a byproduct of muscle metabolism, and excreting it in urine. This study's evaluation of the test animals revealed that hypertensive mice had lower keratin levels than the control group. Thus, as expected, keratinin levels have been reduced by using mistletoe mango extract.

Table 3. Phytochemical Test Results



Note: A. Saponins, B. Tannins, C. Flavonoids, D. Alkaloids, E. Triterpenoids, F. Mango mistletoe leaves

The phytochemical assays showed that mistletoe mango extract contains flavonoids, saponins, tannins, alkaloids, and triterpenoids (Table 3). For the saponin test (Figure A), 1 gram of mango mistletoe extract was placed in a test tube with 10 ml of hot water, cooled, and shaken violently for 10 seconds. Saponin is present if the foam is 1-10 cm high in 10 minutes and does not dissolve after adding one drop of 2 N HCl. This investigation discovered froth in the extract, indicating saponin.

Second, for the tannin test (Figure B), 1 gram of mango mistletoe extract is placed in a test tube, 10 mL of hot water is added, boiled for 5 minutes, and 3-4 drops of FeCl₃ are added to the filtrate. Catechol tannin is present in blue-green (green-black). Blue and black indicate tannin. A blue-black liquid indicates tannin in tannin test findings.

The Three flavonoid test (Figure C). Concentrated HCl was added to 1 gram of mango mistletoe extract in a test tube and heated for 15 minutes in a water bath. Red or yellow indicates flavonoids (flavone, chalcone, and aurone). A yellow extract indicates the presence of flavonoids.

In the fourth alkaloid test (Figure D), 2 grams of mango mistletoe extract was placed in a test tube, dripped with 5 mL of HCl2N, heated, cooled, and divided into 3 1 mL test tubes. Reagents are added to each tube. If Mayer's reagent precipitates white or yellow,

alkaloids are present. In this study, the alkaloid test was red, indicating no alkaloids.

In the fifth triterpenoid test (Figure 5), mango mistletoe extract was added to a test tube with 2 mL of ethyl acetate and shaken. The ethyl acetate layer was dropped onto a drop plate to dry. After drying, two drops of acetic acid and one drop of concentrated sulfuric acid were added. Terpenoids are present if they become red or yellow. Steroids are present if

they turn green. Red indicates triterpenoids in the steroid/triterpenoid test.

According to other studies, flavonoids (quercetin), saponins, and tannins are among the active compounds discovered in mango mistletoe. Quercetin is an aromatic ring compound with a hydroxyl group. Multiple studies show that secondary metabolite molecules like flavonoids can protect biological systems^{19,35-36}.

Table 2. Results of Measurements of SOD, MDA, Ureum, and Creatinine Levels

Group	Repititation	SOD		MDA		Ureum		Creatinine	
		Pra	Post	Pra	Post	Pra	Post	Pra	Post
Control –	1	13.2	13.6	2.2	2.5	16.1	16.7	2.9	3.1
	2	13.9	14.1	3.3	3.1	15.1	15.3	3.3	3.5
	3	12.9	13.2	2.5	2.7	15.7	16.1	4.3	4.2
	4	12.4	12.8	2.2	2.1	15.8	15.9	4.5	4.7
	5	12.1	12.2	3.3	3.5	16.4	16.5	2.6	2.8
	Mean	12.9	13.2	2.7	2.8	15.8	16.1	3.5	3.7
Control +	1	9.1	9.2	9.2	8.5	30.1	29.2	11.2	10.9
	2	9.9	10.1	8.8	7.9	31.4	30.1	11.9	10.2
	3	9.7	9.8	8.9	9.1	30.3	28.2	11.4	9.7
	4	9.2	10.5	8.6	8.9	28.9	28.6	10.9	9.2
	5	10.3	11.3	8.1	8.1	30.9	29.7	10.1	11.1
	Mean	9.6	10.2	8.7	8.5	30.3	29.2	11.1	10.2
Treatment P1	1	9.2	16.1	8.5	4.5	30.3	21.2	11.4	8.1
	2	9.3	16.6	9.9	4.9	31.5	22.1	12.1	7.9
	3	9.1	15.4	9.2	5.4	31.7	20.8	11.6	7.3
	4	9.4	17.3	8.3	5.8	30.5	21.5	10.9	8.2
	5	8.9	15.8	8.7	3.8	29.7	22.6	11.7	9.1
	Mean	9.2	16.2	8.9	4.9	30.7	21.6	11.5	8.1
Treatment P2	1	9.3	17.1	9.1	3.4	33.1	18.9	12.1	6.6
	2	8.9	16.8	8.7	4.1	29.7	19.1	11.3	6.1
	3	9.7	19.5	8.4	3.9	29.2	18.5	11.7	5.9
	4	9.1	17.7	9.5	4.7	32.1	18.2	10.7	7.2
	5	8.5	18.4	9.1	3.1	30.4	19.7	11.6	5.3
	Mean	9.1	17.9	9.0	3.8	30.9	18.9	11.5	6.2
Treatment P3	1	9.8	20.1	8.7	2.8	30.1	15.5	12.4	4.5
	2	8.2	19.2	8.8	2.2	32.4	16.4	11.2	3.3
	3	9.9	18.6	8.1	3.1	31.5	15.2	11.9	3.9
	4	8.6	19.9	9.5	3.8	28.4	16.7	10.8	5.5
	5	9.7	18.9	9.6	4.1	30.5	14.6	11.7	4.1
	Mean	9.2	19.3	8.9	3.2	30.6	15.7	11.6	4.3

