

Kesmas

Jurnal Kesehatan Masyarakat Nasional
(National Public Health Journal)

Quarterly Journal

Invited Article:

Government or Donor: The Budget for HIV/AIDS Control and Financial Commitment in Bandung City, Indonesia (pp. 80-88)

Research Articles:

Dimensions of Vaccination Attitudes in Nigeria: A Study of the Impacts of COVID-19 Vaccine Risk Perception and Acceptance (pp. 89-96)

Effect of Local Culture-based Nutrition Education on Compliance with Iron and Folic Acid Supplementation in Female Adolescents (pp. 112-121)

Effects of Using an Application for Postpartum Contraceptive Use in Family Planning Counseling During Pregnancy (pp. 137-144)

Assessment of Rabies Control Attitudes During the COVID-19 Pandemic through Partial Least Square-Structural Equation Modeling (pp. 145-151)

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READER MAIL

Dear Editorial Team, Authors, Viewers, Subscribers, and Readers

The articles featured in the first edition of Kesmas: Jurnal Kesehatan Masyarakat Nasional (National Public Health Journal) in 2023 are worth reading. Moreover, the first article, that I believe, was the invited article. Combining public health issues with other disciplines is something I do look up to in Kesmas: Jurnal Kesehatan Masyarakat Nasional (National Public Health Journal), and this edition had that article discussing political affiliation, which always become a hot topic in Indonesia and the COVID-19 vaccination program. It is so interesting to read. In the next edition, I hope Kesmas: Jurnal Kesehatan Masyarakat Nasional (National Public Health Journal) can feature more articles combining public health and other disciplines. (Tyna, Semarang)

INFORMATION

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Government or Donor: The Budget for HIV/AIDS Control and Financial Commitment in Bandung City, Indonesia

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Abstract

The number of HIV/AIDS cases in Indonesia has steadily increased since 1987. West Java Province, especially Bandung City, had the highest HIV/AIDS cases among other districts/cities in 2016. Some stakeholders' interventions overlap with others, leading to inefficient use of the limited government budget and flattening international donor funding. This study aimed to estimate the HIV/AIDS budget in Bandung City and then segregate the share of the budget by funding source and objectives. This study was a part of the Priority Setting Involving Stakeholder Using Multiple Criteria (PRISMA) project in 2017 to prioritize HIV/AIDS interventions knowing that Bandung City had the highest HIV/AIDS cases. Data from several institutions and relevant budget allocations were obtained before (2016) and after (2018-2019) the PRISMA project. HIV/AIDS control programs in Bandung City largely depend on international funding: 49% in 2016 (~USD208,898), 85% in 2018 (~USD386,132), and 71% in 2019 (~USD389,943) for a total of ~USD1,433,216. The largest budget was allocated to core interventions, with prevention dominating the budget since 2018. The budget allocated for prevention increased significantly from 2016-2019, most likely under the influence of the PRISMA project.

Keywords: budget, HIV/AIDS, institutions, interventions

Introduction

The number of HIV/AIDS cases in Indonesia has steadily increased since 1987.¹ West Java, the country's most populous province,² is ranked third highest among 34 provinces in Indonesia regarding the number of diagnosed accumulated HIV/AIDS cases.³ Bandung, the capital city of West Java, has the province's highest number of HIV/AIDS cases, with 3,116 cumulative cases reported in 2019.⁴ With a large and dense population (>2.5 million people), Bandung City is at risk of experiencing an ever-increasing number of HIV/AIDS cases.

Different stakeholders carry out various interventions to control HIV/AIDS in Bandung City. By the time this study was conducted, multiple Bandung City government agencies had implemented HIV/AIDS programs for particular purposes: providing medicines, diagnostics, prevention programs, and economic mitigation. Non-governmental organizations (NGOs) actively reach out to marginalized key populations (e.g., sex workers, transgender people), addressing stigmatization and advocating.^{5,6} Universities have conducted operational studies,

such as experimental treatments or models for school health promotion programs.^{7,8} Some of these interventions overlap with others, leading to inefficient use of the limited government budget and flattening international donor funding.

The National AIDS Spending Assessment (NASA) report shows and analyses HIV/AIDS programs and intervention expenditures carried out by public and international partners. However, the report does not provide data at the city level and only estimates budgets at the provincial level.⁹ Differing contexts among settings have prompted tailored HIV/AIDS programming suited to each city and district because the Indonesian Ministry of Health supports the distribution of HIV/AIDS drugs in the country, and decentralized cities and districts focus on social and behavioral interventions. Moreover, key populations can benefit from non-HIV/AIDS programs not included in NASA reports, such as poverty reduction programs. Some spending for HIV/AIDS-related comorbidities among key populations is melded into seemingly non-HIV/AIDS-related health programs, making expense

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tracking a challenge.⁹ Financial support is an important element in HIV/AIDS prevention intervention,^{10,11} and proper budget tracking to estimate actual amounts allocated by the government is needed to monitor its political commitment to HIV/AIDS issues and assess its sustainability.¹²

The Priority Setting Involving Stakeholder Using Multiple Criteria (PRISMA) project was established in 2017 to support the priority setting of HIV/AIDS prevention activities in Bandung City for greater efficiency and organization. An investment case analysis was conducted as part of the situational and response analysis for this project.¹³ Such information is necessary to evaluate the current budget allocation and may serve as crucial input for policy revision. This study had two purposes: first, the study estimated the total HIV/AIDS budget based on the nature of the interventions/program and funding source; and second, the study analyzed the interventions and budget data in 2016, 2018, and 2019, and observe the changes in prioritization. This study was unique as the approach could identify the budget allocated for HIV/AIDS, even if the programs or interventions did not explicitly state that they aimed for the disease. As such, this study could comprehensively picture the budget allocated for HIV/AIDS.

Method

The PRISMA project implemented a joint planning and priority-setting exercise for Bandung City HIV/AIDS stakeholders. The project used evidence-informed deliberative processes, which combined the multi-criteria decision analysis (MCDA) and accountability for reasonableness framework.¹³ Combining the two emphasized a fair and rational process, allowing for more consensus in decision-making. The MCDA has proven useful in ranking interventions based on performance criteria.¹⁴ In terms of controlling HIV/AIDS, this approach can increase collaboration among stakeholders in responding to the epidemic to identify the budget spent on interventions related to HIV/AIDS and observe the changes in spending and prioritization. Therefore, this study developed a method called Budget Tracking, which was generally defined as recording and analyzing the revenue and spending of institutions over a given period to increase the transparency of fiscal data.¹⁵⁻¹⁷

Budget tracking is a refined investment case study that classifies the type of budget, funding sources, beneficiaries, and expected outcomes through budget analyses and in-depth interviews with program implementers. The aim was to consider HIV/AIDS interventions not explicitly specified in HIV/AIDS implementation reports, such as the NASA report focusing on targeted people living with HIV/AIDS (PLWHA) and HIV-impacted communities.¹³ To trace all interventions and budgets related to

HIV/AIDS, this study began by identifying institutions and organizations that were tasked with or potentially have contributed to HIV/AIDS control based on available reports and suggestions from the Bandung City AIDS Commission, Health Office, and Regional Secretariat in Social Welfare Sector in 2016. A total of 11 government agencies and seven NGOs in Bandung City were included in this study, of which the activities and budgets were analyzed between July 2016 and December 2019. Staff members and program managers in relevant government agencies and NGOs were interviewed about their HIV/AIDS-related activities. Interventions and/or programs were grouped into several funding classifications, such as funding source and allocation and intervention design and outcomes (Table 1).

The data processing and analysis were divided into several steps. First, stakeholders or institutions related to HIV/AIDS interventions were identified through discussions with the Bandung City AIDS Commission. Second, the budget percentages allocated for HIV/AIDS-related interventions were calculated based on the total allocation of funds devoted to activities related to HIV/AIDS. Fund allocation was based on the unit cost of each activity and resources used, which were obtained based on the number of beneficiaries, working hours, and percentage of use. This approach was similar to that applied in the micro-costing analysis.¹⁸ Third, several groups of interventions were identified based on their program outcomes: health promotion, prevention, diagnostic, treatment, and impact mitigation.¹⁹ Fourth, the group of interventions was further differentiated into several categories to observe the type of the interventions being implemented: a) the source of funding, categorized as donor or government; b) specific or integrated interventions, "specific" if it was aimed only at an HIV/AIDS program and as "integrated" if the delivery of the HIV/AIDS program was integrated with programs/services for other diseases; and c) core and support interventions,²⁰⁻²³ core interventions were the main activities directly targeted at the beneficiaries, while support interventions were supplemental to core activities such as meetings and training. Last, the data were observed and analyzed concerning the changes in the allocated budget within the context of budget spending and prioritization.

This study complied with all administrative requirements for government agencies' financial reports. The surveys were conducted before (2016) and after (2018-2019) the PRISMA project to observe the changes in priority setting among the government agencies and NGOs (data collection was not conducted in 2017 to allow stakeholders to implement the results of PRISMA project implementation for prioritizing the interventions in 2018 and 2019). All budgets were calculated in Indonesian Rupiah (IDR) and converted to United States Dollars

Table 1. HIV Intervention Budget Categorization Based on Indonesian Ministry of Health Regulations on HIV/AIDS Control

Variable	Category	Classification	Description or Example
Funding source and allocation	Funding source	Donor	International organization, grants, corporate social responsibility funds, humanitarian aid, alms
	Service integration	Government	National, provincial, city, or district entities
		HIV/AIDS specific integrated	Budget fully allocated for HIV/AIDS intervention
Program naming	HIV/AIDS explicit HIV/AIDS implicit	Mentioned "HIV" or "AIDS" in its formal budget report	No "HIV" or "AIDS" or other related terms were mentioned in its formal budget report
		Intervention design and outcomes	Intervention focus
Intervention design and outcomes	Core program outcome	Support	Activity aims at improving systems and quality of service
		Health promotion	Information, education, and communication or campaign
		Prevention	Measures to reduce transmission among the key population or those at risk
	Supporting activities	Diagnostic	HIV test, CD4 test, viral load test
		Treatment	Provision of clinical and or sociopsychological support for HIV/AIDS patients
		Mitigation	Socioeconomic support for PLWHA and their affected families
		Advocacy	Development of policies and regulations
		Coordination	Meetings and communication
		Equipment	Medical instruments
		Infrastructure	Buildings and facilities
		Incentive	Human resource expenses and incentives
		Supplies	Perishables, medicines, reagents
Training	Capacity buildings and workshops		
Survey/surveillance	Data collection for key population and service coverage estimates		
Monitoring and evaluation	Field visitation, supervision, and technical assistance		

Note: PLWHA = People Living with HIV/AIDS

(USD) using the 2016 Bank of Indonesia exchange rate of IDR14,237/USD. All authors reviewed all the interview results, and disagreements were resolved through discussion. However, this rarely occurred as the results were quite straightforward and in line with the function of each institution. To minimize possible bias, the Bandung City AIDS Commission determined the proper institutions to be interviewed. It was later confirmed by Bandung City Health Office and Regional Secretariat in Social Welfare Sector.

Results

HIV/AIDS stakeholders implemented HIV/AIDS interventions based on their organization's tasks and capacities. Tables 2 and 3 show the interviewed government agencies and NGOs, as well as their task description, examples of interventions, and year of implementation to ensure that such institutions are relevant to be interviewed. The figures show the result of the interview in the form of Budget Tracking results.

Several agencies, such as the Health Office, Social Office, Population Control and Family Planning Office, and Bandung City AIDS Commission, were given specific tasks in HIV interventions. The examination revealed HIV programs at every agency implemented from previously unidentified non-health-related sectors, although inconsistently. For instance, in 2019, the Communication

and Information Technology Office allocated a budget to promote HIV/AIDS prevention through public radio. The Population Control and Family Planning Office was no longer intervening because of the transfer of management of HIV/AIDS control within the households to the Bandung City AIDS Commission. In contrast, the National Unity and Politics Agency no longer delivered interventions on HIV/AIDS because its focus shifted to early drug use prevention among adolescents.

Interventions implemented by NGOs were more consistent over the years, and they were designated unequivocally to indicate their HIV/AIDS program activities and targets. Most NGOs whose representatives were interviewed were implementors of, or even initiated by, the Global Fund programs, except for the last NGO because it focused on overcoming cases of sexual violence against children that were not specific to HIV/AIDS. International funding allows NGOs to undertake activities to benefit key populations and PLWHA.

However, these NGOs and their activities were highly susceptible to the volatility of international funding, to change policies at the national and provincial levels, and to policy recommendations from regional stakeholders. Shifts in activity implementation also occurred within NGOs. Of the seven surveyed NGOs, only five consistently delivered HIV/AIDS control activities in 2016, 2018, and 2019. One NGO stopped implementing HIV

Table 2. Interventions Delivered by the Government Agencies

Agency	Task Description	Example of Intervention	Year of Implementation
Communication and Information Technology Office	Organizing public relations tasks of the city government, managing communication technology and infrastructure, and assisting in public information dissemination.	IEC on HIV through public radio	2019
Population Control and Family Planning Office	Developing policies and implementing programs on population control and family planning.	IEC through peer group discussion for teenagers and school-based. This activity promoted adolescent health and delivered an understanding of HIV/AIDS risk to approximately 500 students across the city.	2016
Health Office	Developing policies and implementing programs on disease control, environmental health, and management of health services.	HIV/AIDS service monitoring and evaluation regularly, and training for health service workers by inviting experts for better health service workers and HIV/AIDS assistance volunteers.	2016, 2018, and 2019
Youth and Sports Office	Developing activities and implementing programs on youth empowerment, promoting sports activities, and talent development.	IEC through youth art performance	2016, 2018, and 2019
Education Office	Developing technical policies, monitoring and evaluating the quality of education in the field of primary and secondary education.	A program called "HEBAT" (comprehensive drugs and IEC on HIV/AIDS for junior high school students)	2016, 2018, and 2019
Social Office	Developing policies and implementing programs in the area of social rehabilitation, social protection and empowerment, and poverty eradication.	Vocational training for PLWHA	2016, 2018, and 2019
The National Unity and Politics Agency	Providing guidance and assisting registration for regional NGOs and ensuring alignment of city-level community activities with national and regional values.	IEC of drugs and HIV/AIDS prevention for students and the general public.	2016
Municipal Police	Assisting the regional head in enforcing regional regulations and maintaining public order.	IEC for the prevention of prostitution and drug and alcohol misuse.	2016, 2018, and 2019
Manpower Office	Developing and implementing policies on human resources empowerment and protection, industrial relation, and capacity building.	Anti-stigma and discrimination policy advocacy in workplaces.	2016, 2018, and 2019
Regional secretariat in Social Welfare Sector	Coordinating and facilitating programs across government agencies in the areas of religious affairs, education, youth empowerment, and social welfare.	IEC on HIV/AIDS for the general population, including vulnerable families. Act the regional government representation to hold a workshop containing content about the risks of HIV/AIDS and its transmission, which will be delivered to officers in 22 subdistricts.	2016, 2018, and 2019
Bandung City AIDS Commission	Coordinating, managing, monitoring, and evaluating the implementation of HIV/AIDS control at the city level	HIV/AIDS stakeholder coordination meetings, AIDS Day commemoration.	2016, 2018, and 2019

Notes: IEC = Information, Education, and Communication, PLWHA: People Living with HIV/AIDS, NGOs = Non-governmental Organizations

control activities as it shifted its focus to tuberculosis control. Another NGO started implementing HIV-related activities in 2018 and 2019 based on a recommendation from the Bandung City AIDS Commission.

Decentralization has allowed regional governments to provide more fiscal space to allocate a budget for epidemics representing a national emergency, such as HIV/AIDS. In addition, international donors and Bandung City Government's actual budget for HIV allocated in 2016, 2018, and 2019 were USD430,596; USD456,663; and USD545,958; respectively. In 2016 donors contributed only 49% (USD208,898), while in 2018, it made up 85% (USD386,132), and in 2019 accounted for 71% (USD389,943). Overall, the budget increased from 2016 to 2019.

The funding for HIV programs in Bandung City was dominated by government agencies (2016) and donors (2018-2019). The donor funds were channeled mostly through NGOs, although donors also contributed to programs implemented by government agencies, such as the

Health Office and the Bandung City AIDS Commission. In total, investments in prevention activities increased from 2016 to 2018, with the government taking over the funding in 2019 for several prevention activities that were previously donor-funded. In addition to prevention, treatment, and health promotion programs, PLWHA received increased funding from donors and the government in 2019.

The government agencies' budget dropped from USD221,698 in 2016 to USD70,531 in 2018 before increasing to USD156,015 in 2019. Changes in the government budget were attributed to a major shift in the tasks and responsibilities of government offices, as mandated by the mayor: donors funded all NGOs but some government agencies, such as the Health and Education Offices. The government's HIV budget dropped in 2018 because of a major policy shift regarding the tasks and responsibilities of the government agencies, as mandated by the mayor, although the budget increased in 2019.

In terms of integration between HIV/AIDS and other

Table 3. Interventions Delivered by Non-Governmental Organizations

NGO and Target Population	Role	Example of Intervention	Active Year
NGO that targets PLWHA and women impacted by HIV/AIDS	Providing psychological, socioeconomic, and spiritual assistance for PLWHA and women impacted by HIV/AIDS.	Psychosocial assistance visits for PLWHA	2016, 2018, and 2019
NGO that targets IDUs and MSM	Providing outreach and HIV/AIDS prevention services for IDUs and MSM.	Outreach visits for IDUs and MSM	2016, 2018, and 2019
NGO of community clinic specializing in services for key populations	Key-population-friendly clinic providing various health services, particularly related to HIV/AIDS, STI, and reproductive health.	Mobile VCT	2016, 2018, and 2019
Religion-based NGO that targets TB-HIV care	Organizing community-based efforts for TB-HIV.	TB-HIV IEC, TB-HIV community health worker training	2016
NGO that targets transgender	Promoting non-discrimination for transgender people through advocacy and empowerment programs, including health-related IEC and support activities.	Outreach for transgender peer counseling through a hotline number	2016, 2018, and 2019
NGO that targets IDUs and PLWHA	Providing HIV/AIDS prevention services and empowerment programs for IDUs and PLWHA.	Peer support for PLWHA, a sports training camp for IDUs and PLWHA	2016, 2018, and 2019
NGO that targets marginalized groups in society	Strengthening the capacity of marginalized groups to overcome barriers in accessing education, economic, and legal assistance.	Social inclusion program for underaged prostitutes	2018 and 2019

Notes: IEC = Information, Education, and Communication, PLWHA: People Living with HIV/AIDS, NGOs = Non-governmental Organizations, IDU = Injection Drug User, MSM = Men who have Sex with Men, STI = Sexually Transmitted Infections, VCT = Voluntary Counseling and Testing, TB-HIV = Tuberculosis in relation to HIV.

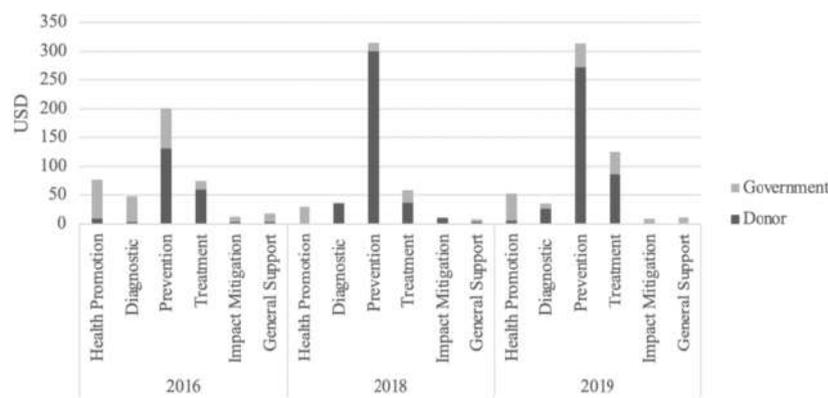


Figure 1. Donor and Regional Government Budget on HIV/AIDS Control in 2016, 2018, and 2019

programs, most HIV/AIDS programs were categorized as "specific," e.g., funding was channeled specifically for programs delivering HIV/AIDS content/services without any integration into other programs (Figure 1). Although government funding in 2016 was more evenly split between HIV/AIDS-specific and integrated programs, the funding was channeled more toward HIV-specific programs in the following years. A similar trend favoring HIV/AIDS-specific programs was also observed in the donor-funded programs, particularly in 2019 (Figure 2).

Figure 3 shows budget segregation based on core and support interventions. The core intervention budget shared more than 75% of the total budget during the 3-year observation period, indicating that more was allocated for interventions that directly target beneficiaries.

Of this allocation, NGOs were able to engage in a steady budget for core interventions. In contrast, the government reallocated budget from core interventions in 2016 to support activities, such as coordination meetings and training, including those conducted by the Bandung City AIDS Commission in 2018 and 2019.

The prevention and treatment budgets increased after 2016. The increase in the prevention budget was mostly related to increased human resource spending for outreach to injectable drug users. In 2019, the budget for health promotion was increased from USD29,829 in 2018 to USD52,082 in 2019 because of bigger attention from the Education Office to providing HIV/AIDS education at the junior high school level. In addition, diagnostics and mitigation were slightly reduced because the

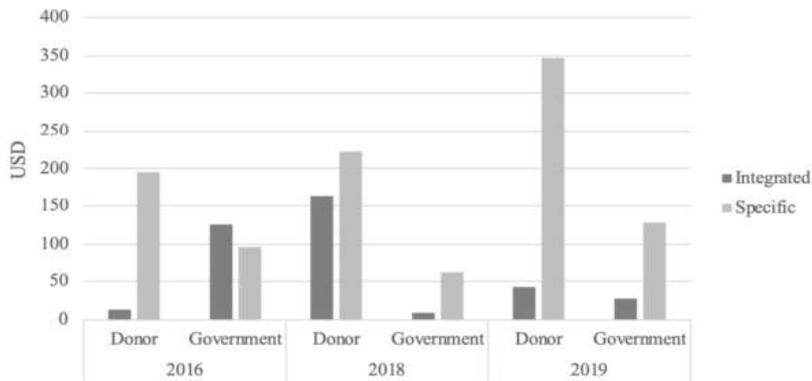


Figure 2. Share of Specific and Integrated Interventions by Source of Funding in 2016, 2018, and 2019

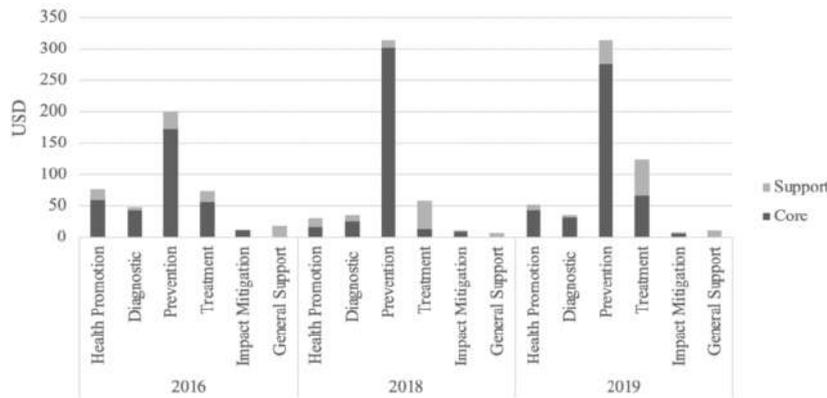


Figure 3. Core and Support by Category 2016, 2018, and 2019

social office was no longer conducting outreach for HIV/AIDS-positive homeless people.

Discussion

The results of this study highlighted the changes in HIV/AIDS control budget share in 2016, 2018, and 2019 at the government agencies' level. It was observed that the budget allocated for prevention significantly increased after the PRISMA project in 2017, which may suggest a priority change after the project implementation. Other findings indicated that donor funding consistently dominated the HIV/AIDS interventions budget, with prevention and treatment interventions having the highest share in 2018 and 2019 and budgets mostly spent on core interventions. Several inferences stand out based on these observations.

First, international donors consistently dominate the HIV/AIDS budget in Bandung City. This pattern also applies at the national level and to most low- and middle-income countries.²⁴ To taper off from international fund-

ing dependency, the government should start investing in interventions targeting key populations, such as IDUs, transgender people, and sex workers. Indeed, sustainable domestic funding is required to attain a robust response to the HIV/AIDS epidemic.¹² According to Piot, *et al.*, ideally, such a transition "should include the following elements: duration of about five years; key financing or high-level political signees; clear and measurable financial targets (for donors and governments); economic and epidemiological data; costed HIV/AIDS strategies and trusting dialogue; reliable monitoring and evaluating systems; and binding incentives (penalties and rewards)."²⁵ These factors are important because donor withdrawal may influence the retention of those on treatment without proper planning and financing by the regional government.

Increased opportunity costs also are possible as financing is redirected from other crucial sectors to control the HIV/AIDS epidemic to compensate for the withdrawal.²⁶ In this context, the transition to relying more

on the regional budget can be made by the government's implementation of the interventions or channeling funds through NGOs. Budget tracking provides an overview of allocations to anticipate funding overlaps and conflicts of interest. However, accessing government institutional budgets is difficult because of rigid protocols following the regulations. Public sector funding is limited, and competition occurs among diverse sectors.²⁷

This study found a similar situation in Bandung City, mostly because the government agencies aimed not only at HIV/AIDS reduction, but also at implementing various other programs. Reallocating government funding to HIV/AIDS control programs/interventions implemented by either government or NGOs would require a specific process. In this case, putting the time frame suggested by Piot, *et al.*, into an overall transition plan is important.²⁵ Alternatively, increasing the HIV/AIDS control budget can be achieved by developing innovative and sustainable funding mechanisms.²⁸ Indeed, based on one of our focus group discussions (FGDs), rearranging the budget allocation among posts is more feasible for developing an effective HIV/AIDS control budget while not necessarily increasing the budget itself.

In terms of the NGOs' role, although they are important in outreach, counseling, and support for PLWHA, most NGOs in this study were funded by foreign donors who supported programs within a period. Thus, the sustainability of the interventions is at stake.²⁹ There is a legal limitation for NGOs to receive government funding regularly, and even the sum will not be comparable to the donor funding. Also, the administration for regional funding is potentially daunting for key populations.^{30,31}

Second, funding for most HIV/AIDS programs, both by the donors and the government, was still fragmented. The funding was mostly aimed at financing a single HIV/AIDS service/program instead of supporting integration with other relevant services. This pattern contrasts with major global guidelines that advocate integrating HIV/AIDS responses into broader health programs and services.³² Among the suggested programs and services are those for tuberculosis, sexual reproductive health,³³ and even non-communicable diseases, such as cardiovascular disease, diabetes, and hypertension.³⁴ Such integration will enhance the impact and efficiency of the HIV/AIDS responses and strengthen person-centered care by addressing the broad health needs of PLWHA.^{32,33} Integration of HIV and other services, such as immunization,³⁵ is also expected to reduce stigma and improve patient access to services.

Third, the share of the budget spent on core interventions consistently dominated over the years. After implementing the PRISMA project to prioritize interventions, the budgeting patterns of government institutions and NGOs showed some change, with the prevention budget

significantly increasing in 2018 and remaining high in 2019. Although it cannot be claimed that this change is solely because of PRISMA, the project has likely had some role. The interviews result during data collection confirmed this finding, in which most government office and NGO representatives stated that the prioritization process of the PRISMA project influenced to some degree the decision to prioritize prevention and outreach. This development is important in the face of the prevention crisis as a result of interventions not being provided adequately and intensively enough and possibly not reaching the necessary individuals.³⁶ Such neglect may result in a rebound of the epidemic and catastrophic consequences, especially in the key populations.³⁵

However, implementing, monitoring, and evaluating HIV prevention interventions properly requires systematic data collection and analysis, and clear target outcomes.^{35,36} Indeed, prevention interventions can have a maximum impact only if they are prioritized and made available without stigma and discrimination to those in need.³⁷ A prevention cascade adapted to the national/regional context would help design clear prevention interventions and measure their performance.³⁸ This study performed an approach that relies heavily on interviews to provide a detailed budget composition, which was resource-heavy and time-consuming. This study successfully discovered activities that contribute to HIV control previously uncovered with other methods, such as NASA. It relies on accounting work, which tends to involve the regional budget office skimming for HIV/AIDS-related words in the budget reports.

