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Kesmas: Jurnal Kesehatan Masyarakat Nasional (National Public Health Journal)

Exploration of Positive Deviance in Prevention of Underweight in the Under-Five: A Qualitative Study on Low-Income Urban Families

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Abstract

Children under the age of five (the under-five) from low-income families are more vulnerable to experience underweight. This nutritional vulnerability is evident in the preliminary study, where 35.1% of the under-five experience underweight, and 28.48% are low-income families. This study aimed to explore Positive Deviance (PD) behaviors in preventing underweight among the under-five. The study applied a qualitative approach with a case study design. Data collection took place in July-August 2022, focusing on low-income families in the Gunung Brintik area. Data were collected through two focus group discussions, seven in-depth interviews, and five key informant interviews. Coding, subtheme, and theme development were facilitated using the ATLAS.ti trial package. Triangulation of the study results yielded four major themes influencing the prevention of underweight in the under-five: interventions by health workers and cadres, community awareness and concern, family support, and maternal nutrition literacy. The identified PD behaviors practiced by the community in the study location have been shown to contribute to the prevention of underweight in the under-five. Strengthening these identified PD behaviors and their implementation in other areas is essential to support efforts to combat underweight in the under-five.

Keywords: positive deviance, the under-five, underweight

Introduction

Indonesia is a developing country with rapid economic growth globally. However, Indonesia still faces issues related to poverty and underweight. Research indicates that poverty is the root cause of underweight problems among children.[1] Conversely, being underweight in the early stages of life has been proven to contribute to the low quality of human resources. The low quality of human resources, in turn, becomes a trigger for the increasing poverty.[1–3] Therefore, poverty alleviation and addressing underweight (eliminating hunger) have become targets of the Sustainable Development Goals.[4]

Gradually, Indonesia has been able to reduce the prevalence of underweight in children under the age of five (the under-five). The prevalence of underweight in the under-five was recorded at 19.6% in 2016 and continued to decrease in 2018 to 17.7% and in 2019 to 16.3 %. Unfortunately, the prevalence of underweight increased to 17.0% in 2021 and rose again to 17.1% in 2022.[5,6] At the provincial level, the prevalence of underweight in the under-five remains a significant nutritional problem in Central Java Province. The 2022 data indicates that the underweight prevalence is higher than the national average, at 17.6%. In Semarang City, the provincial capital, the prevalence of underweight in the under-five was 13.5%.[6]

The high prevalence of underweight in the under-five is apparently in line with a high percentage of the poor population. The poor population at the national level in 2022 reached 9.57%, and Central Java Province has a higher percentage at 10.98%. Of 35 districts/cities in Central Java Province, it turns out that Semarang City has the highest percentage of poverty, with 84,000 poor people in 2022, or approximately 4.25% of the population.[7] Poverty in urban areas is a complex social problem. The under-five from poor families are more vulnerable to experiencing underweight.[3,8]

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Semarang, as the capital city of Central Java Province, still has several pockets of poverty, one of each is Gunung Brintik area, located in Community Units III and IV of Randusari Subdistrict, Semarang City. This area has a total of 653 families; 28.48% are classified as poor. The prevalence of underweight in the under-five in Gunung Brintik in 2021 was recorded at 35.1%. The nutritional situation analysis conducted in 2021 in the study location indicates that not all of the under-five from poor families in Gunung Brintik were underweight. Of 33 poor families, eight under-fives (24.2%) had normal nutritional status. This means that almost a quarter of poor families in the Gunung Brintik area exhibit Positive Deviance (PD) behavior.

PD is a behavior carried out to overcome problems in challenging conditions.[9] Studies on PD related to nutritional issues have been extensively conducted, demonstrating that some communities possess local wisdom, values, and social capital, which could be utilized to address various nutritional and health problems.[10–16] Therefore, the identification of PD is crucial so that PD can be replicated as a solution to nutritional problems in other locations. Based on this background, this study aimed to explore the PD behavior of urban poor families in the Gunung Brintik area in the prevention of underweight in the under-five.

Method

A qualitative study with a case study design was conducted to explore PD behavior. The setting was an urban poor area, specifically in the Gunung Brintik area, Community Units III and IV, Randusari Subdistrict, Semarang City, Indonesia. Data collection for the study took place for two months, from July to August 2022. PD, in this study, is defined as a behavior of under-fives' mothers successfully preventing their under-five from experiencing underweight from the poor families. Families are categorized as poor if they have a monthly income of <IDR 2,592,657 (USD 159,961).[7] Underweight is a condition for an imbalance in nutrient intake, characterized by a weight-for-age z-score <-2 SD. Good nutrition is defined if the under-five has a weight-for-age z-score between -2 SD and 2 SD.[17]

PD behavior, in this study, was examined within families categorized as poor but with those under-five in good nutritional status. The selection of subjects from poor families for the study was based on the mothers' activities at Integrated Health Care (IHC), specifically Community Units III and IV IHCs in Randusari Subdistrict, Semarang City. IHC is a social institution established by the community to assist, particularly, the under-five, pregnant women, and the elderly in accessing health services. Each Community Unit area with around 50 under-fives establishes an IHC. Technically, IHC becomes the primary partner for health workers in providing community health services, such as early detection of child development, monitoring the health of pregnant women, nutritional education, distribution of iron supplementation, and others.

Data collection employed three methods: focus group discussion (FGD), in-depth interview (ID), and key informant interview (KII). All data collection activities were recorded using a recorder on a smartphone. FGD was conducted twice, involving the under-five's mothers residing in the study location due to involving more subjects to get more comprehensive data. Each FGD was attended by six mothers selected by health cadres to participate in the FGD activities. FGDs were conducted in the meeting hall where IHC activities took place. The FGD activities were moderated by the researcher and assisted by a research staff to record the proceedings. The duration of each FGD was 40–60 minutes.

In-depth interviews were conducted with seven mothers of the under-fives from poor families residing in the study location; one of them could not come when the data was collected. Subject selection was proposed by health cadres, considering subjects actively participating in the IHC activities and willing to be interviewed. The in-depth interview was carried out through home visits using a pre-prepared interview guide. The implementation of in-depth interviews was adjusted to the respondent's availability, with interview durations within 40–45 minutes. This was done to capture a PD from a poor family in the city with a normal nutritional status of children.

KII involved stakeholders comprising three health cadres and two health workers (one nutrition expert and one midwife). The timing and location of the KII were adjusted to the availability of the informants. KII question guides were prepared to facilitate the interview process. The interview duration was 40–50 minutes for each informant.

After all the FGD, ID, and KII sessions were recorded, each word was transcribed. The transcription process was carried out by independent transcribers. Based on the transcript results, coding was then performed with the assistance of ATLAS.ti free trial package software. The next stage involved systematically identifying code repetitions throughout the data series and grouping them through content analysis, resulting in open codes. Subsequently, these codes were grouped into subthemes. After conducting a comparative analysis among various subthemes, primary themes were derived. Several statements from the subjects were quoted to support the presentation of the findings. Most of the subjects'

statements were delivered in Indonesian language, and some others were in Javanese. For the purpose of presenting the findings, the quotations were translated into English.

Results

A total of two FGDs, eight IDs, and five KIIs were conducted until data saturation was obtained. Tables 1, 2, and Figure 1 summarize the codes obtained from the study, which were then grouped into subthemes and finally into themes. The eight main subthemes emerging from the FGDs were supplementary feeding for malnutrition, active participation at IHC, grandmother's role, husband's role, the "Blessed Friday," public kitchen, nutritional knowledge, and access to information. Grandmother's role is a form of parent-grandmother's co-parenting relationship that is common in Indonesia. In Indonesian culture, the grandmother's role is often more dominant than the mother's, especially for working mothers.[18] The term "Blessed Friday" refers to the religious activities of the Indonesian Muslim community, in which, on Fridays, Muslims usually provide alms in the form of food to those people in need. A soup kitchen is a local wisdom in the form of food service managed by cadres to be given to underweight in the under-five. This behavior was adopted from good practices when COVID-19 survivors faced a lockdown situation. The eight subthemes were then successfully grouped into four themes: interventions by health workers and cadres, family support, community awareness and concern, and maternal nutrition literacy. A summary of the FGD participants' statements, subthemes, and themes can be seen in Figure 1.

In-depth interviews resulted in 10 subthemes consisting of part-time work, utilization of business opportunities, nutritional information from social media, validation of nutritional information, husband's role, grandmother/parent's role, community concern, alms food, supplementary feeding for malnutrition program, and active participation at IHC. The 10 themes could be grouped into five themes: creative supplementary income, maternal nutrition literacy, family support, community awareness and concern, and interventions by health workers and cadres. A summary of the ID results, subthemes, and themes can be seen in Table 1.

Table 1. Excerpts of Statements, Subthemes, and Themes from In-depth Interview

Verbatim	Subtheme	Theme
"Our earnings are very low; if I am not tenacious in finding additional pocket money for my children, it is a pity for my children." (Mother 1) "If relying on husband's wages alone, our needs, including buying nutritious food for our children, will not be enough." (Mother 2)	Part-time work	Creative supplementary income
"Mothers in our area are given the opportunity from the cooperative to work on flower arrangements. We get paid for this part-time job." (Mother 3) "I often take advantage of discounts from minimarkets to get daily necessities at low prices, then I will resell them to get the difference in profit." (Mother 1)	Business opportunity utilization	
"With mobile phone, I use the free WiFi from the local government to look for examples of cheap, nutritious menu variations for our children." (Mother 3) "There is a WhatsApp group created by the cadre mothers. I often read nutrition advice often shared through the WhatsApp group." (Mother 4).	Nutritional information from social media	Maternal nutritional literacy
"Sometimes I am skeptical about nutritional information from social media, so I ask the midwife." "I practiced making nutritious but cheap food for my children that I got from social media." (Mother 3)	Validation of nutritional information	
"My husband is willing not to buy food outside when he goes to work; he says it is to save money so that it can be used to buy nutritious food for the child." (Mother 5) "If my husband gets snacks at work, he often brings them home for the children." (Mother 6).	Husband's role	Family support
"My mother-in-law still often comes to visit and brings food for my child." (Mother 5) "We live not far from my parents' house, so my parents still often share food, especially for our child." (Mother 7)	Grandmother/parent's role	
"*Alhamdulillah*, even though we live poorly in the city, there are still many people who care to help provide food, especially for our children." (Mother 8) "In IHC, there are people who become donors in making additional food for toddlers." (Mother 4)	Community awareness	Community awareness and concern
"Our neighborhood has many poor people, many people from various places give food as "alms" especially every Friday." (Mother 5) "My first child always brings rice packages from the mosque after Friday prayers; he brings several packages to give to his younger siblings." (Mother 7)	Alms meal	
"The midwife said that our child was underweight, so we received one supplementary food package consisting of green beans, sugar, oil, milk powder, biscuits, shredded beef, and anchovies." (Mother 6) "The supplementary food package for underweight children from the PHC is very beneficial for our child." (Mother 7)	Supplementary feeding for underweight children under five	Interventions by health workers and cadres
"We realize that if we are poor, our children may also be underweight, which is why we regularly come to IHC to get check-ups and assistance." (Mother 1) "I feel helped by the IHC; my child is checked for health, given vitamins and food." (Mother 3)	Activeness of IHC visits	

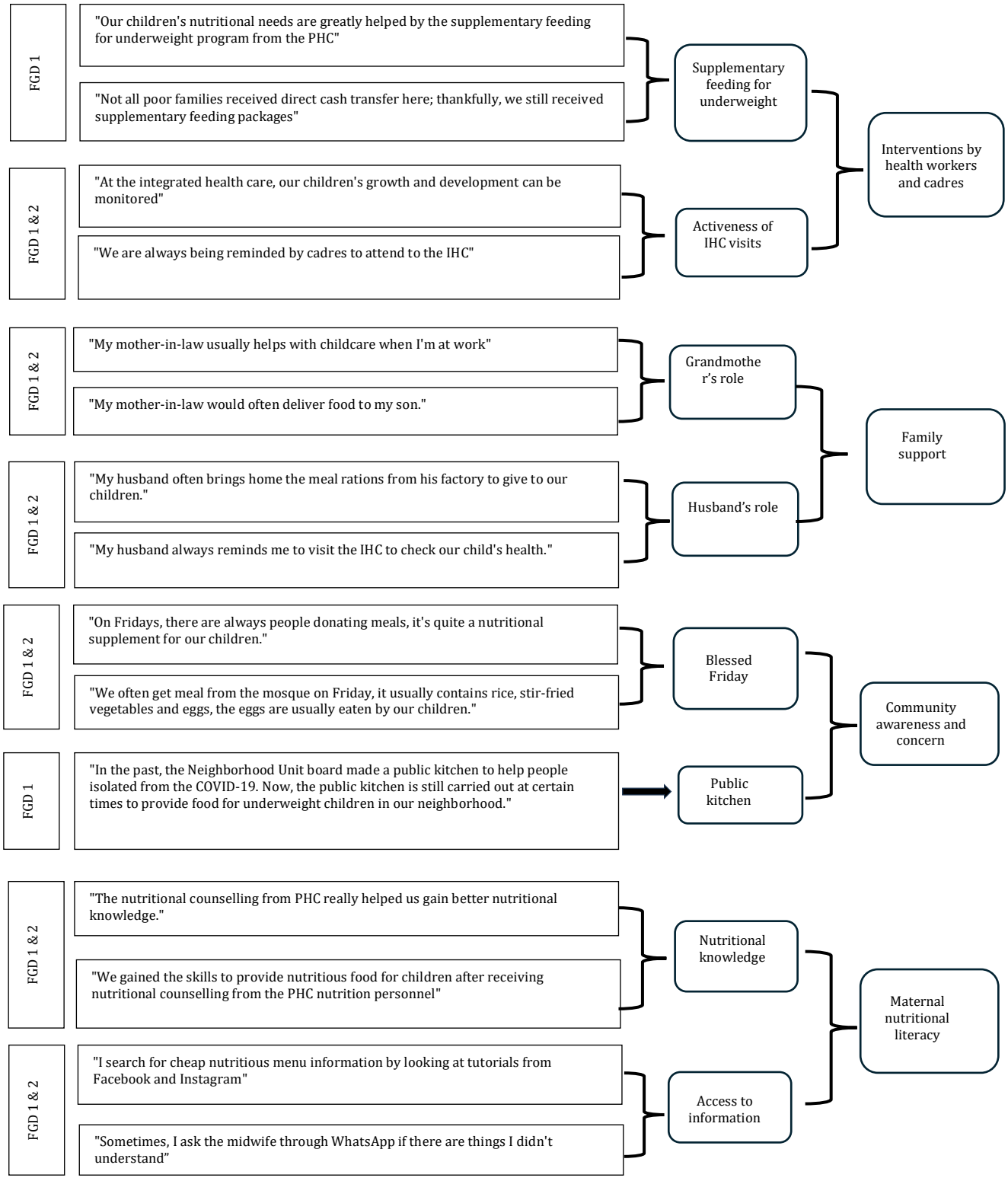

Figure 1. Excerpts of Statements, Subthemes, and Themes from Focus Group Discussion

Interviews with key informants who are the stakeholders related to tackling underweight resulted in 5 important themes: 1) intervention by health workers and cadres, 2) community awareness and concern, 3) family support, 4) maternal nutrition literacy, and 5) sanitation and clean water. The summarized results of the key informant interviews can be seen in Table 2.

Table 2. Summary of Key Informant Interviews

Theme	Statement	Subject
Interventions by health workers and cadres	"PHC is very focused on the malnutrition prevention program. We have implemented various activities such as early detection of growth and development, supplementary feeding, nutritional education, and community empowerment."	PHC nutritionist
	"PHC has received funding from both the Provincial Budget and Budget Allocation Assistance for the supplementary feeding program for malnourished children. We also conduct monitoring so that the assistance is right on target."	PHC midwife
Community awareness and concern	"Although most of our residents live in poverty, the concern and participation of some residents in becoming health cadres is very important to prevent underweight in the under-five."	Health cadre 1
	"Our health cadres work sincerely; at every IHC activity, we always make reminder calls to mothers so that those with the under-five may come to have their children examined."	Health cadre 2
	"The COVID-19 pandemic taught us the necessity of community awareness; to this day, the public kitchen activities are still often carried out to provide nutritious food for children living in our neighborhood."	Health cadre 3
Family support	"Our community's sense of kinship is still quite strong, with grandmothers/mothers-in-law/parents still taking a role in the care of under-fives."	Health cadre 1
	"The husband's support in meeting the nutritional needs of the family is crucial. As cadres, we continue to campaign for husbands to stop smoking and prioritize their money to provide nutritious meals."	Health cadre 2
Maternal nutritional literacy	"Mothers with good nutritional literacy can minimize the risk of their child experiencing underweight. Therefore, we continuously carry out nutritional education efforts within the community."	PHC nutritionist
Sanitation and clean water	Efforts to overcome stunting problems need to be supported by sensitive programs such as environmental sanitation and clean water.	PHC midwife

Note: PHC = primary health care

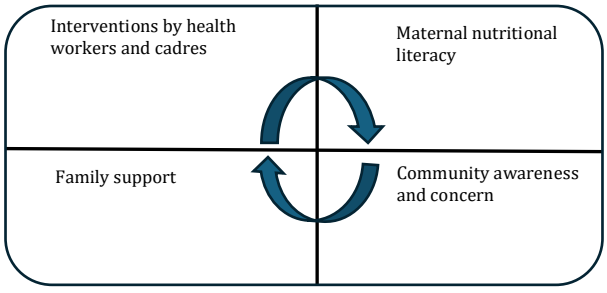

Figure 2. Triangulation of Themes

The triangulation of concepts (from FGD, ID, and KII) resulted in the following four themes: intervention by health workers and cadres, community awareness and concern, family support, and maternal nutritional literacy, as shown in Figure 2. These four themes are forms of PD behavior that can be identified and validated from ID, FGD, and KII data sources. Themes 1 and 2 (intervention by health workers and cadres and community awareness and concern) are forms of PD behavior accepted by all the under-fives at the study location. Themes 3 and 4 (family support and nutritional literacy) are forms of PD behavior the poor families have, but are successful in caring for their under-fives, so they avoid the problem of underweight. Themes 1 and 2 are external factors, while Themes 3 and 4 are internal factors of the family. These four themes work together and are related to forming PD behavior that can prevent underweight problems, especially in urban poor families.

Discussion

This qualitative study utilized a PD approach to investigate factors contributing to the prevention of underweight in the under-five, despite economic hardship. Generally, those under-five from low-income families residing in urban areas are at a high risk of being underweight. However, it has been found that certain behaviors can prevent underweight.[12,19] Several examples of PD behavior are creative supplementary income, willingness to improve nutritional literacy, and family support. Encouraging positive deviant behavior is crucial in addressing the underweight. These PD behaviors can be replicated to tackle the underweight more widely.

Intervention by Health Workers and Cadres

The identification of PD in this study found that intervention by health workers and cadres is an important factor in preventing underweight. In this study, intervention by health workers and cadres refers to services provided by health workers and cadres in the IHC activities. Health cadres were volunteers assisting health workers in providing community health services. IHC provided five-table services: registration, the under-five's height and weight measures, records of maternal and child health books, nutritional counseling, and health services by health workers. In addition to these five activities, IHC also organized supplementary feeding activities. The menu used in the supplementary feeding activity was not only to meet the nutritional needs of the under-fives, but also used as a medium for nutritional education for their mothers.

Health workers provided food parcels to all the malnourished under-fives. Each malnourished young child received a three-stage (three-month) food parcel containing local foods, such as green beans, sugar, oil, powdered milk, biscuits, beef floss, and anchovies. The food parcels were delivered to the homes of families with malnourished children by health workers accompanied by health cadres. During the visits, health workers and health cadres also provided nutritional education to the mother of her young child and family, in particular, the husband and grandmother.

The success of poor families in terms of preventing underweight in their children in the study location depends on their compliance with health workers and cadres.[20] Active participation in every IHC activity is one form of behavior that can prevent underweight in the under-fives from poor families. A previous study suggested that the success of malnutrition prevention programs depends on two factors: innovative health worker interventions and community compliance with officer recommendations.[20]

Community Awareness and Concern

Community awareness and concern can positively contribute to problem-solving for difficulties faced by residents in their neighborhood. One example of PD behavior demonstrating community awareness and concern is the high dedication of health cadres.[21] The health cadres in this study were fully committed to supporting the implementation of IHC. They worked before, during, and after IHC activities. The day before the IHC activity, they made reminder calls to all mothers of the under-five. After the IHC activities, the cadres still actively visited the malnourished under-fives at their respective homes to ensure that the food aid provided by the health workers was actually used for the under-fives' consumption.

The commitment of health cadres is evident in their involvement with public kitchens. These kitchens organized food processing and distributed meals to residents in need of food assistance. Health cadres acted as coordinators and mobilized the community to participate in these activities. The first public kitchen was established during the COVID-19 pandemic when many community members were in self-isolation. Sources of food and funding for public kitchens were obtained through community donations. Even after successfully controlling the COVID-19 pandemic, public kitchens continue to operate periodically to assist those in need. This demonstrates the dedication and commitment of health workers to implement effective measures to address underweight in the under-fives.[22]

Indonesia is basically a religious community. One behavior that contributes greatly to the prevention of being underweight is providing food alms to those in need. Many Indonesian Muslims distribute foods and side dishes to the other people in their neighborhood, specifically on Fridays. Additionally, some community leaders become donors for the procurement of supplementary feeding food during the IHC activities. This study's findings support previous studies indicating that participation is the primary means of addressing many health issues through social capital.[23–26]

Family Support

Poverty restricts access to nutritious food. Most mothers in poor families are facing difficulties in providing some nutritious intake for their under-fives while they do not receive support from their husbands and extended family members. The extended family, particularly parents, in-laws, or grandparents, play a significant role in assisting with food needs. In the paternalistic cultural context, husbands or men typically avoid involvement in kitchen-related tasks. The responsibility for food provision falls entirely on the wife or mother. In impoverished families with such cultural norms, mothers face double challenges in meeting the nutritional needs of their under-fives.[18]

This study identified deviant PD behavior from paternalistic culture. Husbands in the study location showed a concern for meeting the nutritional needs of their children. Some husbands even brought home meals provided by the factory where they worked to give to their children. Nutritional support also comes from in-laws/parents, who have the

ongoing practice of providing food to their grandchildren.[27] This PD behavior aligns with findings of prior studies stating that family support is a form of PD behavior practiced by almost all communities worldwide.[19,28]

Maternal Nutritional Literacy

Mothers are key actors in meeting the nutritional needs of the under-five.[11,28] Nutritional literacy is the capacity they possess to acquire, process, and understand nutritional information for practical application. Mothers from low-income families with good nutritional literacy have a greater likelihood of preventing undernutrition in their under-fives.[29] Maternal nutritional literacy in the context of this study was obtained from nutritional counseling services provided by nutrition officers during IHC activities. Mothers of the under-fives also received nutritional counseling when the health officers and cadres visited their homes to provide food assistance packages.

Some mothers could also utilize the free WiFi facility provided by the government to access nutritional information from social media. Additionally, some mothers demonstrated the ability to validate nutritional information by consulting nutrition experts during counseling sessions at the IHCs. The efforts made by those mothers to advance nutritional literacy represent a form of PD that needs to be maintained and replicated. The findings of this study align with previous studies exploring PD behavior related to preventing nutritional problems among children under five.[30]

Conclusion

Interventions by health workers and cadres, community awareness and concern, family support, and maternal nutritional literacy are key factors contributing to the mitigation of underweight under-five. Strengthening and replicating these factors on a larger scale within the community can aid efforts to address underweight in the under-five. For nutritional program managers, this study's findings can serve as a reference for developing programs related to improving the nutrition and health of children. Further study can be carried out to deepen the understanding of each factor mentioned above.