Note: Pre-Test: After Exposure to DOCA-Salt (nmol/ml). Post-Test: After Administration of Mango Mistletoe Extract (nmol/ml). Group Control –: untreated group. They receive basic food and water. Group Control +: Induced 1.5 ml/kg prednisone and 25% NaCl were not given mango mistletoe extract. Treatment group 1: ordinary meal, water, and 75 mg/kg mango mistletoe extract. Treatment group 2: ordinary meal, water, and 150 mg/kg mango mistletoe extract, and Treatment group 3: ordinary meal, water, and 250 mg/kg mango mistletoe extract,

Table 5. Normality Test SOD, MDA, Ureum, and Creatinine Results

Groups		Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
SOD Results	C -	.118	5	.200 [*]	.996	5	.996
	C +	.142	5	.200 [*]	.992	5	.986
	P-1	.175	5	.200 [*]	.976	5	.912
	P-2	.173	5	.200 [*]	.946	5	.707
	P-3	.208	5	.200 [*]	.928	5	.584
MDA Results	C -	.159	5	.200 [*]	.990	5	.980
	C +	.184	5	.200 [*]	.944	5	.692
	P-1	.148	5	.200 [*]	.985	5	.960
	P-2	.160	5	.200 [*]	.979	5	.927
	P-3	.184	5	.200 [*]	.967	5	.855
Ureum Results	C -	.167	5	.200 [*]	.964	5	.833
	C +	.165	5	.200 [*]	.968	5	.865
	P-1	.177	5	.200 [*]	.974	5	.899
	P-2	.151	5	.200 [*]	.982	5	.943
	P-3	.198	5	.200 [*]	.951	5	.742
Creatinine Results	C -	.181	5	.200 [*]	.953	5	.756
	C +	.203	5	.200 [*]	.946	5	.708
	P-1	.251	5	.200 [*]	.954	5	.763
	P-2	.166	5	.200 [*]	.991	5	.984
	P-3	.191	5	.200 [*]	.924	5	.554

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table 6. Homogeneity Test SOD, MDA, Ureum, and Creatinine Results

		<i>Levene statistic</i>	df1	df2	Sig
SOD Result	Based on Mean	.485	4	20	.746
MDA Result	Based on Mean	.387	4	20	.815
Ureum Result	Based on Mean	.655	4	20	.630
Creatinine Result	Based on Mean	.216	4	20	.926

Table 7. One-Way ANOVA Test SOD, MDA, Ureum, and Creatinine Results

	Result	Sum of Squares	df	Mean square	F	Sig
SOD	Between Groups	273.254	4	68.314	104.137	.000
	Within Groups	13.120	20	.656		
	Total	286.374	24			
MDA	Between Groups	105.652	4	26.413	61.944	.000
	Within Groups	8.528	20	.426		
	Total	114.180	24			
Ureum	Between Groups	606.478	4	151.620	303.847	.000
	Within Groups	9.980	20	.499		
	Total	616.458	24			
Creatinine	Between Groups	148.122	4	37.030	64.806	.000
	Within Groups	11.428	20	.571		
	Total	159.550	24			