This HIV/AIDS investment case analysis has limitations stemming from the inquiry's nature. First, this study did not anticipate the high turnover of program managers, especially in government agencies. In some agencies, data is only obtained from budget planning documents or estimations instead of the actual budget realization. Second, the investment case study did not include expenditures at health units such as hospitals and primary health care. Health units do not have enough decision space to determine their budget and tend to offer routine interventions, such as testing, antiretroviral therapy, or inpatient care. This study's analysis aimed to advocate for the equitable use of available resources; thus, it was more relevant to target organizations with flexibility in determining their programs.

Conclusion

In this study, a comprehensive HIV/AIDS budget is examined in Bandung City. The method has yielded a comparatively detailed estimate, based not only on the name of the intervention but also on its aim (even if the term "HIV/AIDS" is not specifically within the name of the intervention). Throughout 2016, 2018, and 2019, the

budget allocated for prevention increased significantly, most likely under the influence of the PRISMA project. Despite a decrease in government funding between 2016 and 2018, this shift holds promise for reducing HIV infection, issues such as a persistently large share of donor funding for HIV/AIDS, as well as the more fragmented design of the HIV/AIDS interventions (as opposed to their integration with other programs), should be addressed to ensure sustainability.

Abbreviations

NGO: Non-governmental Organization; NASA: National AIDS Spending Assessment; PRISMA: Priority Setting Involving Stakeholder Using Multiple Criteria; MCDA: Multi-criteria Decision Analysis; PLWHA: People Living with HIV/AIDS; IEC: Information, Education, and Communication; IDU: Injection Drug User; MSM: Men who have Sex with Men; STI: Sexually Transmitted Infections; VCT: Voluntary Counseling and Testing; TB-HIV: Tuberculosis in relation to HIV.

Ethics Approval and Consent to Participate

Ethical approval was obtained from the Health Research Ethics Committee of the Faculty of Medicine of Universitas Padjadjaran, number 439/UN6C1.3.2/KEPK/PN/2016 as a part of a larger study of HIV Priority Setting Involving Stakeholders and Using Multiple Criteria.

Competing Interest

The authors declare that there are no significant competing financial, professional, or personal interests that might have affected the performance or presentation of the work described in this manuscript.

Availability of Data and Materials

All budget tracking data related to HIV/AIDS calculation generated or analyzed during the current study are available from the corresponding author on reasonable requests.

Authors' Contribution

IYM designed and led the study, organized data collection, analyzed overall data, and prepared and wrote the manuscript. RP and FM designed the study, analyzed data collection, and prepared the manuscript. JV assisted in developing questionnaires and conducted field surveys while contributing to the writing process. AYMS supervised the study, supported data interpretation and analysis, and took part in the writing of the manuscript. LB provided the final input to the data analysis and manuscript writing. All authors read and approved the final manuscript.

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Dimensions of Vaccination Attitudes in Nigeria: A Study of the Impacts of COVID-19 Vaccine Risk Perception and Acceptance

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Abstract

Nigeria has been affected by the COVID-19 pandemic, and vaccination is a key strategy. However, the country faces vaccination hesitancy, poor risk perception, and low acceptance. This study aimed to assess the direct and interactive impacts of COVID-19 vaccine risk perception and acceptability on COVID-19 vaccination attitudes in the general Nigerian population. In a cross-sectional approach, participants completed a structured questionnaire including demographics, COVID-19 vaccine risk perception, acceptance, and vaccination attitude from April 2-30, 2021. The sample included 1,026 participants from different ethnicities across four regions (Southwest, South, Southeast, and North Central) in Nigeria, which were selected using the convenience sampling method. Multivariate analysis of variance results showed that the COVID-19 vaccine's risk perception and acceptability have separate and interactive effects on overall vaccination attitudes. Interactively, individuals with high-risk perceptions and low acceptance expressed more skepticism about its benefits, were concerned about its long-term body effects, believed more in its commercialization, and preferred natural immunity. Nigerians' apprehension about COVID-19 vaccination is impacted by their high-risk perception and low vaccine uptake.

Keywords: attitude, COVID-19 vaccination acceptance, risk perception

Introduction

The COVID-19 pandemic has global repercussions. Since there is no permanent virus treatment, vaccination is needed.¹ Vaccination is a significant public health intervention that prevents virus spread and saves lives.²⁻⁴ COVID-19 vaccines have been successfully developed and distributed across countries, but Nigeria's vaccination attitudes are concerns. This condition is because many Nigerians are skeptical about the vaccination, believing it could have unintended health consequences now or in the near future; thus, they have negative attitudes toward the COVID-19 vaccine.⁵ Understanding the impact of COVID-19 vaccine acceptability and risk perceptions on various dimensions of vaccination attitudes in Nigeria is crucial for developing effective specific vaccination promotion strategies.

People's attitudes toward the COVID-19 vaccine may be negative or positive. Positive COVID-19 vaccination attitudes, however, may increase immunization rates. In

accordance with the conceptualization of the Vaccination Attitude Examination (VAX) Scale by Martin and Petrie,⁶ the dimensions of COVID-19 vaccination attitudes are described as mistrust of vaccine benefits, worries about unforeseen future effects, concerns about commercial profiteering, and preference for natural immunity. Positivity in these dimensions may motivate an individual to receive the COVID-19 vaccine. It is generally assumed that a person's attitude toward an object affects their behavior. Thus, the COVID-19 vaccination attitude may predict vaccine uptake.

Negative COVID-19 vaccination attitudes in Nigeria are a public health concern; these negative feelings may have stymied COVID-19 vaccinations. Investigations conducted among various Nigerian demographic groups have revealed negative sentiments against COVID-19 vaccinations.⁷⁻⁸ All of this indicates apprehension about taking COVID-19 vaccines in Nigeria.

On the contrary, the vaccination attitude in the

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United States was positive. Baack, *et al.*,⁹ noted that nearly half of the country's adults were fully vaccinated. It lends credence to the conclusion made in a systematic review that vaccination acceptance rates generally varied considerably from one country to the other.¹⁰ However, individuals' attitudes toward COVID-19 immunization may be influenced by their impression of the probable hazards involved with the vaccine. Thus, COVID-19 vaccine risk perception is relevant for shaping vaccination attitudes.

Several health behavior theories rely on risk perception, including the health belief model and protective motivation theory.^{11,12} Darker and Phillips defines risk perception as the belief about possible harm or loss.¹³ Risk perception is crucial to the success of public health intervention programs. Low perception of COVID-19 vaccine health risks may be linked to positive views on vaccination. The COVID-19 vaccination risk perceptions are the perceived dangers of receiving the vaccine. These risk perceptions may include the likelihood and consequences of an unknown COVID-19 vaccine outcome. Several studies in Nigeria have shown high, moderate, or negative risk perceptions of COVID-19 vaccinations in various groups.^{7,14-16} Thus, risk perception may be required for protective measures such as COVID-19 vaccinations. Oyekale argued that reducing people's perceptions of risk and vulnerability is necessary for Nigerians to accept COVID-19 vaccination.¹⁷ This shows how risk perception affects vaccine attitudes in Nigeria. Low-risk perceptions of COVID-19 vaccinations may, therefore, increase Nigerian vaccine uptake.

Along with risk perceptions, vaccine acceptance may affect attitudes toward vaccination. Acceptance of the COVID-19 vaccine is a willingness to get immunizations. COVID-19 vaccination uptake is crucial for preventing virus spread.¹⁸ People must accept the vaccination before getting it. However, studies have observed low to moderate acceptance rates of the COVID-19 vaccine across regions and demographics in Nigeria.^{14,19-21} Although low or non-acceptance of COVID-19 vaccines in Nigeria has been connected to conspiracy theories, misinformation, and potential vaccine side effects.²² Oyekale stated that to lower the frequency of the virus in Nigeria, and the COVID-19 vaccine must be accepted across the country.¹⁵ Thus, the acceptability of the COVID-19 vaccine is necessary for creating vaccination attitudes and should not be overlooked in Nigerian studies. COVID-19 vaccines have been studied extensively across regions in Nigeria. For example, in the Southern Nigeria, Adetayo, Sanni, and Aborisade found a correlation between high COVID-19 vaccine acceptance and positive sentiments toward the vaccine.²³ In the Northern Nigeria, skepticism about the vaccine's efficacy, distrust in authority, rumors, and conspiracy theories were re-

sponsible for low COVID-19 vaccination acceptance.²⁴

This study aimed to fill a gap in the literature by comparing COVID-19 vaccine acceptability to various dimensions of vaccination attitudes in Nigeria. Examining Nigerian vaccination attitudes and potential influencing factors is crucial. The findings could help stakeholders, policymakers, and public health professionals understand how to increase COVID-19 vaccination rates in the country and the myths that need to be addressed to ensure willingness to take the vaccines. Consequently, the study aimed to determine the direct and interactive impacts of COVID-19 vaccine risk perception and acceptance on vaccination attitudes in Nigeria.

Method

This cross-sectional study involved 1,026 participants completed structured questionnaires from 2 to 30 April, 2021. Data were collected from four geopolitical zones in Nigeria (Southwest, South, Southeast, and North Central) using a convenient sampling method to sample locations and participants from classrooms, workshops, and offices. Overall, 1,500 questionnaires were distributed, and 1,196 were returned, with a response rate of 79.7%. However, 1,026 properly completed questionnaires were used for the data analysis in the study. Copies were distributed to the consented participants at various locations, including schools, offices, and workshops. Participants gave verbal consent before completing the questionnaire and were assured of the anonymity and confidentiality of their responses since no form of identification was required. The questionnaires were distributed and 10 trained study assistants followed basic COVID-19 prevention protocols, including wearing face masks, keeping their distance, and using hand sanitizers. This study's inclusion criteria were 1) the participant was 18 or older, 2) a Nigerian resident, 3) could read and answer questionnaire items, and 4) had not received COVID-19 vaccines. These instructions were at the top of the questionnaire. The questionnaires consisted of questions regarding participants' age, sex, occupation, education, religion, marital status, ethnic group, and residence, along with vaccination attitude, COVID-19 vaccine acceptance, and risk perception scales.

The COVID-19 vaccine risk perception data was assessed using a questionnaire consisting of two questions devised based on the literature and explicitly designed for this study. The participants were asked, "Getting the COVID-19 vaccine can result in short-term health problems for me" and "Getting the COVID-19 vaccine can result in long-term health problems for me." Responses to these items were on a 7-point Likert scale, as follows: Not at All (1), Very Little (2), Little (3), Somewhat (4), Much (5), Very Much (6), and A Great Deal (7). A higher score reflected a greater COVID-19 vaccine risk perception.

Participants with scores above the mean ($M = 5.72$) were regarded as high in COVID-19 vaccine risk perception, while those below the mean were regarded as low. The data on COVID-19 vaccine acceptance was assessed using a single item devised based on the literature and designed specifically for this study. Participants were asked on one statement, “Whenever I am approached to take the COVID-19 vaccine, I will accept it without hesitation.” Responses were made using a 5-point Likert scale, where strongly disagree was scored (1), disagree (2), undecided (3), agree (4), and strongly agree (5). A higher score indicated a higher acceptance of the COVID-19 vaccine. Participants with scores above the mean ($M = 2.62$) were regarded as high in acceptance, while those below the mean were regarded as low in acceptance.

While, the COVID-19 vaccination attitude data was assessed using Martin and Petrie’s 12-item VAX Scale and adapted to assess COVID-19 vaccination attitudes.⁶ The VAX Scale examines general views regarding vaccines. However, “COVID-19” was added to each of the 12 sentences to represent this study’s topic. Samples of the items include “I will feel safe after being vaccinated against COVID-19” and “Authorities promote COVID-19 vaccination for financial gain, not for people’s health.” The VAX Scale has four dimensions: 1) mistrust of vaccine benefits, 2) worries about unforeseen future effects, 3) concerns about commercial profiteering, and 4) preference for natural immunity.⁶ Responses were assessed on a 5-point Likert scale from strongly disagree (scored 1) to strongly agree (scored 5). However, items 1, 2, and 3 of the VAX Scale were reversed-scored. A higher score indicated a more negative attitude toward the COVID-19 vaccination. Cronbach’s alphas previously reported in studies ranged from 0.77 to 0.93.^{6,23}

The free version of statistical analysis software for social science was used to analyze the collected data. The demographics of the individuals were described using descriptive statistics, such as mean, standard deviation, percentages, and frequency distribution. The inferential statistics of multivariate analysis of variance (MANOVA) were used to determine the independent and joint influence of COVID-19 vaccine risk perception and acceptance on the dimensions of COVID-19 vaccination attitude for the study objectives. This study accepted a p-value of <0.05 as a statistical significance level. This study obtained a Cronbach’s alpha of 0.75 for the VAX Scale and a Cronbach’s alpha of 0.73 for the COVID-19 risk perception scale in a sample of 1,026. Thus, the scale was reliable and valid.

Results

The participants were aged 18-69, with a mean age of 26.11 ($SD = 9.32$). The participants were from all regions in Nigeria and of diverse demographics. Approximately 83.5% of the participants were from the Yoruba region where the study originated. The study participants had a higher representation of those living in urban areas (74.5%). Most participants were students (67.4%), while most had tertiary education (92.7%). Most of the participants were Christians (89.6%), singles (73.9%), and Yoruba (83.5%). Most participants (74.5%) stayed in the country’s urban areas.

Specifically, the average age of the 1,026 participants was 26.11 years ($SD = 9.32$), with 427 (41.6%) male and 599 (58.4%) female. Of the participants, 692 (67.4%) were students, 151 (14.7%) were civil servants, 74 (7.2%) were from the private sector, 74 (7.2%) were self-employed, 12 (1.2%) were retirees, and 23 (2.2%)

Table 1. Univariate Tests of Between-subject Effects

Source	Dependent Variable	Sum of Squares	df	Mean Square	F	Sig.	η^2
COVID-19 vaccine risk perception	Mistrust of vaccine benefits	371.079	1	371.079	47.236	<0.001	0.045
	Worries about unforeseen future effects	331.939	1	331.939	42.887	<0.001	0.041
	Concerns about commercial profiteering	487.810	1	487.810	61.002	<0.001	0.057
	Preference for natural immunity	380.323	1	380.323	52.898	<0.001	0.050
COVID-19 vaccine acceptance	Mistrust of vaccine benefits	2,759.512	1	2,759.512	351.270	<0.001	0.259
	Worries about unforeseen future effects	1.795	1	1.795	0.232	0.630	<0.001
	Concerns about commercial profiteering	191.562	1	191.562	23.956	<0.001	0.023
	Preference for natural immunity	53.727	1	53.727	7.473	0.006	0.007
Risk perception*Acceptance	Mistrust of vaccine benefit	11.517	1	11.517	1.466	0.226	0.001
	Worries about unforeseen future effects	30.994	1	30.994	4.004	0.046	0.004
	Concerns about commercial profiteering	54.846	1	54.846	6.859	0.009	0.007
	Preference for natural immunity	146.659	1	146.659	20.398	<0.001	0.020
Error	Mistrust of vaccine benefit	7,902.948	1006	7.856			
	Worries about unforeseen future effects	7,786.343	1006	7.740			
	Concerns about commercial profiteering	8,044.540	1006	7.997			
	Preference for natural immunity	7,232.866	1006	7.190			
Total	Mistrust of vaccine benefit	11,518.199	1009				
	Worries about unforeseen future effects	8,157.509	1009				
	Concerns about commercial profiteering	8,896.749	1009				
	Preference for natural immunity	7,853.395	1009				

were unemployed. A total of 16 (1.6%) respondents had primary education, 59 (5.8%) had secondary education, and 951 (92.7%) had tertiary education. In addition, 919 (89.6%) of the participants were Christians, 91 (8%) were Muslims, and 16 (1.6%) were Traditionalists. Regarding the marital status of the participants, 758 (73.9%) were singles, 250 (24.4%) were married, 6 (0.6%) were separated, 8 (0.8%) were widows or widowers, and 4 (0.4%) were divorced individuals. There were 857 Yorubas (83.5%), 100 (9.7%) Igbos, 11 (1.1%) Hausas, and 58 (5.7%) members of other ethnic groups. Also, according to their residence, 262 (25.5%) of the participants were from rural areas, and 764 (74.5%) were from urban areas.

Table 1 shows the results of the univariate analysis of variance, which revealed that participants' perceptions of COVID-19 vaccination risk have a direct impact on their level of mistrust of vaccine benefits [F(1, 1006) = 47.236, p-value<0.001, partial η^2 = 0.045], worries about unforeseen future effects [F(1, 1006) = 42.887, p-value<0.001, partial η^2 = 0.041], concerns about commercial profiteering [F(1, 1006) = 61.002, p-value<0.001, partial η^2 = 0.057], and preference for natural immunity [F(1, 1006) = 52.898, p-value<0.001, partial η^2 = 0.050]. The results were supported by the mean

differences in Table 2, which shows that individuals with a high-risk perception of COVID-19 vaccination (M = 10.27) reported significantly higher levels of vaccine benefit mistrust than those with a low-risk perception (M = 8.47). Participants with a high-risk perception (M = 10.99) expressed significantly more worries about unforeseen future effects of vaccines than those with a low-risk perception (M = 9.83). Participants with a high-risk perception (M = 10.47) reported higher concerns about commercial profiteering of the vaccines than those with a low-risk perception (M = 8.94). In addition, participants with a high-risk perception of COVID-19 vaccines (M = 9.17) indicated a significantly larger preference for natural immunity than those with a low-risk perception of vaccines (M = 7.90).

Furthermore, COVID-19 vaccine acceptance significantly affected participants' mistrust of vaccine benefits [F(1, 1006) = 351.270, p-value<0.001, partial η^2 = 0.259], concerns about commercial profiteering [F(1, 1006) = 23.956, p-value<0.001, partial η^2 = 0.023], and preference for natural immunity [F(1, 1006) = 7.473, p-value = 0.006, partial η^2 = 0.007]. These results were further observed in the mean differences in Table 3, where participants with low acceptance of the COVID-19 vaccine (M = 11.32) reported significantly higher mi-

Table 2. Means and Standard Deviations for Dimensions of COVID-19 Vaccination Attitude by Vaccine Risk Perception

Vaccine Risk Perception	Mistrust of Vaccine Benefit		Unforeseen Future Effects		Commercial Profiteering		Preference for Natural Immunity	
	M	SD	M	SD	M	SD	M	SD
Low	8.47	3.25	9.83	2.87	8.94	2.85	7.90	2.67
High	10.27	3.27	10.99	2.71	10.47	2.91	9.17	2.76

Notes: M = Mean, SD = Standard Deviation

Table 3. Means and Standard Deviations for Dimensions of COVID-19 Vaccination Attitude by Vaccine Acceptance

Vaccine Acceptance	Mistrust of Vaccine Benefit		Unforeseen Future Effects		Commercial Profiteering		Preference for Natural Immunity	
	M	SD	M	SD	M	SD	M	SD
Low	11.32	2.91	10.59	3.08	10.35	3.06	8.94	2.96
High	7.73	2.83	10.29	2.61	9.19	2.78	8.22	2.59

Notes: M = Mean, SD = Standard Deviation

Table 4. Means and Standard Deviations for Dimensions of COVID-19 Vaccination Attitude by Vaccine Risk Perception and Acceptance

Vaccine Risk Perception and Acceptance	Mistrust of Vaccine Benefit		Unforeseen Future Effects		Commercial Profiteering		Preference for Natural Immunity	
	M	SD	M	SD	M	SD	M	SD
High-risk and low acceptance	11.89	2.61	11.19	2.90	10.09	2.91	9.73	2.71
High-risk and high acceptance	8.30	2.89	10.75	2.44	9.73	2.73	8.49	2.66
Low-risk and high acceptance	7.28	2.70	9.93	2.69	8.78	2.75	8.01	2.52
Low risk and low acceptance	10.44	3.13	9.66	3.14	9.20	2.95	7.71	2.91

Notes: M = Mean, SD = Standard Deviation

strust of vaccine benefits than those with high acceptance (M = 7.73). Participants with low acceptance of the COVID-19 vaccine (M = 10.35) reported significantly higher concerns over commercial profiteering than those with high acceptance (M = 9.19). Similarly, participants with low vaccine acceptance (M = 8.94) indicated a stronger preference for natural immunity than those with high vaccine acceptance (M = 8.22).

Similarly, COVID-19 vaccine risk perception and acceptance had an interactive effect on various aspects of vaccination attitudes among the participants. Table 5 shows that participants with a high-risk perception and low acceptance of the COVID-19 vaccination (M = 11.19) indicated significantly more worries about the vaccine’s future effects than those with a high-risk perception and high acceptance (M = 10.75), low-risk perception and high acceptance (M = 9.93), and low-risk perception and low acceptance (M = 9.66). Participants with a high-risk perception and low acceptance of the COVID-19 vaccine (M = 10.09) expressed significantly more concern about commercial profiteering than those with a high-risk perception but high acceptance (M = 9.73), low-risk perception and high acceptance (M = 8.78), and low-risk perception and low acceptance (M = 9.20). Furthermore, participants with a high-risk perception and low acceptance of COVID-19 vaccination (M = 9.73) showed significantly higher levels of preference for natural immunity than those with a high-risk perception but high acceptance (M = 8.49), low-risk perception and high acceptance (M = 8.01), and low-risk perception and low acceptance (M = 7.71).

The bivariate results in Table 5 show that COVID-19 vaccine risk perception has positive correlations with dimensions of vaccination attitudes as follows: mistrust of vaccine benefits (r = 0.30, p-value<0.01), worries about

unforeseen future effects (r = 0.19, p-value<0.01), concerns about commercial profiteering (r = 0.30, p-value<0.01), and preferences for natural immunity (r = 0.27, p-value<0.01) respectively. In addition, COVID-19 vaccine acceptance has negative correlations with dimensions of vaccination attitudes, as follows: mistrust of vaccine benefits (r = -0.56, p-value<0.01), worries about unforeseen future effects (r = -0.11, p-value<0.01), concerns about commercial profiteering (r = -0.24, p-value<0.01) and preferences for natural immunity (r = -0.11, p-value<0.01) respectively.

Table 6 shows the MANOVA results, demonstrating a statistically significant difference in overall vaccination attitudes between participants with high- and low-risk perceptions of the COVID-19 vaccine (Wilks’ (Λ) = 0.883, F(4, 1003) = 33.089, p-value<0.001, η^2 = 0.117). In addition, the overall vaccination attitude of participants with high and low acceptance of the COVID-19 vaccine differed significantly (Wilks’ (Λ) = 0.738, F(4, 1003) = 89.197, p-value<0.001, η^2 = 0.262). COVID-19 vaccine risk perception and acceptance substantially impacted the participants’ overall vaccination attitudes (Wilks’ (Λ) = 0.977, F(4, 1003) = 5.823, p-value<0.001, η^2 = 0.023).

Discussion

Several studies might have shown that certain factors influenced COVID-19 vaccination attitudes in Nigeria. However, the dimensions of COVID-19 vaccination attitudes, risk perception, and acceptance in Nigeria are poorly understood. This study, therefore, examined the direct and interactive effects of COVID-19 vaccine risk perception and acceptance on vaccination attitude dimensions in Nigeria. The findings demonstrated that people’s perceptions of the COVID-19 vaccine risk signifi-

Table 5. Mean, Standard Deviation, and Bivariate Analysis of COVID-19 Risk Perception, Acceptance, and Dimensions of Vaccination Attitudes

Variable	Mean	SD	1	2	3	4	5	6
Risk perception	5.72	3.16	-					
Acceptance	2.62	1.33	-0.26**	-				
Mistrust of vaccine benefits	9.40	3.41	0.30**	-0.56**	-			
Worries about effects	10.41	2.87	0.19**	-0.11**	0.11**	-		
Concerns about profiteering	9.69	2.98	0.30**	-0.24**	0.26**	0.37**	-	
Preference for natural immunity	8.53	2.82	0.27**	-0.11**	0.17**	0.21**	0.38**	-

Notes: SD = Standard Deviation, **p-value<0.01

Table 6. Multivariate Effects of COVID-19 Vaccine Risk Perception and Acceptance on Overall Vaccination Attitude

Effect	Wilks’ Lambda Value	F	Hypothesis df	Error df	Sig.	η^2
COVID-19 vaccine risk perception	0.883	33.089	4.000	1,003.000	<0.001	0.117
COVID-19 vaccine acceptance	0.738	89.197	4.000	1,003.000	<0.001	0.262
COVID-19 risk perception X acceptance	0.977	5.823	4.000	1,003.000	<0.001	0.023

cantly influenced their attitudes regarding mistrust of vaccine benefits, worries about unforeseen future effects, concerns about commercial profiteering, and preference for natural immunity. Specifically, participants who perceived a high risk of COVID-19 vaccines displayed a higher level of mistrust in the benefits of the vaccine, worried more about unforeseen future effects if they took the vaccine, were more concerned about the possibility of giving it out to make money and had a higher preference for taking natural measures as forms of gaining immunity in the body.

These findings were consistent with earlier study that highlighted the importance of COVID-19 vaccine risk perception in fostering favorable attitudes toward the vaccines and the willingness to receive the vaccines among various groups in the Nigerian population.^{6,14-16,26} These findings may be related to the unguided or inaccurate information that many Nigerians appear to have received concerning COVID-19 vaccines, as stated in a previous study.²⁷ It is possibly a significant contributing reason why people have high-risk judgments of immunizations and why they establish negative attitudes toward immunizations.

This study found that COVID-19 acceptance significantly influenced Nigerian vaccination attitudes regarding mistrust of vaccine benefits, concerns about its commercial profiteering, and preference for natural immunity. In other words, vaccination attitudes regarding mistrust of vaccine benefits, its commercial purpose, and preference for natural immunity over vaccination were a function of low acceptance of the vaccines in Nigeria. These findings were consistent with those of other studies that demonstrated a link between acceptance of the COVID-19 vaccine and attitudes held by various groups within the Nigerian community.^{15,22} These findings may be ascribed to a lack of awareness of the benefits of immunizing against COVID-19, negative information, or concerns linked to safety. To provide evidence in favor of this claim, Nomhwange, *et al.*, observed that reticence toward the COVID-19 vaccination in Nigeria might be attributable to a perceived lack of safety and inadequate information read about the vaccines on social media channels.²⁸

Interactively, COVID-19 vaccine risk perception and acceptance influenced vaccination attitudes in the areas of worries about the vaccination's future effects, concerns about its commercial profiteering, and preference for natural immunity. In other words, participants perceived as high risk with a low acceptance of COVID-19 vaccines reported negative vaccination attitudes, believing that the vaccines have unforeseen future effects, were for money-making, and could not be effective as natural immunity. These findings were consistent with a study demonstrating that risk perception and acceptance are

relevant factors that could have combined influenced the implementation of COVID-19 vaccinations in Nigeria.¹⁶ It demonstrated that several factors might be interactively responsible for various forms of Nigerians' attitudes toward COVID-19 immunization and the process of implementing it. Nevertheless, it is essential to note that the authors utilized a cross-sectional methodology in which the participants were selected at a particular time. As a result, it is possible that the study would not be able to consider all the potential confounding variables that could influence the vaccination attitudes held by the Nigerian public regarding COVID-19.

This study had several limitations. This was a cross-sectional study; thus, causal conclusions about the studied variables were limited. As a result, it could not be categorically inferred that risk perception and acceptance caused a change in participants' COVID-19 vaccination attitudes. The participants were limited to those who could read and write; thus, the findings should be evaluated in Nigeria's elite community context. The data collection tool was self-reported, meaning participants may have given socially acceptable answers.

Future studies should employ a longitudinal design to overcome the limitations noted above. This design would allow data collection over an extended period, perhaps documenting shifts in COVID-19 vaccination risk perception, acceptability, and attitudes. This should encompass a more varied sample, accounting for a wider variety of demographics that may influence vaccine attitudes. A qualitative study that includes in-depth interviews and focus group discussions may be conducted in future studies to better understand the factors influencing vaccination attitudes. Vaccination attitude is a complex phenomenon that cannot be comprehensively captured through a cross-sectional study alone because of the depth of information it can provide.