Abbreviations

PD: Positive Deviance; IHC: Integrated Health Care; FGD: Focus Group Discussions; ID: in-depth interviews; KII: Key Informant Interviews; PHC: Primary Health Care.

Ethics Approval and Consent to Participate

The research was conducted after obtaining ethical clearance documents from the Health Research Ethics Commission of Universitas Negeri Semarang, registration number 048/KEPK/III/2022. All subjects participating in the study provided informed consent before the research was carried out.

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

Data and materials are available from the corresponding authors.

Authors' Contribution

IB was responsible for the entire process, including the analysis, writing, and revision of the manuscript. LF was responsible for the conceptualization, and DSR supervised the findings of the work. All authors discussed the results and contributed to the final manuscript.

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Risk Factors for Cognitive Impairment in Adult Population of Coastal Area: A Cross-Sectional Study in Maringkik Island, Indonesia

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Abstract

Cognitive impairment is a medical condition commonly found in elderly populations, which can be due to vascular risk factors in patients. There remains limited data on risk factors for cognitive impairment among coastal region populations. This study aimed to investigate risk factors for cognitive impairment in the adult population of Maringkik Island, West Nusa Tenggara Province, Indonesia. Data collected were age, sex, education level, hypertension, antihypertensive treatment, diabetes mellitus, cigarette smoking, and body mass index status. A total of 114 participants were recruited using a consecutive sampling method. The participants' cognitive function assessment used the Mini-Cog instrument. The cognitive impairment frequency in the island's adult population was approximately 48.2%. The final model of multiple regression analysis showed that hypertension (OR: 2.3; 95%CI: 1.0 – 5.0; p-value: 0.045) was a characteristic associated with the cognitive impairment frequency. Thus, the high frequency of cognitive impairment and hypertension frequency as primary risk factors for cognitive impairment in the island's adult population implies the need to develop strategies for detecting and managing hypertension and hypertension-related cognitive impairment in the population by local health authorities.

Keywords: coastal area, cognitive impairment, hypertension, vascular risk factor

Introduction

Cognitive impairment is a common medical condition found in the population over 55 years, increasing with age. Dementia has a global prevalence of 2-3% in the 70-75 age group. This percentage increases 10-fold to 20-25% in the age group of 85 years.[1,2] This cognitive impairment can be found in a wide clinical spectrum, ranging from mild to severe cognitive impairment, a condition called dementia.[3] In the dementia stage, patients will experience a decline in social and functional capacities, resulting in a high dependence on their caregivers. This condition will ultimately give rise to economic, social, and health burdens for patients, families, and health service providers.[4]

The cognitive impairment can develop with increasing age or due to existing vascular risk factors in patients, including hypertension, diabetes mellitus, dyslipidemia, overweight/obesity, stroke, and cigarette smoking.[5,6] Identification and good control of these vascular risk factors should be integrated with the cognitive impairment and dementia intervention program developed by healthcare authorities for both community-based and hospital-based populations. In addition to health-related risk factors, socioeconomic factors and limited access to healthcare services also influence and contribute to the decline in cognitive function in the elderly population.

Higher socioeconomic status is associated with better cognitive abilities among the elderly population. Good financial and emotional support is linked to better cognitive abilities.[7] Cognitive impairment is more prevalent among the elderly

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population with low economic status. However, education and improved access to healthcare centers help improve the cognitive function of the elderly population with low economic status.[8] A proper intervention for cognitive impairment in at-risk populations is a cost-effective way to slow the progression of cognitive impairment and allow them to maintain optimal social and functional activities for many years before their cognitive function ultimately declines significantly.[9,10]

Population living in coastal areas is susceptible to myocardial infarction associated with distinct vascular risk factors.[11] Since vascular risk factors also increase the risk of cognitive impairment and dementia, the population living in coastal regions should be considered to have a distinct frequency of cognitive impairment. Previous studies showed that hypertension was the vascular risk factor consistently showing a high prevalence in coastal regions,[12–14] while other well-identified vascular risk factors, including hyperlipidemia, diabetes mellitus, smoking, alcoholism, and arterial peripheral disease, show mixed results.[11,14,15] Differences in the distribution of vascular risk factors other than hypertension in various regions based on previous studies are mainly due to differences in economic levels, education levels, eating habits, and climatic conditions in different regions.[16]

The consumption of high-salt marine products generally found in coastal populations among Southeast Asian countries, including Indonesia, is likely an important dietary factor contributing to the high frequency of hypertension.[17] However, data on the frequency of cognitive impairment in coastal populations is currently still scarce. Given the different sociocultural characteristics between coastal and non-coastal populations, investigating risk factors for cognitive impairment in coastal populations is pivotal. This study aimed to investigate risk factors for cognitive impairment in the adult population of Maringkik Island, representing populations of coastal areas in the West Nusa Tenggara Province.

Method

This study was conducted on Maringkik Island, a small island located in the Southeastern part of Lombok Island, West Nusa Tenggara Province, Indonesia. This small island has an area of six hectares inhabited by approximately 2,763 people based on the latest 2019 population census.[16] More than half of male islanders are fishermen. The island has relatively limited health and education service facilities for its inhabitants, an auxiliary Primary Health Care, and formal education facilities up to junior high school. Most islanders commonly use sodium salt as a food flavoring and a traditional preservative for their seafood products.

This cross-sectional study involved the adult population of Maringkik Island as participants recruited consecutively between January and June 2023. Using the formula $(Z\alpha 2PQ)/d2$ to calculate the sample size, where $Z\alpha = 1.96$, prevalence (P) = 31.5,[18] Q = 1 – P, and margin of error (d) = 0.1, the minimum sample size required in this study was 85 (n = 85). The inclusion criteria were participants aged ≥18 years, fully conscious, and voluntarily participated. The exclusion criteria included significant visual and hearing impairments, as well as illiteracy. All participants provided written informed consent before participating in the study.

Data collected in this study were sociodemographic and clinical characteristics of the participants. Sociodemographic data, including age, sex, and education level, were collected using a questionnaire. Age was categorized as adult (<60 years old) and older adult (≥60 years old); sex was categorized as male or female; and education level was categorized as lower (≤6 years) or medium to high (>6 years). Clinical data, including hypertension, diabetes mellitus, cigarette smoking, and body mass index (BMI) status, were obtained using questionnaires and/or physical examinations.

Participants were categorized as having hypertension if they had a record of hypertension diagnosis and/or were taking antihypertensive medicines at the time of the interview and/or had systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg at the time of physical examination. They were categorized as having diabetes mellitus if they had a record of diabetes mellitus diagnosis and/or were taking antidiabetic agents at the time of examination and/or had a random blood glucose level of ≥200 mmHg. Participants were categorized as smokers if, at the time of the interview, they were actively smoking. The participants' BMI was obtained by dividing their weight in kilograms by the square of their height in meters (kg/m^2). Using the cut point value of 25 kg/m2, the BMI status of the participants was categorized as normoweight (BMI <25 kg/m^2) or overweight/obese (BMI ≥25 kg/m2). Data collection on the sociodemographic and clinical characteristics of the participants was carried out by well-trained fourth-year medical students.

The cognitive function of the participants was assessed using the Mini-Cog instrument. The Mini-Cog is a simple cognitive function evaluation instrument that is suitable for use at the population level, and its screening value is not significantly affected by education.[19] The instrument consisted of sequential instructions, including repeating and

remembering three unrelated words, completing the clock drawing test, and recalling the three unrelated words mentioned earlier. This instrument had a score range of 0-5, and participants with a score ≥3 were considered to have normal cognitive status, while those with a score <3 were considered to have cognitive impairment. Evaluation of cognitive function using the Mini-Cog instrument for the participants was carried out by well-trained general practitioners.[20]

In the first step, participants entitled to visit the public health examination program that had been prepared were directed by the research team to the fourth-year medical students to obtain information on research procedures to confirm their willingness to participate in the study. The participants who agreed to participate were asked to sign an informed consent form provided. In the second step, participants voluntarily agreed to participate in this study. They underwent an interview session with the fourth-year medical students on the same day, which was the first step in obtaining data on their sociodemographic and clinical characteristics using structured questionnaires.

Blood pressure measure, random capillary blood glucose examination, and participants' weight and height measures were also conducted in the second step. Any data collected from the participants were recorded carefully and in detail on the participant's case report form by the fourth-year medical students responsible for the completeness of the participant's data. In addition, capillary blood glucose examination was carried out aseptically by trained laboratory staff using test strips and blood glucose meters.

Data are presented as mean value±standard deviation (SD) for continuous variables or frequency (%) for categorical variables. The analyses were performed in two steps. First, simple logistic regression tests were conducted to determine the factors associated with the frequency of cognitive impairment among participants. Second, a final model of multiple logistic regression tests was applied to determine factors with a p-value of <0.25 in the first analysis, which were significantly associated with the frequency of cognitive impairment among participants. Statistical significance was set at a p-value of <0.05.

Results

This study recruited a total of 114 participants. Table 1 shows the sociodemographic and clinical characteristics of participants. The frequency of cognitive impairment in the adult population of Maringkik Island was approximately 48.2%. Most participants were adults and females with lower levels of education. Hypertension and obesity/overweight were vascular risk factors found with high frequency in this adult population.

Table 2 shows the results of a simple regression analysis examining the association between independent variables (sociodemographic and clinical characteristics) and dependent variables (cognitive status). This analysis showed that age (OR: 2.7; 95%CI: 1.1 – 6.7), education level (OR: 2.0; 95%CI: 0.9 – 4.8), and hypertension (OR: 2.7; 95%CI: 1.3 – 5.8) were the eligible characteristics for inclusion in the multiple logistic regression analysis. However, other characteristics, including sex, antihypertensive treatment, diabetes mellitus, overweight/obese, and cigarette smoking, were ineligible for subsequent analysis (p-value ≥0.25).

Table 3 shows the results of the final model of multiple regression analysis examining the risk factor for cognitive impairment among participants. This analysis showed that hypertension (OR: 2.3; 95%CI: 1.0 – 5.0) was the only characteristic that was a risk factor for cognitive impairment. However, older adults and lower educational levels were not the risk factors for cognitive impairment.

Table 1. Characteristics of the Participants

Variable	Mean±SD or Frequency (%)
Age in years, mean±SD	47.6±12.5
Age category, n (%)	
Adult	87 (76.3)
Older adult	27 (23.7)
Sex, n (%)	
Male	26 (22.8)
Female	88 (77.2)
Years of education, mean±SD	
Education level, n (%)	6.2±3.4
Lower (≤6 years)	83 (72.8)
Medium to high (>6 years)	31 (27.2)
Hypertension, n (%)	
Yes	56 (49.1)
No	58 (50.9)
Antihypertensive treatment, n (%)	
Yes	31 (27.2)
No	83 (72.8)
Diabetes mellitus, n (%)	
Yes	11 (9.6)
No	103 (90.4)
BMI, mean±SD	26.8±4.9
BMI status, n (%)	
Overweight/obese	74 (64.9)
Normoweight	40 (35.1)
Cigarette smoking, n (%)	
Yes	22 (19.3)
No	92 (80.7)
Mini-Cog score, mean±SD	2.4±1.2
Cognitive status, n (%)	
Impaired	55 (48.2)
Normal	59 (51.8)

Notes: SD = standard of deviation, BMI = body mass index.

Table 2. Simple Logistic Regression Showing Variables Associated with Cognitive Impairment Among Participants

Variable	Cognitive Status		Crude OR (95%CI)	p-value
	Impaired	Normal		
Age category, n (%)				
Older adult	18 (66.7)	9 (33.3)	2.7 (1.1–6.7)	0.031*
Adult	37 (42.5)	50 (57.5)	Reference	
Sex, n (%)				
Male	12 (46.2)	14 (53.8)	1.1 (0.5–2.7)	0.808
Female	43 (48.9)	45 (51.1)	Reference	
Education level, n (%)				
Lower (≤6 years)	44 (53.0)	39 (47.0)	2.0 (0.9–4.8)	0.099*
Medium to high (>6 years)	11 (35.5)	20 (64.5)	Reference	
Hypertension, n (%)				
Yes	34 (60.7)	22 (39.3)	2.7 (1.3–5.8)	0.010*
No	21 (36.2)	37 (63.8)	Reference	
Antihypertensive treatment, n (%)				
Yes	15 (48.4)	16 (51.6)	1.0 (0.4–2.3)	0.985
No	40 (48.2)	45 (51.6)	Reference	
Diabetes mellitus, n (%)				
Yes	5 (45.5)	6 (54.5)	1.1 (0.3–3.9)	0.846
No	50 (48.5)	53 (51.5)	Reference	
BMI status, n (%)				
Overweight/obese	36 (48.6)	38 (51.4)	1.0 (0.5–2.3)	0.907
Normoweight	19 (47.5)	21 (52.5)	Reference	
Cigarette smoking, n (%)				
Yes	8 (36.4)	14 (63.6)	1.8 (0.7–4.8)	0.218
No	47 (51.1)	45 (49.9)	Reference	

Notes: *eligible for multiple regression analysis, OR = odds ratio, CI = confidence interval, BMI = body mass index.

Table 3. Final Model of Multiple Logistic Regression Analysis Showing Eligible Variables Associated with Cognitive Impairment Among Participants

Variables	Cognitive status		Adjusted OR (95%CI)	p-value
	Impaired	Normal		
Age category, n (%)				
Older adult	18 (66.7)	9 (33.3)	1.9 (0.7–4.9)	0.201
Adult	37 (42.5)	50 (57.5)	Reference	
Education level, n (%)				
Lower (≤6 years)	44 (53.0)	39 (47.0)	1.8 (0.7–4.4)	0.193
Medium to high (>6 years)	11 (35.5)	20 (64.5)	Reference	
Hypertension, n (%)				
Yes	34 (60.7)	22 (39.3)	2.3 (1.0–5.0)	0.045*
No	21 (36.2)	37 (63.8)	Reference	

Notes: *eligible for multiple regression analysis, OR = odd ratio, CI = confidence interval.

Discussion

This study investigated the frequency of cognitive impairment and its risk factors in the adult population of Maringkik Island, a small coastal area in the West Nusa Tenggara Province, Indonesia. This is the first study conducted among the adult population of residents in coastal areas. This study showed a quite high frequency of cognitive impairment in the adult population of Maringkik Island at 48.2%, and hypertension was a risk factor for cognitive impairment. Previous studies showed that hypertension was an important vascular risk factor for cognitive impairment, both independently and through its interaction with other vascular risk factors.[21,22] Therefore, hypertension management is a crucial intervention that should be made as an effort to prevent cognitive impairment in the adult population on Maringkik Island.

Previous studies showed that populations in coastal areas typically had hypertension as their major vascular risk factor.[23–25] This might be related to the population's high daily consumption pattern of sodium salt (>5 grams per day), either through the long-standing habit of consuming marine food sources that are high in sodium, the use of sodium salt as a food seasoning, and the use of sodium salt to preserve fish for daily consumption.[17,26] Theoretically, sodium intake contributes to the pathophysiology of hypertension by affecting vascular smooth muscle cells, sodium pump dysfunction, influx of calcium ions, vascular smooth muscle contraction, and increased vascular resistance.[27]

Accordingly, educating the population about the necessity of reducing daily salt intake as an effort to prevent and control hypertension is pivotal. Optimal control of hypertension is expected to reduce the risk of cognitive impairments related to hypertension in coastal populations. However, since more than half of the Maringkik Island population has a low level of education and consuming sodium salt in food is their habit, developing an educational strategy for low daily consumption of sodium salt in this area poses a challenge for the local health authority.

This study also showed that clinical characteristics, including diabetes mellitus, overweight/obesity, and cigarette smoking, were not associated with an increased frequency of cognitive impairment in the Maringkik Island population. The relationship between these variables and the frequency of cognitive impairment in coastal populations has never been studied. Previous studies have shown that diabetes mellitus, overweight/obese, and cigarette smoking are risk factors for cognitive impairment in the general population.[5,6]

The difference between the results of this study, which represents the adult population in coastal areas, and the results of previous studies conducted on the general population regarding the relationship between these variables and the frequency of cognitive impairments might be related to differences in participant characteristics and the study methods applied, including differences in cognitive assessment instruments. Despite these differences in results, identification and intervention strategies for vascular risk factors such as hypertension, diabetes, and smoking still need to be carried out as part of cognitive impairment intervention strategies designed for coastal populations.

This study has several limitations. First, most of the data on the characteristics of participants were obtained only based on the participants' self-reports, which could lead to possible inaccuracies in the data. Since participants mostly had a low level of education, recall bias of the participants regarding the data collected was likely to occur. Second, the diagnosis of diabetes mellitus is ideally based on measuring blood glucose levels during and two hours after the oral glucose tolerance test using a venous blood sample. Considering that this method is difficult to apply to the population studied due to their busy daily activities, the measurement of blood glucose levels in this study used samples obtained from capillary blood examined using the strip test and glucose meter method.

Third, since this study was carried out on a single population and small sample size with a cross-sectional design, generalization of the study results to populations in other coastal areas should be done carefully. Fourth, the consecutive sampling technique is a non-randomized method, meaning that the samples collected were possibly not

evenly distributed. This uneven distribution could potentially impact the study findings. Fifth, the absence of adaptation of the Mini-Cog instrument to potential cultural or educational differences in Maringkik Island and the lack of validation and questionnaire reliability testing might affect the results of this study. Sixth, this study did not evaluate depression as part of confounding variables. However, due to the lack of data on the frequency and risk factors for cognitive impairment in coastal populations, the results of this study are valuable to be used as a basis for developing early detection strategies and interventions for cognitive impairment and accompanying vascular risk factors in coastal populations.

Conclusion

The adult population of Maringkik Island has a high frequency of cognitive impairment, and hypertension is the risk factor for this high frequency. Strategies developed for early identification and intervention of cognitive impairment and accompanying risk factors in this population should be structured based on their sociodemographic characteristics. A longitudinal study is suggested to be conducted to investigate the influence of hypertension on the progression of cognitive function impairment in Maringkik Island. In addition, future studies should include the analysis of relevant biomarkers to observe pathological changes and utilize more comprehensive neurocognitive evaluation tools to confirm the diagnosis.

Abbreviations

BMI: Body Mass Index; SD: standard deviation; OR: odds ratio; CI: confidence interval.

Ethics Approval and Consent to Participate

This study was approved by the Health Research Ethics Commission of Universitas Mataram, Mataram (Register number: 352/UN18.F7/ETIK/2022). All subjects provided were informed under written consent prior to their participation.

Competing Interest

The authors declare no competing financial, institutional, or personal interest.

Availability of Data and Materials

Data and materials for this study are available from the corresponding author at reasonable request and for non-commercial purposes.

Authors' Contribution

HSH, AWR, N, FFZ, DS, LOS, and YI were conceptualizing and designing the study. HSH, AWR, NN, FFZ, DS, LOS, YI, AA, MH, and ADH were analyzing and interpreting the results of the study. HSH, AWR, and YI were drafting the manuscript. HSH, AWR, N, FFZ, DS, LOS, and YI were revising the manuscript.

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Exploring Informal Caregivers' Perspectives on Oral Care for Stroke Patients

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Abstract

Stroke often results in physical disability and functional impairment, which may severely limit patients' ability to care for personal hygiene, including oral care. This study aimed to identify the challenges faced by informal caregivers in managing the oral health of stroke patients. This study conducted semi-structured individual interviews with eight home-based caregivers of stroke patients recruited from a community-based clinic facility of a public university in Malaysia. The interviews took 30-45 minutes to complete and were transcribed verbatim. Transcripts were analyzed thematically using a phenomenological approach. Relevant themes that emerged were variations in oral hygiene care, caregivers' concerns in providing oral care, dental clinic utilization, and caregivers' perceived educational and training needs. This study highlights the challenges faced by caregivers in managing the oral health of stroke patients. Improving access to dental services for stroke patients and tailoring educational programs to suit the specific learning needs of caregivers, as identified in this study, may result in improved health outcomes for stroke patients.

Keywords: caregivers, oral care, oral hygiene, stroke care, stroke rehabilitation

Introduction

Stroke is a major cause of impairment and vascular death worldwide, including in Asia.[1] The incidence and prevalence of stroke increase steadily associated with nutritional changes and the aging of the population.[2] Every year, the global incidence of stroke is reported to reach 12.2 million new cases. Furthermore, it is projected that one in four individuals aged older than 25 years will experience a stroke in their lifetime. Stroke is the third leading cause of death in Malaysia, with almost 20,000 fatalities reported annually.[3]

Stroke often leads to physical disability and functional impairment, greatly restricting the patient's ability to maintain their personal hygiene, including brushing their teeth and cleaning their mouths. This limitation has a negative impact on their oral health, as poor oral hygiene can lead to serious complications, such as pneumonia and other infections.[4] In addition, the impact of stroke on alertness, cognition, and perception significantly reduces the patient's ability to independently perform self-care tasks, including oral care routines.[5] It is noteworthy that since the stroke mortality rate in Malaysia is lower compared to the other Southeast Asian countries, the number of patients living with stroke-related disabilities is higher.[3] Therefore, improving the quality of life of stroke survivors through effective oral care practices is urgently needed.

Despite increasing awareness of the importance of oral health in stroke care, it remains under-recognized in Malaysia. The Integrated Care Pathway for Post Stroke patients (iCaPPS ©), omits the oral health component of rehabilitation and routine screening for post-stroke complications.[6] A multidisciplinary approach to oral care, extending beyond professional care to include home-based caregivers, often family members of stroke patients, can significantly enhance oral health outcomes. These caregivers play a key role in early identification, assessment, and referral, complementing the work of occupational therapists, nutritionists, and speech-language pathologists in stroke rehabilitation. However, they often lack adequate knowledge of oral health care due to the absence of tailored guidelines.[7]

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Numerous devices and technologies can assist in post-stroke oral care, but many caregivers are unaware of them.[8] Good oral health contributes to overall well-being and can enhance recovery and rehabilitation outcomes. Therefore, educating both patients and their caregivers is crucial to addressing the challenges of caring for this group's oral health. For these points, this study aimed to identify challenges faced by caregivers in managing stroke patients' oral health and to establish a foundation for creating oral care training guidelines tailored to caregivers' needs, making it significant as it not only addresses specific local needs in Malaysia but also contributes valuable insights and models that can be applied regionally and internationally. It bridges gaps in existing research by focusing on the multidisciplinary and caregiver-inclusive aspects of oral health in stroke rehabilitation, advocating for a more integrated and holistic approach to health care.

Method

This study used the phenomenological approach, a type of qualitative research to explore multiple perspectives and deeply understand individual life experiences. A qualitative methodology was selected to investigate deeply into the perspectives and experiences of caregivers concerning oral care for stroke patients. By conducting in-depth interviews, subjective perspectives, beliefs, and emotions allow a more comprehensive understanding of the caregiver's experiences to be revealed. This approach captured the complex and contextual nature of caregiver's experiences, offering insights that quantitative methods alone might not reveal.