Table 8. LSD Post-Hoc Test SOD, MDA, Ureum, and Creatinine Results

Dependent Variable : LSD Result		SOD Level		MDA Level		Ureum Level		Creatinine Level	
Group (I)	Group (J)	Mean difference (I-J)	Sig	Mean difference (I-J)	Sig	Mean difference (I-J)	Sig	Mean difference (I-J)	Sig
C+	C+	3.00000*	.000	-5.72000*	.000	-13.06000*	.000	-6.56000*	.000
	P1	-3.06000*	.000	-2.10000*	.000	-5.54000*	.000	-4.46000*	.000
	P2	-4.72000*	.000	-1.06000*	.018	-2.78000*	.000	-2.56000*	.000
	P3	-6.16000*	.000	-.42000	.321	.42000	.358	-.60000	.224
C-	C-	-3.00000*	.000	5.72000*	.000	13.06000*	.000	6.56000*	.000
	P1	-6.06000*	.000	3.62000*	.000	7.52000*	.000	2.10000*	.000
	P2	-7.72000*	.000	4.66000*	.000	10.28000*	.000	4.00000*	.000
	P3	-9.16000*	.000	5.30000*	.000	13.48000*	.000	5.96000*	.000
P1	C-	3.06000*	.000	2.10000*	.000	5.54000*	.000	4.46000*	.000
	C+	6.06000*	.000	-3.62000*	.000	-7.52000*	.000	-2.10000*	.000
	P2	-1.66000*	.004	1.04000*	.020	2.76000*	.000	1.90000*	.001
	P3	-3.10000*	.000	1.68000*	.001	5.96000*	.000	3.86000*	.000
P2	C-	4.72000*	.000	1.06000*	.018	2.78000*	.000	2.56000*	.000
	C+	7.72000*	.000	-4.66000*	.000	-10.28000*	.000	-4.00000*	.000
	P1	1.66000*	.004	-1.04000*	.020	-2.76000*	.000	-1.90000*	.001
	P3	-1.44000*	.011	.64000	.137	3.20000*	.000	1.96000*	.001
P3	C-	6.16000*	.000	.42000	.321	-.42000	.358	.60000	.224
	C+	9.16000*	.000	-5.30000*	.000	-13.48000*	.000	-5.96000*	.000
	P1	3.10000*	.000	-1.68000*	.001	-5.96000*	.000	-3.86000*	.000
	P2	1.44000*	.011	-.64000	.137	-3.20000*	.000	-1.96000*	.001

*. The mean difference is significant at the 0.05 level.

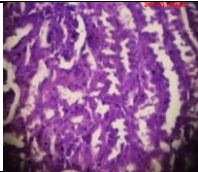
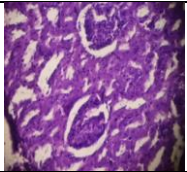
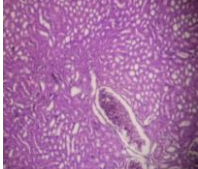
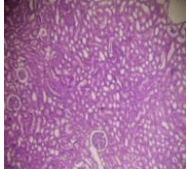
Note: C-: untreated group. They received basic food and water, C+: Induced 1.5 ml/kg prednisone and 25% NaCl were not given mango mistletoe extract, P1: ordinary meal, water, and 75 mg/kg mango mistletoe extract. P2: ordinary meal, water, and 150 mg/kg mango mistletoe extract, and P3: ordinary meal, water, and 250 mg/kg mango mistletoe extract,

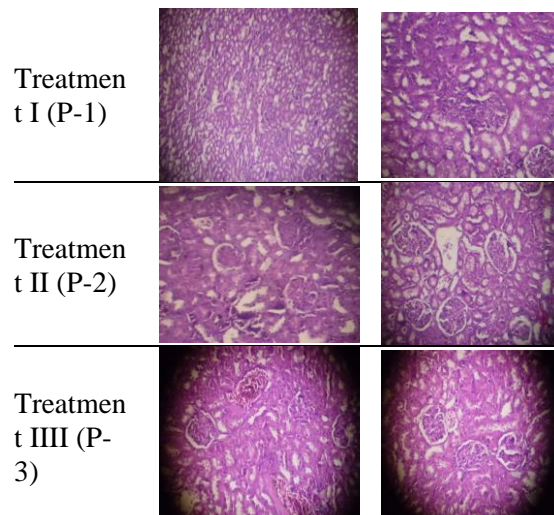
Histopathological investigations were made with a 400x light microscope. This observation examined the cell structure and morphology of kidney tissue specimens from the control and treatment groups, using mango mistletoe extract at 75mg, 150mg, and 250mg/KgBW.

Histopathological observations (Table 4) demonstrate distinct cells. Histopathological preparations were assessed for quantitative data. Score 0 indicates no histopathological damage, Score 1 is focal (mild), Score 2 is multifocal (moderate), and Score 3 is diffuse (severe) ⁴⁷.

The negative control group fed ordinary pellets and distilled water had normal kidney histology and scored 0. Due to their lack of DOCA-Garam exposure, the negative control group's kidney histology was normal. Thus, it was utilized to describe the other groups and compare them to the treatment group that received mango mistletoe extract. Due to DOCA-salt ingestion, the positive control group's kidneys displayed different histological structures. Damaged kidney histology scored this group in category 3 (diffuse/severe damage). Group 1 received 75mg/KgBW mango mistletoe extract and saw kidney histological improvement, but there was still multifocal/moderate damage. Therefore, it was scored in category 2. Group 2 received 150mg/KgBW mango mistletoe extract and improved, but it still has focused or mild harm; thus, it is in scoring category 1. Treatment group 3 received 250mg/KgBW DOCA-Salt and mango mistletoe extract and had a kidney histological structure similar to the control group. Hence, it was scored 0.