In addition, since vaccination attitude is a complex phenomenon, it cannot be comprehensively captured through a cross-sectional study alone. It is possible to gain a more comprehensive understanding of vaccination acceptance by integrating the insights from quantitative study with those gained from qualitative study. This, in turn, can inform the creation of more effective public health interventions and policies. Despite these limitations, the study showed the importance of COVID-19 vaccine risk perception and acceptability in the attitudinal change of Nigerians toward the vaccine.

The COVID-19 pandemic has affected millions of people worldwide and sparked the spread of misinformation and myths about the virus. Not enough effort has been put into dispelling the misconceptions and misunderstandings surrounding this virus. Thus, practice, policies, and educating diverse groups nationwide about COVID-19 myths are advocated for public health interven-

tion. This step will prevent people from using dangerous preventive measures. Policymakers, medical experts, and researchers working on COVID-19 pandemic challenges will also benefit from this study's findings, revealing that people's attitudes about disease transmission might be negatively influenced by high-risk and low acceptability.

The Nigerian Ministry of Health must be strengthened to counter any misinformation on vaccinations that may reduce acceptability. This will dispel any vaccine skepticism in the public's thinking. These efforts aim to increase awareness and understanding of the virus, its transmission, and the most effective methods for prevention and treatment. Specifically, education programs can provide accurate information, debunk myths, and address people's concerns. Policies, such as mask mandates and vaccination requirements, can encourage safe behavior and reduce the spread of the virus. By promoting the policies and practices mentioned above, Nigeria can work toward a more informed and healthier population regarding COVID-19 vaccinations. In addition, increasing vaccine use in Nigeria should include evidence-based risk communication, risk reduction, and trust-building efforts.

Conclusion

This study reveals that Nigerians have varying opinions about the COVID-19 vaccine and finds that risk perceptions and acceptance of COVID-19 vaccines shape their vaccine attitudes. It shows that high risk and low acceptance of COVID-19 vaccination have direct and interacting negative consequences in Nigeria. According to this study, a decrease in people's perception of the COVID-19 vaccine's risk and increased willingness to accept vaccinations will increase the number of Nigerians vaccinated against the virus.

Abbreviations

COVID-19: coronavirus disease 2019; VAX: Vaccination Attitude Examination; MANOVA: Multivariate Analysis of Variance; M: Mean; SD: Standard Deviation.

Ethics Approval and Consent to Participate

Ethics and Research Committee of The Department of Psychology, Federal University Oye-Ekiti approved the study. Respondents were recruited by completing a self-administered structured questionnaire. Responses were confidential, and participants could stop completing questionnaires if they wished. Participants were thanked after completing the questionnaires.

Competing Interest

The authors declared that there are no significant competing financial, professional, or personal interests that might have affected the performance.

Availability of Data and Materials

The dataset is not publicly available but obtainable from the corresponding author upon reasonable request.

Authors' Contribution

AML, BDO, and IMO conceptualized the study. AML, BDO, IMO, AOO, OA, JCA, IOA, EKO, TA, EAO, SIB, TAO, CCO, and SAS collected the data. AML did the data analysis. All authors did the literature review. AML wrote the original draft, while all authors did the review and editing. All authors gave consent for publication.

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Dietary Changes Among Normal and High Blood Pressure Adolescents During the COVID-19 Pandemic

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Abstract

The COVID-19 pandemic has significantly impacted adolescents' unhealthy eating habits and sedentary lifestyles, leading to an increase in blood pressure and obesity rate. High blood pressure among adolescents is an early indicator of adult hypertension, but this condition has received less attention recently. Therefore, this study aimed to determine the differences in dietary changes among high school students with normal and high blood pressure before and during the COVID-19 pandemic in West Lampung District, Indonesia. A cross-sectional design was used, and the sample population consisted of 167 students aged 14-19 years. The results showed that 43 participants had elevated blood pressure and stage 1 hypertension, accounting for 25.7% of the total population. Among these participants, 14 (32.6%) were found to be overweight and obese. Based on the results, students with high blood pressure were less likely to improve their dietary choices during the COVID-19 pandemic than those with normal blood pressure.

Keywords: adolescent, blood pressure, COVID-19, dietary changes

Introduction

High blood pressure (BP) among adolescents is a significant health problem that has received less attention, specifically in developing countries.¹ Furthermore, high BP during childhood and adolescence can be an early indicator of hypertension and cardiovascular diseases later in life.² Several risk factors, such as obesity, high sodium intake, low vegetable and fruit consumption, and sedentary lifestyles, have been reported to contribute to the rising incidence rate of this condition.³ The global prevalence of hypertension in children and adolescents stands at 4%, with 9.7% exhibiting prehypertension (elevated BP).⁴ In Indonesia, the prevalence among adolescents aged 15-17 years was 5.3%, based on the 2013 Indonesian Basic Health Research.⁵

The COVID-19 pandemic has significantly impacted the younger population, leading to lifestyle changes that increase the risk of cardiometabolic disease.⁶ Social restrictions, such as school closure and social distancing, have caused an increase in sedentary activities associated with screen time,⁷ decreased physical activity,⁸ and dietary changes, thereby increasing the risk of obesity and metabolic syndrome.⁹ Furthermore, obesity has been rec-

ognized as a risk factor for hypertension,¹⁰ and its prevalence has continued to increase during the COVID-19 pandemic.¹¹

Maintaining a normal nutritional status is essential, specifically during the COVID-19 pandemic. Several studies have been carried out in international and Indonesian settings to identify changes in the dietary patterns of adolescents due to the viral outbreak.¹²⁻²¹ However, no study has specifically identified these changes among adolescents with different BP categories. Eating habits have been reported to be one of the potentially modifiable risk factors for non-communicable diseases, specifically hypertension and obesity.²²

According to the 2018 Indonesian Basic Health Research, there has been an increase in the prevalence of hypertension among individuals aged 18 years in Lampung Province from 2013 to 2018.²³ In West Lampung, the prevalence was recorded at 29.1%, thereby ranking as one of the top 5 in the province, according to the Lampung Province Health Profile.²⁴ Therefore, this study aimed to determine the differences in dietary changes among adolescents with normal and high BP before and during the COVID-19 pandemic among selected

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high school students in the West Lampung District, Indonesia. The results had the potential to contribute valuable insights into the dietary habits of high school students with and without hypertension. They could also highlight the importance of promoting healthy eating habits among adolescents as a preventive measure against hypertension and other non-communicable diseases later in life.

Method

This study used a cross-sectional design, which involved the collection of primary data from students grades 10-12 attending selected high schools in the West Lampung District, Indonesia. Furthermore, the sample population comprised all the students at Senior High School A during the 2020 academic year. This particular school was selected based on its exceptional performance in the national exam in Liwa (the capital city of West Lampung District), as high-achieving academic institutions often exerted more pressure and stress. Emotional eating habits among students were known to be associated with academic stress, which could impact their blood pressure. A total of two senior high schools were initially selected for the process—Schools A and B. However, due to the increased COVID-19 cases, learning activities were relocated online, and blood pressure measurements could not be completed in School B. The minimum sample size of 46 was calculated using an alpha level of 0.05 (95% CI) and a power of 90%.²⁵ Purposive sampling was utilized to select the total sample size of 167 students who met the inclusion criteria of being healthy and willing to participate.

Data were collected directly in July 2020 for age, sex, BP, weight, height, and pre-pandemic food consumption habits. Subsequently, data on food consumption frequency were collected online in October 2020 during the pandemic due to the increasing number of COVID-19 cases. Age, sex, and food consumption frequency were obtained through interviews, while body mass index (BMI) was calculated by dividing weight (in kilograms) by the square of height (in meters). Body weight was measured using a GEA Medical Type EB9250 digital weight scale (with an accuracy of 0.1 kg), and height was assessed using a GEA Medical microtoise (with an accuracy of 0.1 cm). Blood pressure measurements were obtained using a mercury sphygmomanometer. Data were collected by trained health workers with nursing academy educational backgrounds and trained enumerators with health-related educational backgrounds. Nutritional status was categorized as thinness, normal, overweight, and obese based on the body mass index for age (BMI/A) z-score, as indicated by the Indonesian Ministry of Health regulation for child anthropometry standards.²⁶

The students' eating habits before and during the

COVID-19 pandemic were collected through Food Frequency Questionnaires (FFQ) consisting of five food and one beverage group. The food groups included 1) snacks, such as packaged snacks (chips/snacks/wafers), baked goods (biscuits/bread/donuts/pastries), traditional products (*siomai/pempek/dimsum/batagor/telur gulung/sausage/fishcake*), tapioca-based products (*cilok/cimol/cireng*), noodle dishes (ramen/udon/Indonesian noodle topped with chicken/dumpling/meatball); 2) fast food, such as french fries, fried chicken/nuggets/crispy chicken, burgers/hot dogs/pizza, pasta (spaghetti/lasagna/macaroni), instant noodles, canned foods (corned beef/sardines/canned vegetables and fruits), coconut milk-based foods, fatty foods (beef *rendang*/innards); 3) fritters, such as fried tofu (stuffed tofu/spicy tofu and others), fried tempeh/*mendoan*, fried sweet potatoes/breadfruit/banana/jackfruit/cassava, tempura (vegetables fritters/potato croquette/sweetcorn fritter/shrimp fritter), fried bread, and crackers/potato chips/cassava chips/yam chips/jackfruit chips; 4) vegetables, including green leafy vegetables (spinach/morning glory/cassava leaves/papaya leaves), colorful vegetables (carrots/tomatoes/eggplants/beets and others), and legumes (long beans/green beans/red beans/mung beans); and 5) fruits, such as high water/mineral fruits (bananas/watermelon/cantaloupe/water rose apples), vitamin C-rich fruits (oranges/guavas/mangoes), and fiber-rich fruits (papayas/apples/pears/avocados/pineapples). While, the beverage group in the FFQ included carbonated/soda drinks and packaged sweet beverages.

The variable of food consumption frequency was obtained from FFQ results, assigned by authors with five answer options and scores of 1 = never, 2 = rarely (1-3 times/month), 3 = sometimes (1-3 times/week), 4 = frequently (4-6 times/week), and 5 = daily. The BP data were taken directly based on preexisting health protocols. The results of blood pressure measurements were categorized based on the Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents, published by the American Academy of Pediatrics in 2017.²⁷ Children aged ≥ 13 years were defined as having elevated BP when a value of 120/<80 or 129/<80 mmHg was obtained, and stage 1 hypertension was diagnosed when a value of 130/80 or 139/89 mmHg was recorded.

The data were then analyzed using IBM SPSS Statistics for Windows (IBM Corp., Armonk, New York) Version 26. The descriptive analysis was conducted to obtain an overview of the frequency distribution of the study variables. Furthermore, Wilcoxon-signed tests were carried out to examine the differences in food consumption frequencies in each group before and during the COVID-19 pandemic. Changes in frequencies among adolescents with normal BP or elevated BP and stage 1

hypertension were considered significant at a p-value of <0.05.

Result

Based on the data obtained, 52.1% of the participants were aged 15 (52.1%), and 50.9% were males. Furthermore, 6% and 19.7% of the participants had elevated BP and stage 1 hypertension, respectively. The results showed that most students had a normal BMI (73.7%), and almost one-fifth were overweight and obese, as shown in Table 1. Table 2 shows that 78.2%, 10.5%, 5.6%, and 5.6% of students with normal BP had normal, overweight, obese, and thinness nutritional statuses, respectively. While, 60.5%, 16.3%, 16.3%, and 7% of those with elevated BP and stage 1 hypertension had normal, overweight, obese, and thinness nutritional statuses, respectively.

The results showed significant changes in the consumption of snacks among the food and beverage groups (Table 3). Furthermore, a decrease occurred in the frequency of all types of snack consumption (packaged snacks, baked goods, traditional products, tapioca-based products, and noodle dishes). Among students with normal BP, the frequency of fast food intake generally decreased, including french fries (p-value = 0.004), fried

chicken/nugget (p-value = 0.011), burger/hot dog/pizza (p-value = 0.012), pasta (spaghetti/lasagna/macaroni) (p-value = 0.012), and fatty foods (*rendang/innards*) (p-value = 0.012). In the group with elevated BP and stage 1 hypertension, there was no significant change in the frequency of fast food, as shown in Table 4. The frequency of soft drink consumption showed a significant decrease among students with normal BP (p-value = 0.019)

Table 1. General Characteristics of the Participants

Variable	Category	n	%
Sex	Male	85	50.9
	Female	82	49.1
Age (years)	14	6	3.6
	15	87	52.1
	16	56	33.5
	17	15	9.0
	18	2	1.2
	19	1	0.6
Nutritional status based on BMI/A z-score	Thinness	10	6.0
	Normal	123	73.7
	Overweight	20	12.0
	Obese	14	8.4
Blood pressure category	Normal	124	74.3
	Elevated BP	10	6.0
	Stage 1 hypertension	55	19.7

Notes: BMI/A = BMI-for-age, BP = Blood Pleasure

Table 2. The Distribution of Participants' Data Based on Blood Pressure

Variable	Category	Normal BP (n = 124)		Elevated BP & Stage 1 Hypertension (n = 43)	
		n	%	n	%
Sex	Male	55	55.6	30	30.2
	Female	69	44.4	13	69.8
Age (years)	14	5	4	1	2.3
	15	63	50.8	24	55.8
	16	42	33.9	14	32.6
	17	12	9.7	3	7.0
	18	1	0.8	1	2.3
	19	1	0.8	0	0
Nutritional status based on BMI/A z-score	Thinness	7	5.6	3	7
	Normal	97	78.2	26	60.5
	Overweight	13	10.5	7	16.3
	Obese	7	5.6	7	16.3

Notes: BP = Blood Pressure, BMI/A = BMI-for-age, BP = Blood Pleasure

Table 3. Changes in the Frequency of Snacks Consumption before and during the COVID-19 Pandemic

Varian of Snack	Normal BP (Mean±SD)			Elevated BP & Stage 1 Hypertension (Mean±SD)		
	Before	During	p-value	Before	During	p-value
Packaged snack	2.67±0.917	2.47±1.008	0.002*	2.63±0.787	2.23±0.096	0.001*
Baked goods	2.71±0.872	2.51±0.879	0.005*	2.60±0.821	2.20±0.775	0.022*
Traditional snack	3.06±0.931	2.81±0.991	0.001*	2.91±0.840	2.58±0.932	0.032*
Tapioca starch-based snack	2.71±0.909	2.48±0.950	0.001*	2.58±0.698	2.37±0.817	0.048*
Noodle dishes	2.74±0.864	2.49±0.935	0.001*	2.65±1.021	2.40±0.955	0.008*

Notes: BP = Blood Pressure, SD = Standard Deviation, *p-value<0.05

Table 4. Changes in the Frequency of Fast Food and Beverage Consumption before and during the COVID-19 Pandemic

Varian of Fast Food and Beverage		Normal BP (Mean±SD)			Elevated BP & Stage 1 Hypertension (Mean±SD)		
		Before	During	p-value	Before	During	p-value
Fast food	French fries	1.86±1.145	1.68±0.771	0.004*	1.88±0.851	1.81±0.732	0.257
	Fried chicken/nugget	2.10±0.811	1.98±0.836	0.011*	2.40±0.955	2.21±0.861	0.085
	Burger/hot dog/pizza	1.51±0.681	1.45±0.640	0.012*	1.40±0.541	1.35±0.529	0.317
	Pasta	1.71±0.844	1.65±0.807	0.012*	1.56±0.666	1.65±0.720	0.351
	Instant noodle	2.98±0.865	2.89±0.921	0.131	3.05±0.754	2.95±0.815	0.384
	Canned food	2.24±0.810	2.19±0.852	0.506	2.05±0.872	2.14±0.966	0.329
	Foods with coconut milk	3.00±0.946	2.98±0.988	0.775	3.00±0.926	3.05±0.872	0.665
Beverage	Fatty food	2.53±0.795	2.15±0.857	0.012*	2.21±0.833	2.21±0.804	1.000
	Soft drink	2.17±0.740	2.04±0.800	0.019*	2.28±0.734	2.05±0.815	0.018*
	Packaged sweet drink	2.43±0.861	2.29±0.951	0.002*	2.72±0.826	2.55±0.785	0.002*

Notes: BP = Blood Pressure, SD = Standard Deviation, *p-value<0.05

Table 5. Changes in the Frequency of Fritters Consumption before and during the COVID-19 Pandemic

Varian of Fritter		Normal BP (Mean±SD)			Elevated BP & Stage 1 Hypertension (Mean±SD)		
		Before	During	p-value	Before	During	p-value
	Fried tofu	2.57±0.964	2.44±0.982	0.029*	2.65±0.997	2.70±1.036	0.627
	Fried tempeh	3.02±0.975	2.94±0.998	0.115	2.77±0.751	3.00±0.787	0.012*
	Fried sweet potato/others	2.86±0.922	2.81±0.945	0.307	2.84±0.814	2.88±0.879	0.704
	Tempura	2.85±0.852	2.88±0.852	0.672	2.84±0.871	3.02±0.851	0.101
	Croquette	2.26±0.927	2.10±0.932	0.007*	2.23±0.895	2.12±0.851	0.251
	Fried bread	2.14±0.839	2.08±0.822	0.211	2.16±0.924	2.12±0.981	0.595
	Chips	2.97±0.874	2.94±0.931	0.752	3.14±0.915	3.33±0.919	0.124

Notes: BP = Blood Pressure, SD = Standard Deviation, *p-value<0.05

Table 6. Changes in Frequency of Vegetable and Fruits Consumption before and during The COVID-19 Pandemic

Varian of Vegetable and Fruit		Normal BP (Mean±SD)			Elevated BP & Stage 1 Hypertension (Mean±SD)		
		Before	During	p-value	Before	During	p-value
Vegetable	Green vegetables	3.82±0.875	3.78±0.889	0.585	3.86±0.804	3.65±0.897	0.020*
	Colorful vegetables	3.71±0.863	3.65±0.867	0.355	3.35±0.923	3.40±0.903	0.658
	Cabbage	3.40±0.855	3.40±0.834	0.981	3.07±0.856	3.21±0.888	0.156
	Beans	3.32±0.851	3.27±0.877	0.248	3.09±0.840	3.12±0.823	0.782
Fruits	Rich in water	3.10±0.840	3.20±0.892	0.061	3.30±1.015	3.16±1.111	0.361
	Rich in vitamin C	3.19±0.810	3.48±0.841	0.001*	3.30±0.860	3.44±0.934	0.206
	Rich in fiber	3.15±0.827	3.15±0.917	0.786	3.12±0.931	3.00±0.951	0.485

Notes: BP = Blood Pressure, SD = Standard Deviation, *p-value<0.05

and elevated BP, and stage 1 hypertension (p-value = 0.018). The results also showed a significant decrease in the intake of packaged sweet drinks in the normal BP group (p-value = 0.002) and the elevated BP and stage 1 hypertension group (p-value = 0.002), as shown in Table 4.

The consumption of various fritters generally decreased in the normal BP group (Table 5). A significant reduction was also found in the frequency of fried tofu (p-value = 0.029) and croquette (p-value = 0.007) intake. While, there was a significant increase in the frequency of fried tempeh consumption in the elevated BP and stage

1 hypertension group (p-value = 0.012).

Based on the results, there was an insignificant decrease in the intake of vegetables among students with normal BP except for those who consumed cabbage (Table 6). In the elevated BP and stage 1 hypertension group, there was a significant decrease in the frequency of green vegetable consumption (p-value = 0.020). The frequency of vitamin C-rich fruit consumption significantly increased among students with normal BP (0.001). While, participants with elevated BP and stage 1 hypertension did not show significant changes in the frequency of intake of all fruits.

Discussion

This study was the first to report that dietary changes differed between adolescents with normal and higher BP (elevated BP and stage 1 hypertension) before and during the COVID-19 pandemic. Furthermore, the results highlighted that adolescents with higher blood pressure were less likely to change their food consumption toward a healthier eating pattern compared to those with normal BP during the COVID-19 pandemic. A significant decrease in consumption of snacks, fast food, sweet packaged drinks, and soft drinks was due to limited access to such foods, social distancing, and increased parental control.²⁸⁻³⁰

During the pandemic, people tried harder to maintain a healthy diet and lifestyle to support their immunity and avoid infection.³¹ Several studies showed contradictory results, in which the viral outbreak caused increased snack consumption due to loneliness, anxiety, and depression during social restrictions. The COVID-19 pandemic has changed adolescents' lifestyles and emotions, which could affect the intake of comfort foods, including snacks.¹²⁻¹⁴ However, most of these studies used completely online self-reported data, indicating the possibility of some recall bias or inaccurate data.

The eating habits of students with elevated BP and stage 1 hypertension showed a lack of positive changes before and during the COVID-19 pandemic compared to others with normal BP. For example, there was a significant decrease in the consumption of almost all types of fritters, particularly fried tofu, and croquettes. However, an opposite trend was observed in the group with elevated BP and stage 1 hypertension. It was indicated by increased intake of most foods in the fritters category, but only fried tempeh significantly increased. The consumption of vitamin C-rich fruits experienced a significant increase only in the normal BP group. These findings indicated that unhealthy eating patterns developed over a long period were difficult to change, and these habits contributed to the occurrence of high BP.³² However, further studies were still needed to investigate long-term dietary patterns and their correlation with adolescents' blood pressure.

The descriptive analysis revealed that among the elevated BP and stage 1 hypertension group, 14 students (32.6%) were identified as overweight and obese. A previous study in Italy also showed that overweight and obese children and adolescents had poorer eating habits and physical activity during the COVID-19 lockdown.¹⁵ Higher BMI was one of the risk factors that played a role in the emergence of hypertension in adolescents. The results followed the existing theory that nutritional status was related to blood pressure, which could be mediated by leptin. The effect of this hormone on systolic blood

pressure occurred through the modulation of the sympathetic nervous system and subsequent increase in heart rate.³³ People with food-induced obesity often experience disrupted hormonal regulation of body weight and hunger due to the coexistence of leptin resistance and hyperleptinemia. The occurrence of leptin resistance made the hypothalamus increasingly unresponsive to this hormone. This condition caused the hunger level to remain high, and food intake did not decrease even though energy in the form of adipose was abundant.³⁴

A previous study had shown that adolescents with an obese nutritional status had more problematic eating patterns compared to others without obesity.³⁵ This study showed that the proportion of adolescents consuming an adequate amount of fruits was higher in the non-obese group; while, the intake of fast food was higher in the obese group.³⁵ Obese people tended to be more sensitive to food cues compared to others with normal-weight people. The occurrence of obesity was reported to affect changes in brain and peripheral responses to food cues and disrupt the hormonal and energy balance mechanism. Changes caused by obesity under homeostatic conditions could increase brain responses triggered by food cues and make people more motivated to increase their intake level, making it difficult to lose weight or maintain weight loss.³⁶ Changing eating patterns was also challenging for overweight and obese individuals due to various factors, including intrapersonal, interpersonal, and environmental factors, as shown in the study of 31 women in a low-income neighborhood of Santiago, Chile.³⁷ Factors beyond an individual's control, such as family and economic circumstances, could also influence the dietary patterns of adolescents, specifically those with an overweight or obese nutritional status and high blood pressure problems.

Several studies have previously examined the correlation between eating habits and BP.^{32,38} However, this study focused on presenting the differences in dietary changes among normal and high BP groups of adolescents during the COVID-19 pandemic. This could be used for implementing nutrition education and non-communicable disease prevention among adolescents. The limitation of this study was that the samples did not represent adolescent diets in other regions. Future studies in diverse locations are advised to investigate dietary patterns in high BP adolescents and the external factors associated with their difficulty developing healthier eating habits.

Conclusion

Based on the results, there are differences in food consumption changes among adolescents with normal and high BP at a selected high school in West Lampung District, Indonesia. Furthermore, students in the elevated

BP and stage 1 hypertension group are less likely to adopt healthier eating habits, such as increased consumption of fried foods and decreased intake of vegetables. To reduce the risk of developing non-communicable diseases in the future, it is important to provide nutrition education for all adolescents, particularly those with high blood pressure.

Abbreviations

BP: Blood Pressure; COVID-19: coronavirus disease 2019; BMI: Body Mass Index; SD: Standard Deviation; BMI/A: BMI-for-age, BP: Blood Pressure.

Ethics Approval and Consent to Participate

This study was approved by the Research and Community Engagement Ethical Committee of the Faculty of Public Health, Universitas Indonesia, with number: Ket- 607/UN2.F10.D11/PPM.00.02/2020. Written informed consent was obtained from all of the participants.

Competing Interest

The authors declared that there are no significant competing financial, professional, or personal interests that might have affected the performance or presentation of the work described in this manuscript.

Availability of Data and Materials

This study's data can be provided upon reasonable request.

Authors' Contribution

BV was involved in data analysis and interpretation, and prepared the manuscript draft; RADS reviewed the manuscript, advised on the data analysis and interpretation, and owned the primary data; RMP was involved in data collection and compilation.

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COVID-19 Prevention in People Living with HIV/AIDS: Entering the Endemic Phase

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Abstract

The mortality and severity risks due to COVID-19 infection are higher in people living with HIV/AIDS (PLWHA) than those with no such condition. This study aimed to analyze the relationship between health literacy, social support, and the health belief model in PLWHA in preventing COVID-19 from entering the endemic phase. An analytic observational study with a cross-sectional design was conducted in October 2021 among 94 PLWHA selected by purposive sampling in Kupang City, Indonesia. The bivariate data analysis used the Chi-square, and the multivariate data analysis used the binomial logistic regression test. The results showed that 88.3% of the participants had poor COVID-19 literacy, 67% had low emotional support, and 71.3% had poor COVID-19 prevention behavior. The results of the multivariate analysis showed that the factors with the strongest association, COVID-19 literacy (95% CI = 1.71–108.55; PR = 4.15) and emotional support (95% CI = 1.01–53.81; PR = 2.35), improve COVID-19 prevention behavior. Implementing communication, information, education, and policy strategies is important to improve literacy and emotional support to prevent COVID-19 from entering the endemic phase among PLWHA.

Keywords: COVID-19 prevention, literacy, people living with HIV/AIDS, social support

Introduction

The first coronavirus disease 2019 (COVID-19) case was discovered in December 2019 in Wuhan City, China. The disease became a worldwide pandemic in March 2020.¹ The spread and prevalence of COVID-19 increased rapidly worldwide. A World Health Organization report as of 26 October 2021 stated that 243,561,596 people had been infected with COVID-19, and 4,947,777 had died due to COVID-19 infection (case fatality rate: 2.0%).² A total of 204 countries have been infected with coronavirus, and 151 countries have experienced community transmission.² Indonesia ranks 20th among the most cases worldwide, with 4,241,090 people infected and 143,270 total deaths.³ Increased cases also occurred in the East Nusa Tenggara Province, with 63,508 cases and 1,323 total deaths.³

One high-risk group during the COVID-19 pandemic was people living with human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS) (PLWHA). A study of 144,795 hospitalized COVID-19 patients in North America, Europe, and Asia found that the prevalence of PLWHA among those infected with COVID-19 was 1.22%, twice as high as the overall local

HIV prevalence of 0.65%. These data indicate the possible susceptibility to COVID-19 infection of people with HIV.⁴ The worrying case is the fact that the vast majority of PLWHA around the world live in a country with a poor health care infrastructure.⁵

By 2021, 38.4 million people worldwide were infected with HIV/AIDS.⁵ Indonesia had reached 558,618 cases by March 2021.⁶ Antiretroviral therapy (ART) is crucial for PLWHA. Therefore, the Indonesian Ministry of Health set a target that, by 2021, 45% of PLWHA in all regencies and cities of Indonesia would receive ART.⁶ However, not all districts and cities have reached the target, including Kupang City, the capital city of the East Nusa Tenggara Province. The number of HIV/AIDS patients in this province is 8,666 cases, and Kupang has the highest number of PLWHA in this region, with a significantly increasing number of cases, from 1,026 in 2020 to 1,144 in 2021.⁷

The relationship between COVID-19 morbidity and mortality in PLWHA has been established in various studies. ART therapy is crucial for PLWHA, as it suppresses virus replication, strengthening the immune system, which enables them to fight the COVID-19 infec-

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tion. A study in the UK found that COVID-19-infected PLWHA had a higher risk of death than those with no such infection.⁸ PLWHA are at high risk of respiratory issues.⁹ The weakening of the immune system among PLWHA is a severity risk for COVID-19 infection.¹⁰

Adherence to ART does not eliminate the risk of COVID-19 infection.¹¹ The clinical course of COVID-19 among PLWHA is similar to that in the general population. However, a concern is the high level of inflammation in the two conditions, which can lead to complications in PLWHA. Prevention as early as possible is essential so that PLWHA do not get infected with COVID-19. One of the COVID-19 prevention measures among PLWHA is to ensure that the cluster of differentiation 4 (CD4) remains high by regularly taking ART.¹²

The strategy to eradicate COVID-19 as it enters the endemic phase is to continue carrying out health protocols and conducting COVID-19 vaccination.¹³ The transmission of COVID-19 can be prevented by implementing health protocols, such as washing hands, wearing masks, and maintaining social distancing.¹⁴ In addition to preventing infection, the COVID-19 vaccine reduces severity and mortality risk.¹⁵ However, many people still do not take the vaccine.¹⁶ A previous study found that knowledge, attitudes, health belief, and media are factors related to COVID-19 prevention behavior.¹⁷

PLWHA, as a group vulnerable to COVID-19, should carry out health protocols and take the vaccine. Therefore, this study analyzed the relationship between health literacy, social support, and the health belief model in PLWHA in preventing COVID-19 from entering the endemic phase. This study's importance lies in identifying the factors that influence COVID-19 prevention in PLWHA as an effort to prevent PLWHA from experiencing a more severe impact of COVID-19.