A semi-structured interview guide was developed through consultation with experts in long-term stroke care and dental public health with topics on knowledge and practices regarding the oral health of the patients, challenges faced by caregivers in caring for stroke patient's oral health care, and training needs relating to caring for the oral health of the patient. The interview guide applied the following sequence: introduction and ice-breaking, background information of the stroke patient's condition, caregivers' knowledge and practices regarding the oral health of the patients, their insight on the challenges faced in caring for the oral health of the patients, and their perspectives on training needs related to caring for the oral health of the patients. Two researchers were tasked as interviewers and were provided the necessary training by senior team members with vast qualitative study experience. The interview guide was pilot-tested, followed by minor amendments. Discussions were held to ensure smooth execution and standardization of interviewing techniques.

The participants in this study were recruited from a primary clinic under the Universiti Kebangsaan Medical Centre. The target population consisted of the stroke patients' caregivers. Purposive sampling and snowballing technique were employed to select participants who met specific inclusion criteria, including being a family member or caregiver of a stroke patient with a Modified Rankin Scale (MRS)[9] score of 3 and above, aged ≥18 years, and having provided care for the stroke patient for at least one year. Exclusion criteria included caregivers responsible for patients in the rehabilitative phase and non-Malaysian caregivers.

The MRS score is a tool commonly utilized to assess functional disability and the overall outcome of stroke patients. It provides a measure of the patient's level of disability or dependence after a stroke. The scale ranges from 0 to 6, with each level representing a specific degree of disability. The MRS score is typically determined through clinical assessment and examination of the patient's functional abilities to evaluate the impact of stroke on a patient's daily life and guide treatment decisions and rehabilitation planning. This study took a structured interview to determine the patients' MRS scores.[9]

The interview was structured into five sections, each tailored to a particular level of disability in the MRS,[10] as follows: Section 1: constant care (corresponding to MRS grade 5) includes individuals who are bedridden, incontinent, and require constant nursing care; Section 2: assistance for bodily needs/walking (corresponding to MRS grade 4) involves individuals who are unable to walk without assistance and require help with their bodily needs; Section 3: assistance to look after own affairs (corresponding to MRS grade 3) pertains to individuals requiring some assistance but can walk without assistance; Section 4: usual duties and activities (corresponding to MRS grade 2) refers to individuals who are unable to carry out all previous activities but can manage their own affairs without assistance; and Section 5: symptom checklist (corresponding to MRS grades 1 and 0) includes individuals who can carry out all usual duties and activities despite experiencing symptoms (MRS grade 1) or have no symptoms at all (MRS grade 0).

To recruit caregivers for stroke patients, their contact information was accessed from the primary clinic patient database. Potential participants were contacted via WhatsApp, and online interviews were coordinated by Microsoft Teams or Google Meet, based on the participants' convenience. Each session lasted 30-45 minutes and was recorded with

the participants' consent. The interview process occurred from December 2022 to March 2023, with data saturation achieved after eight comprehensive interviews.

The recorded interviews were transcribed verbatim into a Google Sheet prior to analysis. Field notes were taken down at the time of interviews, and reflexivity was used during data analysis. Referrals to the videos were made whenever there was a need to clarify the pronunciation of words or the way they were spoken. A content analysis of the interview transcripts was then undertaken following the guidelines for thematic analysis specified by Braun and Clarke.[11] First, the interviewers acted as initial analysts by reading and rereading the transcripts to familiarize themselves with the dataset. Second, an initial coding frame was developed from the identified initial codes. To enhance data triangulation, these codes were presented to the senior team members, and any discrepancies in codes were discussed until consensus was achieved. Some of the team members were clinicians treating stroke patients and being familiar with issues related to caregivers' experiences. Third, once all the transcripts had been coded, team members explored possible emerging themes that would reflect the meanings of the participants' words. Fourth, the emerging themes were reviewed, and once again, discrepancies were discussed until consensus was achieved. Data remained in the Malay language during the analysis, and illustrative quotes were eventually translated into English.

Results

Table 1 shows the caregivers' and patients' background information. Eight caregivers participated in this study. Seven of them were either sons or daughters of stroke patients; all of them lived with the patients. One caregiver was a neighbor staying with the patient except for Sundays. More than half of the caregivers were females, attaining higher education, and aged 22-58 years. All the stroke patients were elderly, aged in the range of 64-86 years. They had been diagnosed with stroke within the last 1-20 years, and their MRS scores ranged from 3 to 5. Patients getting an MRS score of 5 were on feeding tubes. All except two of the patients had missing teeth; one patient was fully edentulous. Only two patients used dentures to replace their missing teeth.

Table 1. Background Information of Study Participants

Caregiver's Information					Patient's Information			
Code	**Name**	**Age (years)**	**Highest Education**	**Relation with patient**	**Age (years)**	**Number of years Since stroke diagnosis**	**MRS**	**Using denture**
CG1	Mrs W	58	Secondary school	Daughter	72	5	4	No
CG2	Miss I	41	University	Daughter	78	20	3	No
CG3	Mr S	33	Secondary school	Son	64	14	5	No
CG4	Miss A	24	University	Daughter	66	4	4	No
CG5	Mrs M	41	University	Neighbor	86	1	4	Yes
CG6	Mr R	51	University	Son	78	8	5	No
CG7	Miss Q	22	University	Daughter	66	4	4	Yes (patient is fully edentulous)
CG8	Mrs H	37	University	Daughter	73	2	3	No (having dentures but not using them since the stroke)

Notes: MRS = Modified Ranking Scale, CG = caregiver

A total of four themes and 14 subthemes emerged during the interviews, summarized in Table 2 above and detailed with some selected responses below:

Variations in the Oral Hygiene Care

Ability to clean mouth

The caregivers (CG) reported a mix between the ability of the patients to clean their mouths and teeth and the type of oral hygiene tools that they used. Some were able to brush their own teeth and used standard toothbrushes without any need for modifications, while others required assistance.

Independent

CG1: "Mum uses her left hand to brush (not affected by stroke)."

CG5: "The stroke affects her left side. Her dominant hand is her right hand, so she can brush by herself."

Assisted

CG3: "I have to help her clean her mouth because she uses the feeding tube."

G5: "She has been able to brush by herself from the beginning, but I need to help her with taking water for gargling."

CG6: "My mother is bedridden and has dementia. She cannot brush on her own. I have to do it for her."

Table 2. Summary of Themes and Subthemes in the Study

Theme	Subtheme
Variation in oral hygiene care	• Ability to clean mouth • Types of toothbrush • Other ways of cleaning the mouth • Denture care
Caregivers' concern in providing oral care	• Attentiveness and proactivity • Concern about potential complications • Patient-specific challenge
Dental clinic utilization	• Difficulty in accessing dental services • Denture-related problem • Attitude towards seeing a dentist
Caregivers' perceived educational and training need	• Acknowledged the need for training • Knowledge needed by caregivers • Importance of training • Caregiver's constraint

Types of toothbrush

Most of the caregivers reported the use of standard toothbrushes except for two patients.

Modified

CG1: "I make it (the toothbrush) longer and thicker by attaching a stick to it."

Small-sized

CG3: "She can use a normal toothbrush, but it must be small; otherwise, it will cause her pain."

CG5: "At first, she used a children's toothbrush, but now she can open her mouth wider and use an adult toothbrush."

Other ways of cleaning the mouth

CG2: "He enjoys gargling, and if he feels he cannot brush properly, he opts for gargling instead."

CG3: "Cleaning her mouth is limited because she cannot swallow. I rarely use toothbrushes…, I usually clean her mouth with gauze wet with Listerine."

Denture care

CG7: "He does not want to clean his dentures, so I have to help him with that. It is also hard for him to remove (denture) himself."

Caregivers' Concerns in Providing Oral Care

Attentiveness and proactivity

CG1: "We must always look after the patients; if she becomes quiet, that is a signal to check on her and offer assistance with cleaning her mouth."

CG1: "When she has an ulcer, she will be very quiet. We have to give her barley water or coconut water."

Concerns about potential complications

CG1: "She has challenges eating and drinking. Every time she eats, she will consume slowly and drink a little water. I noticed that ulcers tend to form (due to lack of water)."

CG1: "…heard her choke when she's brushing; this is not good".

CG3: "Brushing has its own risks because my mother wears a feeding tube. The technique is different from ours, and if done incorrectly, it may cause infection in the lungs due to excessive swallowing of saliva, toothpaste, and water during brushing."

Patient-specific challenges

G3: "Sometimes she does not want to open his mouth."

CG3: "Mother eats through the feeding tube. We cannot use toothbrush…"

CG3: "One time, she bit my finger while I was cleaning her teeth. I had to use a small spoon to get her mouth open (and release my finger)."
CG5: "She took a month or two before she is accustomed to using her left hand to brush."
CG5: "Previously had a problem opening mouth adequately."

Dental Clinic Utilization

Difficulties in accessing dental services

CG1: "I do not take her to dental clinics anymore. Most clinics are on the second floor, and there is no lift. And I cannot push her wheelchair up. I used to carry her up, but it made my back hurt."
CG3: "Doctors at the stroke clinic referred her for dental treatment…, she went three times to the dental clinic at the university hospital…, the (private) ambulance took her…, Then, she was referred to the Kajang dental clinic. The dental team from there came for a home visit. They stopped after covid (pandemic)."
CG5: "…Health clinics (government) will take a long team to get an appointment. For private clinics, it is so expensive, and no easy access for wheelchair."

Denture-related problems

CG5: "The denture is unfit as she lost weight due to a stroke. May need to do new denture but have no plans for now."
CG8: "Dad has difficulty chewing as he only has a few remaining teeth left, and he is not wearing his denture because it does not feel good anymore."

Attitude towards seeing a dentist

CG4: "She was supposed to make a denture after pulling out her teeth, but she prefers to just stay at home instead… She is in a wheelchair; most of the time, she does not want to go out."
G5: "I never took her for a dental checkup. Seems she does not have any problem. But do we need to do that? If we need, we can arrange."

Caregivers' Perceived Educational and Training Needs

Acknowledged the need for training

CG1: "Need to have (training program) because this knowledge you got to know cause the stroke over here is not just for a person but two people."
CG2: "Honestly, for me it is (training program) needed because we do not know what is needed for the oral care of the patient."

Knowledge needed by caregivers

CG2: "...I want to know the size of the toothbrush. Because nowadays, there are a lot of sizes for toothbrushes in the market. We do not know what is the suitable one, so maybe the type of toothbrush that is suitable for us? What toothpaste is suitable because maybe there is a presence of sugar in it. We do not know because we could not understand to read the label (on the toothpaste)."
G3: "Expand more programs in the bedridden wards. It is important for the family and caregivers of the bedridden patient to know how to take care of the teeth. If you can, visit each of the bedridden patient's wards. This (oral) knowledge, the exposure needs to be face-to-face then only they can understand."
CG8: "…(important to know about) long term effect of not wearing a denture, because existing denture can only be worn for a few years, so need to inform us (what we should do in this situation)."

Importance of training

G5: "They need to explain the importance of this oral health related to stroke because many people do not understand. For me, people do not know about it…, try to show what will happen if they are not taking care (of oral health), Malaysian people need to be shown the consequences. Just informing them to take care of their mouth, nothing's going to happen, but if showing what is going to happen of not taking care (oral health) then they can understand."

CG7: "Caregivers need to know about oral healthcare because everything starts with a caregiver; if caregivers feel it is not important, then it is very unfortunate for their patients."

Caregivers' constraints

CG2: "If there is a program, if the time at that time is suitable and I am available, I would like to join the program to increase my knowledge."

CG6: "Depends on the time because I am also busy. If the program does not clash with my schedule, I have no problem (to attend)."

G8: "I can come if it is done online."

Discussion

The findings of this study highlighted the challenges faced by caregivers in managing stroke patients' oral health and emphasized the significance of oral care for stroke patients. The qualitative approach allowed for an in-depth exploration of caregivers' experiences, attitudes, and practices related to oral hygiene routines for stroke patients, revealing important insights that quantitative methods alone might not have captured. One key theme emerging from the interviews was variation in oral hygiene practices among stroke patients. While some patients were able to brush their teeth using a standard toothbrush, others required assistance or modified tools. Those with higher dependency scores (MRS grade 5) are the ones who need help, which is not unexpected considering they have limited physical, sensory, and cognitive abilities, which comprise self-care.[12]

Oral hygiene care is a core component of self-care, and extra care is needed for stroke patients with difficulties in carrying out personal oral hygiene care. A review indicated that oral hygiene interventions could have positive effects on stroke patients' oral health status, such as reducing plaque index (PI), gingival index (GI), candida colonization, bleeding gums, and preventing stroke-associated pneumonia (SAP).[13] Moreover, Dai *et al.* advocate for the inclusion of oral hygiene care programs within stroke outpatients as it may improve the patient's oral hygiene and increase the knowledge of the other aids available to help with oral hygiene care.[14] One way is to integrate oral care into iCaPPS ©.[6]

This study featured concern regarding oral care for stroke patients, considering the challenges experienced by both caregivers and care recipients. First, stroke patients' caregivers provide support, encompassing physical aid and psychosocial assistance; yet, this supportive role might impose a significant burden on the patient and caregiver. Such burdens might impact caregivers' health, social life, and overall well-being. Informal caregivers invest substantial time and attention, and any oversight could lead to unwarranted consequences for stroke patients. Not surprisingly, the caregivers in this study expressed worries about potential risks during oral hygiene, such as patients accidentally swallowing saliva or toothpaste, which poses a health threat, particularly for those with systemic conditions such as aspiration pneumonia. These concerns emphasized the caregivers' commitment to the patient's well-being, highlighting the need for effective interventions to help caregivers manage challenges associated with patients' considerable cognitive and emotional adjustments.[15]

Additionally, patient-related challenges in oral care stem primarily from inadequate dexterity skills. Post-stroke, hand function abnormalities arise due to lesions in the motor cortex and corticospinal tract, crucial for independent finger movements.[16] Technology such as powered oral care tools, non-powered tools, and modifications to non-powered tools are accessible to help overcome barriers in post-stroke oral care.[8] In fact, various training and rehabilitation strategies have explored the impact of finger and hand training in chronic stroke patients to address deficits in dexterous movement.[17] Therefore, enhancing hand dexterity is beneficial for achieving positive outcomes in oral health care, and its role in oral care could be integrated into the overall rehabilitation of patients.

In this study, the findings related to dental clinic utilization highlighted several key issues that the stroke patients' caregivers faced. They reported various barriers to accessing dental services, including physical accessibility issues (e.g., clinics located on upper floors with no lift access), closure or renovation of clinics, long waiting times for appointments at public health clinics, and high costs at private clinics. These findings align with a previous study indicating that physical, systemic, and financial barriers can significantly hinder access to dental care for individuals with disabilities.[18] Several caregivers noticed that their care recipients had problems with their dentures, such as ill-fitting dentures due to weight loss after a stroke and difficulties in chewing due to few remaining teeth, but did not associate this with the need to be seen by a dentist.

Most caregivers sought dental care when the care recipient was in pain, suggesting a reactive rather than preventive approach to oral health care. These attitudes might reflect less awareness or understanding of the significance of routine dental checkups and preventive oral health care. These findings highlighted the need for interventions to improve dental service access for stroke patients and caregivers, which includes making dental facilities more accessible, streamlining appointment systems, and providing affordable care options. Consideration should be made to initiate dental hygiene care even while patients are in the acute stroke wards. Additionally, education can bolster caregivers' understanding of routine checkups, preventive care, and effective denture management.

On this note, effective caregiver training has proven to improve the oral health and plaque control performance of stroke patients.[19] Providing targeted training programs covering topics such as oral care techniques, proper tool selection, and the importance of oral health for stroke patients can significantly elevate the caregivers' knowledge, skills and commitment.[20] Many caregivers turn to health professionals, such as physicians, nurses, and therapists, for information to navigate through unfamiliar situations. However, the success of oral care training hinges on its accessibility to caregivers. The caregivers in this study expressed some constraints on their availability to attend classes. Thus, relevant training should consider various platforms and timings, for example, offline sessions on weekends that include practical demonstrations or more flexible e-learning modules or online webinars. This tailored approach enhances the program's effectiveness and boosts the caregivers' motivation to actively participate in the training.

Given the current stroke burden in Malaysia, addressing oral health in stroke care is of utmost importance. Similar to many countries, Malaysia witnessed a rising incidence of stroke attributed to lifestyle changes and an aging population.[3] With stroke being a major cause of impairment and vascular death, prioritizing holistic care for stroke patients, including their oral health, becomes essential.[3] In Malaysia, where home-based informal caregivers, often family members, play a significant role in the care of stroke patients, their knowledge and skills in oral care are central to ensuring positive outcomes.[21] As primary caregivers of stroke survivors, these individuals often experience significant physical, mental, and social impacts, even more so when they share the same residence with the patients and are expected to provide care around the clock. A local study identified two major needs emerging for these caregivers: the need for information on comprehensive stroke care at home and the need for psychological support for themselves.[21] Without proper care and support for them, caregivers will psychosocially suffer from burnout, anxiety, and depression, ultimately worsening the patient's physical and psychological conditions.[22-25]

This study found a prominent gap in the availability of support and guidelines for caregivers to deliver oral care, emphasizing the need for tailored educational programs. At the same time, informal caregivers in Malaysia encounter multiple unmet needs beyond the learning aspects of oral care for stroke patients. The literature has vast reports on significant concerns of caregivers, such as financial constraints, insufficient information regarding home-based stroke care, lack of psychological support, barriers for survivors to return to work, and a shortage of community-based rehabilitation therapies.[22-27] Addressing these unmet needs is critical to improving the quality of life for both stroke survivors and their caregivers.

The COM-B model, a theoretical framework used in behavioral science to comprehend and interpret behavior,[28] can be applied to expand the conclusions of this study. This model outlines four prerequisites—behavior, opportunity, motivation, and capability—that must exist in order for a voluntary behavior to take place. This study proposes that the term "capability" refers to the psychological and physical capacities of stroke patients' caregivers to offer oral care, probably impacted by their knowledge and abilities. "Opportunity" may refer to external variables that make dental care possible, for instance, the accessibility of tools and resources such as dental clinics for post-stroke dental care. "Motivation" describes the conscious and unconscious cognitive processes of caregivers that lead and encourage them to facilitate oral hygiene care or seek professional dental care, particularly for their family members. These factors may be addressed through tailored educational programs, as discussed before in the previous paragraph. The COM-B model acknowledges that many factors impact behavior and that for behavioral change to take place, at least one of these components is modified. As such, the model provides a useful framework to interpret the findings of this study and formulate strategies to improve caregivers' oral health practices for stroke patients.[28]

While this study provides valuable insights into the experiences of caregivers of stroke patients, it is pivotal to acknowledge some potential limitations related to the small sample size. An inherent limitation of small-sized studies is that they may limit generalizability; nonetheless, the aim of qualitative study is depth of understanding, not breadth. Furthermore, this study employed purposive sampling, ensuring that participants were selected based on their ability to provide rich, relevant, and diverse data. This, combined with rigorous data analysis techniques, contributed to the

achievement of saturation, indicating a comprehensive capture of experiences and perspectives. However, future studies could benefit from larger or more diverse samples and longitudinal studies to validate this study's findings in different contexts and over time.

To enhance the caregiver's role in facilitating rehabilitation for stroke patients, particularly concerning oral care and overall oral health, several recommendations to consider are developing targeted caregiver education programs focusing on specific challenges of oral care for stroke survivors; emphasizing the integration of oral health into the broader stroke care framework to stress its importance in rehabilitation; fostering open communication channels between caregivers and healthcare professionals to address concerns promptly; establishing the community-based support networks and resources for caregivers to provide ongoing assistance; and disseminating regular updates on the latest advancements in oral care and rehabilitation strategies to keep caregivers informed and empowered.

Conclusion

This study sheds light on difficulties that caregivers face while providing oral health care for stroke patients, emphasizing how essential effective oral care is. With stroke posing a considerable burden in Malaysia, providing holistic care that includes addressing oral health needs becomes imperative. Improving dental service access for stroke patients and tailoring educational programs to match the specific learning needs of caregivers, as identified in this study, can lead to improved health outcomes for stroke patients.

Abbreviations

iCaPPS ©: Integrated Care Pathway for Post Stroke patients; MRS: Modified Rankin Scale; CG: caregivers.

Ethics Approval and Consent to Participate

Permission to conduct the study was obtained from the Universiti Kebangsaan Malaysia Research and Ethics Committee (REF NO: UKM PPI/111/8/JEP-2022-374) prior to the commencement of the study. Prior to the commencement of the online interviews, caregivers were provided with a study information sheet explaining the study's objectives and procedures. They provided a digital signature on the informed consent form once they agreed to participate.

Competing Interest

The authors declare that there are no competing interests in this study.

Availability of Data and Materials

Data and materials used in this project may be available from the corresponding author upon reasonable request.

Authors' Contribution

HR, SNMZ, EO, and TNMD contributed to the design and implementation of the research and the analysis of the results. AFAA and MFA verified the study instruments, analytical methods, and data interpretation. SNMZ, EO, and TNMD were responsible for preparing the manuscript, and all authors discussed the results and contributed to the final manuscript. All authors approved of the final manuscript.

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Complete Dose of Hepatitis B Vaccination Among Children in Indonesia and Factors Associated: A Community-Based Study

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Abstract

Hepatitis B vaccination is widely recognized as the most effective way to prevent hepatitis B infection, yet the rate of complete vaccination among Indonesian children remains low. This study aimed to evaluate the extent of hepatitis B vaccination coverage among children and identify potential associated factors in Indonesia. A community-based cross-sectional study was conducted. The study involved 7,860 Indonesian mothers of children aged 12-59 months, providing data on their children's hepatitis B vaccination status and other relevant factors from the 2017 Indonesian Demographic Health Survey. Overall, the rate of complete hepatitis B vaccination among children was relatively high (89.8%). Several factors were found to be associated with complete hepatitis B vaccination among children: living in Java, the Lesser Sunda Islands, Kalimantan, and Sulawesi compared to Sumatra; having an older mother; having parents with secondary or higher education compared to no education; having an employed mother; belonging to middle or high economic status compared to low economic status; having mothers using media irregularly or regularly, as opposed to never using media; having health insurance; and having a larger family size. These findings highlight the need for further interventions to optimize childhood hepatic vaccination coverage, which health policymakers should support.

Keywords: children, complete dose, hepatitis B, immunization, vaccination

Introduction

Hepatitis is a pathological condition characterized by inflammation of the liver resulting from a viral infection.[1] Roughly 900,000 deaths occur annually worldwide due to hepatitis B virus infection.[2] In addition, 95% of infected infants and early childhood might result in chronic hepatitis B.[1] Indonesia is categorized as a region with a moderate to high prevalence of hepatitis B virus.[3] It was recognized for having the second-highest number of infections in the Asia Pacific region, following India, which contributed to 74% of global deaths from liver cancer.[3-5] Moreover, based on the Indonesian National Health Survey (INHS) conducted in 2013, the prevalence of HBsAg was recorded at 7.1 %.[6] Muljono *et al.* reported several factors related to the high prevalence of hepatitis B in Indonesia, such as inadequate disease surveillance systems, geographical barriers, and limited testing facilities for hepatitis B detection.[7]

The hepatitis B vaccine is the key component in hepatitis B prevention, and in Indonesia, the hepatitis B vaccination program for children has been in place since 1997. The Indonesian hepatitis B vaccination program includes an initial dose given within seven days after birth, followed by three doses of combination vaccines covering diphtheria, tetanus, and pertussis (DTP) administered during the second, third, and fourth months.[8] However, the hepatitis B vaccination coverage was low and remained lower in the second and further doses. According to the 2018 INHS, the proportion of hepatitis B birth dose reached 83.1%, but then it decreased to 65.4% (second dose), 63.9% (third dose), and 61.3% (fourth dose).[9] Similarly, the 2017 Indonesian Demographic Health Survey (IDHS) reported that the hepatitis B vaccination trend stays low from the birth dose (85.1%) to further doses (87.6%, 81.3%, and 74.5% for first, second, and third dose, respectively).[10] Interestingly, this percentage is lower than that of DTP vaccination, although given simultaneously.