Table 4. Histopathological Results

Groups	Histopathological Image of Kidney Tissue	
	Pre-Test	Post-Test
Control Negative (C -)		
Control Positive (C +)		



Note: Pre-Test: After Exposure to DOCA-Salt (nmol/ml). Post-Test: After Administration of Mango Mistletoe Extract (nmol/ml). C-: untreated group. They receive basic food and water, C+: Induced 1.5 ml/kg prednisone and 25% NaCl and were not given mango mistletoe extract, P1: ordinary meal, water, and 75 mg/kg mango mistletoe extract. P2: ordinary meal, water, and 150 mg/kg mango mistletoe extract. P3: ordinary meal, water, and 250 mg/kg mango mistletoe extract,

In male Wistar white rats (*Rattus norvegicus*) subjected to DOCA-Garam, mango mistletoe extract at 150mg/KgBW and 250mg/KgBW improved kidney histology. Because it is closer to the usual group, 250mg/KgBW works better—histopathological studies of the kidneys in control and treatment group 3 show similar morphologies. Mango mistletoe extract compounds improve the kidney organ histology of male Wistar white rats (*Rattus norvegicus*) subjected to DOCA-Garam.

Quercetin, a flavonol molecule of the flavonoid class, is an antioxidant component contributing to mango mistletoe. The hydroxyl group in quercetin inhibits lipid peroxide, making it capable of capturing free radicals. Quercetin can enhance superoxide dismutase (SOD) activity and bind to free radicals ^{19,35-36}. Histological analysis of the kidneys of rats with hypertension reveals that mango mistletoe's antioxidant components improve kidney function.

Due to the small sample size (<30), the Kolmogorov-Smirnov test was utilized for the normalcy test in this investigation ³⁵. The significance of data normality testing lies in that data is believed to represent the population when it follows a normal distribution. The data is said to be regularly distributed if the p-value is more significant than 0.05 and not normally

distributed if the p-value is less than 0.05. In all groups, the results of the normality test on SOD, MDA, Ureum, and creatinine levels were 0.200, as shown in Table 5. Since the p-value is more significant than 0.05, we may conclude that the data in this study follows a normal distribution.

Using a 5% significance threshold, the Levene test was used to assess for group homogeneity. As a rule of thumb, while making decisions, a significance value less than 0.05 indicates that the data is not homogeneous. In contrast, a significance value of more than 0.05 suggests that the data is homogeneous³⁵. All four of the following significance values are more significant than 0.05: SOD (0.746), MDA (0.815), Ureum (0.630), and Karatenin (0.926)—these values are shown in Table 6, which displays the results of the homogeneity test with the probability value in the significance column. It follows that all study groups are representative of similarly distributed or homogeneous populations.

After ensuring that the data was normal and homogenous and that the findings followed a normal distribution with a constant variance, the researchers ran a one-way ANOVA to see whether there was a statistically significant difference in the performance of the groups³⁵. The findings of the One-way ANOVA can be seen in Table 6, which indicates that the levels of SOD, MDA, Ureum, and Karatenin had significance values of 0.000 or less than 0.05. From these numbers, we can deduce that the treatment group differs significantly from the control group, suggesting that a factor with a finite number of levels influences the dependent variable³⁵.

A post-hoc LSD test was performed to compare the group's average SOD levels. A significance value below 0.05 indicates substantial differences between groups and vice versa³⁵. Whether groups differ significantly is determined by the LSD Post Hoc Test. The SOD level analysis (Table 8) shows a significant difference between the negative control group and the positive control group ($p=0.000$), treatment groups 1 and 2, and treatment groups 3 ($p=0.000$).

MDA levels (Table 8) demonstrate a significant difference between the negative control group, positive control group, treatment group 1 ($p=0.000$), and treatment group 2 ($p=0.018$). No difference was seen between negative control and treatment group 3 ($p=0.321$). Similarly, urea levels (Table 8) differ

significantly between the negative control group and the positive control group ($p=0.000$), treatment group 1 ($p=0.000$), and treatment group 2 ($p=0.018$). No difference was seen between negative control and treatment group 3 ($p=0.358$).

Keratin levels (Table 8) demonstrate a significant difference between the negative control group, positive control group, treatment group 1 ($p=0.000$), and treatment group 2 ($p=0.018$). No difference was seen between the negative control and treatment group 3 ($p=0.224$).

DISCUSSION

Many free radicals in the body generate an imbalance between antioxidant production and incoming free radicals⁵. We term this imbalance oxidative stress. The reactivity of ROS, which can damage DNA, proteins, and lipids in cells, reduces SOD levels in response to oxidative stress. Free radicals accumulate and cause necrosis and apoptosis when SOD and other enzyme antioxidants diminish.

The etiology of hypertension involves endothelial cell oxidative stress and inflammation, which cause high mortality and morbidity⁴. Oxidative stress increases cardiovascular disease and its consequences, including hypertension⁵⁻⁶.

The researchers hypothesize that mango mistletoe extract increases SOD levels and improves renal function in male Wistar white rats (*Rattus norvegicus*) exposed to DOCA-Garam. Male Wistar white rats (*Rattus norvegicus*) were tested to confirm this suspicion.