Method

This analytic observational study was conducted in October 2021 using a cross-sectional design. The study population was all individuals infected with HIV/AIDS in 2020, with a total of 1,026 people in Kupang City, Indonesia. The sample was determined using the hypothesis of sample size based on proportion with a 95% confidence level.¹⁸ The number of the sample was 94 participants in Kupang City, including an additional 10% to account for drop-out during the data collection. The sample was recruited using purposive sampling among people registered with a care support group A in Kupang. The inclusion criteria were people aged at least 18 years and living with HIV/AIDS for more than six months.

The selected sample received a study explanation and an informed consent form. If the participants agreed, they were asked to sign the informed consent. The study instrument was a questionnaire comprising the partici-

pants' demographic characteristics and independent and dependent variables. The demographic characteristics data collected were age, sex, education, and occupation. The independent variables were COVID-19 literacy, social support (informational, instrumental, and emotional), and health belief (perceived susceptibility, severity, benefits, barriers, and cue to action).

For the variable COVID-19 literacy, the instrument was adapted from a questionnaire developed by Archila, *et al.* The consistency and internal reliability test yielded a Cronbach's alpha of >0.744.¹⁹ The questionnaire for the COVID-19 literacy variable consisted of questions regarding prevention, early detection of COVID-19, risk factors for transmission, and the behavior of influencing others to prevent COVID-19. Each question had four answer choices. If the answer was correct, the score was 1; if the answer was wrong, the score was 0. The questionnaire consisted of seven questions. A participant with at least four correct answers was categorized as having "good" literacy.

The social support variable was measured using a questionnaire developed by Manurung.²⁰ Its validity and reliability were tested using corrected item-total correlation (<0.36) and Cronbach's alpha (<0.6). The statements for the social support variables had two answer choices: "yes" and "no." For favorable statements, "yes," scored 1, and "no" scored 0. There were five statements each for informational, instrumental, and emotional support. A total score of 3 the participant got was categorized "high". The statements for the perception variables consisted of five choices with a score of 1 to 5. "Strongly agree" on a favorable statement scored 5, and "Strongly agree" on an unfavorable statement scored 1.

To measure the variables of COVID 19 prevention behavior and the health belief model, this study adopted a questionnaire developed by Karimy, *et al.*²¹ There were four statements each for the perceptions of susceptibility and severity and a total score of <12 was categorized as "low." There were eight statements for perceived benefit, for which a total score of <24 was categorized as "low." There were five statements for the perception of barriers, for which a total score of <15 were categorized as "low." There were 10 statements for COVID-19 prevention behavior. Each statement consisted of four answer choices: "never," "rarely," "often," and "always," with a score of 0–3. A total score of <19 was categorized as "low."

At the time of the interviews, the authors ensured that only the enumerators and PLWHA were there. This condition was necessary to avoid bias in the answers of PLWHA when asked about family support. The data obtained from univariate analysis were in the form of frequency and percentage of each variable. Bivariate analysis was conducted using a Chi-squared test to describe the relationship between the independent variable and

COVID-19 prevention behavior, with a p-value of <0.05.

The analysis examined the relationship of COVID-19 literacy, social support, and health belief to COVID-19 prevention. A multivariate analysis using a binomial logistic regression test was applied to examine the dominant factors. The significance of the variable was determined by a p-value of <0.05. The prevalence ratios (PRs) and 95% confidence intervals (CIs) were presented.

Results

The distribution of demographic characteristics in Table 1 shows that most participants were females (61.7%), aged 18–49 years (66.0%), had gone to high school (56.4%), and were self-employed (50%). The youngest respondent was 18 years old, and the oldest was 61 years old. Table 1 indicates that 88.3% of the participants had poor COVID-19 literacy. The lowest literacy value by respondents was 1, and the highest was 6. The highest percentage under social support was found in low instrumental support (86.2%). For the social support variable, the lowest score was 1, and the highest score was 5. The highest average in the social support variable was 2.8. The highest percentage in the variables for

health belief was for perceived benefits (70.2%), and most participants had poor COVID-19 prevention behavior (71.3%). The highest score under health belief was for the variable of perceived benefits, which has a maximum score of 36, a minimum score of 18, and an average of 26.4.

The results of the bivariate analysis in Table 2 show that COVID-19 literacy, instrumental support, emotional support, perceived susceptibility, perceived severity, perceived benefits, and perceived cue to action had a relationship with COVID-19 prevention behavior in PLWHA. The highest PR values were found in instrumental support and COVID-19 literacy. The provision of high instrumental support increased COVID-19 prevention behavior in PLWHA by 5.60 times, and good COVID-19 literacy increased COVID-19 prevention behavior in PLWHA by 8.743 times. The highest PR value under health belief was in the variable of perceived severity, and a higher perceived severity among PLWHA increases prevention efforts by 8.256 times. While, the variables of informational support and perceived barriers did not show a significant relationship.

Table 2 shows that the variable of perceived barriers

Table 1. Distribution of Participants' Characteristics, COVID-19 Literacy, Social Support, Health Belief, and COVID-19 Prevention Behavior (n = 94)

Variable	Category	Min–Max	Mean	n (%)
Sex	Male			36 (38.5)
	Female			58 (61.7)
Age (years)	18–49	18–61	46.2	62 (66.0)
	≥50			32 (34.0)
Education	<Junior high school			14 (14.9)
	Senior high school			53 (56.4)
	Higher education			27 (28.7)
Occupation	Civil servant/police			10 (10.6)
	Self-employed			47 (50.0)
	Housewife			37 (39.4)
COVID-19 literacy	Poor	1–6	2.8	83 (88.3)
	Good			11 (11.7)
Social support	Informational	Low	1–5	65 (69.1)
		High		29 (30.9)
Instrumental	Low	1–5	2.2	81 (86.2)
	High			13 (13.8)
Emotional	Low	1–5	2.6	63 (67.0)
	High			31 (33.0)
Health Belief	Perceived susceptibility	Low	10–20	14.6
		High		54 (57.4)
Perceived severity	Low	12–20	14.2	53 (56.4)
	High			41 (43.6)
Perceived benefits	Low	18–36	26.4	28 (29.8)
	High			66 (70.2)
Perceived barriers	Low	12–24	16.2	32 (34.0)
	High			62 (66.0)
Perceived cue to action	Low	10–24	15.8	31 (33.0)
	High			63 (67.0)
COVID-19 prevention behavior	Poor	8–26	14.8	67 (71.3)
	Good			27 (28.7)

Table 2. Analysis of the Relationships between COVID-19 Literacy, Social Support, and Health Belief to COVID-19 Prevention Behavior

Variable	Category	COVID-19 Prevention Behavior				Sig.	Crude PR	95% CI
		Poor		Good				
		n	%	n	%			
Sex	Male	29	30.8	7	7.5	0.282		0.815–5.852
	Female	38	40.4	20	21.3			
Age (years)	18–49	9	9.6	3	3.1	0.981		0.302–4.981
	≥50	58	61.7	24	25.6			
Education	<Junior high school	12	12.7	2	2.1	0.708		0.063–2.735
	Senior high school	41	43.6	12	12.9			
	Higher education	14	14.9	13	13.8			
Occupation	Civil servant/police	7	7.1	3	2.9	0.518		0.512–0.526
	Self-employed	36	33.5	11	13.5			
	Housewife	24	26.4	13	10.6			
COVID-19 literacy	Poor	66	70.2	17	18.1	0.001	8.743	4.642–324.613
	Good	1	1.1	10	10.6			
Social support Informational	Low	49	52.2	16	17.0	0.182		0.731–4.785
	High	18	19.1	11	11.7			
Instrumental	Low	66	70.1	15	16.0	0.001	5.604	6.362–137.961
	High	1	1.1	12	12.8			
Emotional	Low	53	56.4	10	10.6	0.001	6.417	2.422–17.115
	High	14	14.9	17	18.1			
Health Belief Perceived susceptibility	Low	40	42.6	0	0	0.001	2.301	1.531–2.614
	High	27	28.7	27	28.7			
Perceived severity	Low	47	50.0	6	6.4	0.001	8.256	2.882–23.441
	High ²⁰	21.3	21	22.3				
Perceived benefits	Low	24	28.7	4	1.1	0.001	2.054	0.242–137.164
	High	31	42.6	35	27.6			
Perceived barriers	Low	23	24.5	9	9.6	0.925		0.406–2.691
	High	44	46.8	18	19.1			
Perceived cue to action	Low	27	28.7	4	4.4	0.31	3.801	1.205–12.483
	High	40	42.6	23	24.5			

Notes: Sig. = Significance (p-value of <0.05), PR = Prevalence Ratio, CI = Confidence Interval

does not meet the requirements of the multivariate analysis. The results of the multivariate analysis in Table 3 show that only COVID-19 literacy, emotional support, and perceived benefits influenced COVID-19 prevention behavior in PLWHA. Good COVID-19 literacy increased COVID-19 prevention behavior in PLWHA by 4.153 times over PLWHA with poor literacy, and high emotional support increased COVID-19 prevention behavior by 2.356 times over those with low emotional support.

Discussion

The findings of this study indicated that any increase in literacy increases COVID-19 prevention behavior in PLWHA. The better the COVID-19 literacy, the better the prevention behavior will be. However, most PLWHA in this study still had poor COVID-19 literacy. The low level of knowledge could be because the PLWHA had not been exposed to information on COVID-19. A study in Korea in 2020 found that misinformation about COVID-19 could affect public knowledge of preventing COVID-19.²² In addition, there is a great deal of misin-

formation about COVID-19, such as the perceived existence of a political conspiracy, which may influence the views of PLWHA.²³ This condition will certainly increase the risk of COVID-19 infection in the endemic phase.

COVID-19 literacy is one's knowledge and skills to prevent COVID-19 in oneself and others.²⁴ COVID-19 prevention behavior includes wearing a mask in crowds and closed spaces, washing hands, not touching the nose and mouth with unwashed hands, maintaining social distancing, and getting vaccinated.²⁵ These behaviors are effective in preventing COVID-19 transmission.²⁶ Interventions to improve COVID-19 literacy in PLWHA are important so that PLWHA are more obedient in preventing COVID-19 in the endemic phase.²⁷

Social support is a factor that may influence a person to stay strong in dealing with the threat of COVID-19.²⁸ This study found that social support in the form of high emotional and instrumental support increases COVID-19 prevention behavior in PLWHA. The results of this study were in line with a study in the UK, showing that social support was an important determinant of COVID-

Table 3. Multivariate Analysis of the Relationships between COVID-19 Literacy, Social Support, and Health Belief to COVID-19 Prevention Behavior

Variable	Category	Adjusted PR	Sig. (2-tailed)	95% CI		
				Lower	Upper	
COVID-19 literacy	Poor	4.153	0.023	1.714	108.552	
	Good	Ref				
Social support	Informational	Low	0.462	0.051	3.656	
		High				
	Instrumental	Low	0.877	0.999	0.013	23.564
		High				
Emotional	Low	2.356	0.042	1.012	53.811	
	High					Ref
Health belief	Perceived susceptibility	Low	0.971	0.999	0.022	34.261
		High				
	Perceived severity	Low	1.114	0.918	0.157	7.953
		High				
	Perceived benefits	Low	1.380	0.082	0.728	148.901
		High				
	Perceived cue to action	Low	0.891	0.915	0.119	7.072
		High				

Notes: PR = Prevalence Ratio, CI = Confidence Interval

19 prevention behavior.²⁹

This study indicated that instrumental and emotional supports were more needed by PLWHA to prevent COVID-19. Instrumental support comes from family or friends through assistance such as providing masks and hand sanitizer.²⁴ In addition, family or friends can provide emotional support in the form of affection, attention, trust, and empathy.³⁰ Therefore, it is necessary to increase the role of the family in providing emotional assistance and support concerning the development and prevention of COVID-19 among PLWHA in the endemic phase.²⁹

Everyone is influenced by different factors in determining COVID-19 prevention efforts.³¹ Behavior is an individual's response to a stimulus that can be observed and has a specific frequency, duration, and purpose.³² Perceived susceptibility, severity, cue to action, barriers, and benefits can bring about compliance in COVID-19 prevention.³³ The interactions among perceptions were so complex that it was difficult to identify the cause of a person's adopting a specific behavior. Therefore, examining the reasons behind individual behavior before changing it is important.³⁴

An analysis of the health belief model can be used as a reference in conducting interventions to improve COVID-19 prevention behavior.³⁵ This study found that perceived susceptibility, severity, cue to action, and benefits were related to COVID-19 prevention behavior in PLWHA, whereas perceived barriers were not. The higher the perceived barrier, the lower PLWHA's COVID-19

prevention behavior.³⁶ This study's results aligned with a study conducted among health school students in Korea, finding that the higher the health belief model score, the stronger the COVID-19 prevention habit.²²

The logistic regression analysis showed that COVID-19 literacy, emotional support, and perceived benefits influence PLWHA to prevent COVID-19. The greater the COVID-19 literacy, emotional support, and perceived benefits, the better the COVID-19 prevention behavior in PLWHA.^{20,36} However, the results of this study revealed that most of the three variables were still low. As a result, the risk of PLWHA not making efforts to prevent COVID-19 would be higher. Therefore, it is important to make interventions to improve COVID-19 literacy, emotional support, and perceived benefits so that PLWHA will prevent COVID-19 during the endemic phase.

Interventions can be in the form of information, communication, and education that aims to increase the awareness of PLWHA about making efforts to prevent the transmission of COVID-19.³⁷ In addition, they make it easier for PLWHA to access vaccines and ARTs and to become more comfortable regarding health services. PLWHA are one of the vulnerable groups to COVID-19 transmission, then it is important to help them protect themselves in the endemic phase.

All instruments were tested for validity and reliability. However, this study has some limitations, first, in relation to the small cells found. This could be caused by almost all the respondents being interviewed by telephone, which may have influenced the respondents' answers.

Furthermore, the number of questions was too small for each variable. The authors suggested that future studies employ face-to-face interviews. Second, because this was a cross-sectional study, it examined only a limited time and determined the conditions obtained at the study's time. Changes in each variable that may have occurred or will occur could not be observed. Therefore, further study is needed on PLWHA families to support the prevention of COVID-19 in the endemic phase.

Conclusion

COVID-19 literacy, social support in the form of instrumental and emotional support as well as health belief in the form of perceived susceptibility, severity, benefits, and action cues, are related to COVID-19 prevention behavior in PLWHA. In addition, the results of the multivariate analysis show that the better the COVID-19 literacy and emotional support, the better the COVID-19 prevention behavior will be. However, the results show that most PLWHA still had poor COVID-19 literacy, low emotional support from family and friends, and low perceived benefits of COVID-19 prevention. Therefore, it is necessary to improve COVID-19 literacy and emotional support for COVID-19 prevention in PLWHA. It is necessary to increase the quality of health services for PLWHA by supporting their peers to be health communicators, particularly concerning COVID-19 prevention behavior. Sustainable health education could increase social support for PLWHA in maintaining their preventive behavior in the endemic phase. It is expected that PLWHA, as a vulnerable group, will be increasingly obedient in carrying out prevention efforts and preventing the transmission of COVID-19 during the endemic phase.

Abbreviations

COVID-19: coronavirus disease 2019; HIV: Human Immunodeficiency Virus; AIDS: Acquired Immunodeficiency Syndrome; PLWHA: People Living with HIV/AIDS; ART: Antiretroviral Therapy; CD4: Cluster of Differentiation 4; PR: Prevalence Ratio; CI: Confidence Interval.

Ethics Approval and Consent to Participate

Research ethical clearance was obtained from the Health Research Ethics Commission of the Faculty of Public Health, Universitas Nusa Cendana Kupang (No. 2021087 – KEPK).

Competing Interest

The authors declare that there are no significant competing financial, professional, or personal interests that might have affected the performance or presentation of the work described in this manuscript.

Availability of Data and Materials

The data and materials in this study are available and may be requested

from the corresponding author.

Authors' Contribution

IFEM developed ideas, methodology, instruments, and data analysis and drafted the manuscript. AELT developed instruments and collected, analyzed, and interpreted the data. JC developed instruments and provided administration and supervision.

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Effect of Local Culture-based Nutrition Education on Compliance with Iron and Folic Acid Supplementation in Female Adolescents

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Abstract

The non-compliance of female adolescents with the consumption of iron and folic acid supplementation (IFAS) poses a challenge to reducing the incidence of anemia. Therefore, this study aimed to determine the effect of nutrition education using the local culture-based approach on the level of knowledge and attitudes regarding awareness, interest, evaluation, trial, and adoption dimensions, as well as compliance of female adolescents in consuming IFAS. The intervention was conducted using a quantitative quasi-experimental design approach. The sample comprised 68 and 58 senior high school girls in the control and intervention groups. The intervention group received IFAS and local culture-based nutrition education for 12 weeks and followed up after four weeks; while, the control group was given a leaflet and IFAS. Univariate analysis was conducted to analyze the participants' characteristics; while, bivariate analysis used an independent T-test. The multivariate analysis was carried out using multiple linear and logistic regression analyses. The study showed a statistically significant increase in knowledge and attitudes scores in the intervention group (p -value <0.01) compared to the control group. In conclusion, the compliance with IFAS in the intervention group was 82.8%.

Keywords: compliance, female adolescent, iron and folic acid supplementation, local culture, nutrition education

Introduction

Anemia is a global public health problem.¹ According to the World Health Organization (WHO), in 2018, a prevalence of anemia above 20% to 39.9% is considered a moderate public health problem.² While, in Indonesia, the 2018 Indonesian Basic Health Research showed a prevalence of 23.7%, with 27.2% in women and 20.3% in men.³ Generally, anemia is common among women, especially female adolescents. Based on the survey conducted by the Health Office of Ogan Komering Ilir (OKI) District, South Sumatra Province, in 2019, the prevalence among female adolescents was relatively high (25.63%), comprising 15.12%, 9.79%, and 0.72% in the mild, moderate, and severe categories, respectively.⁴

Anemia among female adolescents is higher than among males. Anemia in adolescents has a negative impact on decreased immunity, study concentration, fitness, and productivity.⁵ In addition, anemia experienced by young women, in particular, will have a more serious im-

pact, considering that they are prospective mothers who will become pregnant and give birth to a baby, thus increasing the risk of death for mothers giving birth to premature babies and low birth weight babies (LBW).⁵

Anemia is characterized by a decrease in the functional erythrocyte count or hemoglobin.⁶ In adolescence, not only does the illness affect health status, but it also has long-term effects.⁷ Although the underlying causes vary, non-compliance with iron and folic acid supplementation (IFAS) consumption contributes to the high prevalence. It is proven by the 2018 Indonesian Basic Health Research data showed that out of 76.2% of female adolescents consuming IFAS, only 1.4% consume 52 tablets in one year, and 81% receive IFAS at school.³ Compliance with IFAS consumption is related to factors such as less awareness and knowledge of anemia and IFAS among female adolescents.⁸⁻¹¹ Therefore, intervention related to nutrition education is needed to improve the knowledge of female adolescents about anemia and IFAS.

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A previous study showed that education intervention effectively improves compliance among target populations.¹² However, the media must be considered to ensure effective information delivery to adolescents. Social media as an information medium is one of the alternatives due to its popularity among adolescents, including platforms such as Instagram.¹³ Providing education with a local culture-based approach can also increase the enthusiasm of the target population.¹⁴

Based on the preliminary study, female adolescents in OKI District prefer local cultural traditions, such as *kelakar* or jokes.¹⁵ A form of humor widely practiced in South Sumatra Province using the Palembangnese language is well known as the term *betok*.¹⁶ Therefore, this study aimed to determine the effect of local culture-based nutrition education on improving knowledge, attitudes, and compliance with IFAS consumption among female adolescents. These findings were expected to serve as a comprehensive intervention, such as an education model for improving compliance with IFAS consumption among female adolescents.

Method

This study used a quantitative approach with a quasi-experimental design to determine the effect of local culture-based nutrition education on improving knowledge, attitudes, and compliance with IFAS consumption among female adolescents. The minimum required sample was determined by a formula of two population proportions on one side with a significant level of 5%, power test of 80 %, P1 of 93%, and P2 of 65%. P1 was compliance with iron supplement tablets from the intervention group, and P2 was compliance with iron consumption tablets from the control group. Based on the formula, a minimum sample of 41 for each group was obtained. To anticipate the dropout, 30% was added, so the minimum number of samples per group was 53.

The intervention was conducted for 12 weeks, with a 4-week follow-up period to observe the resistance to behavioral change. This study was conducted with the Iron Deficiency Anemia Prevention and Control Program for Female Adolescents implemented by the OKI District's Health Office. The intervention group was given IFAS and local culture-based nutrition education. The nutrition education provided used the Awareness, Interest, Evaluation, Trial, and Adoption (AIETA) behavioral change stage. It was applied in videos based on local culture containing humor and education. In comparison, the control group received IFAS as part of the prevention program of the Indonesian Ministry of Health. It was based on the existing program of OKI District, providing subsidized IFAS for female adolescents aged 11-18 years, distributed through schools.¹⁷

This study was conducted in OKI District for six

months, from November 2021 to April 2022. The location was purposively selected based on the relatively high prevalence of anemia. The prevalence among female adolescents was relatively high (25.63%), comprising 15.12% (in the mild), 9.79% (moderate), and 0.72% (severe).⁴ The participants were female adolescents attending senior high schools, including 44 schools across 18 subdistricts. Public senior high schools were selected as the samples to reduce bias due to differences in characteristics between public and private schools, which were quite distant. The inclusion criteria for schools were public schools that had received the IFAS program from the government and were at least 10 kilometers apart from one another. The exclusion criteria for schools were schools currently being used as the object of another study and were difficult to access (located in remote areas).

The sample was female students who met the inclusion and exclusion criteria. The selection was performed using simple random sampling. The inclusion criteria for the sample were female students grade 11, aged 15-17 years, experiencing menstruation, owned a smartphone and an Instagram account, and obtained parental consent to participate in this study. While, the exclusion criteria for the sample were female students with a body mass index (BMI) ≤ -3 SD. The schools and samples were selected using cluster and simple random sampling.

Local culture-based nutrition education intervention was conducted for 12 weeks using Instagram as the medium. Education was delivered through local culture-based videos on the Instagram account named @remaja.bebasanemia. The videos were shared through Instagram stories, a feature on Instagram. The intervention group received six videos, with a frequency of once every two weeks and approximately 3-5 minutes per video, for 12 weeks. While, the control group only received nutrition education provided by the health office's staff during IFAS distribution.

The IFAS was used as an intervention was blood-boosting tablets containing 60 mg of FeSO₄ and 400 mcg of folic acid, following the government program. The policy of providing IFAS to female adolescents was carried out once a week throughout the year, using a blanket approach. The IFAS was given once at the beginning of this study in 16 tablets. Compliance with IFAS consumption was monitored by counting the remaining tablets and through control cards. Participants' characteristics (age, body weight, height, and BMI) were measured in week 0 (pre-test). Knowledge and attitude variables were measured repeatedly: at week 0 (pre-test), week 13 (post-test 1), and week 17 (post-test 2). Subsequently, the compliance variable, such as IFAS side effects and parents, teachers, and peer support, was measured in week 17.

Table 1. Participants' Characteristics

Variable	Control (n = 68)		Intervention (n = 58)	
	Mean±SD	Min-Max	Mean±SD	Min-Max
Age (years)	16.15±0.55	15-18	15.95±0.71	14-18
Body weight (kg)	48.36±9.51	35.30-86.70	47.83±8.56	37.200-71.90
Body height (cm)	151.76±5.25	135.60-162.00	153.04±6.12	140.50-169.00
Body mass index (kg/m ²)	21.04±4.14	15.10-35.80	20.49±3.47	15.60-30.40

Note: SD = Standard Deviation

The collected data were processed using computerized statistics programs and analyzed using univariate analysis to evaluate the participants' characteristics (age, body weight, height, and BMI). Subsequently, a bivariate analysis was conducted using an independent T-test to examine differences in knowledge and attitude outcomes in control and intervention groups. The Chi-squared test was applied to assess the differences in compliance with IFAS. At the same time, the multivariate analysis included multiple linear regression in determining the intervention model's effectiveness on knowledge and attitudes.

While, the effectiveness of compliance with IFAS was determined through logistic regression analysis. Multivariate analysis was carried out through several stages: first, the full model; at this stage, all independent and dependent variables were included in the modeling. Second, confounding selection; confounding variables from the initial modeling results (full model) with p-values>0.05 were issued gradually, starting from the largest p-value. The main independent variable shall not be excluded from modeling. After gradual expenditure on the confounding variable, if the main independent variable changes in relative risk (RR) value of >10%, the excluded confounding variable is reinserted in the modeling, and the variable is a confounding variable. However, if the main independent variable does not experience a change in RR value of >10%, then the confounding variable is excluded from the model. The confounding selection remains until no more variables with p-values of >0.05.

Third, the final model would be analyzed after the confounding selection stage was completed, and a final model that can be interpreted will be obtained. Interpret the results by considering the value of the p-value and the strength of the relationship in the variables related to the dependent variable seen in the magnitude of the RR value. This multivariate analysis of RR values has been controlled by the variables in the modeling.

Results

The participants' characteristics were divided into

two groups: intervention and control. The general profile of the subjects included individual characteristics such as age, body weight, height, and BMI before intervention (baseline), as shown in Table 1.

Table 1 shows that the youngest average age was in the intervention group at 15.95 years. Based on body weight, the lowest was found in the intervention group at 47.83 kg, while the lowest average height was obtained in the control group at 151.76 cm. While, the lowest BMI was found in the intervention group at 20.49.

In post-test 2, the results of nutrition intervention on the knowledge of female adolescents showed significant differences (p-value<0.05) between the control and intervention groups, except for the trial dimension. While, the comparison of pre-test and post-test 2 results showed significant mean differences (p-value<0.05) between the groups, except for the awareness dimension, as presented in Table 2.

The effect of the intervention on attitudes, as indicated in the average attitude scores before, after, and one month after intervention between groups, showed significant differences in post-test 2, except for the awareness dimension (p-value>0.05). While, comparing pre-test and post-test 2 results between groups showed significant differences only in the interest and evaluation dimensions (p-value<0.05), as presented in Table 3.

The percentages of female adolescents who were compliant with consuming IFAS in intervention and control groups were 82.80% and 60.30%, respectively. The percentage of compliant female adolescents in the intervention group was 22.5% higher than the control group. However, when compared, both groups were statistically significantly different (p-value<0.01). Based on the multivariate analysis, intervention on knowledge showed that the intervention group had a higher knowledge score of 6.45 points than the control group after being controlled by parent support and side effect, as shown in Table 4.