There are several influential factors in complete hepatitis B vaccination among children. A study by Kyuregyan *et al.* in 2018 showed that the principal reason for the absence of a hepatitis B birth dose in the Russian Federation was parental refusal.[11] A study on homeless children in Paris found that children in contact with the healthcare system at least once in the previous year had higher coverage of vaccination.[12] Wilson *et al.* claimed that children missing the hepatitis B birth

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dose vaccine were at risk for under-immunization by 18 and 24 months.[13] However, few studies have specifically assessed hepatitis B vaccination coverage. It is debatable whether the determinants are comparable to those influencing routine vaccination coverage among children. The findings of this investigation are expected to enhance the body of evidence regarding the factors predicting hepatitis B vaccination completeness in children and thus serve as reference material for policymakers. Therefore, this study aimed to analyze hepatitis B vaccination completeness in children using a large-updated dataset from the 2017 IDHS.

Method

This cross-sectional study analyzed secondary data from the 2017 IDHS, provided by Statistics Indonesia in collaboration with the National Population and Family Planning Board, the Indonesian Ministry of Health, and the Inner City Fund (ICF) implementing the Demographic and Health Survey (DHS) program.[11] After being registered and sending the concept idea of this study through the website, the DHS issued an access permit to utilize the dataset. Since the data had no individual identifiers, the confidentiality of participants was ensured. This study was a continuation of a previous study,[14] and the abstract of this paper was presented at the 2021 Asia Pacific International Conference.[15]

The study population was 86,265 mothers participating in the 2017 IDHS. The samples in this study were mothers who fit the inclusion and exclusion criteria. The study included 7,867 mothers who met the inclusion criteria: mothers having children aged 1-3 years at the time of the survey in 2016 and having comprehensive data on their hepatitis B vaccination status, as well as other independent variables. Mothers who did not know their child's immunization status were excluded from the study.

After receiving authorization from the DHS program, the data from the source was retrieved or extracted, and data cleansing was then taken to verify its usability. This encompasses the tasks of verifying the presence of any absent values, eliminating any duplicate entries, rectifying errors, and establishing uniformity in formats. Subsequently, consecutive sampling was employed to select a sample, wherein all eligible mothers who met the predetermined criteria for inclusion and exclusion were included in the subsequent analytic phase.

The outcome variable was considered a binary outcome consisting of incomplete vaccination (the child did not receive any hepatitis B vaccine or did receive less than three doses of hepatitis B vaccines) and complete vaccination (the child received three or more hepatitis B vaccines). The independent variables were sociodemographic characteristics, including geographic region[16] (Sumatra vs. Java, Lesser Sunda Island, Kalimantan, Sulawesi, Maluku Island, Papua and West Papua), residency (urban vs. rural), child's age (1 year vs. 2 and 3 years), child's sex (male vs. female), economic status corresponding to five weighted welfare levels, where lower and lower-middle rated as low income, middle as middle income, and upper-middle and upper rated as high income (low vs. middle and high), health insurance (no vs. yes), and the number of children in the household (>2 children vs. ≤2 child/children). Besides, this study also involved parental factors: age of mother and father (15 to 19 years vs. 20 to 24, 25 to 29, 30 to 34, 35 to 39, and ≥40 years), educational level of mother and father (no education vs. primary, secondary, and higher education), occupational status of mother and father based on monthly salary (unemployed vs. employed), parent's marital status (married vs. living with partner), and mother's media use (never used vs. irregularly and regularly).

In this study, the mother's media use was assessed through two combined variables: type of media use (newspaper/magazine, radio, television, and internet) and frequency of media use in the last year before the survey. Children with mothers using any media at least once a week or almost every day were given a score of two. A score of one and zero was given if a mother used media less than once a week and never used at all, respectively. Accordingly, each mother received a media usage score between 0 and 8, categorized into three groups: no use (score 0), irregular use (score 1), and regular use (score ≥2).

Analyses were done using STATA version 16 (Licensed to Putri Bungsu, Martin Luther University of Halle Wittenberg). The distribution of children's hepatitis B vaccination status, following sociodemographic and parental factors, was cross-tabulated using the Chi-square test. The crude odds ratio resulted from univariate analysis, which evaluated how each independent variable was related to the probability of incomplete hepatitis B vaccination in children. Furthermore, a multi-step logistic regression analysis was applied to evaluate the adjusted association between independent variables and the hepatitis B vaccination status of children. All independent variables with a p-value of ≤0.25 in the univariate analysis were included in the multivariate analysis. The association between the selected independent variables and the completeness of hepatitis B vaccination was analyzed using a multivariate binary logistic regression.

Results

This study included a total of 7,860 mothers with children older than one year (Figure 1). About 10% of children were never vaccinated or vaccinated with less than three doses of hepatitis B. The children's sex was equal between the male and female aged 1-3 years (mean, aged 1.69 years). Over half of the children lived in Sumatra and Java (26.3% and 29.5%, respectively). In addition, the majority of the parents were secondary school graduates. About 80% of fathers were employed, while more than 50% of mothers were unemployed. In terms of economic resources, almost 50% of children lived under a low economic status. Moreover, more than 60% of children were not covered by health insurance. Lastly, most mothers reported using media regularly in the last year of the survey (Table 1).

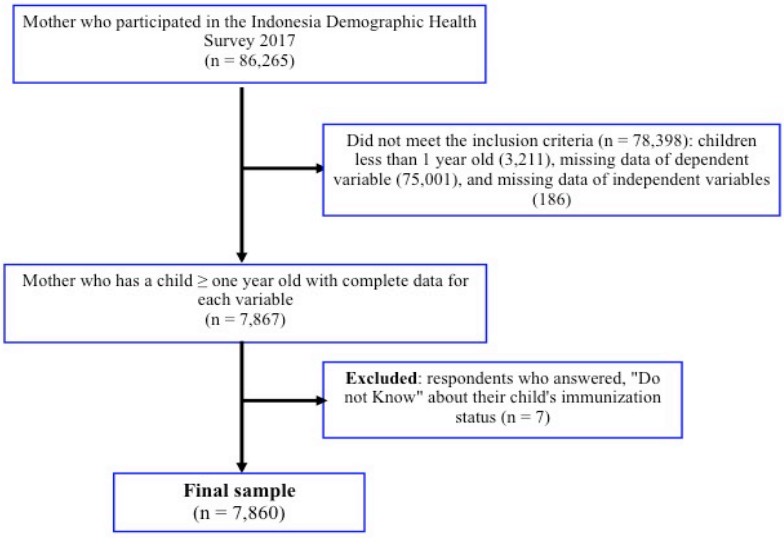

Figure 1. Flow Chart of Participant Selection for the Study

Before adjustment, the study found that geographic region, place of residency, age of mother, parent's education, father's occupational status, economic status, the number of children, health insurance ownership, and mother's media use were associated with complete hepatitis vaccination independently. In contrast, there was no association between the father's age, mother's occupational status, child's age, and sex of children with complete hepatitis B vaccination (Table 2).

Out of 15 factors, place of residency, father's age and occupation, child's age and sex, and marital status were not included in the final model. Table 2 and Figure 2 also summarize the multivariable logistic regression results between the remaining factors and the likelihood of completing hepatitis B vaccination. In terms of geographic region, the likelihood of completing vaccination dose of hepatitis B was highest among mothers with children living in the Lesser Sunda Island. Mothers living in this region were four (AOR= 4.14, 95%CI 2.96–5.77) times more likely to vaccinate their children completely compared to those living in the Sumatra region. Moreover, mothers living in Java and Kalimantan had almost three (AOR= 2.62, 95%CI 2.10–3.27 and AOR= 2.91, 95%CI 2.10–4.04, respectively) times higher odds of completing their children's hepatitis B vaccination than those living in Sumatra. Besides, the odds of being completely vaccinated among children were double higher among mothers with children living in Sulawesi (AOR = 2.13, 95%CI 1.68-2.70) than those living in Sumatra.

Table 1. Demographic Characteristic

Variable	Hepatitis B Vaccination Status (%)		Total	
	Incomplete	Complete	Frequency	Percentage
Geographic region				
Sumatra	4.0	22.3	2,068	26.3
Java	1.7	27.8	2,317	29.5
Lesser Sunda Island	0.6	9.2	774	9.8
Kalimantan	0.6	8.6	722	9.2
Sulawesi	1.4	13.7	1,190	15.1
Maluku Island	1.1	5.9	547	7.0
Papua and West Papua	0.8	2.3	242	3.1
Place of residency				
Rural	3.6	46.0	3,899	49.6
Urban	6.6	43.8	3,961	50.4
Age of father (years)				
15–19	0.1	0.3	33	0.4
20–24	0.6	5.8	502	6.4
25–29	1.9	18.0	1,563	19.9
30–34	2.7	24.2	2,113	26.9
35–39	2.3	20.6	1,802	22.9
≥40	2.7	20.8	1,847	23.5
Age of mother (years)				
15–19	0.3	1.8	166	2.1
20–24	1.7	14.7	1,289	16.4
25–29	2.7	23.2	2,032	25.9
30–34	2.3	24.8	2,132	27.1
35–39	2.2	17.4	1,541	19.6
≥40	1.1	7.8	700	8.9
Father's education				
No education	0.4	1.1	118	1.5
Primary	4.0	21.7	2,021	25.7
Secondary	4.9	52.5	4,509	57.4
Higher	1.0	14.4	1,212	15.4
Mother's education				
No education	0.4	0.9	103	1.3
Primary	4.0	19.6	1,858	23.6
Secondary	4.5	51.6	4,406	56.1
Higher	1.3	17.7	1,493	19.0
Father's occupational status				
Unemployed	0.7	8.8	743	9.5
Employed	9.5	81.0	7,117	90.5
Mother's occupational status				
Unemployed	6.1	52.9	4,636	59.0
Employed	4.1	36.9	3,224	41.0
Marital status				
Married	10.0	88.2	7,718	98.2
Living with a partner	0.2	1.6	142	1.8
Economic status				
Low	6.8	40.1	3,687	46.9
Middle	1.3	17.0	1,437	18.3
High	2.1	32.7	2,736	34.8
Child's age (year)				
1	4.7	39.8	3,498	44.5
2	4.2	38.3	3,339	42.5
3	1.3	11.7	1,023	13.0
Child's sex				
Male	5.1	46.2	4,033	51.3
Female	5.1	43.6	3,827	48.7
Number of children				
>2 children	5.2	30.8	2,829	36.0
≤2 children	5.1	58.9	5,031	64.0
Cover by health insurance				
No	4.5	32.1	2,874	36.6
Yes	5.8	57.6	4,986	63.4
Mother's media use				
Never	1.1	2.9	312	4.0
Irregularly	0.8	4.3	397	5.1
Regularly	8.3	82.7	7,151	91.0

Table 2. Logistic Regression Model of Hepatitis B Vaccination Status Among Children in Indonesia

Variable	Crude Odds Ratio (COR)		Adjusted Odds Ratio (AOR)	
	COR (95%CI)	p-value	AOR (95%CI)	p-value
Geographic region				
Sumatra	1	1	1	1
Java	2.85 (2.31 – 3.52)	**<0.001**	2.62 (2.10 – 3.27)	**<0.001**
Lesser Sunda Island	2.69 (1.96 – 3.69)	**<0.001**	4.14 (2.96 – 5.77)	**<0.001**
Kalimantan	2.55 (1.85 – 3.51)	**<0.001**	2.91 (2.10 – 4.04)	**<0.001**
Sulawesi	1.69 (1.35 – 2.13)	**<0.001**	2.13 (1.68 – 2.70)	**<0.001**
Maluku Island	0.91 (0.71 – 1.18)	0.495	1.23 (0.94 – 1.62)	0.132
Papua and West Papua	0.55 (0.40 – 0.76)	**<0.001**	0.80 (0.56 – 1.13)	0.201
Place of residency				
Urban	1	1	1	1
Rural	0.52 (0.45 – 0.61)	**<0.001**	0.91 (0.77 – 1.09)	0.320
Age of father (years)				
15–19	1	1	1	1
20–24	1.69 (0.62 – 4.58)	0.303	1.55 (0.54 – 4.45)	0.419
25–29	1.73 (0.66 – 4.58)	0.265	1.46 (0.51 – 4.13)	0.478
30–34	1.60 (0.61 – 4.19)	0.338	1.26 (0.44 – 3.59)	0.667
35–39	1.57 (0.60 – 4.12)	0.359	1.28 (0.45 – 3.70)	0.643
≥40	1.40 (0.54 – 3.66)	0.494	1.42 (0.49 – 4.13)	0.524
Age of mother (years)				
15–19	1	1	1	1
20–24	1.38 (0.86 – 2.21)	**0.189**	1.18 (0.72 – 1.94)	0.513
25–29	1.42 (0.89 – 2.25)	**0.139**	1.32 (0.81 – 2.15)	0.268
30–34	1.72 (1.08 – 2.75)	**0.022**	1.97 (1.19 – 3.27)	**0.008**
35–39	1.29 (0.81 – 2.06)	0.288	1.86 (1.11 – 3.13)	**0.019**
≥40	1.15 (0.70 – 1.88)	0.584	1.81 (1.05 – 3.14)	**0.034**
Father's education				
No education	1	1	1	1
Primary	1.94 (1.26 – 2.97)	**0.002**	1.34 (0.82 - 2.20)	0.247
Secondary	3.85 (2.52 – 5.88)	**<0.001**	2.02 (1.22 – 3.33)	**0.006**
Higher	5.25 (3.28 – 8.41)	**<0.001**	2.09 (1.18 – 3.71)	**0.011**
Mother's education				
No education	1	1	1	1
Primary	2.40 (1.56 – 3.68)	**<0.001**	1.37 (0.83 – 2.26)	0.225
Secondary	5.75 (3.76 – 8.79)	**<0.001**	2.48 (1.48 – 4.16)	**0.001**
Higher	6.51 (4.13 – 10.28)	**<0.001**	1.97 (1.11 – 3.51)	**0.020**
Father's occupational status				
Unemployed	1	1	1	1
Employed	0.71 (0.54 – 0.94)	**0.016**	0.98 (0.72 – 1.34)	0.910
Mother's occupational status				
Unemployed	1	1	1	1
Employed	1.05 (0.9 – 1.21)	0.556	1.20 (1.02 – 1.41)	**0.025**
Marital status				
Married	1	1	1	1
Living with partner	0.78 (0.47 – 1.29)	**<0.001**	1.01 (0.57 – 1.79)	0.97
Economic status				
Low	1	1	1	1
Middle	2.19 (1.76 – 2.73)	**<0.001**	1.55 (1.23 – 1.97)	**<0.001**
High	2.72 (2.26 – 3.26)	**<0.001**	1.54 (1.23 – 1.93)	**<0.001**
Child's age (years)				
1	1	1	1	1
2	1.06 (0.91 – 1.24)	0.481	1.08 (0.92 – 1.27)	0.356
3	1.06 (0.84 – 1.34)	0.612	1.12 (0.88 – 1.42)	0.372
Child's sex				
Male	1	1	1	1
Female	0.95 (0.82 – 1.10)	0.525	0.92 (0.79 – 1.07)	0.289
Number of children				
>2 children	1	1	1	1
≤2 children	1.94 (1.68 – 2.25)	**<0.001**	1.90 (1.56 – 2.31)	**<0.001**
Cover by health insurance				
No	1	1	1	1
Yes	1.40 (1.21 – 1.62)	**<0.001**	1.34 (1.14 – 1.57)	**<0.001**
Mother's media use				
Never	1	1	1	1
Irregularly	2.08 (1.45 – 3.00)	**<0.001**	1.52 (1.03 – 2.25)	**0.036**
Regularly	3.91 (3.02 – 5.07)	**<0.001**	1.80 (1.32 – 2.44)	**<0.001**

Regarding parent's parent-associated factors, children whose mothers were aged 30-34 years, 35-39 years, and ≥40 years had almost two-fold (AOR= 1.81, 95%CI 1.05–3.14, AOR= 1.86, 95%CI 1.11–3.17, and AOR= 1.97, 95%CI 1.19–3.27, respectively) higher odds of completing hepatitis B vaccination compared to children whose mothers aged 15–19 years. Mothers with secondary and higher education showed two-fold (AOR = 2.48, 95%CI 1.48–4.16) and almost two (AOR= 1.97, 95%CI 1.11–3.51), respectively, completing their children's vaccination of hepatitis B compared to those uneducated. Similarly, children whose fathers had secondary and higher education had double odds (AOR= 2.02, 95%CI 1.22–3.33 and AOR= 2.09, 95%CI 1.18–3.71, respectively) of having complete hepatitis B vaccination compared to uneducated fathers. Children with employed mothers had higher odds of being completely hepatitis B vaccinated (AOR = 1.20, 95%CI 1.02–1.41) than those with unemployed mothers. In addition, children whose mothers had irregular or regular media usage displayed increased odds (AOR= 1.52, 95%CI 1.03–2.25 and AOR= 1.80, 95%CI 1.32–2.44, respectively) of being complete-dose of hepatitis B vaccination compared those mothers who never used media.

Furthermore, in terms of enabling resources, the odds of completing hepatitis B vaccination were higher among mothers with children living in middle and high economic status compared to those with low economic status (AOR = 1.55, 95%CI 1.23–1.97; and AOR = 1.54, 95%CI 1.23–1.93, respectively). Furthermore, children born to mothers with health insurance had higher odds of completing hepatitis B vaccination compared to those born to mothers lacking health insurance (AOR = 1.34, 95%CI 1.14–1.57). Lastly, children whose mothers had two children or fewer had almost double the odds of having complete hepatitis B vaccination compared to mothers having more than two children (AOR = 1.90, 95%CI 1.56–2.31) (Table 2, Figure 2).

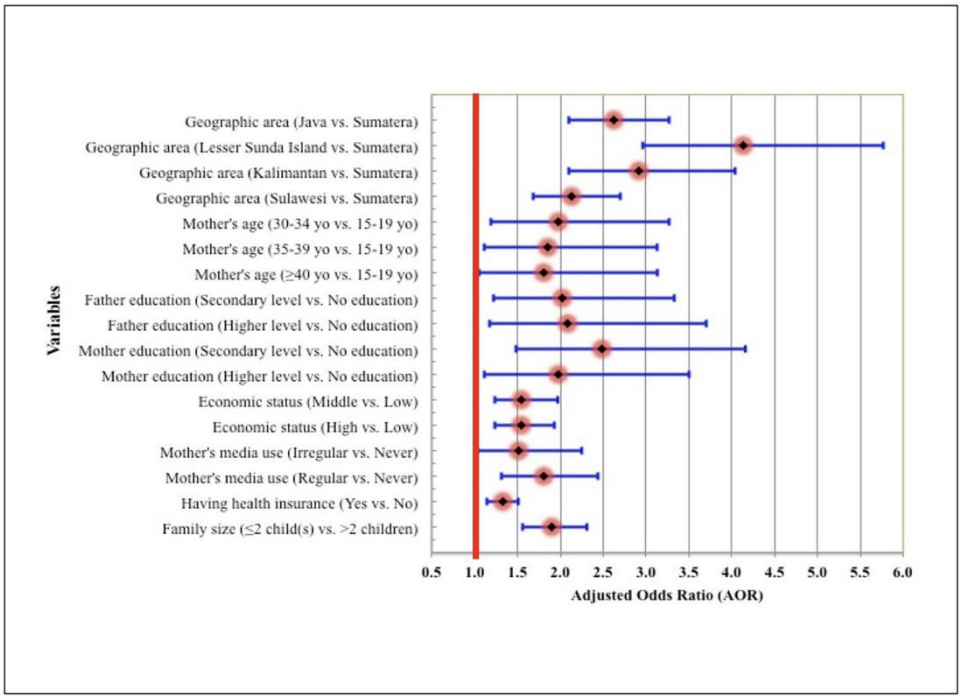

Figure 2. Final Model of Multivariable Analysis

Discussion

This study found that several factors, such as geographic region, father's education, mother's education, mother's age, mother's occupational status, economic status, health insurance ownership, the number of children in the household, and mother's media use were associated with complete hepatitis B vaccination among Indonesian children. This finding aligns with previous studies,[12,17-21] except for residence, child's age, child's sex, and marital status, which were not in line with previous studies.[12,17,22-24] For example, Cao *et al.* found that children living in rural areas in China were more likely to be vaccinated fully for hepatitis B than those living in urban areas.[25] In contrast, a study from Vietnam found that the prevalence of receiving full vaccination, including hepatitis B zero dose, was higher in urban compared to rural areas.[23] Anh *et al.* explained that this finding might be attributed to the fact that urban areas in Vietnam had greater access to and higher quality of vaccination services, owing to concentrated efforts by organizations and individuals involved in

vaccination services.[23]

Certain factors strongly linked to the hepatitis B vaccination status among children were not able to be evaluated in this study, such as factors related to the accessibility of health facilities. Studies from France,[12] India,[17] Tanzania,[18] and East Africa[20] showed the association between an antenatal and postnatal visit of a mother and complete immunization among children, including hepatitis B vaccination. Similarly, Cao *et al.* found that mothers giving birth at home were four times more likely to immunize their children incompletely. Besides, this study also showed that the odds of children being incompletely vaccinated were almost two times higher among the mothers living far from a health provider, which takes >40 minutes of travel time to the health provider, compared to those living nearby (<20 minutes travel time).[25] Furthermore, previous studies also revealed other factors that are associated with children's hepatitis B vaccination, such as birth order, birth interval, religion, ethnicity, and parents' safety concerns related to vaccination.[14,19,21,22,24,25] For instance, a study from India reported that Muslim and Christian mothers were 17% and 10%, respectively, less likely to vaccinate their children compared to Hindu mothers.[17]

This study found an association between geographic region and complete hepatitis B vaccination among children. In this study, the region was one factor affecting the completeness of hepatitis B vaccination in children. Khan *et al.* reported a similar result, in which there was a considerable disparity in the coverage of hepatitis B vaccine across the district of India.[17] A multilevel study also found that several countries in East Africa had a different opportunity from the primary vaccination of childhood among children aged 12-23 months.[20] Again, this finding reflected the necessity of equality of health provider accessibility, such as maternal health care, which could increase the possibility of hepatitis B vaccination.