Quercetin derivatives from flavonoids are found in mango mistletoe's phenol, routine, tannin, and meso-inositol groups⁴⁶. Multiple studies show that manganese mistletoe can treat many ailments, including hypertension. Mango mistletoe contains flavonoid derivatives such as quercetin, phenols, routine, and tannins⁴⁵. Quercetin releases hydrogen ions to peroxy free radicals during propagation and initiation, making them more stable and preventing oxidation²⁹.

DOCA-Salt induced hypertension in test animals to start this study. Salt and DOCA raised blood pressure in this animal test. DOCA-induced male Wistar rats subcutaneously. DOCA increases blood vessel LDL buildup, causing blockages and

hypertension. DOCA, an adrenal gland steroid hormone, is a mineralocorticoid and precursor of aldosterone. The adrenal zone glomerulosa produces most aldosterone.

This 28-day research approach produced data that needed to be processed and assessed; therefore, normality, homogeneity, and significance tests were required. The Kolmogorov-Smirnov test in SPSS determined normality. Thus, all SOD, MDA, urea, and creatinine test groups had normally distributed data with a significance value of 0.200. Thus, the data is regularly distributed or represents the population.

Ureum and creatinine data were then analyzed for homogeneity using the Levene test to check if the population had the same variance. SOD, MDA, urea, and creatinine levels had significance values of 0.746, 0.815, 0.630, and 0.926, respectively. A significant probability value larger than 0.05 indicates that SOD, MDA, urea, and creatinine levels in all groups are homogeneous or from the same population. One-way ANOVA assessed this normally distributed and homogeneous data for efficacy and significance.

The One-way ANOVA test on SOD, MDA, urea, and creatinine levels yielded 0.000 or greater than 0.05. Based on this data, a follow-up post-hoc LSD test is needed because the control group, treatment group 1, treatment group 2, and treatment group 3 differ significantly. A post-hoc LSD test was used to compare the group's average urea and creatinine levels.

The LSD Post Hoc Test examination of SOD levels demonstrated significant differences between the negative control group and the positive control group ($p=0.000$), treatment groups 1 and 2, and treatment group 3.

The LSD Post Hoc Test examination of MDA levels demonstrated a significant difference between the negative control group, positive control group, treatment group 1 ($p=0.000$), and treatment group 2 ($p=0.018$). No difference was seen between negative control and treatment group 3 ($p=0.321$).

A significant difference in Ureum levels was found between the negative control group and the positive control group ($p=0.000$), treatment group 1 ($p=0.000$), and treatment group 2 ($p=0.018$). No difference was seen between negative control and treatment group 3 ($p=0.358$). Creatinine levels differed

significantly between the negative control group, positive control group, treatment group 1 ($p=0.000$), and treatment group 2 ($p=0.018$). No difference was seen between the negative control and treatment group 3 ($p=0.224$). This investigation shows that treatment group 3, administered mango mistletoe extract at 250mg/KgBW, had MDA, Ureum, and creatinine levels similar to the negative control group and healthy mice.

The kidneys of tested mice were examined histologically. In male Wistar white rats (*Rattus norvegicus*) subjected to DOCA-Garam, mango mistletoe extract at 150mg/KgBW and 250mg/KgBW improved kidney histology. Because it is closer to the usual group, 250mg/KgBW works better—histopathological studies of the kidneys in control and treatment group 3 show similar morphologies. Mango mistletoe extract compounds improve the kidney organ histology of male Wistar white rats (*Rattus norvegicus*) subjected to DOCA-Garam.

According to phytochemical assays, the mistletoe mango extract contains flavonoids, saponins, tannins, and triterpenoids. This study's mango mistletoe extract content matches with another researcher^{19, 35-36}. This study discovered mango mistletoe extract's flavonoid, saponin, and tannin components.

Mango mistletoe flavonoids can heal hypertension-damaged kidneys. Plant flavonoids have antioxidant, antiapoptotic, and anti-inflammatory effects. Flavonoids decrease excess reactive oxygen species, boost antioxidant status, and mediate antioxidant responses, protecting the kidneys. Flavonoids control inflammatory indicators, reduce inflammation, and protect kidney cells from apoptosis^{19, 35-36}.

CONCLUSION

Lifestyle choices, genetics, and other medical issues are among the many potential causes of hypertension. This study used mango mistletoe extract to examine the effects on hypertensive rats. Researchers found that white Wistar rats (*Rattus norvegicus*) exposed to DOCA-Garam had their SOD levels increased by 250 mg/kg body weight of mango mistletoe extract. Evidence suggests that superoxide dismutase (SOD) can shield cells from oxidant stressors, also known as free radicals.

SOD is a main line of defense against oxidative stress since it breaks down superoxide anions into H₂O and peroxide. The lowest levels of malondialdehyde (MDA) relative to the other groups in treatment three further demonstrated that MDA was an effective marker of cellular abnormalities induced by free radicals.