The intervention group had a higher attitude score of 6.36 points than the control group after being controlled by knowledge, parent support, and side effect. For every 1 increase in the knowledge score, the attitude score in-

Table 2. Description of Mean Knowledge Score

Knowledge Score		Control (n = 68)	Intervention (n = 58)	p-value
		Mean±SD	Mean±SD	
Total	Pre	11.18±1.65	9.72±1.58	<0.001*
	Post 1	10.94±1.81	11.95±1.77	0.001*
	Post 2	11.68±1.46	12.81±1.78	<0.001*
	%Δ (Pre-Post1)	(-2.14%) -0.24±2.44	(22.8%) 2.22±1.99	<0.001*
	p-value (Pre-Post1)	0.424	<0.001*	
	%Δ (Pre-Post2)	(4.47%) 0.50±2.09	(31.8%) 3.09±2.02	<0.001*
	p-value (Pre-Post2)	0.047*	<0.001*	
	Δ (Post1-Post2)	0.74±1.93	0.86±2.23	0.917
Awareness	p-value (Post1-Post2)	0.004*	0.005*	
	Pre	2.47±0.76	2.54±0.98	0.770
	Post1	2.60±0.55	2.48±0.84	0.842
	Post2	2.76±0.49	2.52±0.65	0.013*
	%Δ (Pre-Post1)	(5.26%) 0.13±0.88	(5.98%) 0.14±0.94	0.763
	p-value (Pre-Post1)	0.241	0.299	
	%Δ (Pre-Post2)	(11.74%) 0.29±0.95	(7.26%) 0.17±1.01	0.477
	p-value (Pre-Post2)	0.014**	0.197	
Interest	%Δ (Post1-Post2)	(6.15%) 0.16±0.59	(1.21%) 0.05±1.02	
	p-value (Post1-Post2)	0.029**	0.918	
	Pre	2.12±0.68	2.14±0.69	0.909
	Post1	2.12±0.70	2.41±0.82	0.008*
	Post2	2.12±0.76	2.55±0.68	0.001*
	%Δ (Pre-Post1)	(0%) 0.00±0.88	(13.08%) 0.28±1.06	0.070
	p-value (Pre-Post1)	0.982	0.037**	
	%Δ (Pre-Post2)	(0%) 0.00±0.93	(19.16%) 0.41±0.79	<0.001*
Evaluation	p-value (Pre-Post2)	0.971	<0.001**	
	%Δ (Post1-Post2)	(0%) 0.00±0.86	(5.81%) 0.14±0.83	
	p-value (Post1-Post2)	0.919	0.227	
	Pre	2.52±0.76	1.14±0.44	<0.001*
	Post1	1.24±0.71	2.57±0.75	<0.001*
	Post2	2.24±0.81	2.62±0.67	0.003*
	%Δ (Pre-Post1)	(-46.98%) -1.09±0.05	(125.44%) 1.45±0.98	<0.001*
	p-value (Pre-Post1)	<0.001**	<0.001**	
Trial	%Δ (Pre-Post2)	(-3.88%) -0.09±0.68	(129.82%) 1.48±0.90	<0.001*
	p-value (Pre-Post2)	0.426	<0.001**	
	%Δ (Post1-Post2)	(80.65%) 1.00 ± 1.01	(1.95%) 0.05±1.01	
	p-value (Post1-Post2)	<0.001**	0.704	
	Pre	2.18±0.42	2.24±0.54	0.379
	Post1	2.60±0.52	2.45±0.50	0.072
	Post2	2.41±0.41	2.55±0.53	0.102
	%Δ (Pre-Post1)	(19.72%) 0.43±0.61	(9.38%) 0.21±0.81	0.105
Adoption	p-value (Pre-Post1)	<0.001**	0.058	
	%Δ (Pre-Post2)	(11.01%) 0.24±0.63	(13.84%) 0.31±0.75	0.419
	p-value (Pre-Post2)	0.003**	0.004**	
	%Δ (Post1-Post2)	(-7.31%) -0.19±0.71	(4.08%) 0.10±0.79	
	p-value (Post1-Post2)	0.053	0.317	
	Pre	2.09±0.59	1.86±0.66	0.037*
	Post1	2.38±0.69	2.05±0.32	<0.001*
	Post2	2.15±0.60	2.57±0.68	<0.001*
	%Δ (Pre-Post1)	(13.88%) 0.29±0.86	(9.14%) 0.17±0.68	0.369
	p-value (Pre-Post1)	0.008**	0.059	
	%Δ (Pre-Post2)	(2.87%) 0.06±0.83	(38.17%) 0.71±0.86	<0.001*
	p-value (Pre-Post2)	0.577	<0.001**	
	%Δ (Post1-Post2)	(-10.08%) -0.24±0.90	(26.11%) 0.55±0.73	
	p-value (Post1-Post2)	0.037**	<0.001**	

Notes: SD = Standard Deviation, *Significant at the 0.05 significance level between groups, **Significant at 0.05 significance level within the group

creased by 0.23 points after being controlled by the group, parent support, and side effect, as shown in Table 5. The multivariate analysis of the effects of intervention, knowledge, and attitude on IFAS consumption compli-

ance showed that participants with the intervention did not affect compliance (p-value>0.05), as presented in Table 6.

Table 3. Description of Mean Attitude Score

Attitude Score		Control (n = 68)	Intervention (n = 58)	p-value
		Mean±SD	Mean±SD	
Total	Pre	43.44±4.27	43.71±4.15	0.601
	Post 1	42.47±4.58	45.09±5.80	<0.001*
	Post 2	42.41±5.33	45.84±4.43	<0.001*
	%Δ (Pre-Post1)	(-2.14%) -0.97±5.46	(3.15%) 1.38±2.96	0.002*
	p-value (Pre-Post1)	0.144	0.001*	
	%Δ (Pre-Post2)	(-2.57%) -1.03±5.78	(4.89%) 2.14±4.95	0.003*
	p-value (Pre-Post2)	0.177	0.006*	
	%Δ (Post1-Post2)	(-0.14%) -0.06±4.31	(1.68%) 0.76±5.89	0.250
	p-value (Post1-Post2)	0.808	0.204	
	Awareness	Pre	9.12±1.42	8.62±1.58
Post1		8.41±1.19	8.67±1.15	0.311
Post2		8.87±1.41	8.86±1.54	0.933
%Δ (Pre-Post1)		(-7.79%) -0.71±1.60	(0.58%) 0.05±1.52	0.005*
p-value (Pre-Post1)		0.01**	0.945	
%Δ (Pre-Post2)		(-2.74%) -0.25±2.03	(2.78%) 0.24±1.53	0.142
p-value (Pre-Post2)		0.296	0.236	
%Δ (Post1-Post2)		(-2.13%) -0.18±1.85	0.85±2.26	0.005*
p-value (Post1-Post2)		0.007**	0.348	
Interest		Pre	8.44±1.46	8.09±1.85
	Post1	8.22±1.48	8.86±1.56	0.021*
	Post2	8.26±1.56	8.91±1.44	0.023*
	%Δ (Pre-Post1)	(-2.61%) -0.22±1.95	(9.64%) 0.78±2.09	0.009*
	p-value (Pre-Post1)	0.314	0.007**	
	%Δ (Pre-Post2)	(-2.13%) -0.18±1.85	(10.26%) 0.85±2.26	0.005*
	p-value (Pre-Post2)	0.375	0.008**	
	%Δ (Post1-Post2)	(0.49%) 0.04±1.20	(0.56%) 0.95±1.67	
	p-value (Post1-Post2)	0.884	0.895	
	Evaluation	Pre	8.53±1.18	8.52±1.35
Post1		8.05±1.13	8.81±1.15	<0.001*
Post2		7.99±1.23	9.05±1.28	<0.001*
%Δ (Pre-Post1)		(-5.86%) -0.50±1.49	(3.40%) 0.29±1.36	0.003*
p-value (Pre-Post1)		<0.013**	0.108	
%Δ (Pre-Post2)		(-6.33%) -0.54±1.58	(6.22%) 0.53±1.71	0.001*
p-value (Pre-Post2)		0.008**	0.031**	
%Δ (Post1-Post2)		(-0.49%) -0.04±1.39	(2.72%) 0.24±1.45	
p-value (Post1-Post2)		0.977*	0.133	
Trial		Pre	9.09±1.23	9.52±1.27
	Post1	9.29±1.29	9.64±1.15	0.086
	Post2	9.07±1.56	9.76±1.39	0.008*
	%Δ (Pre-Post1)	(2.31%) 0.21±1.71	(1.26%) 0.12±1.52	0.665
	p-value (Pre-Post1)	0.372	0.695	
	%Δ (Pre-Post2)	(-0.11%) -0.01±1.72	(2.52%) 0.24±1.84	0.701
	p-value (Pre-Post2)	0.945	0.380	
	%Δ (Post1-Post2)	(-2.37%) -0.22±1.62	(1.24%) 0.12±1.57	
	p-value (Post1-Post2)	0.237	0.586	
	Adoption	Pre	8.26±1.25	8.97±1.21
Post1		8.51±1.12	9.10±1.28	0.007*
Post2		8.22±1.29	9.26±1.15	<0.001*
%Δ (Pre-Post1)		(3.03%) 0.25±1.57	(1.56%) 0.14±1.47	0.564
p-value (Pre-Post1)		0.207	0.540	
%Δ (Pre-Post2)		(-0.48%) -0.04±1.58	(3.23%) 0.29±1.64	0.604
p-value (Pre-Post2)		0.980	0.236	
%Δ (Post1-Post2)		(-3.41%) -0.29±1.37	(1.76%) 0.16±1.56	
p-value (Post1-Post2)		0.070	0.456	

Notes: SD = Standard Deviation, *Significant at the 0.05 significance level between groups, **Significant at 0.05 significance level within the group

Discussion

A previous study showed that most female adolescents were unaware of anemia, its symptoms and impacts, and did not know the appropriate actions to handle

this illness.¹⁸ In this study, the female adolescents did not receive education on anemia and were mostly given incomplete or inadequate health information, which can determine their knowledge level. According to previous

Table 4. Effect of Intervention on Knowledge

Variable	Initial Model			Final Model		
	β	p-value	(95% CI)	β	p-value	(95% CI)
Group (Intervention)	6.40	0.007	(1.78–11.03)	6.45	0.002	(2.33–10.57)
Fathers' education (high)	0.69	0.742	(-3.43–4.81)	-	-	-
Mothers' education (high)	-0.41	0.838	(-4.39–3.57)	-	-	-
Parent support (yes)	-2.43	0.288	(-6.93–2.07)	-2.23	0.284	(-6.24–1.88)
Teacher support (yes)	0.40	0.866	(-4.35–5.16)	-	-	-
Peer support (yes)	-0.19	0.929	(-4.49–4.10)	-	-	-
Side effect (no)	4.69	0.014	(0.79–8.66)	4.69	0.014	(0.95–8.44)
Constant	71.82	0.000	(62.27–81.38)	72.24	0.000	(65.59–78.88)

Note: CI = Confidence Interval

Table 5. Effect of Intervention and Knowledge on Attitude

Variable	Initial Model			Final Model		
	β	p-value	(95% CI)	β	p-value	(95% CI)
Group (Intervention)	6.05	0.027	(0.69–11.39)	6.36	0.010	(1.54–11.18)
Knowledge	0.23	0.027	(0.03–0.44)	0.23	0.023	(0.03–0.44)
Fathers' education (high)	2.24	0.340	(-2.39–6.86)	-	-	-
Mothers' education (high)	0.40	0.858	(-4.06–4.87)	-	-	-
Parent support (yes)	-2.33	0.366	(-7.39–2.75)	-1.62	0.492	(-6.27–3.03)
Teacher support (yes)	0.60	0.822	(-5.94–4.73)	-	-	-
Peer support (yes)	-0.45	0.853	(-5.27–4.36)	-	-	-
Side effect (no)	-6.19	0.008	(-10.69–1.67)	-6.35	0.004	(-10.67– -2.02)
Constant	95.01	0.000	(76.85–113.19)	98.44	0.000	(82.05–114.83)

Note: CI = Confidence Interval

Table 6. Effect of Intervention, Knowledge, and Attitude on Compliance with Iron and Folic Acid Supplementation

Variable	Initial Model			Final Model		
	β	p-value	(95% CI)	β	p-value	(95% CI)
Group (intervention)	0.69	0.185	2.01 (0.72–5.65)	0.65	0.167	1.92 (0.87–5.34)
Knowledge (good)	-0.73	0.109	0.48 (0.19–1.18)	-	-	-
Attitude (good)	0.76	0.097	2.15 (0.87–5.29)	-	-	-
Fathers' education (high)	0.83	0.089	2.29 (0.88–5.98)	0.76	0.088	2.14 (0.89–5.13)
Mothers' education (high)	-0.43	0.349	0.65 (0.27–1.59)	-	-	-
Parent support (yes)	1.20	0.020	3.35 (1.20–9.28)	1.21	0.010	3.38 (1.33–8.55)
Teacher support (yes)	0.09	0.873	1.09 (0.38–3.09)	-	-	-
Peer support (yes)	0.13	0.788	1.14 (0.44–2.92)	-	-	-
Side effect (no)	0.25	0.595	1.28 (0.52–3.15)	-	-	-
Constant	-0.33	0.576		-0.24	0.493	

Note: CI = Confidence Interval

literature, female adolescents had very low knowledge about anemia,¹⁹ and only consumed IFAS during menstruation.¹⁵ A study on compliance attitudes of female adolescents towards IFAS consumption revealed that most participants showed a non-compliant attitude when consuming IFAS.²⁰

The results of this study illustrated that nutrition interventions with local culture-based nutrition education (*kelakar betok*) in post-test 2 measurements could in-

crease knowledge in all dimensions of awareness, interest, evaluation, trial, and adoption. However, compared to the group control, dimensions of knowledge did not differ significantly on the dimensions of awareness and trials. The stage of behavioral change in the awareness dimension explains that a person begins to realize and know the given stimulus or object.²⁰ The information in the awareness stage video showed a scene about a young woman who is physically shown to have a pale face, un-

able to concentrate while studying in class, then this young woman gets a low score. The young woman then asked the teacher to level up her grades. Seeing the condition of the young woman, the teacher suspects that the young woman is suffering from anemia, and then there is a dialogue between the young woman and the teacher, in which the teacher explains anemia (the definition of anemia, symptoms of anemia, and the effects of anemia). This situation indicated that the education video did not effectively elevate knowledge about the link between excessive blood loss during menstruation and anemia.

Similarly, at the knowledge trial stage in the intervention group at post-test 2, the percentage of young women who answered the correct knowledge statement, the smallest proportion, was in the statement that taking iron tablets could be stopped if the body felt fresher so that the scenes in the educational video at the trial stage did not yet have the leverage to increase knowledge, regarding taking iron tablets which should be continued even though they have felt a positive impact so that they do not come back again. This result showed that the educational video did not effectively elevate knowledge of continuing IFAS consumption to avoid the recurrence of anemia even after feeling the positive effect.

In the interest knowledge stage, the intervention group significantly increased the percentage of participants who answered correctly about the statement that anemia can lower intelligence. The result suggested that participants' knowledge about anemia and its effect on intelligence was low before intervention. However, the knowledge increased after intervention, which indicated a significant improvement in the interest dimension. In the evaluation knowledge stage, the intervention group had the highest percentage increase in participants who answered consuming IFAS makes the appearance fresher correctly. This condition suggested that the evaluation video highly raised knowledge of consuming IFAS to improve appearance. In the adoption knowledge stage, the intervention group had the highest percentage increase in participants who answered correctly about the statement that IFAS can be consumed at night before sleeping to avoid side effects.

The effect of the intervention on attitude showed that nutritional intervention with *kelakar betok* in post-test 2 improved attitudes in the dimensions of awareness, interest, evaluation, and trial. However, compared to the control group, the increase is not significantly different on the dimensions of awareness, trial, and adoption. The effect of the local culture-based nutritional intervention on attitudes in the awareness dimension significantly differed between the control and intervention groups in the first measurement (p -value = 0.005). In the second measurement, there was no significant difference between both groups. This result indicated that the educational

video did not have enough leverage to improve awareness attitudes. It occurred when the attitudes of female adolescents regarding awareness were still low but increased significantly after intervention.

However, an insignificant increase was observed in the second measurement because there was already a significant increase in the first measurement. Before entering the trial phase, changes in behavior occurred in the evaluation dimension. In this study, the change in attitude scores in the evaluation dimension significantly differed between the control and intervention groups in the first and second measurements (p -value<0.001). This result suggested no longer an increase in attitude scores at the trial stage due to changes in evaluation attitudes. Therefore, the trial can occur simultaneously, causing educational video intervention to become insignificant in changing trial attitudes.

The results indicated that local culture-based nutrition intervention did not increase attitude scores in the adoption dimension. At the adoption attitude stage in the intervention group during post-test 2, the smallest proportion of correct attitude statements was found: "I will continue to take IFAS even when I have to buy them myself." Therefore, the adoption stage video did not have the leverage to improve attitudes toward that statement. It was also related to the characteristics of the parents who had low-income levels, resulting in the inability to buy IFAS independently because other, more important things needed to be prioritized.

Local culture-based nutrition education intervention media was developed using the local language and packaged with humor. This communication approach was common at every societal level in South Sumatra, making it easy for female adolescents to understand the information. Nutrition education intervention can create a fun learning atmosphere that encourages female adolescents' interest and motivation to understand the information conveyed.²¹ Therefore, they will be more inclined to practice the information received.

This study's results indicated that intervention in nutrition education using local cultural jokes could increase compliance with IFAS consumption. In the intervention group, compliance with IFAS consumption was 82.80%, 22.5% higher than in the control group (p -value=0.010). This result referred to a previous study that grouped compliance as consuming at least 70% of the total IFAS.¹¹ The average number of IFAS participants in the intervention group consumed 13 tablets. According to WHO, compliance with IFAS consumption was when the target consumed at least 80% of the required IFAS.⁶ This study found that increased IFAS consumption compliance was followed by increased knowledge and attitude. Based on the results of multivariate analysis, knowledge and attitude did not affect IFAS consumption compliance.

These results were in line with a study in which compliance of female adolescents after being given health education via videos and reminders on WhatsApp was mostly in the moderate category (56%).²² According to a previous study; there were differences in the level of compliance with IFAS consumption in the group that was given the explanation video intervention (p -value <0.001).²³ Another study also revealed increased compliance in the group given the diary education: the intervention group had a compliance rate of 32%, and the control group had 4% (p -value <0.05).²⁴ According to a previous study, the group that received IFAS intervention and the communication program had an IFAS compliance rate of 11%, where the compliance rate of the intervention group was higher than the control group (9%).²⁵

Kelakar betok is a nutritional education media packaged to entertain, also known as edutainment. This edutainment media is suitable for school-age children because it can develop their imagination and make learning fun.²⁶ The advantage of *kelakar betok* is that the target group is not compelled to learn, as the information is conveyed through humor or funny stories. The concept of entertainment is more dominant and allows the target group in education to learn and enjoy. It can also be used in nutrition education, making learning fun and not boring.

Based on the Theory of Stress Adaptation Model for school-age children, humor is essential for developing physical, cognitive, and psychological health.²⁶ The ability of a child to participate in humoral intervention depends on their age and stage of development.²² Not only the intervention given with humor or jokes provide humorous stimuli, but also it makes laughter and be a therapeutic effect.²⁷ Humorous interventions that seem funny will make children feel better and make them laugh. Therefore, this is the healthiest and most powerful factor for maintaining a life balance.²⁸ When the target groups like the message, they feel more relaxed, energetic, responsive, fearless, and open to learning.²⁹ This is because feelings of joy can make children think positively, overcome problems, and adapt more easily to the information they receive.²¹

This study gave nutrition education intervention with *kelakar betok* in video form. The video was a powerful tool for increasing the reach and effectiveness of health promotion programs.³⁰ Based on Dale's Cone of Experience Theory, students will remember 10% of what they read, 20% of what they hear, 30% of what they see, 50% of what they hear and see, 70% of what they say, and 90% of what they say and do.³¹ This study used video media which was part of the audio-visual media. Hence, according to Dale's Cone of Experience theory, at least 50% of female adolescents can remember the message conveyed.³¹

When carried out effectively, health information conveyed through audio-visual media can convey information and empower targets to make positive health decisions and change behavior.³² Therefore, this study used social media, specifically Instagram, to convey nutritional information on anemia and IFAS. Based on the preliminary study, this platform was the most preferred media for female adolescents in finding and obtaining information.¹⁵ Nutrition education for adolescents can be delivered by using media that follows the preferences of young women to attract the attention and interest of adolescents and make it easier for them to receive and absorb nutrition information.

Conclusion

This study shows that intervention using a local culture-based approach (*kelakar betok*) increased knowledge in terms of dimensional interest, evaluation, and adoption, as well as attitudes based on dimensional interest and evaluation. The results indicate that intervention can encourage female adolescents to comply with the consumption of IFAS to prevent anemia. Local cultures such as *kelakar betok* can be developed as a medium in nutrition education to increase compliance with iron supplements consumption so that other regions can adapt to their respective local cultures as long as the community maintains the local culture and provides a sense of humor and joy.

Abbreviations

OKI: Ogan Komering Ilir; WHO: World Health Organization; IFAS: Iron and Folic Acid Supplementation; BMI: Body Mass Index; RR: Relative Risk; SD: Standard Deviation; CI: Confidence Interval.

Ethics Approval and Consent to Participate

This study was ethically approved by the Ethics Committee for Research and Community Health Services at the Faculty of Public Health, Universitas Indonesia, with the number Ket-454/UN2.F10.D11/PPM.00.02/2021.

Competing Interest

The authors declared that there are no significant competing financial, professional, or personal interests that might have affected the performance or presentation of the work described in this manuscript.

Availability of Data and Materials

All information and related materials from this study are accessible and can be given by the primary author.

Authors' Contribution

AR, KSD, TKR, and DMU designed the study, developed a data instrument for data collection analysis, and drafted the manuscript. RDJ and ASS contributed to the proofreading. BSL, DHP, and CMD contributed to the interpretation of results, as well as the reviewing and editing of

the article. All co-authors reviewed and approved the final manuscript before submission.

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Development of Pandemic Burnout Inventory for Health Personnel

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Abstract

The COVID-19 pandemic has increased the workload of health personnel in Indonesia, and the risk of burnout has thus doubled. Several instruments exist to assess burnout, but none have been specifically developed for health personnel during the COVID-19 pandemic. Therefore, to close this gap, developing a Pandemic Burnout Inventory for health personnel is important. This study used mixed methods with a sequential exploratory design at five COVID-19 referral hospitals. A total of 30 informants were employed in the qualitative phase, selected using an intensity sampling approach, and 731 respondents in the quantitative phase were obtained in field trials and online questionnaires. Finally, a Pandemic Burnout Inventory was formed with 14 items. The content validity, based on expert judgment, showed very good results. The assessment of item discrimination and construct validity showed good results. The concurrent validity and reliability of the instrument showed fairly good results. In general, the Pandemic Burnout Inventory meets the criteria for a good instrument according to psychometrics: it is objective, standard, valid, and practical. Health care institutions can use this instrument to evaluate and prevent the deterioration of the mental health condition of health personnel handling COVID-19 or similar health crises.

Keywords: burnout, health personnel, instrument, pandemic

Introduction

At the end of 2019, the world was shocked by an infectious disease outbreak that began in China. The disease, caused by a novel coronavirus (nCoV-19),¹ quickly spread to various continents. In January 2020, the World Health Organization (WHO) declared a global emergency status and named the disease COVID-19.² The Indonesian government reported the first case of COVID-19 on 2 March 2020 in an official announcement.³ As of 14 October 2022, there were 6,453,864 confirmed cases of COVID-19 in Indonesia,⁴ ranking the 20th highest in the world.⁵ Three COVID-19 case peaks occurred in Indonesia between March 2020 and December 2022.⁴ To combat COVID-19, the Indonesian government shifted its strategy in response to this.

As a result of the uncertainty surrounding the fluctuation of COVID-19 cases in Indonesia, personal energy is lost, and psychological pressure develops. This condition impacts workload and procedures and is particularly difficult for health personnel at the forefront of the COVID-19 pandemic response. The prevalence of burnout among health personnel has risen because of the

strain of carrying out activities during the COVID-19 pandemic conditions.⁶⁻¹⁰ End-of-2020 survey findings revealed that 83% of Indonesian health personnel had moderate to severe levels of burnout.¹¹ The definition of burnout at the time of the term's first use was an expression of emotional exhaustion and cynicism that frequently affects professionals in the social services sector due to interpersonal pressures associated with work.¹² The terms "parental burnout," "student burnout," and, most recently, "pandemic burnout" has evolved because burnout is thought to affect a variety of other occupations and groups.¹³

Based on the results of a literature review on burnout studies in health personnel,¹⁴ several instruments were obtained, such as the Maslach Burnout Inventory (MBI),¹⁵ Oldenburg Burnout Inventory (OLBI),¹⁵ Shirom and Melamed Burnout Measurement (SMBM),¹⁶ Burnout Assessment Tool (BAT),¹⁷ Burnout Measure (BM),¹⁸ and Copenhagen Burnout Inventory (CBI).¹⁹ Existing tools are not always appropriate because health personnel could have been measured when the instruments were being developed. Still, those were not built

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specifically for professionals who front the charge in fighting pandemics. In addition, those instruments were created within the framework of a foreign culture. Language and cultural styles in instrument development may not match the situation in other countries.¹⁹ Each instrument was created expressly for certain groups and purposes, and the validity of measurements with those psychological instruments cannot be generalized to different subjects and situations.²⁰ This situation raised a question which was the starting point for this study, how to develop a specific instrument for Indonesian health personnel in the pandemic situation. Instrument development is typically driven by a combination of theoretical advancement, empirical advancement, practical application, and market needs.²¹ In short, this study aimed to develop a Pandemic Burnout Inventory (PBI) that met the validity and reliability criteria.

Method

This study used a mixed method with a sequential exploratory design, which was suitable for developing an instrument.²² The development of several previous burnout instruments, such as the MBI,²³ and the BAT,¹⁷ also used the same approach. A qualitative approach was used to explore ideas related to the signs of health personnel burnout,¹² in the COVID-19 pandemic situation. The outcomes of the earlier conception were used to develop the instrument prototype. Furthermore, a quantitative approach was used to test the validity and reliability of the instrument. Qualitative and quantitative data collection was carried out in mixed modes, online and offline. Mixed modes were used for increased coverage, increased response rates, reduced bias, reduced costs, and the potential for better metering.²⁴

The population of this study was Indonesian health personnel at five COVID-19 referral hospitals in West Sumatra, East Kalimantan, East Java, South Sulawesi, and Papua Provinces. The study location was selected randomly by random cluster sampling representing five major islands in Indonesia. This approach was taken considering Indonesia's territory is very broad. The number of participants was distinguished at each stage. In the first qualitative stage, in-depth interviews were conducted with 30 health personnel from various regions in Indonesia, selected using an intensity sampling approach. The second stage was a judgment by 17 specialists with expertise in occupational health and safety, psychometry, clinical psychology, psychiatry, and occupational medicine.

The third stage was the qualitative pre-trial stage, or readability test involving 30 potential users. No reference states the minimum number of informants in qualitative study, the number of experts involved in expert judgment, or the minimum number of respondents for the

readability test. The fourth stage was a field test with 731 health personnel as participants. This number already exceeds the minimum sample size for instrument trials: some psychometricians argue the minimum sample size was 5-10 times the number of items tested.²⁰ The number of items in the instrument prototype was 60, then the minimum sample was 300-600 respondents. At this stage, online data was collected via Google Forms, distributed throughout the country, and onsite at five COVID-19 referral hospitals. The inclusion criteria in the first, third, and fourth stages were health personnel who treat patients at the COVID-19 referral hospital.

In the qualitative data analysis stage, textual data content was interpreted using a manual coding classification procedure to systematically identify themes.¹⁷ A dialectical approach was carried out in this analysis. Following classification (coding), the textual data was matched using categories obtained from theoretical sources. To boost data accuracy and dependability, member checking was used at the interview data transcription stage, and peer debriefing was used to determine data saturation during the qualitative content analysis stage. The latent variable in this study was pandemic burnout. Exploration was carried out at a qualitative stage to determine the aspects or dimensions building the concept of pandemic burnout itself. Quantitative data analysis was performed to confirm the validity and reliability of the PBI. This analysis phase included content validity through expert judgment with the Aiken V formula,²⁵ discrimination of items with item score correlation and total score, construct validity with factor analysis, concurrent validity with the MTBI,¹⁰ and the COVID-19 Anxiety Scale (CAS),²⁶ and reliability evaluation with the Cronbach alpha coefficient.