Education is among the indirect factors significantly influencing childhood vaccination coverage. This finding is reasonable, given that education has a close association with knowledge and perception regarding the benefit of vaccination; parents with higher education levels tend to have a high awareness of their child's health.[17-21,23,27,28] Education also links with health literacy. Johri *et al.* showed that a mother's literacy was associated with a greater understanding of health aspects, including disease mechanisms, the importance of accessing health services, motivation to care for their child's health, and improved negotiation capacity for the health system.[29]

Related to literacy and knowledge, the mother's media use was also associated with complete hepatitis B vaccination. Previous studies showed similar results, in which children with mothers exposed to media were most likely to have a complete basic vaccination.[19,29] This is expected, given that the media is one of information access related to a child's vaccination, which could increase the mother's knowledge and act as an information tool for vaccination schedule-reminder.[25,31]

Previous studies have shown that older mothers are associated with complete hepatitis B vaccination among children.[18-21,23] For instance, Nadella *et al.* showed that children with younger mothers had higher odds of being unvaccinated or late vaccination of DTP.[18] One possible reason is that older mothers may have more experience in caring for their children, including maternal healthcare services, which often serve as the gateway for childhood vaccinations, including hepatitis B vaccination.[20]

Regarding the ability to afford vaccination services, economic status was the crucial factor influencing the complete hepatitis B vaccination among children. This was also accordant with other studies, showing that children whose families have a middle or high economic status were more likely to be completely vaccinated compared to children from families with a low economic status.[12,17-21,23] This finding reflected that even though primary hepatitis B vaccination for children is free in Indonesia; economic status still plays an important role, potentially influencing the complete vaccination. Accordingly, health insurance was also essential for vaccination status among children.[22]

This study also investigated the number of children associated with hepatitis B vaccination status among children. Similarly, a study by Awasthi *et al.* illustrated that an increase in the number of family members was related to a decreasing quality of care in the family in India.[22,30,32] This finding might be due to limited financial and time resources reducing the opportunity for each family member to access health services.

Furthermore, in this study, children with employed mothers were likely to complete hepatitis B vaccination. This is unexpected given that working time and vaccination schedule were common issues for working mothers. In 2011, Ueda *et al.* reported that working mothers were much less likely to follow recommended vaccine schedules for their children in Japan.[20] Similarly, a qualitative study from Indonesia also found that the major reason for their children's partial immunization status was unmatched mothers' scheduled activities with regular time of immunization services.[33]

However, a study by Chen *et al.* claimed no correlation between working mothers and vaccination coverage among children aged 19-35 months in California.[22] This discrepancy in current literature points out the need for further examination of this association.

This study represents the initial attempt to identify factors correlated with hepatitis B vaccination coverage, specifically in Indonesia, utilizing the latest dataset from the 2017 IDHS dataset. In addition, all potential confounding variables included in this study were controlled from a large representative population study, impacting the validity of the results. However, this study had several limitations. First, since this study relied on secondary data, there was a possibility of residual confounding due to the limited description of certain characteristics in the available data. For instance, less information on the mother's free time for vaccination, even if she is unemployed, creates a missed opportunity situation.

Another limitation is that this study was unable to incorporate variables specifically identifying children under the care of caregivers due to the working mother factor. It was hypothesized that there might be variation in vaccination rates among children under the care of mothers compared to those under the care of caregivers. Hence, data on the missed chances related to the mother's occupational variable was investigated. However, secondary analysis of DHS data remains an important contribution to public health knowledge.

Conclusion

The completeness of hepatitis B vaccination among children in Indonesia is influenced by several factors: accessibility to services, accessibility to information, and economic capability. Therefore, this study highlights the need to expand the coverage of vaccination services to areas far from health facilities as a crucial intervention in boosting childhood vaccination coverage, as this also has an impact on reducing the transportation burden for mothers when taking their children to health services. In addition, information dissemination is tailored to the characteristics of each region so that information on the benefits of vaccination can be well received by the community.

Abbreviations

INHS: the Indonesian National Health Survey; DTP: Diphtheria-Tetanus-Pertussis; IDHS: the Indonesian Demographic Health Survey; DHS: the Demographic and Health Surveys; AOR: adjusted odds ratio; COR: crude odds ratio; CI: confidence interval.

Ethics Approval and Consent to Participate

Ethical approval was obtained from the Research Ethics Committee of the Faculty of Public Health, Universitas Indonesia (Ethical approval number: Ket-73/UN2.F10.D11/PPM.00.02/2024).

Competing Interest

The authors have no conflict of interest associated with the material presented in this paper.

Availability of Data and Materials

The dataset generated and/or analyzed during the current study is not publicly available because it constitutes an excerpt of research in progress but is available from the first author upon reasonable request.

Authors' Contribution

Conceptualization: PBM, DG, EA; Data Curation: PBM; Formal Analysis: PBM; Methodology: PBM, DG, EA; Writing – original draft: PBM; Writing – review & editing: PBM, DG, EA.

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Food Hygiene and Sanitation at the Jakarta Pondok Gede Hajj Embarkation Dormitory: Food Safety Efforts for the Hajj Pilgrims

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Food Hygiene and Sanitation at the Jakarta Pondok Gede Hajj Embarkation Dormitory: Food Safety Efforts for the Hajj Pilgrims

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Abstract

Several health risks are associated with performing Hajj pilgrimage. Food poisoning is a major cause of diarrhea and vomiting during Hajj. Food hygiene is an effort to control aspects of food, people, places, and equipment that could cause disease or health problems. This study aimed to describe food hygiene and sanitation efforts implemented in 2023 at the Jakarta Pondok Gede Hajj Embarkation Dormitory in Jakarta, implemented in 2023 to safeguard foods for the Hajj pilgrims. Using a descriptive qualitative design with a document analysis approach, this study examined activities during the pre-embarkation and embarkation periods. Pre-embarkation efforts included inspecting the kitchen environment and coaching the catering team, while during the embarkation period, activities involved checking the hygiene of catering services, inspecting foods brought by pilgrims, and assessing the quality of food and drink. This study found that the dormitory kitchen did not meet the necessary facilities and infrastructure requirements, affecting food safety. Additionally, food handlers did not fully comply with hygiene and sanitation standards. This study emphasized the necessity of meeting hygiene requirements in the kitchen, food handling, equipment, and ingredients since the pre-embarkation period.

Keywords: food safety, Hajj, hygiene, sanitation

Introduction

The Hajj pilgrimage takes days to a month for the regular Hajj program, with all its pillars and obligations requiring a healthy body and physical condition.[1] Hajj carries several health risks that can interfere with the pilgrimage.[2] A health risk that might occur is diarrhea, which is common during the pilgrimage. Food poisoning is a major cause of diarrhea and vomiting during the pilgrimage. Over the past 12 years, the number of reported cases of food poisoning has ranged from 44 to 132 cases in each Hajj season.[3] Providing healthy food is the key to preventing food poisoning. Efforts to prevent food poisoning include food hygiene and sanitation, focusing on cleanliness in handling, storing, and serving foods. Risks for microbiological, chemical, and physical contaminations can be reduced by maintaining the cleanliness of the environment, equipment, and food handlers. This means a crucial aspect of food safety, aiming to ensure that food is free from hazards that can cause illness.[4,5]

Poor food processing will allow food contamination with pathogenic bacteria. Bacterial contamination can come from food processing and storage not paying attention to hygiene sanitation requirements, such as poor hygiene of food handlers and food storage at unsafe temperatures. The study of gastrointestinal cases in Sudanese pilgrims during the 2017 Hajj season showed that the main possible cause of the outbreak was food contaminated with *Bacillus cereus* and *Clostridium perfringens*, with the most likely contributing factors being poor hygiene levels of food handlers and food storage at unsafe temperatures.[6]

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During the regular Hajj program, the Indonesian Government must provide food for Hajj pilgrims in Hajj embarkation and dormitories in Indonesia and Saudi Arabia, using a catering system. At embarkation, the congregation gets three meals and two snacks.[1] Seeing any risk for health problems caused by food among Hajj pilgrims, the government must protect foods consumed during the Hajj pilgrimage.[6] The food protection at Hajj embarkation and dormitories is performed through food hygiene and sanitation activities as an effort to control aspects of food, people, places, and equipment that could result in disease or health problems.[7,8]

Food hygiene and sanitation efforts at a Hajj embarkation start from the pre-embarkation period and continue until the embarkation period when the Hajj pilgrims' health is inspected.[7] Hajj embarkation is the airport where prospective Hajj pilgrims depart directly to Saudi Arabia. Meanwhile, the Hajj dormitory is the location for organizing and arranging activities during departure and return. It is located in the city where the airport of departure is located.[9]

Jakarta Pondok Gede (JKG) Hajj Embarkation serves prospective Indonesian Hajj pilgrims from Jakarta and Banten Provinces with the departure at Soekarno Hatta International Airport and the JKG Hajj Embarkation Dormitory as the place for organizing and arranging departure and return activities. JKG Hajj Embarkation is one of the largest embarkations in Indonesia to dispatching pilgrims from Jakarta and Banten Provinces. It also organizes the departure of pilgrims from Lampung Province and parts of the West Java Province.[10,11] There remain few studies on food hygiene and sanitation at the Hajj embarkation; therefore, this study aimed to describe food sanitation and hygiene efforts implemented in 2023 at the JKG Hajj Embarkation Dormitory to safeguard the foods for the Hajj pilgrims.

Method

This study applied a descriptive qualitative design with a document analysis approach. Hence, documents related to implementing supervision on food hygiene and sanitation at the JKG were limited. This study described the supervision of food hygiene and sanitation at JKG Hajj Embarkation Dormitory from the pre-embarkation to the embarkation period of Hajj embarkation implemented by the Class I Soekarno Hatta Port Health Office in 2023 as an effort to safeguard foods for Hajj pilgrims. Descriptive study is a method attempting to describe and interpret objects as they are.[12] The document analysis method is a qualitative approach, examining and interpreting data to reveal meaning, gain understanding, and arrive at a conclusion from reports and documents on the results of activities.[13] The document in question is the health supervision report of the JKG Hajj Embarkation owned by the Class I Soekarno-Hatta Port Health Office.

This study was conducted on May 13-18, 2024 at the JKG Hajj Embarkation Dormitory. The variables analyzed were activities during the pre-embarkation period, including environmental health checks for food processing kitchens and catering guidance. The embarkation period includes inspecting the sanitation of the catering services, screening of food brought by pilgrims, and checking the quality of food and drink. The assessment of environmental health aspects in food processing kitchens included floors, walls, ventilation, waste disposal channels, cleanliness of the kitchen space, facilities and infrastructure, lighting, room division, and drinking water. Catering coaching was conducted through training for the food handlers.

The data was obtained from the results of the analysis of the pre-embarkation JKG Hajj Embarkation Dormitory sanitation inspection report, the daily report of the Environmental Risk Control Unit during embarkation, and the implementation of prospective Hajj pilgrims' health at the JKG Hajj Embarkation in 2023 at the Class I Soekarno Hatta Port Health Office report, during the Islamic calendar of 1444 Hijriah (2023) Hajj season. The data obtained was processed and displayed in graphs, numbers, and narratives.

Based on the reports above, the results of the Environmental Health Inspection (EHI) of the kitchen for food processing are divided into four categories based on the yes answer score. The "poor" category got a yes answer score of <65%; the "sufficient" category got a yes answer score of 65-74%; the "good" category got a yes answer score of 75-84%, and the "excellent" category got a yes answer score of 85-100%.

Results

Pre-Embarkation Period

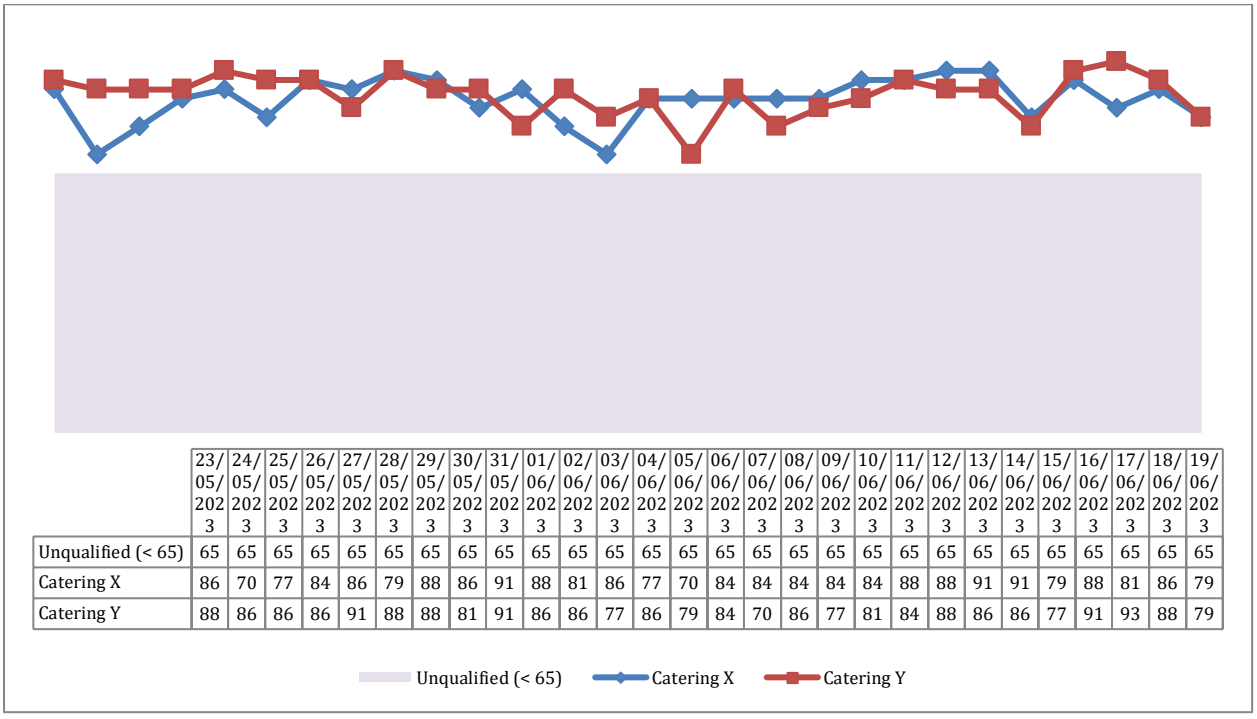
The pre-embarkation period began with a health check on the kitchen environment, where food processing was carried out twice: six months (D-6 months) and a week (D-1 week) before the embarkation period. The inspection results were divided into four categories: poor, sufficient, good, and excellent. The D-6 months inspection was in the poor category (yes answer score = 60.19%). This was because the kitchen still had several problems, such as the

damaged floor and ceiling, no grease trap in the waste channel of the meat and fish cutting room, no special room for storing dry and wet foods, no shelves for storing equipment, the dirty space around the kitchen, and the waste channel clogged with rubbish and dirt. After some repairs on D-1 week, a reexamination was carried out with the results reaching a score of 79.61% or in the good category, where repairs were made to the floor and ceiling, and grease traps were installed in the waste channel, but not all the kitchen waste water channels were connected to the grease traps.

The development of catering services at the JKG Hajj Embarkation Dormitory was carried out through counseling activities on sanitary hygiene and vector control in food processing for food handlers working to serve food for the Hajj pilgrims and officers at the JKG Hajj Embarkation. The counseling began with a pre-test and delivery of material on the policy of sanitary hygiene certificates in the fast food businesses, washing equipment, sanitary hygiene requirements in food processing places, specific requirements, and principles of food hygiene and sanitation. It was then continued with a discussion of questions and answers related to common problems at the JKG Hajj Embarkation Dormitory kitchen during the embarkation period. The activity ended with an EHI post-test. The lowest score in the pre-test was 25%, and the highest was 75%, with an average of 52.5%. After the delivery of material, discussion, and handwashing practice, the post-test was continued with the lowest score of 65% and the highest score of 95%, with an average score of 75%.

Embarkation Period

Sanitary checks on catering services at the Hajj dormitory were done daily through EHI at the JKG Hajj Embarkation Dormitory's public kitchen. In 2023 or 1444 Hijriah, in the Islamic calendar, there were two catering service providers operating in the kitchen. Catering X served food for Hajj pilgrims, and Catering Y served food for Hajj Pilgrimage Organizing Committee/*Panitia Penyelenggara Ibadah Haji* (PPIH) at the JKG Hajj Embarkation Dormitory. The results of the EHI on those two providers varied each day but were still in the qualified category, with no inspection results and a score of less than 65% (Figure 1). The average assessment during the embarkation period for Catering X and Y was both in the good category at 81.64% and 81.89%, respectively. The findings in terms of aspects of food hygiene and sanitation encountered each day are outlined in Figure 2.



	23/05/2023	24/05/2023	25/05/2023	26/05/2023	27/05/2023	28/05/2023	29/05/2023	30/05/2023	31/05/2023	01/06/2023	02/06/2023	03/06/2023	04/06/2023	05/06/2023	06/06/2023	07/06/2023	08/06/2023	09/06/2023	10/06/2023	11/06/2023	12/06/2023	13/06/2023	14/06/2023	15/06/2023	16/06/2023	17/06/2023	18/06/2023	19/06/2023
Unqualified (< 65)	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65
Catering X	86	70	77	84	86	79	88	86	91	88	81	86	77	70	84	84	84	84	84	88	88	91	91	79	88	81	86	79
Catering Y	88	86	86	86	91	88	88	81	91	86	86	77	86	79	84	70	86	77	81	84	88	86	86	77	91	93	88	79

Figure 1. The Environmental Health Inspection Results of Catering X and Y at JKG Hajj Embarkation Dormitory from May 23 to June 19, 2023

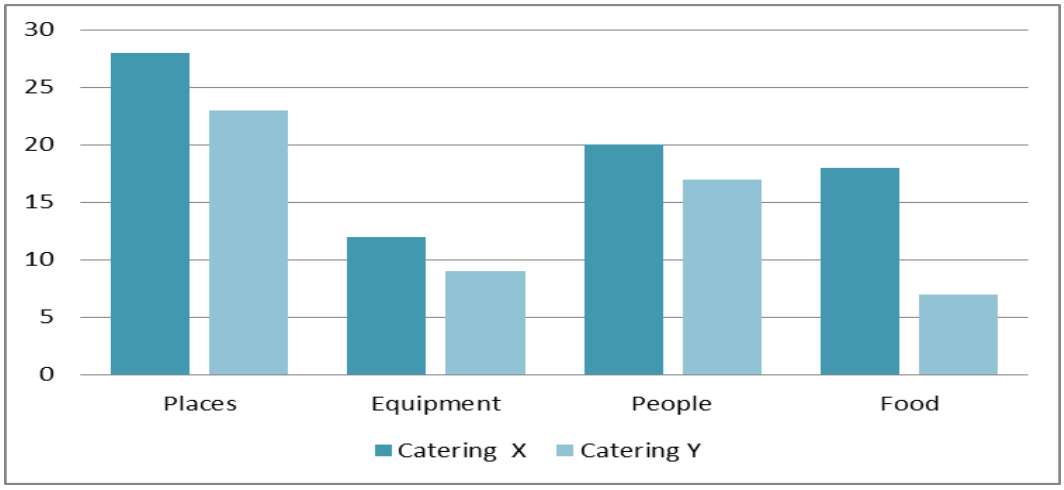


Figure 2. Findings of Food Hygiene and Sanitation Aspects at Catering X and Y During the Embarkation Period

Findings or nonconformities that occurred daily were related to the kitchen where food was processed in both Catering X and Y. Problems often encountered were related to kitchen cleanliness, flies, grease traps not being cleaned daily, and problems with garbage and wastewater disposal. Nonconformities related to the food handler aspect were in second place. The frequent nonconformities encountered were related to habits of food handlers smoking in the kitchen, throwing cigarette butts carelessly, still wearing some accessories (jewelry) while doing their job, and not all of them complying with using personal protective equipment such as masks and gloves.

The food aspect was the third most frequently encountered aspect. The nonconformities encountered included not covering dry food and vegetables with pallets, sorting food ingredients and arranging the messy ingredients in the chiller, not maintaining the cleanliness of the chiller or refrigerator, and not immediately covering cooked food. At the same time, the nonconformities related to food equipment that was often encountered were stoves not cleaned immediately after work was finished, water and tubs used to wash the equipment not immediately disposed of and cleaned, and the placement of washed equipment not in a clean place.

The selection of Hajj pilgrims' food prioritizes perishable foods, such as rice, *lontong* (an Indonesian dish made of compressed rice cake in the form of a cylinder wrapped inside a banana leaf), rissole, vegetables, vermicelli, fried noodles, and shredded chicken. Hajj pilgrims from Banten Province were more likely to carry these foods as supplies during the trip to Jakarta. The purpose of this activity was to prevent the occurrence of food poisoning due to food that has passed its serving date. Checking the quality of food and drink includes organoleptic examination and sample banks at each mealtime (three main meals and two snacks). The sample bank was stored at a temperature of <0°C for 2 x 24 hours for investigation purposes in case of food poisoning among the pilgrims and officers.

Chemical and microbiological quality testing of food and drink was conducted on food ingredients and cooked food samples. Food testing was carried out on formalin, borax, and food coloring parameters, and the results showed that no hazardous chemicals were found in the food. Tests of cooked food were carried out to determine the content of pathogenic bacteria in cooked food. Of the 20 cooked food samples that underwent microbiologically testing, there was one sample of congregate food, an omelet, containing *Escherichia coli* bacteria.

Discussion

Sanitary inspection of the JKG Hajj Embarkation Dormitory kitchen indicated some unresolved problems at D-1 week still existed. This ultimately affected the sanitary conditions of the kitchen for food processing during the embarkation period, referring to flies, dirty grease traps, and clogged waste channels. The results of the EHI of the dormitory kitchen carried out daily by the Port Health Office sanitation officers showed that there were discrepancies related to the kitchen: problems were still found that were closely related to waste disposal channels. According to the Indonesian Minister of Health Regulation Number 2 of 2023, catering kitchens are required to have a waste channel connected to a grease trap before being discharged into the city sewerage.[14] The grease trap functions to filter the grease and food processing residues in the kitchen, thus not clogging the channel, generating odors, and inviting disease-transmitting insects such as flies and cockroaches.[8]

Efforts to foster the food handlers had already been made during the pre-embarkation period. However, during the

embarkation period, problems related to the food handlers comprised their smoking behavior in the kitchen and noncompliance in using personal protective equipment. Sustainable training for the food handlers is crucial, not only through counseling during the pre-embarkation period, but it should also be carried out continuously and periodically by catering service providers. Noncompliance of food handlers will affect levels of hygiene and quality of the processed food. A previous study discussing food safety practices during the 2022 Hajj season revealed that catering service providers in Makkah and Madinah, Saudi Arabia, showed that food handlers from trained establishments were more likely to comply with food safety practices compared to food establishments with untrained food handlers.[15] Factors closely associated with the food handlers' compliance were kitchen hygiene, commitment to health requirements, food handling, and food storage practices.[5]

Food safety efforts made by the Class I Soekarno Hatta Port Health Office during the embarkation period have included continuous supervision on a daily basis for four aspects of food hygiene and sanitation, including the kitchen where food was processed, food processing equipment, food handlers, and food ingredients/processed food. Supervision is taken on the six principles of food processing.[8] Catering/gourmet managers who do not pay attention to the principles of food processing will produce food contamination, which can come from humans, animals, and the environment. Cross-contamination can be caused by food handlers, equipment, insects, and waste.[5]

The microbiological test results on 20 samples showed that one sample of the pilgrims' food contained *Escherichia coli* bacteria as much as 1.7 x 103 CFU/gr in the omelet. This puts the pilgrims in jeopardy since it has the potential to cause foodborne illness. *Escherichia coli* bacteria are bacteria that include normal flora in the tracts of livestock and humans.[5,16] The presence of the bacteria indicated that the omelet was already contaminated by animal/human feces. These microbiological test results were not in accordance with the environmental health quality standards in the Indonesian Minister of Health Regulation Number 2 of 2023 concerning Implementing Regulations of Government Regulation Number 66 of 2014 concerning Environmental Health because the required standard is <1.1 CFU/gr of test food ingredients.[14]

Food processing that does not pay attention to the principles of food sanitation hygiene will contribute to the risk of biological contamination from the hands of food handlers, eggshells included in food ingredients, and the possible cross-contamination from flies commonly found in the kitchen.[7,8,15] The behavior of food handlers is related to the presence of *Escherichia coli* bacteria in food. This is in line with a study conducted at the Surabaya Hajj Dormitory in 2019, which showed a relationship between the personal hygiene of food handlers and the presence of *Escherichia coli* in the foods of Hajj pilgrims at the respective embarkation.[17] The results of bacterial findings in samples of cooked food for the Hajj pilgrims had been followed up by the Class I Soekarno Hatta Port Health Office by providing a recommendation letter to the head of PPIH and the JKG Hajj Embarkation Dormitory, as well as suggestions for improvement to the catering manager to immediately take corrective steps to pay attention to the principles of food processing in every aspect of food hygiene and sanitation.[18] Attention to aspects of sanitary hygiene such as food handlers, equipment, ingredients, and cooked food must be considered from the preparation stage in the pre-embarkation period. This preparation supports the implementation of the principles of food hygiene and sanitation by catering managers.