Treatment group 3 also had lower Ureum levels than the other groups, according to the results. It follows that mango mistletoe extract can mitigate the effects of consuming too many high-protein foods by lowering urea levels.

Results showed that treatment 3 had the lowest Creatinine levels compared to the other groups, suggesting that the hypertensive rats' kidneys benefited from the mango mistletoe extract's ability to lower Creatinine levels.

The histological examinations of kidney tissue in the third treatment group, which received 250 mg/kg body weight of mistletoe mango extract, showed the maximum recovery and were very close to those in the control group.

This leads us to believe that the secondary metabolites found in mango mistletoe extract, such as tannins, saponins, flavonoids, and triterpenoids, aid in the restoration of damaged kidney cells and the elevation of superoxide dismutase (SOD) levels, both of which are consequences of hypertension.

This study's findings may provide light on whether or not hypertensive patients benefit from taking mango mistletoe extract to boost superoxide dismutase (SOD) levels and enhance kidney function. Additionally, additional studies are required to determine the safety and efficacy of mango mistletoe extract when administered to human subjects.

REFERENCES

1. Duke JA., Bogenschutz-Godwin MJ, duCellier J, Duke, PAK. Handbook of medicinal herbs. CRC press; 2002. Retrieved from [https://repository.poltekkes-kaltim.ac.id/1148/1/Handbook%20of%20Medicinal%20Herbs%20\(%20PDF%20Drive%20\).pdf](https://repository.poltekkes-kaltim.ac.id/1148/1/Handbook%20of%20Medicinal%20Herbs%20(%20PDF%20Drive%20).pdf)
2. Singh P, Mishra A, Singh P, Goswami S, Singh A, Tiwari KD. Hypertension and herbal plant for its treatment: a review. *Indian Journal of Research in Pharmacy and Biotechnology*. 2015 Sep 1;3(5):358.
3. Xue Z, Li Y, Zhou M, Liu Z, Fan G, Wang X, Zhu Y, Yang J. Traditional herbal medicine discovery for the treatment and prevention of pulmonary arterial hypertension. *Frontiers in pharmacology*. 2021 Nov 9;12:720873.
4. Deng Y, Liu W, Yang X, Guo Z, Zhang J, Huang R, Yang X, Yu C, Yu J, Cai J, STEP Study Group. Intensive blood pressure lowering improves left ventricular hypertrophy in older patients with hypertension: the STEP Trial. *Hypertension*. 2023 Sep;80(9):1834-42.
5. Griendling KK, Camargo LL, Rios FJ, Alves-Lopes R, Montezano AC, Touyz RM. Oxidative stress and hypertension. *Circulation research*. 2021 Apr 2;128(7):993-1020.
6. Dubois-Deruy E, Peugnet V, Turkieh A, Pinet F. Oxidative stress in cardiovascular diseases. *Antioxidants*. 2020 Sep 14;9(9):864.
7. Giugliano D, Ceriello A, Paolisso G. Diabetes mellitus, hypertension, and cardiovascular disease: which role for oxidative stress?. *Metabolism*. 1995 Mar 1;44(3):363-8.
8. Tauffenberger A, Magistretti PJ. Reactive oxygen species: beyond their reactive behavior. *Neurochemical Research*. 2021 Jan;46(1):77-87.
9. Shafiq M, Chen Y, Hashim R, He C, Mo X, Zhou X. Reactive oxygen species-based biomaterials for regenerative medicine and tissue engineering applications. *Frontiers in Bioengineering and Biotechnology*. 2021 Dec 23;9:821288.
10. Checa J, Aran JM. Reactive oxygen species: drivers of physiological and pathological processes. *Journal of Inflammation research*. 2020 Dec 2;1057-73.
11. Kapoor D, Singh S, Kumar V, Romero R, Prasad R, Singh J. Antioxidant enzymes regulation in plants in reference to reactive oxygen species (ROS) and reactive nitrogen species (RNS). *Plant gene*. 2019 Sep 1;19:100182.