Results

Conceptualization of Pandemic Burnout among Health Personnel

The conceptualization of pandemic burnout was carried out using semi-structured in-depth interviews with health personnel from various regions in Indonesia. The 30 participants consisted of various professionals at the COVID-19 referral hospitals with the potential to experience burnout, as well as a group of practitioners (clinical psychologists and psychiatrists) usually carry out assessments and provide care to patients experiencing burnout. The profiles of the participants are described in Table 1.

Screening before in-depth interviews were conducted to ensure that participants could provide strong data regarding burnout experiences among health personnel during the pandemic. The health personnel group was asked the following questions: (1) Have you felt an increased workload since the COVID-19 pandemic? (2)

Table 1. The Profiles of the Participants

Informant's Code	Profession	Origin (City, Province)
B01	Midwife	Madiun, East Java
B02	Midwife	Surabaya, East Java
D01	Physician	Ciamis, West Java
D02	Physician	Cilegon, West Java
D03	Physician	Manokwari, Papua
D04	Physician	Pekanbaru, Riau
D05	Physician	Medan, North Sumatera
D06	Physician	Pekanbaru, Riau
D07	Physician	Surabaya, East Java
D08	Physician	Banjarmasin, South Kalimantan
Kj01	Psychiatrist	Ponorogo, East Java
Kj02	Psychiatrist	Wonosobo, Central Java
Kj03	Psychiatrist	Sleman, the Special Region of Yogyakarta
Kj04	Psychiatrist	Palangka Raya, Central Kalimantan
Kj05	Psychiatrist	Takengon, Aceh
Kj06	Psychiatrist	Bintan, Riau
Ok01	Occupational Therapist	The Special Capital Region of Jakarta
L01	Medical Laboratory Technician	Tuban, East Java
P01	Nurse	Pekanbaru, Riau
P02	Nurse	Madiun, East Java
P03	Nurse	Belitung, Bangka Belitung
P04	Nurse	The Special Capital Region of Jakarta
P05	Nurse	Bandung, West Java
P06	Nurse	Bintuni, West Papua
Ps01	Clinical Psychologist	Surabaya, East Java
Ps02	Clinical Psychologist	Klaten, the Special Region of Yogyakarta
Ps03	Clinical Psychologist	Bogor, West Java
Ps04	Clinical Psychologist	Samarinda, East Kalimantan
Ps05	Clinical Psychologist	Makassar, South Sulawesi
Ps06	Clinical Psychologist	Ambon, Maluku

Table 2. Aspects of Pandemic Burnout Based on Interview Results

Aspect of Pandemic Burnout	Number of Category (15)	Number of Keyword/Code (61)
Emotional exhaustion	4	25
Depersonalization	4	7
Low personal achievement	4	5
Pandemic worry	3	24

Do you feel more physically and mentally tired than before the COVID-19 pandemic? (3) Did these changes affect your performance during the COVID-19 pandemic? The practitioner group was only given the following question: During the COVID-19 pandemic, have you ever treated or are you treating patients with symptoms of burnout? In-depth interviews were conducted at an agreed time with the informants, with a duration of 30-60 minutes, using the interview guidelines that had been prepared. The process of exploring experiences related to pandemic burnout was carried out using a dialectical approach. Qualitative content analysis was carried out simultaneously with the elaboration of the theoretical framework. A total of 61 codes emerged from the interview process, which were then grouped into 15 categories.

The aspects in Table 2 were determined deductively

based on the three dimensions of burnout in the MBI as a gold standard of burnout instrument. Still, the in-depth interviews showed that pandemic worry also appeared significantly in all participants during the COVID-19 pandemic. The emergence of the pandemic worry aspect is supported by an expert's definition of pandemic fatigue or COVID-19 burnout.²⁷ These aspects were then used as the basis for conceptualizing pandemic burnout among health personnel: the syndrome felt by health personnel during the COVID-19 pandemic characterized by emotional exhaustion, depersonalization, low personal achievement, and pandemic worry.

Development of the Pandemic Burnout Inventory

The concept of pandemic burnout was further developed more operationally into indicators that became the main reference for writing instrument items. In

Table 3. Aspects and Indicators of Pandemic Burnout

Aspect	Indicator
Emotional exhaustion	a. Feeling drained of energy to do work b. Experiencing mental fatigue c. Experiencing cognitive impairment d. Feeling more sensitive emotionally
Depersonalization	a. Feeling isolated and trapped in a work routine b. Decreased empathy for the patient/patient's family c. Feeling overly charged with the problems of the patient/patient's family d. Decreased motivation to work
Low personal achievement	a. Feeling less effective at work b. Feeling their work is not meaningful to others c. Feeling their professionalism was dropping d. Withdrawing from work
Pandemic worry	a. Overthinking b. Fear of being exposed and spreading the virus from the work environment c. Experiencing psychosomatic complaints

Table 4. Final Composition of Pandemic Burnout Inventory

Aspect	Statement item	Factor Loading
Emotional exhaustion	My job is more tiring than before the pandemic.	0.677
	The pandemic situation increased my stress level.	0.711
	I have been feeling sad more often since the pandemic.	0.587
Depersonalization	Patients/patients' families often blame me for their problems.	0.517
	I am not trusted by the patient/patient's family because of the stigma since the pandemic.	0.601
Low personal achievement	I am always excited to come to work.	0.521
	I feel I have worked effectively during the pandemic.	0.514
Psychosomatic complaints	I can adapt to changes in workload during the pandemic.	0.629
	I have experienced stomach pain more often since the pandemic.	0.665
	I have had more headaches since the pandemic.	0.71
Pandemic worry	I have been breaking out in cold sweats more since the pandemic.	0.742
	I am worried that the pandemic won't end soon because people often ignore health protocols.	0.563
	I am afraid of bringing the virus to my family through clothes or things from work.	0.704
	Losing family to exposure to the virus is my greatest fear.	0.61

writing, a reference list of sub-scales and items from the previous burnout instrument (such as the MBI, OBI, SMBM, BAT, BM, and CBI) was used.¹⁴ Notably, these instruments were irrelevant to the context of the health personnel and the specific situation of the COVID-19 pandemic, then the diction was adjusted to the results of the interview content analysis. The description of the indicators of pandemic burnout is further explained in Table 3. These 15 indicators were further developed into 60 statement items to develop a prototype. A 7-point Likert scale was used, with a score of 0–6 (0 representing “never” and 6 representing “every day”), based on the frequency of experience or feeling by the participants.¹³

The Validity and Reliability of the Pandemic Burnout Inventory

a. Content Validity

The evaluation results using the Aiken V formula for the prototype's 60 items ranged from 0.632 to 0.897, with an average of 0.777. The experts were asked to

provide feedback with a score on a scale of 1 to 5, which improved the prototype. Of 39 items (65%) met the high validity criteria, and the remainder met the very high validity criteria. As a result, item elimination was not performed at this point, and items were only revised based on expert recommendations.

b. Face validity

The prototype's readability by 30 participants suggested that the instrument could be completed in less than 30 minutes on average. The respondents thought that the statement items were fairly simple to understand. When working on the instrument, they had no questions concerning the statement items' intentions, although the majority gave feedback about the many items that needed to be completed.

c. Evaluation of the Items' Discrimination

Items' discrimination is considered good if the correlation coefficient is $r_{ix} \geq 0.25$.²⁰ The PBI showed the

lowest coefficient as $r_{ix} = 0.136$ and the highest coefficient as $r_{ix} = 0.506$. These results might justify removing items, but the construct validity findings below were considered.

d. Construct Validity

Factor analysis to evaluate the construct validity was carried out with the Jamovi Program (a statistical program) version 2.3.²⁸ The data used were from field tests on 731 respondents. Exploratory factor analysis (EFA) with the maximum likelihood extraction method and varimax rotation with an eigen value of >1 showed that five factors appeared in the 60 items of the prototype. The initial hypothesis that pandemic burnout consisted of four components was contradicted by this fact. The pandemic worry aspect items were split into two groups; the item on the “psychosomatic symptoms” indicator was distinct from the other items. The factor loading values of the 60 items varied from 0.301-0.742. The loading factor threshold value of >0.5 was applied to eliminate the item.²⁰

Further evaluation was carried out by confirmatory factor analysis (CFA) using the goodness of model fit indicator Chi-square (X^2/df) <3 ; standardized root mean square residual (SRMR) <0.08 ; robust root mean square error of approximation (RMSEA) <0.06 ; Tucker–Lewis index (TLI) >0.90 ; and comparative fit index (CFI) >0.90 .²⁹ Finally, 14 items were selected (Table 4) based on high factor loading, strong content according to qualitative content analysis and the results of expert judgment, and considering the composition of each factor. The goodness of model fit indicator showed the results $X^2/df = 3.0149$, SRMR = 0.0430, RMSEA = 0.0525, TLI = 0.939, and CFI = 0.955.

e. Concurrent Validity

The results of the correlation between the 14 items of the PBI and MTBI10 showed a sufficient coefficient ($r = 0.422$, p -value <0.001), as well as the results of the correlation with CAS26 ($r = 0.505$, p -value <0.001).

f. The Reliability Test

Instrument reliability was represented by the Cronbach alpha coefficient (α), with a value of 0.761.

Discussion

In the context of a pandemic, the COVID-19 Burnout Scale,³⁰ and the COVID-19 Burnout Frequency Scale,²⁹ have been developed. The COVID-19 Burnout Scale is an adaptation of the Burnout Measurement—Short Version,¹⁸ with editorial items adapted to the context of the COVID-19 pandemic in Turkey. In contrast, the COVID-19 Burnout Frequency Scale is a burnout instrument specific to the context of the zero-COVID policy in

China. What these two instruments have in common is that they both target the general population, including the “non-working” population.

Unlike these instruments, this study introduced a specific definition of pandemic burnout for health personnel. A dialectical approach that combined inductive and deductive approaches to create instruments appropriate to the measurement context without leaving the theoretical foundation,³¹ was used in this study. The definition of pandemic burnout is a syndrome conceptualized as a result of chronic stress at work that is not well-managed and is characterized by feelings of emotional exhaustion, depersonalization related to one’s job, low self-achievement, pandemic worry, and psychosomatic symptoms. These five aspects of pandemic burnout were developed into a prototype instrument comprising 15 indicators and 60 items. The instrument was created by integrating the findings of a qualitative content analysis of the interview data and an analysis of the dimensions and items on the previous burnout instrument.³¹ Nonetheless, due to the unique circumstances surrounding the pandemic, decisions based on interview results carry more weight than those based on a literature study.

The instrument prototype was then validated through an expert judgment mechanism to uphold content and logical validity.²⁰ This stage involved groups of practitioners and academics in providing comprehensive input from various scientific perspectives and developing theoretical and practical elements.³¹ Aiken V content validity was used because this instrument is a scale for measuring non-cognitive attributes.²⁰ This expert judgment process was also reported in developing the COVID-19 Burnout Frequency Scale instrument,²⁹ although the scientific publication does not include a quantitative assessment. The item content validity index is essential to maintain legitimacy as the most important determinant of the instrument’s measuring function based on its theoretical concept.²⁰

A total of 30 potential users were requested to work on the pandemic burnout questionnaire and offer feedback from the user’s perspective as part of a face validity study on the prototype instrument. Input from potential users was also considered in developing instruments to make revisions.³² At the field test stage, data obtained from 731 respondents were analyzed to estimate the item discrimination and test the construct validity and reliability of the PBI. Item discrimination distinguishes individuals who do or do not have the attributes being measured.²⁰ The PBI’s estimation findings for item discrimination indicated that not all items had adequate coefficients ($r_{ix}>0.25$).

The item discrimination parameter is important for assessing the quality of the instrument, but it should not be regarded as the only standard. The selection of items

must also consider the purpose of using the instrument, the composition of the aspects of the instrument, and the findings by experts who evaluate the instrument's design.²⁰ Because expert reviews indicated that the 60 items properly represented the measurement objectives, item elimination was not performed. Factor loading is considered another criterion for item quality, which was acquired from construct validity using factor analysis.

The goal of construct validity in this study was to demonstrate a strong association between the measurement results acquired through statement items and the theoretical conceptions that guided the instrument's development. There were five groupings of items, according to the EFA results. These results contradicted the concept that pandemic burnout comprised four aspects developed based on the previous qualitative content analysis. The BAT development experienced a similar situation.³¹ Schaufeli, Desart, and De Witte still adopt the findings of factor analysis as a basis for distinguishing the six dimensions of burnout.¹⁷ However, many experts consider BAT components to have very similar definitions.

The prototype EFA results also showed various factor loading values. Because this value is required for gaining construct validity, the factor loading parameter less than 0.5 was employed to reject items from the analysis.³² This value exceeds the factor loading more than 0.4 parameters in developing the MBI.¹² To assess the applicability of the instrument model, the items were cut down for the first confirmatory factor analysis (CFA-1) from 60 to 31 items based on the EFA results. Only the SRMR values fit the criteria, according to the CFA-1 results (31 items), whereas the others did not.

The reduction from 31 to 14 items was based on high factor loading, strong content according to qualitative content analysis and the results of expert judgment, and considering the composition of each factor, which refers to five aspects. The PBI-14 was decided as the final composition because the second CFA (CFA-2) showed a statistically good fit for the model. Procedures for reducing items are common in instrument development. In developing their instruments, Maslach and Jackson,¹³ reduced 47 to 22 items, Schaufelli, *et al.*,¹⁷ reduced 90 to 33 items, and Lau, *et al.*,²⁹ reduced 11 to five items. A researcher should provide enough high-quality items (around three times the number of items planned) to account for discarding items because of qualitative and empirical evaluation techniques.²⁰

The concurrent validity test was carried out by estimating the correlation between the PBI scores and the MTBI and CAS scores, both of which have been tested psychometrically. Based on the field test data, the reliability of the MTBI and CAS showed a coefficient of 0.911 and 0.899, respectively. MTBI is the Indonesian version of the MBI, which is still the gold standard for measuring

burnout.¹⁰ CAS,²⁶ was chosen as the criterion instrument because of the pandemic worry aspect that emerged from the qualitative content analysis. The correlation coefficients of the PBI with the MTBI and CAS were $r = 0.422$ and $r = 0.505$, respectively. Although some experts believe that a decent validity coefficient should be over 0.50, coefficients between 0.30 and 0.50 can be considered a positive contribution.²⁰ These results were better than the concurrent validity test conducted on the C-BFS with "fear of COVID-19" as the criterion instrument.²⁹

The reliability of instrument measurement results was performed by evaluating the internal consistency of 14 PBI items through a single-trial administration. This method was applied because it is more practical and highly efficient.²⁰ The reliability coefficient was indicated by a Cronbach alpha (α) = 0.761. This value was slightly lower than the acceptable coefficient, which was more than 0.80,¹⁴ but still considered high reliability according to Guilford in Suroso.³² The preceding MBI instrument similarly has low internal consistency; several dimensions have internal consistency values between 0.77 and 0.74.¹²

Because of numerous sources of error, including those from the measuring instrument, the internal condition factors of the measuring subjects, and the situational factors during the implementation of the measurement, perfect consistency is difficult to achieve for instruments that measure psychological attributes using humans as the subjects. By making changes to the test items, response formats, and field testing, these flaws can be fixed.²⁰ However, this was not carried out in this study due to the duration and the momentum of the COVID-19 pandemic. This study's limitations can be used as input for future study. Although it is not perfect, overall, the PBI has met the majority of the validity and reliability requirements, making it feasible to use as a measurement tool. This study has produced a specific assessment tool for pandemic burnout for health personnel in Indonesia, which has not been available in previous studies.

Conclusion

The PBI was developed due to theoretical developments, empirical progress, and practical needs. Pandemic burnout is conceptualized as a syndrome felt by health personnel during the COVID-19 pandemic, which is characterized by feelings of emotional exhaustion, depersonalization, low self-performance, psychosomatic symptoms, and pandemic worried. Since the initial draft, the PBI produced 60 items, then was reduced based on a qualitative and quantitative evaluation to 14 items. Although not perfect, the PBI generally meets good criteria according to psychometricians: valid, reliable, objective, standard, and practical. This instrument can be used to evaluate the handling of COVID-19 in terms of the

mental health condition of health personnel. However, developing PBI with item revisions and different response formats to improve the initial version of PBI can be carried out in future study.

Abbreviations

nCOV-19: novel coronavirus 2019; COVID-19: coronavirus disease 2019; MBI: Maslach Burnout Inventory; OLBI: Oldenburg Burnout Inventory; SMBM: Shirom and Melamed Burnout Measurement; BAT: Burnout Assessment Tool; BM: Burnout Measure; CBI: Copenhagen Burnout Inventory; PBI: Pandemic Burnout Inventory; CAS: COVID-19 Anxiety Scale; EFA: Exploratory Factor Analysis; CFA: Confirmatory Factor Analysis; SRMR: Standardized Root Mean Square Residual; RMSEA: Robust Root Mean Square Error of Approximation; CFI: Comparative Fit Index; TLI: Tucker Lewis index.

Ethics Approval and Consent to Participate

Ethical approval was obtained from Hassanuddin University Hospital (No. 412/UN4.6.4.5.31/PP36/2022), Dr. M. Djamil Hospital (No. LB.02.02/5.7/343/2022), and Dr. Harjono Hospital (No. 00542135021211520220707000/VII/KEPK/2022). Each participant or respondent was asked for his consent to participate after being given an explanation about the study.

Competing Interest

The authors declared no conflicts of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Availability of Data and Materials

The primary data used in this study is limited.

Authors' Contribution

SMP was the lead researcher who designed the research framework and analyzed the data. AD assisted in the conceptualization and validation of the instrument. AHS and SA were the research supervisors and validators.

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Extremely Hot Ambient Temperature and Injury-related Mortality

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Abstract

This pilot study aimed to evaluate the effects of extremely hot ambient temperatures on the total number of fatal injuries. Data were collected from a population-based mortality registry of Thanh Hoa, a province in the North Central region of Vietnam. This study qualified the distributed lag non-linear model and calculated the RR and 95% CI adjusted for long-term trend and absolute humidity. For the entire study population with 3,949 registered deaths due to injuries collected during 2005-2007, after the onset of extremely hot ambient temperatures, an increased risk of death was observed on the 9th day RR (95% CI) = 1.44 (1.06–1.97), and reached the peak on the 12th day RR (95% CI) = 1.58 (1.14–2.17), and at the 15th day RR (95% CI) = 1.49 (1.08–2.06). Men and old adults were identified as the most vulnerable groups. This study confirmed a positive association between hot temperatures and injury-related deaths in the province of 3.6 million people. The findings motivated further investigation into the effect of warm climate changes and the risk of deaths related to other specific causes such as road traffic, work-related injury, and etc.

Keywords: distributed lag non-linear model, fatal injuries, hot ambient temperature

Introduction

The Intergovernmental Panel on Climate Change reported that the global surface temperature was 1.09°C higher in 2011–2020 than in 1850–1900.¹ Global warming is well known to cause a rise in adverse health effects on humans. Extremely high temperatures trigger cumulative physiological stress on the human body and increase incidence rates of mortality,² and hospital admissions.³ Previous studies highlighted the heat on all-cause mortality,^{4,5} or specific diseases, such as cardiovascular,^{6,7} and respiratory illness.^{8,9} Few studies still discuss the association between temperature and injury mortality.

This study investigated the effect of hot temperatures on injury-related mortality among adults (aged ≥ 16 years) in Thanh Hoa Province, Vietnam. The study population of interest was in the North Central region of Vietnam, with a registered population of over 3.6 million during 2005–2007. The distributed lag non-linear model (DLNM) proposed by Gasparrini,¹⁰ was applied to identify the lag effects of temperature anomalies on the

incidence of injury-related death. Moreover, age- and sex-specific analyses were performed to implement a more targeted preventative strategy.

This study was motivated by several perspectives. First, injury-related deaths are remarkably high in Vietnam. Injury-related deaths are characterized by both unintentional events (poisonings, falls, and road traffic accidents) and intentional behaviors (self-harm, assault, and suicide).¹¹ Vietnam is presently regarded as one of the fastest-growing economies in Southeast Asia, and it is becoming a more significant contributor to the global economy.¹² This change contributes to increased mortality risk due to injury because infrastructure and safety provisions fail to keep up with economic development. Injury-related deaths account for 9% of total deaths and are mainly caused by road injuries, falls, exposure to mechanical forces, and interpersonal violence.¹³ Road traffic accidents are always among the leading causes of death in Vietnam. The incidence of road traffic accidents is reported as the highest rate globally (30.54 deaths per 100,000 population in 2019).¹⁴

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Second, epidemiological studies have stated that extremely hot temperatures affect human behaviors and feelings. Miles-Novelo and Anderson,¹⁵ concluded that hot temperatures increase aggression and violence. Similarly, Noelke, *et al.*,¹⁶ reported that daily average temperatures above 21°C diminish positive feelings and magnify negative ones. Long-term exposure to hot temperatures is linked with high incidence rates of assault cases in South Wales, Australia.¹⁷ Grjibovski, *et al.*,¹⁸ used time series regression analysis and found that a 2.1% rise in suicide rates in Astana, Kazakhstan, is associated with a 1°C increase in average ambient temperature. These results then motivated a study to examine whether injury-related deaths are affected by hot temperatures. Therefore, this study aimed to evaluate the effects of extremely hot ambient temperatures on total fatal injury rates in Vietnam.

Method

Time series analysis determined the relationship between the health outcome and risk factors. The dependent variable was the daily mortality caused by injury, described by the International Classification of Diseases code from S00 to Y59. In Vietnam, the lack of consistent, reliable national mortality data continues to be a serious problem.¹⁹ Currently, data on annual mortality are exclusively derived from the Government Statistics Office’s yearly mortality surveys.

Daily counts of deaths in Thanh Hoa Province were obtained from the Vietnamese A6 mortality reporting system, a logbook used to routinely record every death event noted by primary health care (PHC) staff across the country. Data on population-based mortality registration were very good, with completeness, sensitivity, specificity, and positive predictive values of 94%, 75.4%, 98.4%, and 88.4%, respectively.²⁰ The database from the A6 system was not, however, regularly shared and publicized. There was only access to Thanh Hoa Province’s daily death tolls from 2005 to 2007. Thus, this

investigation was conducted as a pilot study to determine the relationship between hot temperatures and injury-related deaths in Vietnam. A temporal and geographic extent will be conducted in the future after the complete data is obtained.

The data sets consisted of daily counts of deaths and meteorological data in Thanh Hoa Province from 1 January 2005 to 31 December 2007. Mortality data consisted of the death date, sex, and age. Age was categorized as 16-29 years (young adults), 30-59 years (middle-aged adults), and ≥60 (old adults). The weather data were obtained from the National Center for Hydro-meteorological Forecasting,²¹ including the daily average temperature (°C) and absolute humidity (g/m³).

Table 1 summarizes the descriptive statistics of daily injury-related mortality and weather data. This study identified 3,949 injury-related deaths in 2005 to 2007, with the average daily count being approximately four cases, higher for men and adults. The daily mean temperature was 24.13°C, ranging from 11.2°C to 33.1°C. The daily mean absolute humidity was 18.48 g/m³, ranging from 5.90 to 25.8 g/m³.

It was necessary to determine the statistical distribution that best fits the injury mortality variable. The Poisson and negative binomial distributions commonly describe the count data. Table 2 presents the goodness-of-fit criteria. Akaike information criterion (AIC) and Bayesian information criterion (BIC) are derived from the maximum likelihood estimation. The Chi-squared statistics with Poisson assumption was 48.96, whereas it was only 4.21 in the case of a negative binomial distribution. Thus, the null hypothesis that injury mortality followed the negative binomial distribution was supported. Also, the smaller AIC and BIC confirmed again that the negative binomial distribution fitted the data better than the Poisson distribution.

The negative binomial distribution combined with the distributed lag non-linear model (DLNM) proposed by Gasparini,¹⁰ was used to identify the potential delayed

Table 1. Summary of the Descriptive Statistics of Daily Injury-related Mortality and Weather Data

Variable	Mean	SD	Percentile				
			Min	25 th	50 th	75 th	Max
Injury-related death	3.05	2.00	0.00	2.00	3.00	4.00	11.00
Sex							
Male	1.75	1.87	0.00	1.00	2.00	3.00	11.00
Female	0.87	1.02	0.00	0.00	1.00	1.00	4.00
Age							
16–29 years	1.09	1.14	0.00	0.00	1.00	2.00	7.00
30–59 years	1.25	1.22	0.00	0.00	1.00	2.00	7.00
≥60 years	0.72	0.86	0.00	0.00	1.00	1.00	5.00
Temperature (°C)	24.15	4.80	11.20	20.40	25.20	28.10	33.10
Absolute humidity(g/m ³)	18.48	4.79	5.90	14.90	19.70	22.70	25.80

Note: SD = Standard Deviation

effects of daily temperature on injury mortality in Thanh Hoa Province. The supposed DLNM to temperature,²² is given as in Formula 1. The non-linear temperature and lagged effects were modeled using a natural cubic spline. The two spline knots of temperature were placed at the 33.3rd and 66.7th percentiles, whereas only one knot was placed at the median of the logarithm scale of lags. Because of the long-lagged effect of temperature on mortality, the maximum lag at 30 days was often used to determine the overall temperature effects completely.^{23,24} The cubic spline bases,²⁵ were used to control the non-linear effect of some confounders, including long-term trends and absolute humidity. The degree of freedom (df) was 7 per year and 3 for trend and absolute humidity, respectively. The degrees of freedom of the temperature-lag-response curve and the smoothing function of confounders were chosen by minimizing the quasi-AIC. The days of the week were included as dummy variables. The estimated relative risk (RR) was computed relative to the reference median temperature value at 25.2°C. The significant level was chosen at 5%.

Results

Figure 1 shows the overall effects of daily mean temperatures on injury mortality over 30 days, with 95% confidence intervals (95% CIs). The exposure-response curves for cumulative effects on the total population and men were non-linear with a J-shaped curve, where the RR changed gradually and increased rapidly at low and high temperatures, respectively. The overall effects of heat exposure on injury mortality were estimated at an RR of 1.40 (95% CI = 0.99–1.99) and 1.41 (95% CI = 0.94–2.11) in the total population and men, respectively. The overall curve for women was U-shaped, but it showed that both cold and heat had no significant effect on injury-related deaths.

The single lag effects of heat on injury mortality, with 25.2°C as a reference, are presented in Figure 2. The hot

temperature increased injury mortality by 1.15 (95% CI = 0.80–1.64) and 1.56 (95% CI = 0.88–2.76) for men and women, respectively, but these relationships were not statistically significant. Furthermore, no single significant effect was found along the lags.

The cumulative RRs of extremely hot temperatures on injury mortality at different lags are shown in Table 3. The cumulative effects of the heat on female mortality induced by injuries were found to be insignificant at every lag. No significant cumulative RR was observed for the total population during 0-8 days lags. Excessive heat events lasting at least nine consecutive days significantly increased the risk of fatal injury. Statistically significant results among men started at lag 9 and lasted until 15. Besides, injury mortality had the highest risk of death related to the extremely hot temperature on day 12 after

Table 2. Goodness-of-fit Criteria Comparing the Performance of Poisson and Negative Binomial Distributions

	Chi-squared Statistic	AIC	BIC
Poisson distribution	48.96 (<0.001)	4510.378	4515.37
Negative binomial distribution	4.21 (0.65)	4468.67	4478.66

Notes: AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion, p-values are in parentheses

$$Y_t \sim \text{Negative binomial}$$

$$\log(\mu_t) = \alpha + f \cdot g(\text{Temp}_t, \text{lag}) + s(\text{trend}, \text{df} = 7/\text{year}) + s(\text{AH}_t, \text{df} = 3) + \theta \text{Day}_t$$

Notes:

- Y_t is the observed daily all-cause mortality at day t;
- μ_t is the expected mortality on day t;
- f·g(Temp_t, lag) denotes the bidimensional function on temperature and lag produced by the distributed lag non-linear model (DLNM);
- s(trend) and s(AH) are the smoothing functions for trend and absolute humidity (g/m³), respectively; and
- Day_t is the day of the week dummy variables.