Conclusion

Food sanitation hygiene efforts at the JKG Hajj Embarkation dormitory have been made since the pre-embarkation and embarkation periods by improving the facilities and infrastructure of the Hajj embarkation kitchen to meet the requirements, such as installing exhaust fans, building a centralized wastewater disposal system with one grease trap, dividing the room by paying attention to food processing lines to avoid cross-contamination and providing equipment storage shelves. Cross-sectoral coordination in implementing food hygiene and sanitation at the Hajj embarkations is highly useful for improving food safety for Hajj pilgrims. A further qualitative study needs to be taken with a rapid assessment procedure approach to finding out a comprehensive picture of how food sanitation hygiene is implemented at the JKG Hajj Embarkation Dormitory; therefore, problems of why food sanitation hygiene requirements are not met in the kitchen, equipment, handlers, and food can be identified.

Abbreviations

JKG: Jakarta Pondok Gede; EHI: Environmental Health Inspection; PPIH: *Panitia Penyelenggara Ibadah Haji/* Hajj Pilgrimage Organizing Committee.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee for Health Research, Faculty of Public Health, Universitas Indonesia (Ket-188/UN2.F10.D11/PPM.00.02/2024). To obtain secondary data on the results of food hygiene and sanitation supervision, the first author first submitted a data request permit to the Soekarno Hatta Health Quarantine Center to be processed, analyzed, and presented in the form of scientific writing (PP.06.02/C.IX.6/4527/2024).

Competing Interest

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

Availability of Data and Materials

Data were available upon request.

Authors' Contribution

Both FH and AA conducted secondary data collection, data processing, analysis and interpretation, and writing the manuscript. BW, HR, and ZM equally provided scientific input when writing the manuscript.

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Differences in Active Ingredients of White Chicory Leaves (Brassica pekinensis L) as a Bio-Larvicidal Against Aedes aegypti larvae

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Differences in Active Ingredients of White Chicory Leaves *(Brassica pekinensis L)* as a Bio-Larvicidal Against *Aedes aegypti larvae*

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Abstract

Continuous chemical dengue control can cause vector resistance and environmental pollution. Developing natural larvicides (bio-larvicides) from plant toxins like white chicory, which can poison *Aedes aegypti larvae,* is necessary for a sustainable alternative. This study aimed to analyze differences in active ingredients in white chicory leaves *(Brassica pekinensis L*) as bio-larvicide against *Aedes aegypti larvae.* This study was a pure experiment using a post-test-only control design using 1,225 *Aedes aegypti* instar III *larvae* with extracts of alkaloid active ingredients, flavonoids, and concentrations of 0%, 24%, 34%, and 40% with 3 times replication. Data were analyzed using a probit test, one-way ANOVA, and Post Hoc LSD. The results showed the potential of active ingredients in white chicory leaves against the death of *Aedes aegypti larvae* (p-value = 0.000). The average percentage of larval mortality concentration was 24%, 34%, 40%, in alkaloids was 41%, 60%, 66%, and in flavonoids was 45%, 64%, 68%. The active ingredient of white chicory leaves can kill *Aedes aegypti larvae* with LC_{50} in 29% alkaloids and 27% flavonoids.

Keywords: *Aedes aegypti larvae,* bio-larvicidal, *Brassica pekinensis L, pest control, vector-borne diseases*

Introduction

Dengue hemorrhagic fever (DHF) is an infectious disease caused by the dengue virus of the genus *Flavivirus*, family *Flaviviridae,* and transmitted through the bite of *the Aedes aegypti* mosquito[1] leading to death in a short period if no proper treatment is performed.[2] DHF remains a public health problem in tropical countries, specifically Indonesia.[3] The 2020 Indonesia Health Profile data showed that DHF cases in the country reached a total of 108,303 cases, and the death rate was 747 people, even though it decreased in 2021, dengue cases reached 73,518, and the death rate was 705 people.[4] The total number of cases and deaths only decreased by 32% from 2020 to 2021; thus, some control efforts are critically needed.

The DHF control efforts made in general are through the elimination of breeding sites, protective measures, and biological and chemical means.[5,6] General control often taken by the community is by chemical methods.[7] Over time, the *Aedes aegypti* mosquito population can develop resistance to commonly used larvicides, occurring through natural selection, where the surviving mosquitoes pass on their resistant traits to their offspring so that subsequent control efforts become less effective.[8,9] Judging from the side effects caused, it is necessary to make innovation by making natural larvicide or bio-larvicide derived from plants having a toxic effect on insects,[10] but not causing side effects on environment. The effect of bio-larvicide can be found in active metabolites in the forms of saponins, tannins, alkaloids, and flavonoids.[11,12] These substances can be found in Indonesia in various types and parts of plants, such as roots, stems, leaves, flowers, fruits, and green seeds.[13] As for plants containing bio-larvicide, one of them is white chicory (*Brassica pekinensis L*).[14]

Based on the preliminary study test results from the phytochemical laboratory, white chicory leaves (*Brassica pekinensis L*) contained flavonoid active ingredients with a percentage of 2.61% and alkaloids of 3.32%, which can be used as natural larvicides. Flavonoids and alkaloids contained in white chicory leaves (*Brassica pekinensis L*) have the potential

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to be bio-larvicides against *Aedes aegypti larvae*. Flavonoids work by disrupting larval metabolic processes, increasing the production of free radicals, resulting in oxidative damage to cells, and damaging larval cell membranes, resulting in ion leakage and dehydration. Alkaloids act as neurotoxins, disrupting the larval nervous system, inhibiting the enzyme cholinesterase, causing muscle overstimulation, and disrupting the hormonal balance of larval development. These mechanisms lead to paralysis, molting failure, and larval death, making white chicory leaves extract an environmentally friendly alternative for mosquito population control.[15]

A study on betel leaf extract (*Piper betle L*) containing active ingredients of saponins, tannins, alkaloids, flavonoids, phenols, chavicol, eugenol, and essential oils at concentrations of 5%, 10%, 15%, 20%, and 25% was declared capable of killing *Aedes aegypti larvae* with a mortality rate above 50% within 24 hours of each treatment.[16] Within one hour, 5% concentration can kill 60% of *larvae*, 10% and 15% concentrations can kill 60% of *larvae*, and 20% and 25% concentrations show a 100% effective killing of *larvae* because they can kill 100% of tested *larvae* within 24 hours.[16] A study on tobacco extract bio-larvicide emulsions against *Aedes aegypti larvae* stated that LC_{50} nanoemulsions for 24 hours and 48 hours were effectively used as bio-larvicides.[17] Extraction using the reflux method has the advantage of being able to extract samples that are relatively heat resistant. However, reflux extraction has several disadvantages; it requires a relatively long time and a lot of solvents, and it also allows certain compounds not to be extracted for their low solubility at room temperature.[17]

Based on this description, the development of bio-larvicides that are harmless and environmentally friendly needs to be advanced, and the killing power derived from toxic substances in plants can act as stomach poison and contact poisons for mosquitoes. Leaves are parts not widely utilized compared to other parts of the plant. Hence, the use of plant leaves provides added value to a plant. With this phenomenon, this study intended to conduct an evidence-based practice study to determine differences in active ingredients, alkaloids, and flavonoids in white chicory leaves (*Brassica pekinensis L*) as bio-larvicide against *Aedes aegypti larvae* for 24 hours with variations in concentrations of 0%, 23%, 34%, and 40%.

The purpose of this study was to evaluate the difference in active flavonoids and alkaloids in white chicory leaves (*Brassica pekinensis L*) as a bio-larvicide against *Aedes aegypti larvae*. This study compared the effectiveness of flavonoids and alkaloids in killing *Aedes aegypti larvae*. In addition, this study also aimed to identify specific compounds in flavonoids and alkaloids with the highest larvicidal activity.

Method

This study utilized a purely experimental approach with a post-test-only control design to investigate the efficacy of active ingredients extracted from white chicory leaves (*Brassica pekinensis L*) as bio-larvicides against *Aedes aegypti larvae*. The research tools included analytical scales, a stopwatch, a porcelain dish, an extractor, a blender, a rotary evaporator, a drip pipette, a thermometer, a spatula, a room thermometer, a measuring cup, a pH meter, and filter cloth. Materials used encompass white chicory leaves, 2N sulfate, 96% ethanol, hydrochloric acid, $FeCl_3$ 5%, *Aedes aegypti larvae*, 2N HCl, paper labels, Aquades, and plastic cups.

The experiment involved exposing 1,225 *Aedes aegypti* instar III *larvae* to extracts containing varying concentrations (0%, 24%, 34%, and 40%) of alkaloids and flavonoids, replicated three times. Mortality data of *larvae* were collected and analyzed using probit analysis, one-way ANOVA, and Post Hoc LSD tests to determine the effectiveness of different extract concentrations. This study was conducted with sufficient repetition to ensure the validity and reliability of the results. Each extract concentration and control was repeated three times. Each replicate involved the same number of *larvae*, 20 *larvae* per container. This repetition was done for each concentration of flavonoid and alkaloid extracts, as well as the control group.

The time-based method of measuring *Aedes aegypti larvae* mortality in this study was designed to evaluate the effectiveness of flavonoids and alkaloids extracts from white chicory leaves (*Brassica pekinensis L*) as bio-larvicides. *Larvae* that had been bred in the laboratory were placed in Petri dishes filled with hygienic water and treated with extracts in various concentrations, as well as a control group without extracts. Mortality observations were made at 24-hour intervals for a period of 72 hours after treatment. *Larvae* were considered dead if they showed no movement when touched. Mortality data were recorded and analyzed to determine the percentage of mortality at each time interval and extract concentration. These analyses would provide information on the potential effectiveness of white chicory leaf extract as an alternative control for *Aedes aegypti larvae*, with potential applications in environmentally friendly vector control.

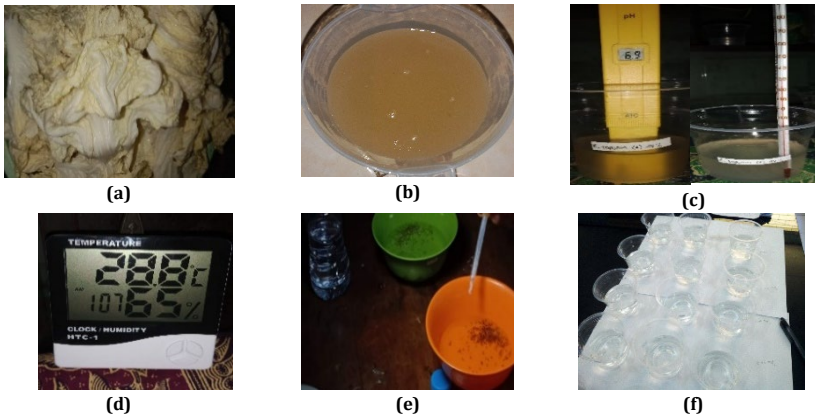

Figure 1. (a) white chicory leaves drying process; (b) extract results; (c) pH and water temperature measurement; (d) room temperature and humidity measurement; (e) transfer *of Aedes aegypti larvae;* (f) process of administering white chicory leaves active ingredient extract

Results

The room temperature results for 24 hours obtained an average of 28.5°C and a room humidity of 64%. The results of water temperature and water pH measurements at a concentration of 0% or control treatment of the death of *Aedes aegypti* instar III *larvae* for 24 hours obtained an average water temperature of 29 and a water pH of 0.68. The active ingredient of alkaloids was obtained at an average water temperature of 29°C and water pH of 6.9, while the active ingredient of flavonoids was obtained at an average water temperature of 28°C and water pH of 6.8.

Table 1 . Average Results and Standard Deviations of Water Temperature, Water pH, Room Temperature, and Room Humidity of White Chicory Leaves (*Brassica pekinensis L*) Active Ingredients for 24 Hours

Active Ingredient	Concentration	Temperature Water (°C)		Water pH		Room Temperature (°C)		Room Humidity	
		$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Control	0%	29	0.68	6.2	0.25	28.5	0.79	64%	1.29
Alkaloid	24%	29	0.61	7.0	0.10	28.5	0.79	64%	1.29
	34%	28	0.49	6.9	0.07	28.5	0.79	64%	1.29
	40%	29	0.60	6.9	0.05	28.5	0.79	64%	1.29
Flavonoid	24%	28	0.27	6.8	0.04	28.5	0.79	64%	1.29
	34%	29	0.64	6.7	0.05	28.5	0.79	64%	1.29
	40%	28	0.49	6.9	0.04	28.5	0.79	64%	1.29

Note: SD = standard deviation

Table 2. Average and Standard Deviation of Percentage of Mortality of *Aedes aegypti Larvae* After 24-hour Exposure to White Chicory Leaves (*Brassica pekinensis L*) Active Ingredient Extract

Active Ingredients	Concentration	Average	SD
Control	0%	0%	0%
Alkaloid	24%	41%	3.31
	34%	60%	4.89
	40%	66%	6
Flavonoid	24%	45%	3.31
	34%	64%	2.82
	40%	68%	4.89

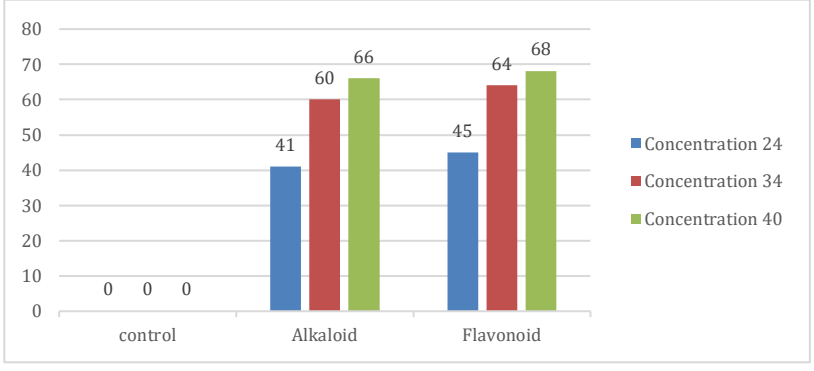

Figure 1. Average Percentage of *Aedes aegypti larvae* Mortality Over 24 Hours

Based on Table 2 and Figure 1, the death of *Aedes aegypti* instar III *larvae* at a control or concentration of 0% for 24 hours obtained an average larval mortality of 0% and a standard deviation of 0%. Extracts of alkaloid active ingredient concentrations of 24%, 34%, and 40% for 24 hours with four-fold replication obtained the average mortality of *Aedes aegypti larvae* of 41%, 60%, and 66%, with a standard deviation of 3.31-6. The active ingredients of flavonoids obtained the average mortality of *Aedes aegypti larvae* amounted to 45%, 64%, and 68% with a standard deviation of 2.82-4.89. Based on Table 3, the results of probit analysis of the extract of the active ingredient of chicory (*Brassica pekinensis L*) against *Aedes aegypti larvae* in treatment for 24 hours found that the LC50 value of the alkaloid active ingredient was located at a concentration of 29.084%. Meanwhile, flavonoids were located at a concentration of 26.580%.

Table 3. Results of LC_{50} Value of Chicory (*Brassica pekinensis L*) Active Ingredient Extract Against the Mortality of *Aedes aegypti larvae* for 24 Hours

Active Ingredients	Lower Limit	Middle Border	Upper Limit
Alkaloid	22.780%	29.084%	32.610%
Flavonoid	16.985%	26.580%	30.509%

Discussion

Water temperature measurement of *Aedes aegypti larvae* breeding media at control (0%) and at extract media of active ingredients of alkaloids and flavonoids in white chicory leaves (*Brassica pekinensis L*) was 28°-29°C. The standard water temperature is at 25°C-30°C;[18] therefore, the temperature of the test media at the time of the study was the optimum temperature for larval breeding. The pH measurement of the test media in the control group and alkaloid extracts, white chicory leaves (*Brassica pekinensis L*) flavonoids was 6.2–7.0 and in the control group the average pH was 6.2. The standard of water pH is 5.8–8;[19,20] therefore, the water pH of the test media at the time of the study, both treatment and control groups, was the optimum pH for larval breeding.

The measures of room temperature were obtained at an average of 28°C. The standard room temperature was 25°C-30°C;[21,22] Therefore, the room temperature used at the time of the study was the optimum temperature for larval development. The measure of room humidity obtained an average result of 64%. The optimum humidity for the life of *Aedes aegypti larvae* ranges from 60% to 80%;[18,23] therefore, room humidity during the study was the optimum humidity for larval breeding.

The results of using alkaloid active ingredient extracts at concentrations of 24%, 34%, and 40% with treatment for 24 hours obtained an average percentage of larval death of 41%, 60%, and 66%. These results proved that there was a larvicide effect on the administration of the alkaloid extract as an active ingredient of white chicory leaves (*Brassica pekinensis L*). The mechanism of alkaloid compounds is inhibiting the feeding power of *larvae* and acting as stomach poison.[24]

Meanwhile, the results of using flavonoid active ingredient extracts at concentrations of 24%, 34%, and 40% with treatment for 24 hours obtained an average percentage of larval death of 45%, 64%, and 68%. These results proved that there was a larvicide effect on the administration of flavonoid extract as the active ingredient of white chicory leaves (*Brassica pekinensis L*). Flavonoid compounds work as powerful respiratory inhibitors or as respiratory toxins.[25–27] The results of the Post Hoc LSD test of the active ingredients of alkaloids and flavonoids in general found that the higher the concentration, the higher the larvicide effect that could cause the death of test *larvae*. This was evidenced by the advantage of 40% extract concentration compared to 24% and 34% concentrations.

According to a study on the potential of fragrant pandan leaf (*Pandanus amaryllifolius Roxb*), larvicide from ethanol extract is effective as a natural larvicide for *Aedes aegypti* with six effective concentrations compared to controls. The concentrations are at 0.125%, 0.5%, 1%, 2%, and 4%, with an ineffective concentration of 0.05% and LC values of 2.113% and 3.497%.[24] LC_{50} value in the extract of alkaloid and flavonoid active ingredients contained in white chicory leaves (*Brassica pekinensis L*) probit test results showed that the LC_{50} value was a concentration that could kill 50% of *larvae* test for 24 hours at 29.084% alkaloid and 26.580% flavonoids active ingredients. World Health Organization (WHO) also stated that the minimum percentage of larvicide studies used is 1%,[28] meaning that the LC_{50} test results met the WHO standards and effectively killed 50% of *larvae* test.

The weakness of this study was that it used white chicory leaves from traditional markets. It also explored only alkaloids and flavonoids as the active ingredients of white chicory leaves, with a duration of exposure of 24 hours. The concentrations used were 24%, 34%, and 40%, obtained from the results of probit analysis. The *larvae* imposed were *Aedes aegypti* instar III *larvae* from the rearing results of the Entomology Laboratory of Poltekkes Kemenkes Surabaya, and water temperature, water pH, room temperature, and room humidity measured were rooms used as research sites.

Furthermore, the implication of this study was to provide considerable alternatives for the prevention and control of *Aedes aegypti* vectors that were environmentally friendly, affordable, and natural. Also, it was hoped to broaden horizons and knowledge of the *Aedes aegypti larvae* control through alkaloid and flavonoid extracts as active ingredients of white chicory leaves (*Brassica pekinensis L*) and can be used as a reference for the control of *Aedes aegypti larvae* with the use of bio-larvicide.

Conclusion

This study finds that higher concentrations of both alkaloid and flavonoid extracts significantly increased the mortality rate of *Aedes aegypti larvae*. A 40% concentration of both extracts shows the most effective results compared to lower concentrations. Further research is needed to understand the mechanism of action of the alkaloid and flavonoid extracts on *Aedes aegypti larvae*. In addition, more extensive field studies are needed to ensure the effectiveness and safety of using these extracts on a large scale in natural environments.

Abbreviations

DHF: Dengue hemorrhagic fever; SD: standard deviation; WHO: World Health Organization.

Ethics Approval and Consent to Participate

Ethical clearance has been obtained for the study from Poltekkes Kemenkes Surabaya (No.EA/1398/KEPK-Poltekkes_Sby/V.2023).

Competing Interest

All authors declare no conflicts of interest.

Availability of Data and Materials

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request. Any additional materials and data used in this research are also accessible upon request, ensuring transparency and reproducibility of the findings.

Authors' Contribution

M, DSOA, and N developed the research concept and design. DN and IS carried out laboratory experiments and collected data. M and AP were responsible for data analysis and interpretation of results. All authors, including M, DSOA, N, DN, IS, and AP, contributed to the writing and revision of the article and approved the final version for publication.

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Variation and Predictors of COVID-19 Mortality in Hospitalized Cases in West Sumatra Province, Indonesia: A Retrospective Observational Study

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Variation and Predictors of COVID-19 Mortality in Hospitalized Cases in West Sumatra Province, Indonesia: A Retrospective Observational Study

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Abstract

During 2020, the year of the COVID-19 pandemic, different Indonesian provinces had different numbers of COVID-19 infections and fatalities, particularly in West Sumatra Province. This study aimed to investigate the variation of confirmed COVID-19 cases and determine predictors of mortality in hospitalized patients across districts in West Sumatra Province. A retrospective observational study was conducted during the COVID-19 pandemic. From March 2020 to June 2021, 46,005 confirmed cases were collected in the province, of which 42,308 were hospitalized and analyzed. Confirmed cases and deaths were compared by geographic location using spatial analysis. The risk predictors of death were estimated using logistic regression. COVID-19 incidence and mortality varied across cities/districts, with less than 1,000 confirmed cases appearing to be the lowest number. A distinct pattern was visible nonetheless when the incidence density of confirmed cases and deaths was higher. Acute respiratory distress syndrome during the COVID-19 treatment had a higher risk of death (OR = 75.2, 95% CI: 25.6–250). The most significant predictors of death in terms of comorbidity were pneumonia, followed by cancer, chronic obstructive pulmonary disease, diabetes, cardiac disease, and hypertension.