12. Carmo de Carvalho e Martins MD, Martins, da Silva Santos Oliveira AS, da Silva LA, Primo MG, de Carvalho Lira VB. Biological indicators of oxidative stress [malondialdehyde, catalase, glutathione peroxidase, and superoxide dismutase] and their application in nutrition. In *Biomarkers in Nutrition* 2022 Jul 12 (pp. 1-25). Cham: Springer International Publishing.
13. He L, He T, Farrar S, Ji L, Liu T, Ma X. Antioxidants maintain cellular redox homeostasis by elimination of reactive oxygen species. *Cellular Physiology and Biochemistry*. 2017 Nov 17;44(2):532-53.
14. Strycharz-Dudziak M, Kielczykowska M, Drop B, Świątek Ł, Kliszczewska E, Musik I, Polz-Dacewicz M. Total antioxidant status (TAS), superoxide dismutase (SOD), and glutathione peroxidase (GPx) in oropharyngeal cancer associated with EBV infection. *Oxidative medicine and cellular longevity*. 2019 Jul 8;2019.
15. Sharifi-Rad M, Anil Kumar NV, Zucca P, Varoni EM, Dini L, Panzarini E, Rajkovic J, Tsouh Fokou PV, Azzini E, Peluso I, Prakash Mishra A. Lifestyle, oxidative stress, and antioxidants: back and forth in the pathophysiology of chronic diseases. *Frontiers in physiology*. 2020 Jul 2;11:694.
16. Huang Y, Ollikainen M, Sipilä P, Mustelin L, Wang X, Su S, Huan T, Levy D, Wilson J, Snieder H, Kaprio J. Genetic and environmental effects on gene expression signatures of blood pressure: a transcriptome-wide twin study. *Hypertension*. 2018 Mar;71(3):457-64.
17. Kemenkes RI. Laporan Nasional Riset Kesehatan Dasar – 2018. 2019. [Online]. Available: <https://www.kemkes.go.id/article/view/19093000001/penyakit-jantung-penyebab-kematian-terbanyak-ke-2-di-indonesia.html>
18. Těšitel J, Li AR, Knotková K, McLellan R, Bandaranayake PC, Watson DM. The bright side of parasitic plants: what are they good for?. *Plant Physiology*. 2021 Apr 1;185(4):1309-24.
19. Artanti N, Firmansyah T, Darmawan A. Bioactivities evaluation of Indonesian mistletoes (*Dendrophthoe pentandra* (L.) Miq.) leaves extracts. *Journal of Applied Pharmaceutical Science*. 2012 Jan 30(Issue):24-7.
20. Endharti AT, Permana S. Extract from mango mistletoes *Dendrophthoe pentandra* ameliorates TNBS-induced colitis by regulating CD4+ T cells in mesenteric lymph nodes. *BMC Complementary and Alternative Medicine*. 2017 Dec;17:1-8.
21. Elsyana V, Bintang M, Priosoeryanto BP. Cytotoxicity and antiproliferative activity assay of clove mistletoe (*Dendrophthoe pentandra* (L.) Miq.) leaves extracts. *Advances in Pharmacological and Pharmaceutical Sciences*. 2016 Jan 1;2016.
22. Hasan M, Ali MT, Khan R, Palit P, Islam A, Seidel V, Akter R, Nahar L. Hepatoprotective, antihyperglycemic and antidiabetic effects of *Dendrophthoe pentandra* leaf extract in rats. *Clinical Phytoscience*. 2018 Dec;4(1):1-7.
23. Ang HY, Subramani T, Yeap SK, Omar AR, Ho WY, Abdullah MP, Alitheen NB. Immunomodulatory effects of *Potentilla indica* and *Dendrophthoe pentandra* on mice splenocytes and thymocytes. *Experimental and Therapeutic Medicine*. 2014 Jun 1;7(6):1733-7.
24. Handono K, Pratama MZ, Yuniati MG, Sermoati IA, Norahmawati E, Endharti AT, Irwanto Y, Hidayat S, Solikhin MB, Indahwati L, Fatmawati F. The effect of mango mistletoes (*Dendrophthoe pentandra*) leaves extract toward Immunosenescence on old balb/c mice. In *AIP Conference Proceedings* 2023 Jan 24 (Vol. 2634, No. 1). AIP Publishing.
25. Mutiah R. Cytotoxic activities profile of parasite mango (*Dendrophthoe pentandra*) from various areas in Indonesia against T47D breast cancer cells and normal vero cell lines. *Journal of Islamic Pharmacy*. 2019;4(1):1-8.
26. Hardiyanti R, Marpaung L, Adnyana IK, Simanjuntak P. Isolation of quercitrin from *Dendrophthoe pentandra* (L.) Miq leaves and it's