Formula 1. Distributed Lag Non-linear Model to Temperature²²

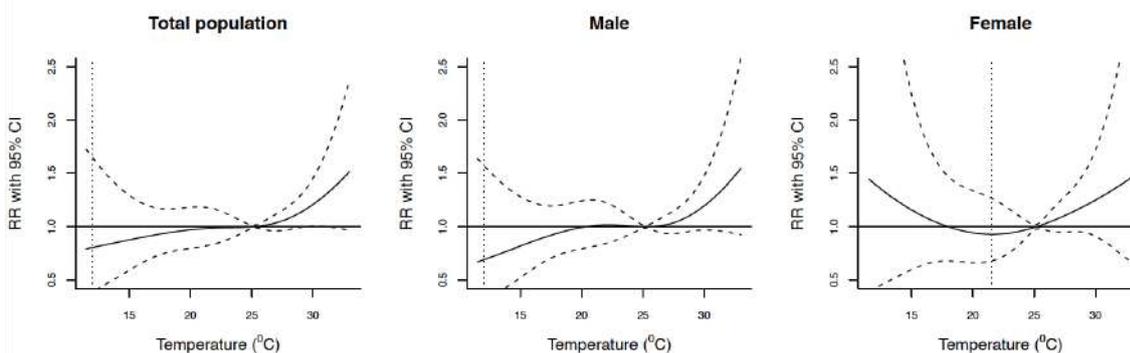


Figure 1. Cumulative Exposure-Response Relationships between Mean Temperature and Injury Mortality over 0-30 Days

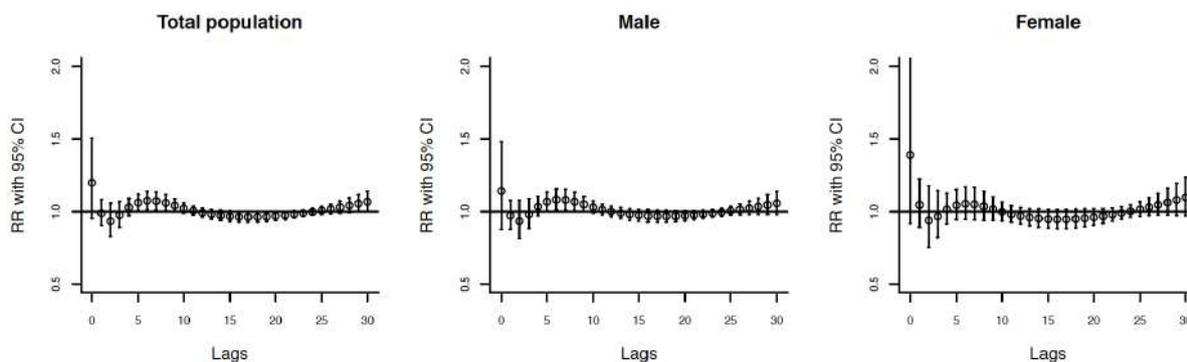


Figure 2. The Single-day Relative Risk (RR) of Extremely Hot Temperature on Injury Mortality over 0-30 Days

Table 3. Cumulative Relative Risks (95% Confidence Interval) of the Heat Effects on Injury-related Mortality over Different Lags (Entire Study Population)

Lag	Relative Risks (95% CI)		
	Total Populaton	Male	Female
0	1.24 (0.91–1.70)	1.14 (0.80–1.64)	1.56 (0.88–2.76)
0–1	1.13 (0.82–1.56)	1.14 (0.79–1.65)	1.10 (0.61–1.97)
0–5	1.25 (0.92–1.71)	1.21 (0.85–1.73)	1.38 (0.78–2.44)
0–9	1.44 (1.06–1.97)*	1.41 (0.99–2.01)	1.55 (0.89–2.72)
0–10	1.51 (1.11–2.06)*	1.48 (1.04–2.11)*	1.63 (0.93–2.84)
0–11	1.56 (1.14–2.14)*	1.53 (1.07–2.19)*	1.67 (0.95–2.93)
0–12	1.58 (1.14–2.17)*	1.56 (1.08–2.24)*	1.66 (0.94–2.95)
0–13	1.57 (1.13–2.17)*	1.55 (1.07–2.25)*	1.62 (0.91–2.90)
0–14	1.53 (1.11–2.12)*	1.53 (1.06–2.22)*	1.55 (0.87–2.77)
0–15	1.49 (1.08–2.06)*	1.50 (1.04–2.17)*	1.47 (0.83–2.61)
0–20	1.21 (0.86–1.69)	1.27 (0.86–1.86)	1.06 (0.58–1.94)
0–25	1.11 (0.78–1.60)	1.17 (0.78–1.77)	0.95 (0.49–1.83)
0–30	1.40 (0.97–1.99)	1.41 (0.94–2.11)	1.37 (0.74–2.55)

Notes: CI = Confidence Interval, *Values indicate statistically significant results at 5%.
Heat effect is the relative risk at the 99th percentile of temperature (32°C) against the reference temperature (25.2°C).

exposure, with cumulative RRs of 1.58 (95% CI = 1.14–2.17) and 1.56 (95% CI = 1.08–2.24) for the total population and men.

The cumulative RRs of sweltering temperatures on age-specific injury mortality are shown in Table 4. Old adults (≥60 years) seemed to have the highest risk of dying due to injuries. The RRs associated with high temperature were significant at lags 0-12 days (RR = 1.80, 95% CI = 1.01–3.20) to lags 0-15 days (RR = 1.81, 95% CI = 1.02–3.23). The highest cumulative effect was observed 14 days after exposure to hot temperatures (RR = 1.85, 95% CI = 1.03–3.30). Among young adults, the cumulative heat effects increased the risk of injury-related death significantly at a lag of 0-10 days with cumulative RRs of 1.63 (95% CI = 1.01–2.62) and

Table 4. Cumulative Relative Risks (95% Confidence Interval) of the Heat Effects on Injury Mortality over Different Lags by Age Groups

Lag	Relative Risks (95% CI)		
	Young Adults	Middle-aged Adults	Old Adults
0	1.19 (0.72–1.95)	1.16 (0.72–1.87)	1.50 (0.84–2.68)
0–1	1.45 (0.87–2.43)	1.03 (0.63–1.69)	0.90 (0.50–1.64)
0–5	1.16 (0.71–1.88)	1.39 (0.86–2.23)	1.22 (0.69–2.16)
0–9	1.55 (0.96–2.51)	1.41 (0.88–2.26)	1.39 (0.79–2.44)
0–10	1.63 (1.01–2.62)*	1.42 (0.88–2.29)	1.55 (0.89–2.72)
0–11	1.67 (1.03–2.71)*	1.43 (0.88–2.32)	1.70 (0.96–2.99)
0–12	1.67 (1.02–2.74)*	1.42 (0.87–2.32)	1.80 (1.01–3.20)*
0–13	1.65 (0.99–2.72)	1.40 (0.85–2.30)	1.84 (1.03–3.30)*
0–14	1.60 (0.97–2.64)	1.37 (0.83–2.25)	1.85 (1.03–3.30)*
0–15	1.53 (0.93–2.53)	1.33 (0.81–2.19)	1.81 (1.02–3.23)*
0–20	1.20 (0.71–2.03)	1.17 (0.70–1.95)	1.41 (0.77–2.57)
0–25	1.12 (0.64–1.96)	1.16 (0.67–2.00)	1.15 (0.60–2.18)
0–30	1.52 (0.88–2.63)	1.48 (0.87–2.51)	1.26 (0.67–2.37)

Notes: CI = Confidence Interval, *Values indicate statistically significant results at 5%.
Heat effect is the relative risk at the 99th percentile of temperature (32°C) against the the reference temperature (25.2°C).

reached the peak RRs at lags of 0–12 days with cumulative RRs of 1.67 (95% CI = 1.02–2.74). Regarding middle-aged adults, there were no significant cumulative heat effects.

Discussion

This study observed a significantly increased risk of death 9-15 days after the onset of extremely hot ambient temperatures for the total population. Men and old adult subpopulations were identified as the most vulnerable groups to high temperatures. Excessive heat events lasting at least nine consecutive days increased the risk of fatal injury. Statistically, significant results among men started at a lag of 9 days and lasted up to 15 days.

Long-term exposure to sweltering temperatures was

significantly associated with an increased risk of injury mortality. In agreement with the findings of this study, Kim confirmed that hot temperatures significantly caused accidental mortality rates in Korea.²⁶ Also, Sheng, *et al.*, stated that a 1°C increase in maximum temperature is related to a 1.4% increase in daily injury claims in Guangzhou, China.²⁷ In a review by Otte, *et al.*, 11 out of 13 studies confirmed that high temperatures increased unintentional injuries.²⁸

It is possible to outline several specific mechanisms by which high temperatures could increase the frequency of injury-related mortality. On hot days, physical issues (fatigue and dizziness) and mental issues (inability to focus, irritability, and mood swings) often occur.²⁹ These issues reduce the work performance of humans and exacerbate the risk of unintentional injuries. Increased discomfort in hot weather contributes to increased sentiments of animosity and violent thoughts, which may result in aggressive behavior and indirectly increase injury mortality.³⁰ External factors also cause injury mortality. For example, the changes in road and car conditions in extremely hot temperatures raise the risk of road accidents, or outdoor fires occur more frequently in high temperatures.

This study found significant positive increases in injury-related mortality only in men and no effect on women. This result was consistent with some previous studies.^{27,31} A significant increase in injury claims for male workers with increased temperature possibly reflects sex segregation and division at home and work. Men are more likely than women to engage in high-risk activities.

The relationship between higher daily injury-related mortality with hot temperatures considerably rises in young adults (aged 16-29 years). Long-term exposure to high temperatures significantly affects the neural circuitry of emotion regulation of young individuals,³² predisposing them to increased stress, anxiety, and aggression. Besides, a significant increase in mortality risk in old adults may be due to their poor acclimatization compared to other groups, resulting in decreased wakefulness, impaired performance, and increased injury risk.

The sensitivity of populations to excessively hot temperatures considerably rises in Vietnam due to population aging. Therefore, it is essential to develop adaptation plans to reduce the detrimental effects of global warming.³³ In the context of global warming, measures to prevent exposure to excessively hot temperatures and implementing systems for alerting specific sensitive subgroups of temperature-related health concerns may lower injury mortality.

There were several limitations in this study. First, this study focused on the general injury risk without considering the cause-specific injury. Thus, this study could not

evaluate the underlying, immediate, or contributing causes by which extreme temperatures influence the number of injury-related deaths. Second, this study used a small sample from only one province, causing biased estimates. The data from 2005-2007 cannot reflect the current situation accurately.

Conclusion

This pilot study examines the effect of extremely hot ambient temperatures on injury mortality in Thanh Hoa Province, Vietnam. Despite several limitations, this pilot study suggests that warm climate changes increase the risk of deaths from injuries and reveals a group of additional causes of mortality that could be preventable. Further investigation can focus on the effect of warm climate changes and the risk of cause-specific deaths due to road traffic, suicides, work-related injury, interpersonal violence, and others.

Abbreviations

PHC: Primary Health Care; SD: Standard Deviation; AIC: Akaike Information Criterion; BIC: Bayesian Information Criterion; DLNM: the Distributed Lag Non-linear Model; RR: Relative Risk; CI: Confidence Interval.

Ethics Approval and Consent to Participate

Not Applicable

Competing Interest

The authors declare that there are no significant competing financial, professional, or personal interests that might have affected the performance or presentation of the work described in this manuscript.

Availability of Data and Materials

All datasets generated and analyzed are available in the article.

Authors' Contribution

NTL participated in collecting the data, conceptualizing, and designing the manuscript. HVN wrote the introduction section. MTNN and HVTL ran the R-codes and wrote the method section. MVMN and VAN participated in analyzing and writing the result section. All authors interpreted the findings and discussed the results of the study.

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Effects of Using an Application for Postpartum Contraceptive Use in Family Planning Counseling during Pregnancy

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Abstract

A decision-making tool for family planning flipchart is used for contraceptive counseling, but the use of this flipchart is suboptimal. In this study, primary study resulted in innovative decision-making tools for family planning applications. "Si KB Pintar" was also developed, a tool that women can use to discuss contraceptives with their husbands after family planning counseling. This study analyzed the effectiveness of family planning counseling during pregnancy by applying postpartum contraceptive use. Analytical quantitative quasi-experimental methods were used with a control group design. The sampling method was two-stage sampling. In the first stage, from 22 primary health care (PHC) in Cirebon City, Indonesia, 11 intervention and 11 control groups were selected using random allocation. Five participants were taken from each PHC in the second stage using simple random sampling. The findings indicated that participants given family planning counseling using an application had a 2.4 times higher likelihood of using postpartum contraception compared to flipcharts after controlling for age and parity variables. Because these applications are only for Android users, applications should be produced that all users can utilize in further study.

Keywords: application, counseling, family planning, postpartum contraceptive

Introduction

Approximately 800 women worldwide die daily from avoidable conditions associated with pregnancy and childbirth, and 99% of all maternal mortality occurs in developing countries.¹ One factor causing high maternal mortality in Indonesia and other developing countries is being too young or old to give birth. If the family planning program is adequately implemented, 33% of maternal mortality may be prevented through contraception.² This aligns with the population control problem, which remains a largely unaddressed issue. In the last 10 years, a downward trend in unmet needs in Indonesia was stagnant at 11%, while the target in 2024 is 7.4%.³ The percentage of unmet needs in Cirebon City exceeds the national figure at 23.02%.⁴

A causative factor of unmet needs is inadequate communication of information on family planning education and suboptimal counseling.⁵ Based on the Indonesian Method Information Index in Family Planning Report 2020, the quality of family planning counseling is 30.4%,⁶ indicating that it has not been carried out ade-

quately. Hence, efforts must be made to strengthen the implementation of counseling, including technical implementation, which can be done more efficiently by the government. The tool used for contraceptive counseling is the decision-making tool for family planning flipchart.⁷ Previous studies have concluded that counseling using family planning decision-making flipcharts for pregnant women has a significant effect on postpartum contraceptive use.⁸⁻¹⁰

The problem is that the use of these flipcharts is relatively low. In one study of 117 midwives in Surakarta City, Indonesia, they were used by only 17.9%.¹¹ In Cirebon City, midwives' mastery of the structure and ability to use this flipchart remain lacking; therefore, the quality of family planning counseling is suboptimal.¹² Decision-making tools for family planning flipcharts are rarely used because they are complex and take a long time. Hence, midwives are not confident in conducting family planning to counsel.¹³ This tool has the disadvantage of being impractical, large, and heavy, especially when providing counseling at the client's home.¹⁴

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Technological innovation is required to make it easier for midwives to use decision-making tools for family planning. The use of technology-based contraceptive decision aids has a positive effect on contraceptive use.¹⁵ A previous study conducted primary study that resulted in Android-based digital decision-making tools for family planning innovations that met requirements for system quality, information quality, and user satisfaction.¹³

Based on expert input, the decision-making tools for family planning digitally changed their name to “decision-making tools for family planning applications,” and a feasibility test was carried out.¹⁶ Based on input from midwives who were participants in previous studies,¹³ this study also developed “Si KB Pintar,” an Android-based application that contains information on various contraceptives, including criteria for medical requirements, side effects, how to use them, when to revisit, and things to remember, which can be used at home if the client does not decide immediately during counseling.

Family planning counseling should be started during pregnancy so that mothers have time to choose contraceptive methods. This study analyzed the effectiveness of family planning counseling during pregnancy using a decision-making tool for family planning application and Si KB Pintar for postpartum contraceptive use. This study will reference family planning counseling media that can address unmet needs.

Method

The design of this study was quasi-experimental with

a control group. The effect of family planning counseling during pregnancy was measured using decision-making tools for family planning applications and Si KB Pintar on postpartum contraceptive use. The primary independent variable in this study was family planning counseling, and the dependent variable was postpartum contraceptive use. Potential confounders, including age, parity, and knowledge (before intervention), controlled for the association between family planning counseling and postpartum contraceptive use.

The study was conducted in Cirebon City, West Java Province, Indonesia from May to December 2022 with the population of pregnant women. The inclusion criteria for participants were gestational age ≥ 37 weeks, have access to an Android device, and registrated in the cohort. The exclusion criterion was the unwillingness to be a participant. The estimated sample size for each group was determined according to the formula by Lwanga and Lemeshow,¹⁷ resulting in a minimum sample size of 41 participants. To account for the potential loss to follow-up, 35% was added, resulting in 55 participants for each group. The sampling method was two-stage sampling. In the first stage, from all primary health care (PHC) in Cirebon City (22 PHCs), 11 intervention and 11 control groups were determined using random allocation. Five participants were taken from each PHC in the second stage using simple random sampling. This study’s enumerators were all coordinating midwives from 22 PHCs in Cirebon (Figure 1).

The intervention in this study was family planning

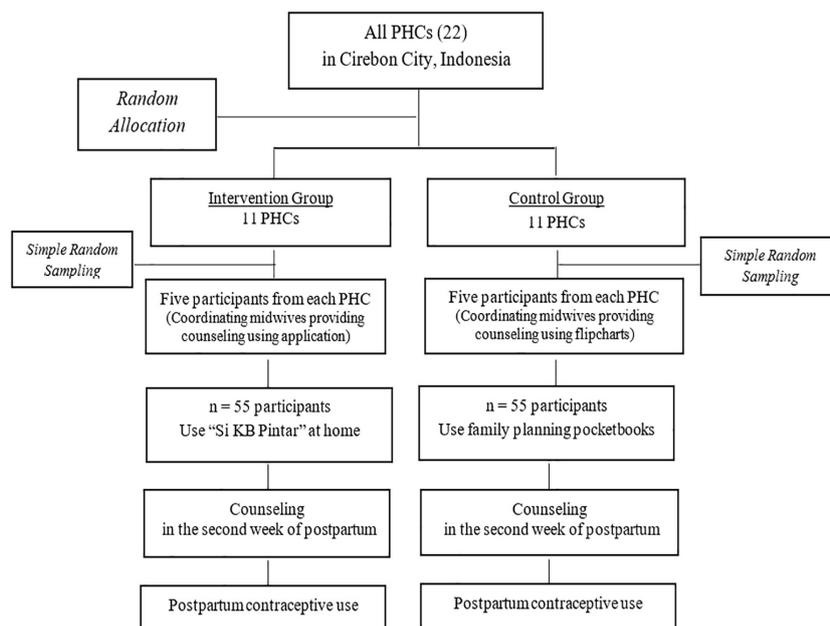


Figure 1. Sampling Framework

counseling using an application for postpartum contraceptive use. In the preparatory stage, enumerators in the intervention group were trained to use decision-making tools for family planning applications. Enumerators in the control group were given refresher training in using decision-making tools for family planning flipcharts. Each midwife then counseled five participants. Participants in the intervention group installed Si KB Pintar to discuss family planning with their husbands, while participants in the control group were given family planning pocketbooks. This is important because all participants' decision-making for contraceptive use was based on mutual agreement between the wife and husband. During the second-week postpartum visit, they were asked whether they had chosen a contraceptive to use. The second counseling was carried out to explain what was not understood. Data collection on postpartum contraceptive use was carried out 42 days after delivery. The study instruments included decision-making tools for family planning applications and Si KB Pintar for the intervention group, decision-making tools for family planning flipcharts and family planning pocketbooks for the control group, and questionnaires (Figure 2).

The analysis began with data completion by editing, coding, and entering. Data were analyzed by univariate, bivariate, and multivariate analyses. Univariate analysis was conducted to describe each group's characteristics and distribution frequency of age, parity, and knowledge. Bivariate analysis was conducted using the Chi-squared test to analyze the relationship between the independent and dependent variables. Multivariate analysis with logistic regression was conducted to control for potential confounders, including age, parity, and knowledge. The variables to be included in the logistic regression had a p-value of <0.25.

Results

Table 1 shows that most pregnant women were 20–34 years old, but some were <20 years in the intervention group, and there were women ≥35 years in both groups. Most pregnant women had a parity of 2–3, but some had a parity ≥4, 21.8% for each group. Most pregnant women had insufficient knowledge of contraception. Based on a p-value of >0.05, there were no statistically significant differences in age, parity, or knowledge between the two groups, thus indicating homogeneity.

As shown in Table 2, family planning counseling using the application and age were significantly related to postpartum contraceptive use (p-value = 0.021 and 0.039, respectively). Still, parity and knowledge were not significantly associated with postpartum contraceptive use.

The variables to be included in logistic regression had a p-value of <0.25 (age and parity). The model was de-

veloped, and the confounding variables were evaluated by comparing the OR of the primary variable (family planning counseling) before and after a confounding variable was excluded. Then, the variable with the most significant p-value was excluded. Because the difference in the OR of the family planning counseling variable was higher than 10%, age and parity were included in the model. Table 3 shows that participants given family planning counseling using an application had a 2.4 times higher likelihood of using postpartum contraception compared to flipcharts after controlling for age and parity variables.



Figure 2. Main Menu in Decision-making Tools for Family Planning Application and Si KB Pintar

Table 1. Frequency Distribution of Participant's Characteristics

Variable	Category	Intervention Group		Control Group		p-value
		n	%	n	%	
Age (years)	≥35	10	18.1	8	14.5	0.174
	20–34	42	76.4	47	85.5	
	<20	3	5.5	0	0	
Parity	≥4	12	21.8	12	21.8	0.797
	2–3	29	52.7	26	47.3	
	1	14	25.5	17	30.9	
Knowledge	Good	0	0	4	7.3	0.079
	Enough	24	43.6	27	49.1	
	Insufficient	31	56.4	24	43.6	

Table 2. Association of Family Planning Counseling and Characteristic Factors with Postpartum Contraceptive Use

Variable	Category	Postpartum Contraceptive Use				p-value
		Yes		No		
		n	%	n	%	
Family planning counseling	Using application	38	69.1	17	30.9	0.021
	Using flipchart	25	45.5	30	54.5	
Age (years)	≥ 35	14	77.8	4	22.2	0.039
	20–34	46	51.7	43	48.3	
	<20	3	100	0	0	
Parity	≥ 4	17	70.8	7	29.2	0.244
	2–3	31	56.4	24	43.6	
	1	15	48.4	16	51.6	
Knowledge	Good	1	25	3	75	0.372
	Enough	31	60.8	20	39.2	
	Insufficient	31	56.4	24	43.6	

Table 3. Multivariate Analysis of the Effectiveness of Family Planning Counseling Using Applications on Postpartum Contraceptive Use Controlling for Age and Parity

Variable	Category	Postpartum Contraceptive Use	
		OR	95% CI
Family planning counseling	Using application	2.421*	1.080–5.428
	Using flipchart	1	
Age (years)	≥ 35	2.439	0.673–8.840
	20–34	0.000	<0.001
	<20	1	
Parity	≥ 4	1.645	0.545–4.966
	2–3	2.084	0.594–7.308
	1	1	

Notes: OR = Odds Ratio, CI = Confidence Interval, *Significant value (p-value<0.05)

Discussion

Maternal age can be a risk factor for maternal and infant mortality. Based on data from 144 countries and territories, there is a higher risk of maternal death for adolescents compared to mothers aged 20-24 years, and the highest risk is in women older than 30.¹⁸ The higher risk of maternal adolescent death relates to biological maturity and social conditions. There are many compelling reasons for adolescents to avoid early childbearing, including adverse social, educational, and economic consequences for young mothers.¹⁹

The higher risk of maternal mortality when pregnant or giving birth at a young or old age is due to biological characteristics. Based on the 2018 Indonesian Basic Health Research data, pregnancy complications are the most common in women aged 10–14 years, as high as 38.5%.²⁰ The highest rate of birth complications occurs for women aged <15 years at 35.8% and at ≥35 years at 27%. The highest rate of postpartum complications occurs in women aged 15-19 years at 13.1%.²⁰ Character-

istics related to the mother’s age also affect infant mortality. In Indonesia, the chance of infant mortality is higher for children born to mothers who are too young or too old. The highest risk ratio is for births to mothers aged 35 years and over.²¹

Some pregnant women in this study had a parity ≥4. A previous study using data from the Indonesian Demographic and Health Survey, which included 14,827 live births in the 2012–2017 period, showed that women with a parity ≥4 had 1.9 times the risk of experiencing neonatal death compared to multiparas after controlling for the mother’s age, birth attendant, and place of delivery.²² Another study using Demographic and Health Survey data in 10 countries in Africa, Asia, and Latin America concluded that maternal and child mortality rates were higher at high parity and associated with lower access to health interventions.²³

Pregnancy among women aged ≥35 years and those with high parity are associated with a higher risk of maternal and infant mortality. These pregnancies often occur because family planning and reproductive health programs are neglected. Efforts to reduce teenage pregnancies, geriatric pregnancies, and pregnancies with high parity involve using contraceptive. Maternal mortality can be prevented by increasing access to contraception.¹⁹ When associated with unmet needs, women of childbearing age ≥35 have a 1.8 times higher risk of unmet needs for family planning than women under 35 because the demand for contraception increases with age.²⁴

Based on the findings of this study, age influences contraceptive use, with the highest use observed at age <20, followed by >35. This indicated that after receiving the intervention, participants in these age groups understood the importance of contraceptive use. The results of this study aligned with a study conducted in Bangladesh that found that age influenced contraceptive use.²⁵

One cause of unmet needs is suboptimal family planning counseling. This can be caused by service providers' low competence in counseling, insufficient time for counseling clients, and suboptimal collaboration between service providers and clients in the counseling activities carried out. Clients' shared understanding of family planning can also cause them to leave decisions to their service providers. This certainly impacts the effectiveness of family planning counseling in improving family planning behavior. Based on the findings of this study, most pregnant women had insufficient knowledge of contraception, which indicated that family planning counseling has not been optimal.

The goal of family planning counseling is to assist clients in identifying their contraceptive needs, selecting the optimal method, and making decisions that can be implemented as needed. Counseling is carried out to provide input on contraceptive methods and factors necessary to consider in the choice based on their reproductive goals. This counseling focuses on the client's interests in selecting the contraceptive method they want. Service providers are obliged to respect the decisions made by clients.²⁶ Family planning counseling can help clients choose the desired method, manage side effects, and support methodological changes, and high-quality counseling can reduce unmet needs for contraception.²⁷

Family planning counseling should be provided from the time of pregnancy, even though, in reality, family planning counseling that begins during pregnancy remains suboptimal. A study in Nepal showed that one-third of 24 pregnant women did not receive family planning counseling services during antenatal care. The quality of antenatal family planning counseling was considered unsatisfactory based on client expectations and interactions with providers. Reasons given included a crowded environment, short time with providers, unavailability of providers, long waiting times, a limited number of days for antenatal care services, and clients feeling they did not receive complete information on family planning.²⁸

In Indonesia, information on family planning must be provided to pregnant women. Various studies have shown the effectiveness of family planning counseling on contraceptive use during pregnancy. Family planning counseling begins during the prenatal period because women who have entered the postpartum period usually focus on recovering from labor and caring for their newborns.²⁹ One systematic literature review concluded that contraceptive counseling during pregnancy and postpartum could increase contraceptive use.²⁷ Service providers should start contraception counseling from prenatal care and arrange several visits.³⁰ Contraceptive counseling is crucial for antenatal and postnatal periods.³¹

In this study, the study's enumerators, midwives,

agreed to provide family planning counseling during pregnancy because the mothers were still focused, and there was still time to choose a contraceptive method. If they had already given birth, they might have been more focused on caring for their babies. In this study, the intervention for family planning counseling was provided at ≥ 37 weeks of pregnancy using decision-making tools for family planning applications and Si KB Pintar, and was reevaluated at the second-week postpartum visit to determine whether the respondent had chosen a contraceptive method. The second counseling session was conducted to explain anything that was not understood with the decision-making tools for family planning. Postpartum contraceptive use commenced 42 days after delivery.