Keywords: comorbidity, COVID-19, pandemic, prevention, risk factor

Introduction

SARS-CoV-2 spread rapidly from its origin in Wuhan, China, to many countries worldwide since its emergence in December 2019. It resulted in a global pandemic within three months only, as the World Health Organization announced the coronavirus disease 2019 (COVID-19) pandemic in March 2020.[1] The total confirmed cases shortly reached 213,050,725 cases, including 4,448,352 deaths, as of August 26, 2021.[2]

Indonesia is no exception to the COVID-19 pandemic, reaching a total of 765,350 confirmed cases with 22,734 deaths as of December 28, 2020.[3] A five-fold increase of confirmed cases and deaths due to COVID-19 occurred eight months later, to 4,008,166 cases and 128,252 deaths as reported on August 28, 2021.[3] Furthermore, the pandemic curve seemed to be lifted significantly from June to August 2021 due to the massive spread of the delta variant of COVID-19 in the country.[4]

Two months after the pandemic outbreak in India from January 2021 to May 2021,[5] Indonesia was named the new epicenter of the pandemic in Asia and contributed the highest number of cases globally during June 12–18, 2021, surpassing the United Kingdom, Brazil, India, and the United States.[6] The COVID-19 cases and death numbers vary across provinces in Indonesia. The highest numbers were reported in Java and Bali, two islands where most of the population live. However, the ongoing number of cases and deaths reported in other provinces could not be disregarded in this developing country with a decentralized government.[7,8] The variation in the number of cases and deaths across cities/districts or provinces may reflect the local government's response in following the national policy on pandemic control. It differs according to their coordination and decision-making capacity, which may decelerate the national agenda to address this pandemic.[9]

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The COVID-19-related deaths in developing countries are critical, even though the numbers are likely an underestimate of actual deaths.[10,11] From a public health perspective, deaths due to a novel virus reflect the severity of the disease in the community, the population at risk, the readiness of the health system, and the quality of health care.[12] Fewer studies on COVID-19 mortality in low and middle-income country (LMIC) settings have been published, discussing factors associated with COVID-19 mortality, analyzing one-month COVID-19 cases in Iran,[13] population-level indicators in Africa,[14] mortality in children,[15] and demographic and clinical factors of the COVID-19-related deaths in Jakarta, Indonesia.[16]

However, previous studies did not include a large cohort of hospitalized patients of COVID-19 in their analysis since the beginning of the pandemic, and none of those studies revealed whether COVID-19 mortality indicators varied across areas in the LMIC settings. To direct the medical interventions and public health policy during the COVID-19 pandemic, it was essential to assess mortality rates and predictors of death among hospitalized cases. The necessity to adequately manage resources and save lives was the driving force behind the haste.[17,18]

This study presents a different insight into COVID-19 mortality for a one-year period of the pandemic and contributes to filling the gap in the existing literature concerning COVID-19-related deaths in LMIC. This study aimed to investigate the variation of confirmed COVID-19 cases and determine predictors of mortality in hospitalized patients across cities/districts in West Sumatra Province, Indonesia. This study emphasizes the importance of understanding comprehensive mortality patterns and risk factors to serve public health strategies in responding to and controlling pandemics.

Method

This retrospective observational study was conducted in collaboration with the West Sumatra Provincial Health Office and the Faculty of Public Health, Universitas Andalas. Data recorded by the West Sumatra Provincial Health Office through the Epidemiological Surveillance System for Viral Respiratory Diseases were analyzed. The study population of confirmed cases of COVID-19 admitted to the hospital from the beginning of the pandemic on March 2020 to June 7, 2021, as confirmed by laboratory tests of the real-time PCR (RT-PCR) assay for SARS CoV-2.

Data collection involved the entire provincial government health authority network, from primary health care (PHC) in each subdistrict, across cities/district health offices, public and private hospitals, and laboratories to the provincial health office. The RT-PCR results from the laboratories were delivered to and verified by the city and district health offices to ensure whether the confirmed case was registered as residents of their respective cities and districts. Demographic, contact records, symptoms, and clinical data were recorded by 279 PHCs for self-quarantined cases and by hospitals for hospitalized cases. These data were then recorded by the respective city and district health offices and forwarded to the provincial health offices to be compiled and reported to the Indonesian Ministry of Health for the national database.

A total of 46,005 confirmed cases from March 2020 to June 7, 2021, were collected in West Sumatra Province, from which 42,308 cases were hospitalized and analyzed in this study. A total of 3,697 cases were excluded from the analysis of this study for several reasons, including having died in a private or public isolation center, an unknown place of death, and still being hospitalized at the time of analysis (Figure 1).

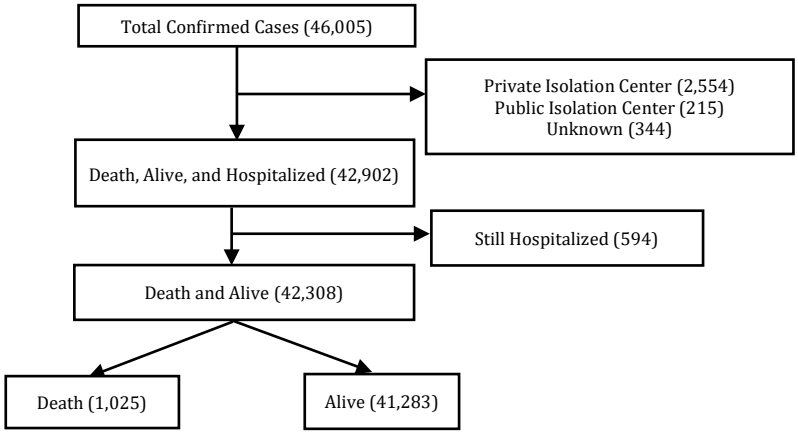

Figure 1. Study Flowchart of the Number of Cases

Treatment outcomes were categorized as patients alive (discharged alive) and deceased (dead). For analysis purposes, only one episode of hospitalization for patients discharged and then readmitted within the study period was considered. The discharged alive is defined as confirmed COVID-19 cases who recovered from the disease, as evidenced by negative COVID-19 RT-PCR laboratory results; no symptoms for three consecutive days; met discharge criteria based on comprehensive medical assessment including radiology and blood tests; and approved by a physician.[19] Deceased is defined as discharge due to the death of a patient with COVID-19.

Patient characteristics and severity variables during the course of the disease covered in this study were sex (categorized as male and female), age (in years), employment status (categorized as employed, unemployed, and unknown), and pregnancy (for females). Closed contact was defined as a person with a record of face-to-face contact within a one-meter distance for at least 15 minutes, or having direct physical contact such as shaking and holding hands, or providing direct medical treatment or care without appropriate and standard personal protective equipment or other situations indicating contact based on risk assessment by local epidemiologists, with probable or confirmed cases within two days before to 14 days after symptom onset for symptomatic cases and within two days before to 14 days after the date of the swab examination for asymptomatic case.[19]

Contact records with a suspect of COVID-19 were defined as similar records of contact with a suspect case (a person with one of three criteria: having acute infection of the respiratory tract and having travel history to a place with local transmission in 14 days prior to the infection; showing at least one acute infection of respiratory tract signs or symptoms and having contact with a probable or confirmed case in 14 days prior to the onset of signs or symptoms; and having severe infection of the respiratory tract or severe pneumonia, needing medical treatment in hospital, and no other cause based on convincing clinical features.[19] Travel history was defined as domestic or international travel history within the last 14 days before the onset of signs or symptoms. In addition, vaccination status was categorized as fully vaccinated if receiving two doses of the COVID-19 vaccine, not fully vaccinated if receiving only one dose, and unvaccinated. Symptoms (anosmia, cough, fever, dyspnea, diarrhea) and comorbidities (hypertension, diabetes, heart disease, cancer, asthma, and chronic obstructive pulmonary disease (COPD)) during hospitalization were defined as diagnoses included in the medical record. Severe conditions were critical complications requiring close monitoring and prompt medical intervention in the course of the disease during hospitalization (pneumonia and acute respiratory distress syndrome (ARDS)).

The QGIS (desktop version 3.38.1-Grenoble) for cartography was employed to obtain variations and patterns of confirmed COVID-19 cases and deaths. The QGIS was open-source software available under the terms of the GNU General Public License, Copyright (C) 1989, 1991 Free Software Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA (https://www.qgis.org). The number of confirmed cases, incidence density of confirmed cases per 10,000, the number of deaths per 100,000, and case fatality ratio (CFR) of confirmed cases (in percentage) were compared by geographic location using spatial analysis, respectively. The CFR of confirmed cases was calculated as the number of deaths divided by the total number of confirmed cases. Incidence density was estimated as the number of confirmed cases divided by the number of permanent resident population.

Variables assessed were sex, age, employment, closed contact, contact records with the suspect, travel history, vaccination status, symptomatic status, comorbidity, and number of comorbidities. For categorical variables, descriptive statistics contained proportions; for continuous variables, they included medians and interquartile ranges (IQRs). A Pearson's Chi-square was utilized to evaluate a relationship between two categorical variables. Medians of two independent samples were compared using the Wilcoxon rank sum test, and the independence of a 2x2 contingency table was tested using Fisher's exact test.

The determined risk factors were calculated using bivariable and multivariable logistic regression models, and the results were reported as an odds ratio (OR) with a 95% confidential interval (CI). In the multivariable models, every independent variable in the bivariable analysis with a p-value of <0.10 was included. The Akaike Information Criterion was used to guide the final model selection. All analyses were performed using R software (version 4.1.1) and R Studio software (version 1.4.1717). R Studio is an open-source user interface for R software. The R software and RStudio are available under the GNU Affero General Public License v3. The AGPL v3 is an open-source license.

Results

Morbidity and Mortality Variation

This study found variations in COVID-19 incidence and death across cities/districts in the West Sumatra Province (Figure 2). The highest number of confirmed cases, over 5,000, was found in Kota Padang, the capital city and the most

populous city in the province, with a total case of 20,794 and the incidence density of confirmed cases (more than 240 per 10,000 population). Moreover, the spatial analysis showed several cities and districts: Pariaman, Kepulawan Mentawai, Sawahlunto, and Solok Selatan, which seemed to have the lowest number of confirmed cases (less than 1,000). However, there was a higher incidence density of confirmed cases.

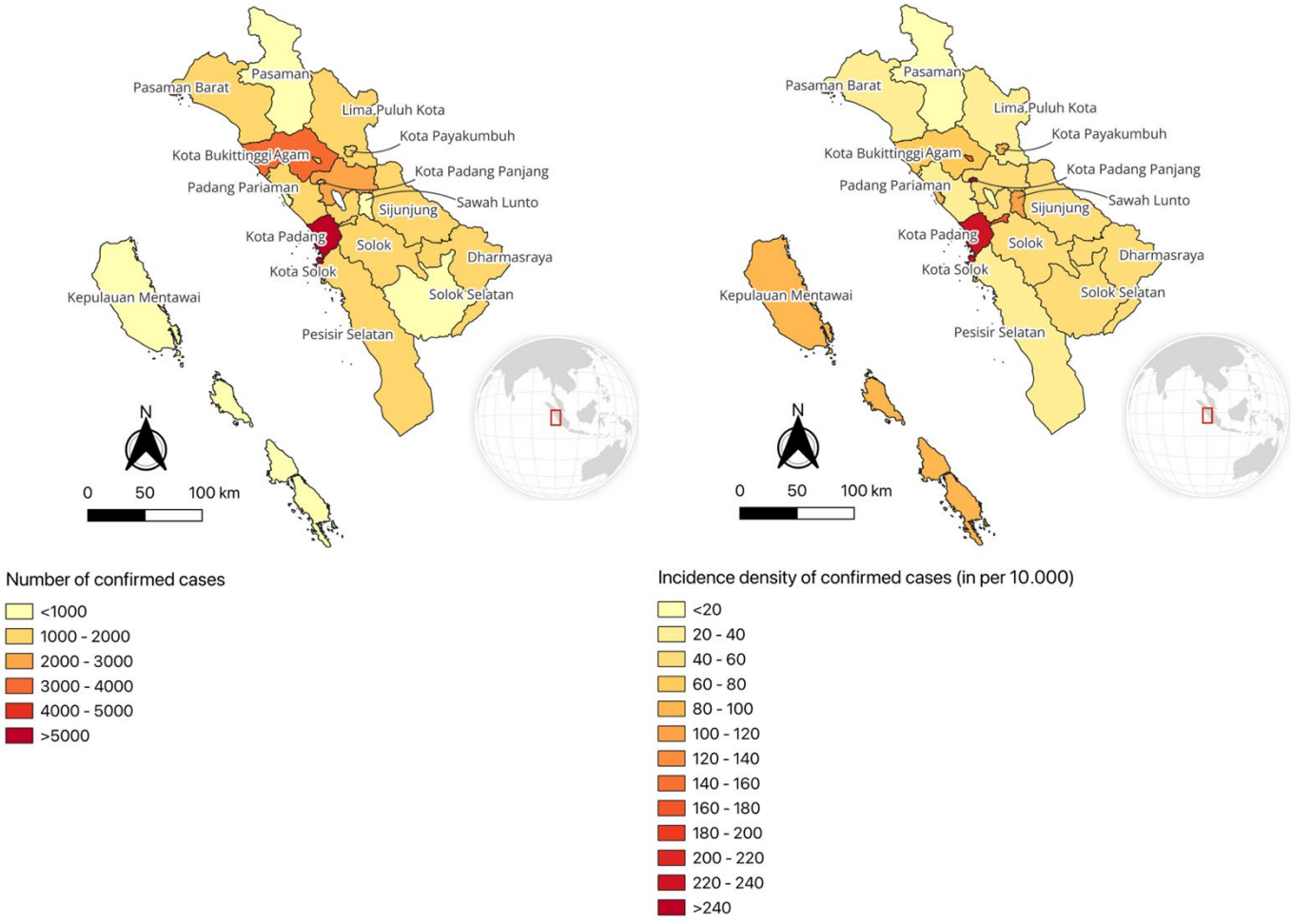

Figure 2. Number of Confirmed Cases and Incidence Density of Confirmed Cases

A different pattern was revealed by the results of spatial analysis for deaths (Figure 3). This study found that 1,025 (2.4%) of the cases analyzed had died. The highest mortality rate was found in Kota Padang (45 to 50 deaths per 100,000 population), followed by Solok, Pariaman, and Sijunjung. Nevertheless, the highest CFR was found in Pasaman and Pasaman Barat (5.1 to 6%), followed by Pariaman, Solok, and Sawahlunto.

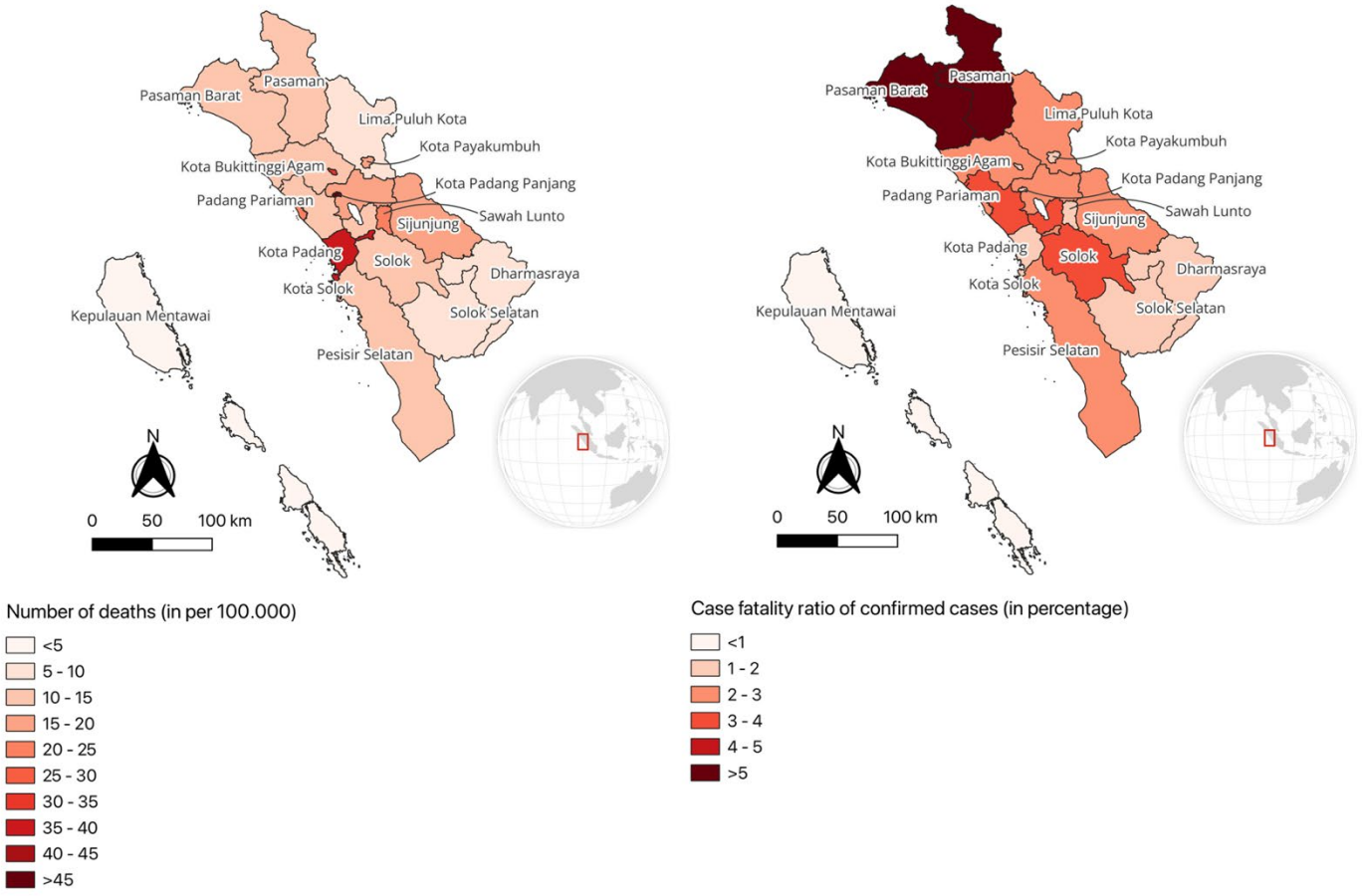

Figure 3. Number of Deaths and Case Fatality Ratio of Confirmed Cases

Demographic, Symptoms, and Clinical Features

Demographics, symptoms, and clinical feature distribution are shown in Table 1. This study analyzed data from 42,308 COVID-19 patients. Of the number of patients, 55% were females, although women were less likely to die from the disease compared to men, having a higher mortality rate. Pregnant women had a lower rate of illness and a reduced death rate compared to other groups. Most patients exhibited symptoms such as fever and cough. Employment status affected outcomes, in which employed individuals showed higher survival rates than those unemployed.

Unvaccinated individuals accounted for the majority of both cases and deaths, while those fully vaccinated experienced significantly fewer cases and fatalities. Diabetes was more common among the dead than in survivors, with a greater likelihood of hypertension. Higher mortality was linked to pneumonia, cancer, and heart disorders. The prevalence of COPD and asthma was low. ARDS was rare but had a notable impact on mortality.

Mortality Predictors

Multivariable analysis showed that men had a higher risk of death compared with women (OR = 1.52, 95% CI: 1.33 to 1.73). The study revealed that among those who develop ARDS during COVID-19 treatment, the risk of death is higher (OR = 75.2, 95% CI: 25.6–250). The most significant predictors of death in terms of comorbidity were pneumonia, followed by cancer, COPD, diabetes, cardiac disease, and hypertension. A COVID-19 case with pneumonia had a 16.2 times higher risk of death than without pneumonia (95% CI: 10.2-25.1). The adjusted ORs for other comorbidities are described in Table 2.

Table 1. Demographics, Symptomatic Characteristics, and Comorbidities of COVID-19 in West Sumatra Province, Indonesia

Characteristic	N = 42,308[1]	Alive, N = 41,283[2]	Death, N = 1,025[2]	p-value[3]
Sex				**<0.001**
Female	23,373 (55%)	22,911 (55.5%)	462 (45.1%)	
Male	18,935 (45%)	18,372 (44.5%)	563 (54.9%)	
Pregnant women	335 (0.8%)	331/41,283(0.8%)	4/1,025(0.4%)	0.14
Median IQR age (years)	36 (24, 51)	35 (24, 50)	61 (54, 70)	**<0.001**
Age interval (years)				
0-10	2,072 (4.9%)	2,067 (5.0%)	5 (0.5%)	
10-19	4,782 (11%)	4,781 (11.6%)	1 (0.1%)	
20-29	8,730 (21%)	8,719 (21.1%)	11 (1.1%)	
30-39	8,269 (20%)	8,232 (19.9%)	37 (3.6%)	
40-49	6,733 (16%)	6,617 (16.0%)	116 (11.3%)	
50-69	6,810 (16%)	6,540 (15.8%)	270 (26.3%)	
60-69	3,416 (8.1%)	3,096 (7.5%)	320 (31.2%)	
70-79	1,126 (2.7%)	940 (2.3%)	186 (18.1%)	
80-89	335 (0.8%)	264 (0.6%)	71 (6.9%)	
90-110	35 (<0.1%)	27 (0.1%)	8 (0.8%)	
Age group				**<0.001**
Infants (1-2 years)	569 (1.3%)	566 (1.4%)	3 (0.3%)	
Children (3-16 years)	4,498 (11%)	4,495 (10.9%)	3 (0.3%)	
Young Adults (17-39 years)	18,786 (44%)	18,738 (45.4%)	48 (4.7%)	
Middle-aged Adults (40-59 years)	13,543 (32%)	13,157 (31.9%)	386 (37.7%)	
Elderly (>59 years)	4,912 (12%)	4,327 (10.5%)	585 (57.1%)	
Employment status				**<0.001**
Employed	38,040 (90%)	37,156 (90.0%)	884 (86.2%)	
Unemployed	1,618 (3.8%)	1,563 (3.8%)	55 (5.4%)	
Unknown	2,650 (6.3%)	2,564 (6.2%)	86 (8.4%)	
Closed contact	21,447 (51%)	21,293/41,283(51.6%)	154/1,025(15.0%)	**<0.001**
Contact record with suspect	7,031 (17%)	6,507/41,283(15.8%)	524/1,025(51.1%)	**<0.001**
Travel history	1,713 (4.0%)	1,668/41,283(4.0%)	45/1,025(4.4%)	0.6
Vaccination status				**0.001**
Fully vaccinated	182 (0.4%)	181 (0.4%)	1 (0.1%)	
Not fully vaccinated	415 (1.0%)	394 (1.0%)	21 (2.0%)	
Unvaccinated	41,711 (99%)	40,708 (98.6%)	1,003 (97.9%)	
Symptomatic status				**<0.001**
Asymptomatic	2,734 (6.5%)	2,716 (6.6%)	18 (1.8%)	
Symptomatic	38,601 (91%)	37,653 (91.2%)	948 (92.5%)	
Unknown	973 (2.3%)	914 (2.2%)	59 (5.8%)	
The number of symptomatic				**<0.001**
0	37,019 (87%)	36,287 (87.9%)	732 (71.4%)	
1	3,053 (7.2%)	2,918 (7.1%)	135 (13.2%)	
2	1,904 (4.5%)	1,793 (4.3%)	111 (10.8%)	
>2	332 (0.8%)	285 (0.7%)	47 (4.6%)	
Anosmia	886 (2.1%)	883/41,283(2.1%)	3/1,025(0.3%)	**<0.001**
Cough	2,918 (6.9%)	2,752/41,283(6.7%)	166/1,025(16.2%)	**<0.001**
Fever	3,571 (8.4%)	3,373/41,283(8.2%)	198/1,025(19.3%)	**<0.001**
Dyspnea	431 (1.0%)	302/41,283(0.7%)	129/1,025(12.6%)	**<0.001**
Diarrhea	62 (0.1%)	60/41,283(0.1%)	2/1,025(0.2%)	0.7
Comorbidity	4,981 (12%)	4,304/41,283(10.4%)	677/1,025(66.0%)	**<0.001**
The number of comorbidities				
0	39,002 (92%)	38,486 (93.2%)	516 (50.3%)	
1	2,639 (6.2%)	2,274 (5.5%)	365 (35.6%)	
2	598 (1.4%)	474 (1.1%)	124 (12.1%)	
>2	69 (0.2%)	49 (0.1%)	20 (2.0%)	
Hypertension	1,455 (3.4%)	1,261/41,283(3.1%)	194/1,025(18.9%)	**<0.001**
Diabetes	1,288 (3.0%)	1,039/41,283(2.5%)	249/1,025(24.3%)	**<0.001**
Cardiac Diseases	563 (1.3%)	477/41,283(1.2%)	86/1,025(8.4%)	**<0.001**
Cancer	236 (0.6%)	170/41,283(0.4%)	66/1,025(6.4%)	**<0.001**
Pneumonia	111 (0.3%)	76/41,283(0.2%)	35/1,025(3.4%)	**<0.001**
Asthma	313 (0.7%)	299/41,283(0.7%)	14/1,025(1.4%)	**0.018**
COPD	59 (0.1%)	43/41,283(0.1%)	16/1,025(1.6%)	**<0.001**
ARDS	20 (<0.1%)	5/41,283(0.0%)	15/1,025(1.5%)	**<0.001**

[1]n (%); Median interquartile ranges (IQR)

[2]n (%); n/N (%); Median interquartile ranges (IQR)

[3]Pearson's Chi-square test; Wilcoxon rank sum test; Fisher's exact test

Notes: IQR = Median interquartile ranges, COPD = Chronic Obstructive Pulmonary Disease, ARDS = Acute Respiratory Distress Syndrome.