- antioxidant and antibacterial activities. *Rasayan J. Chem.* 2019 Oct 1;12(4):1822-7.
27. Awang MA, Nik Mat Daud NN, Mohd Ismail NI, Abdullah FI, Benjamin MA. A Review of Dendrophthoe pentandra (Mistletoe): Phytomorphology, Extraction Techniques, Phytochemicals, and Biological Activities. *Processes.* 2023 Aug 4;11(8):2348.
 28. Sjakoe N, Mubarakati N, Taufiq A. Investigation of Excellent ACE Inhibitor Agents from *Scurrula atropurpure* and *Dendrophthoe pentandra* for Anti-Hypertension. *CMUJ. Nat. Sci.* 2021; 20(3): e2021068
 29. Saputri SD, Sjakoe NA, Mubarakati NJ. Effects of mango mistletoe (*Dendrophthoe pentandra* L. Miq) extracts on brain in hypertensive rats treated with deoxycorticosterone acetate (DOCA)-salt. *Journal of Smart Bioprospecting and Technology*, 2021; 2(2):55–60.
<https://doi.org/10.21776/ub.jsmartech.2021.002.02.55>
 30. Yee LS, Fauzi NF, Najihah NN, Daud NM, Sulain M. Study of *Dendrophthoe pentandra* ethyl acetate extract as potential anticancer candidate on safety and toxicity aspects. *J Anal Pharm Res.* 2017;6(1): 00167.
 31. Endharti AT, Wahyuningtyas TE, Handono K, Widjajanto E, Permana S. *Dendrophthoe pentandra* leaves extract promotes apoptotic effects of doxorubicin in human breast cancer cell via modulation of intracellular calcium and survivin. *Journal of Applied Pharmaceutical Science.* 2018 Aug 31;8(8):039-43.
 32. Aini SQ, Sjakoe NA, Mubarakati NJ. Kadar Superoksida Dismutase (SOD) pada Paru-paru Tikus Hipertensi DOCA-Garam yang Dipapar Ekstrak Metanolik Benalu Tehdan Benalu Mangga. *metamorfosa. Journal of Biological Sciences.* 2021 Sep 1;8(2):291-7.
 33. Lestari TA. *Uji toksisitas ekstrak metanolik kombinasi daun benalu teh dan daun benalu mangga terhadap profil lipid tikus betina (Rattus norvegicus) pada paparan sub-kronik 28 hari.* Universitas Islam Malang.
 34. Notoatmodjo S. *Metodologi Penelitian Kesehatan*, 3rd ed. Jakarta: Rineka Cipta, 2022.
 35. Ghozali I. *Aplikasi Analisis Multivariate dengan Program IBM SPSS 25.* Semarang, 2018.
 36. Hau J, Schapiro SJ. *Handbook of Laboratory Animal Science Volume II - Animal Model*, 3rd ed. Boca Raton, Florida, USA: CRC Press, 2011.
 37. Federer WT. Randomization and sample size in experimentation. *Cornell University Biometrics Unit Technical*, Number BU-236-M, pp. 1–15, Sep. 1966, Accessed: Feb. 07, 2024. [Online]. Available: <https://hdl.handle.net/1813/32334>
 38. Kong D, Wang L, Niu Y, Cheng L, Sang B, Wang D, Tian J, Zhao W, Liu X, Chen Y, Wang F. *Dendrophthoe falcata* (Lf) Ettingsh. and *Dendrophthoe pentandra* (L.) Miq.: A review of traditional medical uses, phytochemistry, pharmacology, toxicity, and applications. *Frontiers in Pharmacology.* 2023 Feb 2;14:1096379.
 39. Haque MA, Haque MU, Islam MA. Evaluation of antioxidant and hepatoprotective effects of *dendrophthoe pentandra* leaves on CCl₄-induced hepatotoxic rat. *Bangladesh Pharm. J..* 2018;21:71-9.
 40. Burcham PC. Genotoxic lipid peroxidation products: their DNA damaging properties and role in formation of endogenous DNA adducts. *Mutagenesis.* 1998 May 1;13(3):287-305.
 41. Niedernhofer LJ, Daniels JS, Rouzer CA, Greene RE, Marnett LJ. Malondialdehyde, a product of lipid peroxidation, is mutagenic in human cells. *Journal of Biological Chemistry.* 2003 Aug 15;278(33):31426-33.
 42. Payana IM, Arianthi NN, Darmana IM. High ureum and creatinine level in 18-year-old male: First diagnosed with chronic kidney disease. *Intisari Sains Medis.* 2020 Mar 27;11(1):277-80.
 43. Windartik E, Rahmawati I, Yuniarti EV. Protein Intake with Blood Ureum Levels in Chronic Kidney Failure

- Patients Undergoing Hemodialysis at dr. Wahidin Sudiro Husodo Hospital. *Jombang Nursing and Midwifery Journal*, 2023; 2(1) pp. 52–57.
44. Wahyuni Y, Surya R, Hartati LS, Sapang M. Diet Quality and Ureum, Creatinine Levels in Patients with Chronic Kidney Disease in the Patient Wards of General Hospital Fatmawati, South Jakarta. 2020
 45. KN SK, Saraswathy A, Amerjothy S, Ravishankar B. Antimicrobial Potential of *Helicanthus elastica* (Desr.) Danser- A less explored Indian mistletoe Growing on Mango Trees. *Journal of Traditional and Complementary Medicine*. 2014 Oct 1;4(4):258-62.
 46. Kumar KN, Shakila R, Balakrishna K, Amerjothy S. Phytochemical examination of compounds from mango mistletoe–*Helicanthus elastica* (Desr.) Danser. *Indian Journal of Chemistry - Section B Organic and Medicinal Chemistry*, vol. 54B, no. 7, pp. 924–929, 2015.
 47. Kelly BS, Govender P, Jeffers M, Kinsella J, Gibney J, Sherlock M, Torreggiani WC. Risk stratification in multinodular goiter: a retrospective review of sonographic features, histopathological results, and cancer risk. *Canadian Association of Radiologists Journal*. 2017 Nov;68(4):425-30.