As shown in Table 3, participants given family planning counseling using the application had 2.4 times the likelihood of using postpartum contraceptive compared to flipcharts after controlling for age and parity variables. Clients needed information provided so that when the counseling process was carried out, they were focused and enthusiastic about asking the midwife. These results were in line with a study conducted in Spain to compare the effectiveness of perinatal contraceptive counseling with standard postpartum contraceptive counseling.³² The media used in that study consisted of leaflets and blogs with practical information on all contraceptive options, plus short reminder messages on cell phones to consult information on contraceptive methods on the blog during the third trimester of pregnancy. This study's strength was that the intervention impacted postpartum contraceptive use (42 days after delivery). In the Spanish study, the intervention had the largest impact 12 months after delivery.³²

Easy-to-use counseling tools are important for increasing their use by service providers. In this study, midwives found it easier to use decision-making tools for family planning applications than flipcharts. This result has been supported by previous study.¹³ One study evaluated the acceptance of an application in Africa and Latin America, showing that the application was acceptable, easy to use, informative, and effective in providing health information.³³ Another study produced iContraception®, an application that provides easy access for service providers based on medical eligibility criteria for contraceptive options.³⁴ In a subsequent study, the application "MyContraception" was shown to help clients make contraceptive decisions.³⁵ Applications for contraceptive use have also been developed and studied in Jordan.³⁶

The strength of this study was that apart from the decision-making tools for family planning applications used by midwives in counseling, clients also installed Si KB Pintar. This Android-based application is already avail-

able in the Play Store to reinforce what the midwife has explained during counseling. It can be used by women for discussions with their husbands if they have not decided at the time of counseling. The difference between the two applications is in the menu and application structure, where the decision-making tools for family planning applications, menu, and usage structure refer to the design of the decision-making tools for family planning flipcharts. In contrast, Si KB Pintar directly focuses on contraceptive methods, including medical criteria for eligibility, side effects, methods of use, time for repeat visits, and things to remember, as well as additional information on HIV/AIDS, pregnancy screening, and emergency contraception.

Si KB Pintar should be provided to clients because the husband or family plays a role in making decisions about contraceptive use. Husbands rarely participate in family planning counseling for various reasons, including feelings of embarrassment, busyness, and less awareness of the importance of family planning programs.³⁷ In this study, all participants said that the decision to use contraceptive was based on agreement with their husbands. This aligns with the 2017 Indonesian Demographic and Health Survey, whose data showed that 57% of family planning decisions are made by the husband, indicating the husband's prominent role in family planning decisions.²¹ Involving the husband is important in family planning counseling.³⁸

A study in Jordan concluded that husbands have an influential role in deciding whether to use family planning services and the type of contraceptive method used; cultural and social norms related to family planning and decision-making continue to pressure women.³⁶ The involvement of men and digital technology in family planning counseling can potentially enhance joint family planning decision-making processes among couples.³⁹ Si KB Pintar was instrumental for participants and their husbands in increasing their knowledge of family planning and decision-making. The limitation of this study was that the application used for intervention was only available for Android users. Technology in family planning services is valuable in increasing women's awareness of family planning methods to empower women in collaborative decision-making processes (with their husbands and families), then digital technology is recommended to improve the coverage and quality of family planning services.⁴⁰

Conclusion

Tools that are easy for midwives and clients to use are important in family planning counseling because they can make the counseling process effective and enjoyable so that clients can absorb the information provided and use it in decisions on postpartum contraceptive use. Provid-

ing family planning counseling during pregnancy using the decision-making tools for family planning application and Si KB Pintar is more effective than flipcharts in increasing the use of postpartum contraception. Because this application is only for Android users, in further study, applications that all users can utilize should be developed.

Abbreviations

PHC: Primary Health Care; OR: Odds Ratio; CI: Confidence Interval.

Ethics Approval and Consent to Participate

The Ethics Commission Board approved this study: Poltekkes Kemenkes Tasikmalaya No. KP-KEPK/0066/2022. Permission to collect data was obtained from official authorities. Participants who agreed to participate in this study were asked to sign an informed consent form.

Competing Interest

The authors declared that there is no significant competing financial, professional, or personal interest that might have affected the performance or presentation of the work described in this manuscript.

Availability of Data and Materials

The data presented in this study are available in this article.

Authors' Contribution

Conceptualization: LN; Application development: ATI; data curation: LN, DW, and ATI; Formal analysis: LN and DW; Data collection: LN, DW, and ATI; Validation: LN, YC, and YF; Writing—original draft: LN; Writing—review and editing: LN, DW, ATI, YC, and YF. All authors have reviewed and approved the manuscript.

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Assessment of Rabies Control Attitudes During the COVID-19 Pandemic through Partial Least Square-Structural Equation Modeling

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Abstract

The COVID-19 pandemic disrupts rabies control activities in the community. A new approach is needed to control rabies during the COVID-19 pandemic through digital health interventions by conducting digital surveillance and education. This study aimed to determine key attitude indicators in controlling rabies during the COVID-19 pandemic. A cross-sectional study on 166 participants in Denpasar City with a total of 31 indicators measuring five variables: perceptions of the benefits of rabies control (6 indicators), perceptions of rabies risk (6 indicators), perceptions of obstacles to rabies control (5 indicators), perceptions of the need for technology (7 indicators), and attitudes toward rabies control (7 indicators) were analyzed using partial least square-structural equation modeling. The results revealed that 80.7% of participants owned a dog, and sources of rabies information were from social media (45%), the internet (33.7%), and rabies volunteers (33.1%). The model explained that perception of the benefits of rabies control and the need for technology had a direct effect on attitudes toward rabies control (p -value < 0.001 and 0.015). In brief, perceived benefits and the need for technology influence attitudes toward rabies control during the COVID-19 pandemic.

Keywords: Bali, COVID-19 pandemic, rabies control

Introduction

Rabies has killed more than 59,000 people in 150 countries, with 95% of cases occurring in Africa and Asia.¹ Rabies is endemic in eight of 11 countries in the Southeast Asia.² According to World Health Organization (WHO) reports, more than 1.5 million people are at risk of being infected with rabies, and 26,000 people die yearly.² Rabies is the global burden of disease at 45%.² The death rate from rabies in Indonesia is still high, around 100-156 deaths per year.³ Based on case reports, dogs contribute up to 98% of rabies transmissions, followed by cats and monkeys (2%).³

Of 34 provinces in Indonesia, eight provinces are free of rabies (Riau Islands, Bangka Belitung, Papua, West Papua, Special Capital Region of Jakarta, Central Java, Special Region of Yogyakarta, and East Java).³ In the last five years (2015-2019), 404,306 cases of animal bites transmitting rabies were reported, with 544 deaths.³ The high mortality from rabies shows that rabies in Indonesia is still a serious public health problem.⁴ Bali Island has been a rabies-infected area since 2008, and vaccination efforts were still limited then, and the dog population

was high.⁵ Since then, the cases have continued to increase and become extraordinary events.⁵ The number of dog bite cases in 2018, 2019, and 2020 (up to the 43rd week) was 19,440, 25,440, and 13,370, respectively.⁶

Based on data from the Department of Agriculture and Food Security of Bali Province, the estimated dog population in Bali Province in 2022 is 619,846.⁷ The coronavirus disease 2019 (COVID-19) pandemic has reduced vaccination efforts. Many unvaccinated dogs increase the rabies risk transmission.⁸ Free-roaming dogs and not being vaccinated are risk factors for the spread of rabies in Bali.⁹ The risk factors that make Bali infected with rabies include free-roaming dogs; the presence of other rabid animals such as monkeys, cats, and bats; dogs that are kept but not being fed; puppies obtained from outside the territory; a flow of dogs in and out of the village, and many people that have not received adequate education on rabies.¹⁰

The Bali Provincial Government has been trying to control rabies, but these efforts are still not optimal. Rabies control must be supported by increasing public

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awareness, routine vaccination, dog registration, population management, and a quick response to dog bite cases.¹¹ For this reason, education on controlling rabies and sociocultural program in the local community are needed. The WHO recommends vaccinating at least 70% of the dog population for rabies control.² Vaccination can increase herd immunity, requiring integrated supervision and increasing public awareness to care for their dogs.²

During the COVID-19 pandemic, it has not been easy to vaccinate, and door-to-door education has become a challenge due to social distancing policies. A study of the leading indicators of attitude is needed in controlling rabies during the COVID-19 pandemic.^{12,13} Therefore, this study aimed to determine the indicators influencing attitudes toward rabies control with the variables of perceptions of the benefits of rabies control, perceptions of rabies risk, perceptions of obstacles to rabies control, and perceptions of the need for technology.

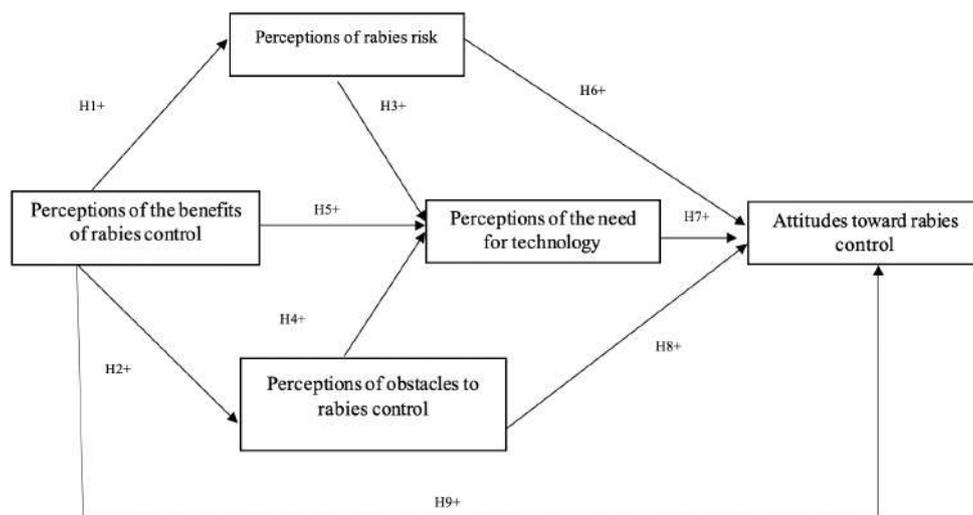
Method

This cross-sectional study was conducted in Denpasar City, Bali Province, from July to December 2021. This primary data was collected to assess indicators influencing attitudes toward rabies control. Data collection of an anonymous electronic survey used an online question-

naire with a Likert scale of 1-5—1 (strongly disagree), 2 (disagree), 3 (neutral), 4 (agree), and 5 (strongly agree) using Google Forms. The number of participants who were interviewed was 166 people in Denpasar City. Inclusion criteria included participants aged ≥17 years living in Denpasar City for over six months. Exclusion criteria were participants living outside the study area, aged <17 years, and could not answer the question.

The study permits were obtained from the Denpasar City Health Office and the Mayor. Thus, the data from the Civil Registry Office was provided. The questionnaires were sent via WhatsApp to the participants after completing a consent form and anonymous data. The theoretical model adopted a Health Belief Model (HBM) defining factors influencing health behavior, such as perceptions of health susceptibility, disease severity, health program benefits, perceptions of program constraints, and self-efficacy.^{14,15} Therefore, this study used five variables: perceptions of the benefits of rabies control, perceptions of rabies risk, perceptions of obstacles to rabies control, perceptions of the need for technology, and attitudes toward rabies control. Figure 1 describes the relationship between the direct and indirect hypotheses on attitudes toward rabies control.

The structural equation model was analyzed in a two-



Notes: The hypothesis from the structural model:

- Hypothesis 1 (H1). Perceptions of the benefits of rabies control positively affect the perceptions of rabies risk.
- Hypothesis 2 (H2). Perceptions of the benefits of rabies control positively affect the perceptions of obstacles to rabies control.
- Hypothesis 3 (H3). Perceptions of rabies risk positively affect the perceptions of the need for technology.
- Hypothesis 4 (H4). Perceptions of obstacles to rabies control positively affect the perceptions of the need for technology.
- Hypothesis 5 (H5). Perceptions of the benefits of rabies control positively affect the perceptions of the need for technology.
- Hypothesis 6 (H6). Perceptions of rabies risk positively affect the attitudes toward rabies control.
- Hypothesis 7 (H7). Perceptions of the need for technology positively affect attitudes toward rabies control.
- Hypothesis 8 (H8). Perceptions of obstacles to rabies control positively affect attitudes toward rabies control.
- Hypothesis 9 (H9). Perceptions of the benefits of rabies control positively affect attitudes toward rabies control.

Figure 1. The Structural Hypothesis of Attitude towards Rabies Control

Table 1. Data Description Indicator

Composite	Indicator	Definition
Perceptions of the benefits of rabies control	Var1a	The rabies vaccination program is beneficial for villages
	Var1b	Dog registration is very useful for the village
	Var1c*	Sterilization can limit the breeding of dogs
	Var1d	Public education is very important
	Var1e*	Treatment of free-roaming dogs needs to be done
	Var1f*	The program helps reduce throwing away dogs
Perceptions of rabies risk	Var2a*	I am at risk of being infected with rabies
	Var2b*	Rabies is a deadly disease
	Var2c*	Rabies is a disease for which there is no cure
	Var2d*	Everyone is at rabies risk
	Var2e	My family is afraid of getting infected with rabies
	Var2f	Tourists are afraid of being infected with rabies
Perceptions of obstacles to rabies control	Var3a*	People do not want to take good care of dogs
	Var3b*	Not willing to vaccinate dogs
	Var3c	Limited program funding
	Var3d	Rabies volunteers are limited in number
	Var3e	Limited vaccine schedule
Perceptions of the need for technology	Var4a	Information technology is very helpful
	Var4b	Have an Android phone to support activities
	Var4c	Accustomed to using social media such as Facebook, Instagram, YouTube, and others
	Var4d	Accustomed to using WhatsApp to communicate
	Var4e*	Rabies information can be found on the internet
	Var4f*	Willing to fill in data via the internet or cellphone
	Var4g*	Willing to share rabies prevention information with family and environment
Attitudes toward rabies control	Var5a	Willing to vaccinate dogs
	Var5b*	Sterilizing free-roaming dogs
	Var5c*	Owners who do not take good care of dogs will be penalized
	Var5d	First aid when bitten by a dog is to wash the wound for 10-15 minutes with running water and soap
	Var5e	First aid when bitten by a dog is to seek immediate health care
	Var5f	There is a need for health education related to rabies
	Var5g	Supporting rabies control program activities

Note: *These indicators were not included in latent variables due to the multicollinearity criteria of PLS-SEM.

step process. The first step described the results of the measurement model. Determine the relationship between constructions and indicators related to the structural model containing the relationship between constructs or model hypotheses. This sequence ensured that the measurement scale was valid and reliable before trying to reach conclusions about the hypotheses included in the structural model. This study used the free version of Smart-PLS software version 3.

Table 1 describes the indicators tested using the partial least square-structural equation modeling (PLS-SEM). Total of 31 indicators measuring five variables: perceptions of the benefits of rabies control (6 indicators), perceptions of rabies risk (6 indicators), perceptions of obstacles to rabies control (5 indicators), perceptions of the need for technology (7 indicators), and attitudes toward rabies control (7 indicators).

Results

The characteristics of participants in this study were mostly aged 17-24 years (25.3%), male (57.8%), private employees (57.8%), and went to senior high school

(55.4%). Based on dog ownership, 80.7% of participants owned a dog. Based on the source of information, most participants obtained information through social media (45.2%), internet (33.7%), health workers (33.7%), rabies volunteers (33.1%), television (15.1%), newspaper (5.4%), and radio (3.6%) (Table 2).

The composite measurement model in mode A (attitude) was assessed regarding individual item reliability, construct reliability, convergent validity, and discriminant validity. First, the reliability of each item was analyzed through a loading factor. The total loading factor of 0.839 has exceeded the cut-off value. Second, Cronbach's alpha and composite reliability were used to evaluate construct reliability. The construct exceeded these three measurements' recommended cut-off value of 0.7. All three convergent validity was proved because the construct's extracted mean-variance (AVE) was higher than 0.50. The measurement model met the criteria. Presents discriminant validity results through the Heterotrait-Monotrait (HTMT) correlation ratio. All constructs reached discriminant validity because the confidence interval did not contain a zero value, meaning each variable

differed.

The composite measurement model in mode B was assessed regarding collinearity between indicators, significance, and relevance of the outer weights. First, removing the indicator was carried out when the indicator exceeded the value of the variance impact factor (VIF = 3). As a result of this process, only the indicators shown in Table 1 were without collinearity. Second, the relevance of the weights was analyzed. Figure 2 shows the relevance of indicators in construction for latent variables. Finally, to assess significance, it was possible to start a bootstrap with 10,000 sub-samples, whether the outer weights differed significantly from zero. Indicators with insignificant weights but significant loadings of 0.50 or higher were considered relevant (Table 3).

The path coefficients and their 10,000 resampling bootstrap significance levels are reported in Table 3 and Figure 2. In addition, Table 3 shows that the VIF constructs range from 1,000 to 1,700, indicating no collinearity between variables. In addition, this study also assessed the quality by examining the overall predictive relevance of the model with a Q2 value above zero, indicating a fit in the prediction model. The coefficient of determination (R2) also exceeded 0.1 for endogenous latent variables, so the construct had an acceptable predictive power quality.

Table 4 also shows that variables 1 (perceptions of the benefits of rabies control) and 4 (perceptions of the need for technology) have a direct effect on variable 5 (attitudes toward rabies control) (p-value<0.001 and 0.015). Variables 1 and 4 were positively related to variable 5. The indirect effect could be seen from the Variance Accounted For (VAF) value. The VAF value indicated that the mediated proportion from variables 1 to

variable 5 through variable 4 was 0.27 or 27% (see the indirect effect in Table 4).

Table 2. Sociodemographic Characteristics of Participants

Variable	Category	n	%
Age (years)	17-24	42	25.3
	25-29	17	10.2
	30-34	15	9
	35-39	16	9.6
	40-44	24	14.5
	45-49	26	15.7
	50-54	13	7.8
	55-59	9	5.4
>60 years	4	2.4	
Sex	Male	96	57.8
	Female	70	42.2
Education	Primary school	1	0.6
	Junior high school	11	6.6
	Senior high school	92	55.4
	Diploma	23	13.9
	Bachelor's degree	33	19.9
	Master's degree	6	3.6
Occupation	Unemployed	7	4.2
	Civil servant	8	4.8
	Private sector worker	96	57.8
	Housewife	12	7.2
	Student	6	3.6
	College student	7	4.2
	Entrepreneur	19	11.4
	Teacher	4	2.4
	Village head	3	1.8
	Farmer	3	1.8
	Veterinarian	1	0.6
Dog ownership	No	32	19.3
	Yes	134	80.7
Source of information	Social media	75	45.2
	Internet	56	33.7
	Newspaper	9	5.4
	Radio	6	3.6
	Television	25	15.1
	Rabies volunteers	55	33.1
Health workers	56	33.7	

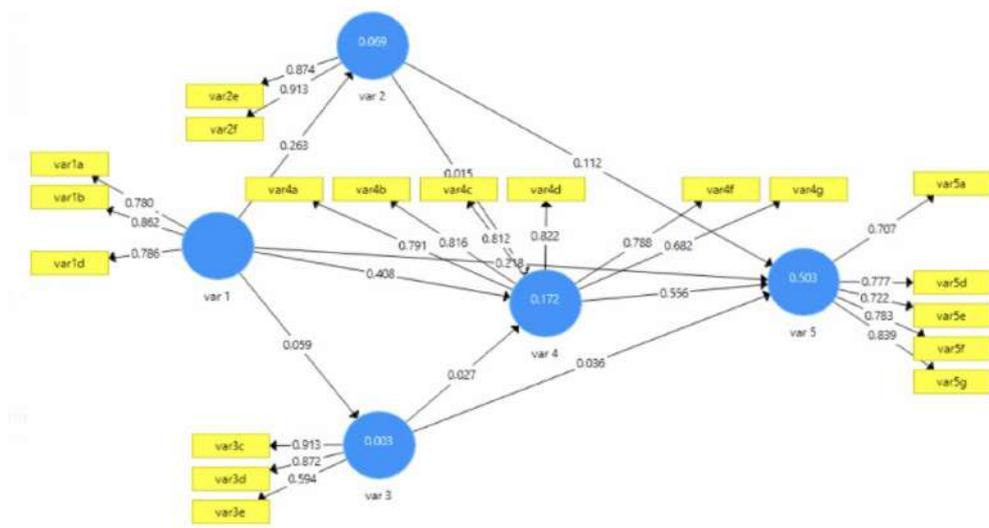


Figure 2. Model Results of Partial Least Square-Structural Equation Modeling

Discussion

This study was valuable as it developed an up-to-date instrument to measure attitudes toward rabies control by modifying the HBM. The indicators that made up the attitudes toward rabies control were being willing to vaccinate dogs, first aid when there was a bite wound, education on rabies, and supporting a particular program for rabies control. This study also found that the perceptions of the benefits of rabies control and the need for technology directly affected people's attitudes toward rabies control (p-value<0.001 and 0.015). Most participants agreed that the existence of information technology benefited them during COVID-19. The perceived benefits of implementing a digital system in controlling rabies were the speed of information, the ease of mapping dog density, the ease of recording data, and reducing data bias.

This study showed that 80.7% of participants owned a dog. Previous studies have shown that the relatively high population of dogs in Bali relates to cultural aspects—house guards and ritual facilities.¹⁶⁻¹⁸ Sources of rabies information mainly came from social media (45%), the internet (33.7%), health workers (33.7%), and rabies volunteers (33.1%). Social media and the internet are information media easily accessible today to get health or other news.¹⁹⁻²² Rabies volunteers and health workers are also essential in providing information to the public because they are an integral part of elevating public knowledge of rabies. Previous studies have found that outreach efforts to provide information are faster and more precise with volunteers and health workers in the field.²³

The concept of one health in the prevention and control of rabies is to combine the prevention of zoonotic diseases with animal welfare and public health approach-

es.²⁴⁻²⁶ It is essential to involve the community and other sectors in implementing rabies control and prevention independently. During the COVID-19 pandemic, many changes were made to all sectors, including the rabies program. Previous studies found that COVID-19 interfered with rabies surveillance and vaccination activities.^{8,27} Many studies have been conducted in the community to examine knowledge, attitudes, and practices regarding rabies prevention.^{15,16,28,29} During COVID-19, to know the attitude model for controlling rabies is

Table 3. Significance of Weights

Variable	Original Sample (O)*	t	Loading	Lo95	Hi95
Var1a	0.344	6.659	0.780	0.228	0.439
Var1b	0.405	8.885	0.862	0.326	0.500
Var1d	0.486	6.008	0.786	0.343	0.658
Var2e	0.510	4.479	0.874	0.262	0.651
Var2f	0.607	4.956	0.915	0.458	0.825
Var3c	0.572	1.407	0.915	-0.269	0.985
Var3d	0.448	1.152	0.872	-0.295	0.971
Var3e	0.146	0.363	0.594	-0.278	0.958
Var4a	0.301	9.716	0.791	0.244	0.362
Var4b	0.219	10.616	0.816	0.182	0.259
Var4c	0.166	8.341	0.812	0.123	0.202
Var4d	0.212	10.367	0.822	0.170	0.248
Var4f	0.179	7.394	0.788	0.132	0.225
Var4g	0.168	8.521	0.810	0.125	0.210
Var5a	0.249	8.296	0.707	0.198	0.312
Var5d	0.249	8.961	0.777	0.191	0.307
Var5e	0.243	6.796	0.722	0.173	0.311
Var5f	0.255	9.124	0.783	0.201	0.302
Var5g	0.305	9.892	0.839	0.244	0.367

Notes: T-statistic and 95% bias-corrected confidence interval performed by a bootstrapping procedure with 10,000 replications, Lo95 = Lower case of 95% CI, Hi95 = Higher case of 95% CI, Var 1 = Perceptions of the Benefits of Rabies Control, Var 2 = Perceptions of Rabies Risk, Var 3 = Perceptions of Obstacles to Rabies Control, Var 4 = Perceptions of the Need for Technology, Var 5 = Attitudes toward Rabies Control.

Table 4. Whole Sample Results

Effect	Path	t	p-value	Lo95	Hi95	f ²	VAF	VIF	R ²	Q ²
Direct effect	Var 1 → Var 2	0.263	2.749	0.006	0.107	0.473	0.074		1.000	0.069
	Var 1 → Var 3	0.059	0.671	0.502 ^{ns}	-0.151	0.195	0.003		1.000	0.003
	Var 1 → Var 4	0.408	5.556	<0.001	0.281	0.560	0.187		1.076	
	Var 2 → Var 4	0.015	0.208	0.835 ^{ns}	-0.122	0.172	0.000		1.076	
	Var 3 → Var 4	0.027	0.287	0.774 ^{ns}	-0.173	0.186	0.001		1.005	0.172
	Var 1 → Var 5	0.218	2.449	0.015	0.076	0.419	0.075		1.278	
	Var 2 → Var 5	0.112	1.673	0.095 ^{ns}	-0.043	0.221	0.023		1.076	
	Var 3 → Var 5	0.036	0.510	0.611 ^{ns}	-0.144	0.150	0.003		1.006	
	Var 4 → Var 5	0.556	7.215	<0.001	0.385	0.691	0.515		1.208	0.503
	0.083									
Indirect effect	Var 1 → Var 2 → Var 4	0.006	0.237	0.813 ^{ns}	-0.036	0.058		0.020	na	
	Var 1 → Var 3 → Var 4	0.006	0.237	0.813 ^{ns}	-0.036	0.058		0.070	na	
	Var 1 → Var 4 → Var 5	0.261	5.060	<0.001	0.171	0.365		0.270	na	
	Var 2 → Var 4 → Var 5	0.008	0.213	0.831 ^{ns}	-0.074	0.095		0.010	na	
	Var 3 → Var 4 → Var 5	0.015	0.290	0.772 ^{ns}	-0.092	0.108		0.030	na	

Notes: VIF = Variance Impact Factor, VAF = Variance Accounted for, Lo95 = Lower case of 95% CI, Hi95 = Higher case of 95% CI, ns = not significant, na = not applicable, Var 1 = Perceptions of the Benefits of Rabies Control, Var 2 = Perceptions of Rabies Risk, Var 3 = Perceptions of Obstacles to Rabies Control, Var 4 = Perceptions of the Need for Technology, Var 5 = Attitudes toward Rabies Control.

necessary. For effective education, attitude influences preventive and protective behavior.¹⁵ The HBM defines factors influencing health behavior, such as perceptions of health susceptibility, disease severity, health program benefits, program constraints, and self-efficacy.^{14,28,29}

This study found a modification of the HBM regarding attitudes toward rabies control. Model development used PLS-SEM, which could display in detail the factors that influence attitudes. During the COVID-19 pandemic, digital technology was needed to carry out rabies surveillance, and a structural model could demonstrate the community's attitude toward using digital technology. This study could also be a consideration for policymakers in controlling rabies using digital technology. The limitations of this study were the limited number and area of the participants; Denpasar City does not represent Bali Province. Participants were limited only to those with cell phones. However, this study demonstrated the role of factors influencing attitudes in controlling rabies.

Conclusion

During the COVID-19 pandemic, innovation is needed to make efforts to control rabies. The perception of the benefits of rabies control and the need for technology affect the community's attitude toward rabies control. The use of technology during the COVID-19 pandemic is needed to provide education and surveillance. Most people prefer information sources through social media and the internet because they are easier to access.

Abbreviations

WHO: World Health Organization; COVID-19: coronavirus disease 2019; HBM: Health Belief Model; PLS-SEM: Partial Least Square-Structural Equation Modeling; AVE: Extracted Mean-Variance; VAF: Variance Accounted for; VIF: Variance Impact Factor.

Ethics Approval and Consent to Participate

This study has received ethical clearance from the Faculty of Medicine, Udayana University (2448.UN.14.2.2.VII/14/LT/2021). This study was carried out following the Declaration of Helsinki and the recommendations of those committees with written informed consent from all participants.

Competing Interest

The authors declared that there is no significant competing financial, professional, or personal interest that might have affected the performance or presentation of the work described in this manuscript.

Availability of Data and Materials

The generated dataset is available to share from the corresponding author upon a reasonable request.

Authors' Contribution

SGP participated in conceptualizing, designing, analyzing, and revising

the manuscript. MS and AU participated in collecting the data, analyzing, and writing the manuscript. KA, IS participated in analyzing and writing the result in the manuscript. The authors discussed the results of the study. All authors read and approved the final manuscript.

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