Table 2. Comorbidity Predictors of COVID-19 Mortality in West Sumatra Province, Indonesia

	Crude OR[1]	95% CI[1]	p-value	Adjusted OR[1]	95% CI[1]	p-value
Sex						
Female	—	—		—	—	
Male	1.52	1.34, 1.72	<0.001	1.52	1.33, 1.73	<0.001
Hypertension						
No	—	—		—	—	
Yes	7.41	6.26, 8.73	<0.001	3.39	2.78, 4.11	<0.001
Diabetes						
No	—	—		—	—	
Yes	12.4	10.6, 14.5	<0.001	7.31	6.10, 8.72	<0.001
Cardiac Diseases						
No	—	—		—	—	
Yes	7.83	6.14, 9.89	<0.001	3.40	2.57, 4.45	<0.001
Cancer						
No	—	—		—	—	
Yes	16.6	12.4, 22.2	<0.001	11.7	8.33, 16.2	<0.001
Pneumonia						
No	—	—		—	—	
Yes	19.2	12.6, 28.5	<0.001	16.2	10.2, 25.1	<0.001
COPD						
No	—	—		—	—	
Yes	15.2	8.29, 26.5	<0.001	9.24	4.65, 17.4	<0.001
ARDS						
No	—	—		—	—	
Yes	123	47.4, 378	<0.001	75.2	25.6, 250	<0.001

Notes: OR = odds ratio, CI = confidence interval, COPD = Chronic Obstructive Pulmonary Disease, ARDS = Acute Respiratory Distress Syndrome.

Discussion

West Sumatra Province, Indonesia, is located on the West Coast of Sumatra Island and inhabited by more than five million people across cities/districts. Several cities/districts in the province have been identified as having the highest level of COVID-19 risk by the Indonesian Ministry of Health. A total of 85,130 confirmed cases and 1,930 total deaths were reported as of June 2021.[20] A significant increase of new cases and deaths were notified in June and July 2021 in the province, a similar pattern to the national level. Specifically, in the number of deaths, a three-fold increase occurred from 524 deaths in December 2020 to 1,941 deaths reported in August 2021.[20]

The epidemiological details of 42,308 hospitalized COVID-19 cases representing a cohort of cases from one year since the start of the pandemic reported in 19 cities and districts in West Sumatra Province, Indonesia (Table 1). Given that 2.4% of the instances resulted in death, a 2.8% CFR of COVID-19 was recorded nationally as of June 7, 2021 (52,879 deaths of 1,911,358 confirmed cases). By 2.16% of confirmed deaths in the same period, the ratio was greater than the global situation. This study's findings about CFR might be overestimated, especially in the early stages of the pandemic when contact tracing and testing were less likely to be carried out successfully and when reporting cases and fatalities was delayed. In addition, access to testing capacity was still uneven and could also occur due to different response capacities between cities and districts.[21,22]

Comparing the variation in the number of deaths and CFR by cities/districts would provide worthwhile insight to evaluate the severity of the disease among those hospitalized.[17] This study found that the COVID-19 morbidity and mortality patterns differ across cities/districts in the West Sumatra Province. The highest number of confirmed cases and deaths was reported in Kota Padang, the capital city of West Sumatra Province. However, the city was detected as having a lower CFR compared to other districts with a lower number of cases and deaths.

This variation might reflect the difference in terms of capacity between local governments at the city/district level and the central government in terms of case detection and providing quality health care. The higher number of cases and lower CFR in Kota Padang could be explained since Padang is the capital city of the province, where health capacity is better than in other districts. The population wealth indicators are higher in the city, leading to higher awareness of the people towards the pandemic and its preventive measures, including seeking care behaviors.

This study revealed that the median age of confirmed cases was 36 years, and most of them were females. However, this study discovered that the median age of the deceased was 61 years and that the risk of death increased with age. This finding was in line with infection susceptibility and the higher prevalence of comorbidities among older adults, hampering the body's response against the infection.[23] Besides, the proportion of deaths among males was significantly higher than that among females. This result is consistent with the possibility of different immune responses between male and female individuals, leading to different impacts on inflammation.[24]

The low-level coverage of COVID-19 vaccination was found during the study period in the West Sumatra Province, as greater than 95% of cases (both discharge alive and death) remained unvaccinated, while the vaccination coverage (fully vaccinated) at the national level was reported at 7.2% by June 27, 2021. Nevertheless, the proportion of vaccinated among the deceased was significantly lower than that of the survivors. Fever and cough were the most frequent symptoms reported in the West Sumatra Province, similar to Jakarta.[16]

This study revealed evidence that COVID-19 cases developing ARDS during the course of the disease had a higher risk of death compared to those without ARDS. ARDS was found to be one of the major causes of COVID-19-related deaths. However, the pathophysiology of ARDS in COVID-19 was relatively more established compared to the initial period of the COVID-19 pandemic. A systematic review found that the highest specific mortality from COVID-19-associated ARDS was identified by studies in China, Poland, and Spain and during a period of time when there was inadequate knowledge on the management of ARDS in COVID-19 cases.[25] Understanding the characteristics of COVID-19-related ARDS is pivotal to early identification and precise treatment.[26]

This evidence reflected the urgent need for an improvement in local health capacity in terms of management of ARDS in COVID-19 cases in West Sumatra Province, as well as in the global perspective setting. In addition to other predictors, the most significant risk factor was COVID-19 pneumonia. A certain kind of COVID-19 pneumonia is brought on by SARS-CoV-2 and is distinguished by bilateral lung involvement and possible severity. In contrast, regular pneumonia symptoms are similar to COVID-19 pneumonia and can arise from various infections, they are not usually as severe.[27,28] While deciding what the government's actions should implement during the pandemic, the description of mortality rates and mortality predictors is crucial information. Even though the pandemic has been proclaimed over, policies based on thorough epidemiological studies are essential to consider in efforts to control and prevent the spread of COVID-19.[8,29,30]

The weakness of this study was that information on mortality had not been comprehensively audited. The definition of a COVID-19 death was developed for the earliest phase of the pandemic in 2020, but not all COVID-19 deaths met these fixed criteria.[31] A comprehensive audit of COVID-19 deaths is needed in the future. Big data was used for this study; hence, the results inherently lead to significant findings. However, big data offers opportunities and challenges; the significance depends on thoughtful analysis and context.[32,33]

Conclusion

Determining the risk factors and epidemic intensity requires an understanding of the predictors of death in hospitalized COVID-19-verified patients. This study adds to the body of information on the various patterns of COVID-19 incidence and mortality across cities and districts when calculated proportionately and adjusted for the population size and the number of cases found. The top five risk factors for COVID-19 mortality include ADRS and comorbidities in the form of pneumonia, cancer, COPD, diabetes, and heart disease.

Abbreviations

COVID-19: coronavirus disease 2019; LMIC: low- and middle-income countries; RT-PCR: real-time PCR; PHC: primary health care; COPD: Chronic Obstructive Pulmonary Disease; ARDS: Acute Respiratory Distress Syndrome; CFR: Case Fatality Ratio; IQR: interquartile ranges; OR: odds ratio; CI: confidence interval.

Ethics Approval and Consent to Participate

The ethical clearance of the study had been approved by the Ethics Committee of the Faculty of Public Health, Universitas Andalas (Approval Number: No.2/UN.16.12/KEP-FKM/2022).

Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this manuscript.

Availability of Data and Materials

Data and materials are available upon request.

Authors' Contribution

Conceptualization: DD and ASEP; methodology: DD and ASEP; data collection: DD, ASEP, and YP; data preparation: DD, ASEP, and YP; data analysis: DD, ASEP, and YP; interpretation: DD and ASEP; writing—original draft preparation: DD and ASEP; writing—review and editing: DD, ASEP, and YP. All authors have read and agreed to the published version of the manuscript.

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The Open Defecation Free Program Evaluation Using the Context, Input, Process, and Product Model in Jambi, Indonesia

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The Open Defecation Free Program Evaluation Using the Context, Input, Process, and Product Model in Jambi, Indonesia

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Abstract

The Open Defecation Free (ODF) program was initiated by the government to increase access to healthy latrines. This study aimed to evaluate the ODF program using the CIPP evaluation model. A qualitative and exploratory descriptive method was adopted to investigate informants' experiences regarding the program's implementation. Data was explored through semi-structured interviews with 17 informants and analyzed using content analysis. The results showed that the program was crucial as numerous people engaged in open defecation due to economic, geographical, cultural, and knowledge factors. The absence of ODF policy was due to lack of priority, limited government and private support, insufficient human resources, inadequate infrastructure, and budget constraints. The ODF program was considered unimportant and tended to follow stunting programs, reflecting the low commitment. The biggest opportunity was implementing an integrated ODF with a stunting reduction program by allocating a special budget. Thus, primary health care is expected to optimize activities further to trigger the ODF program within the environment.

Keywords: CIPP Evaluation, environmental monitoring, Jambi Province, Open Defecation Free, program evaluation

Introduction

Open defecation (OD) behavior is a world problem contributing to an unhealthy environment and death due to diarrhea.[1–3] According to estimates from the World Health Organization, in 2022, 1.7 billion of the global population had not received basic sanitation services, including healthy latrines. Among this number, 494 million still perform OD. Approximately 1.7 billion cases of diarrhea occur yearly, contributing to 370,000 deaths of children under the age of five (the under-five).[4] In Indonesia, the prevalence of the disease among the under-five was 37.8% in 2018 and increased to 40% in 2019.[5,6] In Jambi Province, it was 72.43% in 2019 and decreasing to 48.41% in 2020.[7]

The high number of cases is mostly attributed to OD, a problem associated with access to healthy toilets in the household. The Indonesian Ministry of Health data for 2023 shows that the percentage of households with OD behavior was 18.92%. In Jambi Province, it was 12.71%, while the highest was in the East Tanjung Jabung district, which was 25.39%.[8] Therefore, to encourage increased access to healthy latrines, the government, through a Regulation of the Minister of Health, initiated the Community-Led Total Sanitation (CLTS) program as an approach to community empowerment through a method of triggering behavioral change. The first pillar of CLTS was to stop OD.[9–11]

It is important to acknowledge that the Sustainable Development Goals target for 2030 is to have 100% of the population practicing the Open Defecation Free (ODF) program to improve the public health status. A previous study has proved that ODF and non-ODF villages differed in the incidence of diarrhea among toddlers.[12] Implementing the ODF program as a national strategy requires evaluation efforts to assess its achievements, which will determine future policies. Program evaluation can conducted using the Context, Input, Process, Product (CIPP) evaluation model,[13,14] which was widely adopted due to its comprehensiveness and flexibility.[15]

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This study aimed to evaluate the implementation of the ODF program in East Tanjung Jabung District using the CIPP evaluation model. This study produces scientific evidence that can be used as input to support decision-making or policies in implementing the ODF program for primary health care (PHC) or District Health Offices, as well as providing information for sanitarians to improve performance for triggering the ODF village program.

Method

This study was conducted in two focus location/*lokasi fokus* (lokus) villages within two PHC work areas in the East Tanjung Jabung District, Jambi Province, Indonesia, using a qualitative study with an exploratory descriptive method. This study's lokus village was the village with the highest percentage of households practicing OD in the PHC work areas. A total of 13 informants were selected purposively consisting of six heads of households who had OD as direct targets of the ODF program (A1-A6), two village heads as the policymakers supporting the implementation of the ODF program in the village (B1-B2), two cadres assisting in collecting data and promoting environmental health to the villagers (C1-C2), two sanitarian as implementers of environmental health programs especially the ODF program in PHC work areas (D1-D2), and one district health official managing the ODF program including policy, planning and budgeting, implementation and evaluation (E1).

Semi-structured interviews were conducted to explore the understanding and experience of informants about the ODF program. This was achieved through the CIPP evaluation model, which contains four aspects and 13 categories (Table 1). Documents from the PHC and District Health Office were reviewed to support this study, including data on environmental-based diseases, ownership and access to healthy latrines in households, and households with OD behavior. Data were analyzed using content analysis comprising three stages. These included data reduction, presentation, and conclusion or verification.[16]

Results

The results of this study identified four aspects of the CIPP model in evaluating the implementation of the ODF program: context, input, process, and product, which contain 13 categories, as shown in Table 1.

Table 1. Conceptual Framework for Evaluation of the Open Defecation Free Program

Evaluation aspect	Concept	Category/theme
Context	Conditions underlying the need for an ODF program	1. Toilet ownership and access 2. Public health conditions
Input	Available system capabilities as input for implementing the ODF program	3. Policies and rules 4. Government support 5. Private support 6. Human resources 7. Infrastructure facilities 8. Budget (funds)
Proces	Design of ODF program implementation procedures	9. Planning 10. Organizing and Implementing 11. Evaluation monitoring
Product	The output results are an indicator of the success of ODF implementation	12. ODF village achievements 13. Perceived impact

Note: ODF = Open Defecation Free

Context Aspect

Numerous households did not have access to healthy latrines. In general, informants showed that some residents defecated into the river, while others had latrines in their homes but did not use proper septic tanks. The feces were either channeled into the river or a hole in the ground covered with boards or piles of tree fronds. The public latrines and toilets in every village were unused due to their unkempt nature and dirtiness.

"There is no shelter, only holes covered with boards or tree leaves" (A-1)

"Every village has a public toilet, but it is not well maintained and lacks water" (B-1)

The document review results showed the percentage of households with healthy latrines. In the Muara Sabak Barat PHC work areas, the percentage of households with healthy toilets was 93.2%. The lowest was in Kampung Singkep Village (73.8%), followed by Rano Village (76.8%) and Teluk Dawan Village (93.5%). At the same time, at the Mendahara Ulu PHC work areas, the percentage of households with healthy toilets was 87.9%. The lowest was in Sungai Beras Village (78.1%), followed by Sinar Wajo Village (80.2%) and Pematang Rahim Village (88.2%) (Table 2).

Several factors contribute to the lack of access to and use of healthy latrines. These include 1) economic factors related to financial difficulties in building a healthy latrine, 2) geographical factors where households living on the riverbanks found it difficult and constrained to build healthy latrines, 3) long-standing practice passed down through generations, makes people comfortable defecating on the river, and 4) low public understanding of the dangerous impacts of a dirty environment due to OD behavior.

"Some residents lack accessibility to toilets and resort to OD due to lack of money. Those living on the edge of a river do not have land to build a septic tank... Furthermore, habitual behavior leads to the comfort of defecating in the river... There is a lack of understanding regarding the detrimental impacts of OD… posing obstacle in achieving ODF." (D-1)

Table 2. The Ownership and Access to Healthy Latrines Data in Villages within Muara Sabak Barat and Mendahara Ulu PHC Working Areas[17]

PHC/Village	Number of Households	PHL		SPHL		Sharing		OD		HL	
		n	%	n	%	N	%	N	%	N	%
Muara Sabak Barat PHC											
Kampung Singkep	621	349	56.2	109	17.6	0	0.0	163	26.2	458	73.8
Nibung Putih	502	325	64.7	165	32.9	12	2.4	0	0.0	502	100.0
Parit Culum I	1328	798	60.1	520	39.2	3	0.2	7	0.5	1321	99.5
Parit Culum II	437	313	71.6	95	21.7	29	6.6	0	0.0	437	100.0
Rano	564	349	61.9	84	14.9	0	0.0	131	23.2	433	76.8
Talang Babat	983	642	65.3	330	33.6	11	1.1	0	0.0	983	100.0
Teluk Dawan	356	252	70.8	81	22.8	0	0.0	23	6.5	333	93.5
Total	4791	3028	63.2	1384	28.9	55	1.1	324	6.8	4467	93.2
Mendahara Ulu PHC											
Bukit Tempurung	238	138	58.0	100	42.0	0	0.0	0	0.0	238	100.0
Mencolok	329	91	27.7	186	56.5	19	5.8	33	10.0	296	90.0
Pematang Rahim	739	231	31.3	386	52.2	35	4.7	87	11.8	652	88.2
Simpang Tuan	495	158	31.9	256	51.7	27	5.5	54	10.9	441	89.1
Sinar Wajo	504	116	23.0	265	52.6	23	4.6	100	19.8	404	80.2
Sungai Beras	777	146	18.8	432	55.6	29	3.7	170	21.9	607	78.1
Sungai Toman	580	174	30.0	385	66.4	21	3.6	0	0.0	580	100.0
Total	3662	1054	28.8	2010	54.9	15	4.2	444	12.1	3218	87.9

Notes: PHC = PHC, PHL = permanent healthy latrines, SPHL = semi-permanent healthy latrines, OD = open defecation, HL = healthy latrines

The results of the interviews showed that residents, including toddlers, were often discovered suffering from diseases related to poor environmental sanitation, such as diarrhea, dysentery, itching, malaria, and coughs. According to informants, diseases caused by poor environmental sanitation were always included in the ten most common at PHC: diarrhea and gastroenteritis, acute respiratory infection (ARI), dermatitis, malaria, and influenza.

"Diarrhoea, itching, coughing, and fever often occur in children." (C-2)

"Diseases experienced by people due to poor environmental sanitation, such as diarrhea, dysentery, gastroenteritis, ISPA, fever, malaria, and dermatitis, are quite high and mostly in the top 10 diseases. Another consequence is the incidence of stunting." (D-2)

Input Aspect

In general, informants were not aware of any special policies and regulations regarding implementing the ODF program. It was stated that the ODF program was more of an appeal from villages or health workers to prevent stunting. The Village Head informant admitted the lack of specific policy from the government to deal with OD behavior. It was important to acknowledge that increasing latrine access was related to the Clean and Healthy Behavior Program, the Healthy Indonesia Program with a Family Approach at PHC, and the Increasing the Role of Women towards Healthy and Prosperous Families Program at the Family Welfare Empowerment activities.

"Families were urged to construct good latrines because it is forbidden to defecate in rivers..." (A-3)

"There are no ODF program policies or regulations yet; it is not a priority... Health policies or stunting programs were implemented to prevent OD." (B-1)

"Since ODF is less of a priority, no regulations have been put in place. However, efforts to stop defecation have long been implemented through the PHBS (Clean and Healthy Behavior Program)*, PIS-PK* (the Healthy Indonesia Program with a Family Approach)*, and P2WKSS* (the Increasing the Role of Women towards Healthy and Prosperous Families Program) programs*." (B-2)*

Informant interviews showed that there was support from the district and provincial governments in the form of assistance to build latrines for low-income families and those with stunting toddlers in 2020 and 2021. Other support was

in the form of providing clean water facilities from the Community-based Drinking Water and Sanitation Provision program and assistance for healthy latrines from the Community-based Sanitation program, but this was limited to budget availability. Latrine assistance was not for families living on riverbanks; it was in the form of materials such as toilets, bricks, cement, sand, stone, and drilled wells, which were achieved by the community working together.

"There is assistance for healthy latrines to get materials; this is done in cooperation." (B-1)

"Currently, the focus is on reducing stunting, so healthy toilet assistance is provided to families who have stunted and poor children. Houses on the riverbank did not receive assistance." (E-1).

"Government assistance includes healthy latrines, house renovations, the clean water program from Pamsimas and the Sanimas program for healthy latrines, but it is limited to the project budget" (D-2)

Support from the private sector towards increasing latrine access for the community remains low. Out of two lokus villages studied, only one was reported receiving assistance with toilets and public toilets from the company's corporate social Responsibility program. The villages had difficulty receiving help from the private sector because the proposal submission procedures were difficult to understand.

"Our village has never received latrine assistance from the private sector because the procedure is complicated." (B-2)

"Poor families at villages located in the company area received latrine assistance." (B-1)

Sanitarian personnel supporting the ODF program were limited, with only one person at each PHC, while expected to handle six to eight villages that were quite far away. This is considered a potential obstacle to triggering and monitoring. The village has Human Development Cadres (HDC) facilitating stunting prevention efforts. However, these workers did not assist with OD issues due to limited knowledge and feelings of embarrassment. According to the informant, to achieve ODF villages, it was necessary to add additional health center sanitarian staff or form special environmental health cadres in the villages as the ODF facilitators.

"The sanitarian staff in PHC is (only) *one person, so it is difficult to handle all villages far away. In my opinion, environmental health cadres should be formed as facilitators to stop defecation in villages." (D-2)*

"In the village, there are KPM (Human Development Cadres) *from residents who are tasked with helping handle the stunting program, but they do not want to talk about latrines due to feeling of embarrassment." (B-2)*

The PHC has environmental health equipment, such as water quality checks and Community-Based Total Sanitation Kits for triggering. These were not used due to the lack of an activity budget. The trigger for the ODF program was environmental health counseling or consultation services at the PHC. Several informants also complained about the minimal availability of clean water, specifically during the dry season, which facilitated defecation in rivers.

"There is complete water inspection equipment and an STBM (Community-Based Total Sanitation) trigger *prop, which has not been used for a long time" (A-6)*

"The trigger is only counseling and environmental health consultation service at the PHC." (D-1)

"Residents need drilled wells and clean water for latrine use. Sometimes clean water is difficult to obtain, specifically in the dry season." (C-2)

The village was not allocated funds specifically for building family latrines because the program was less prioritized and was private. It was important to acknowledge that village development funds could only be distributed for public purposes. At PHC, the budget to support the ODF program was allocated from Health Operational Assistance funds but only for the transportation costs of officers to the field to conduct counseling and monitoring. Triggering activities have never been budgeted for since 2020.

"The village does not budget for building family latrines because it should be self-supporting by the community." (B-1)

"The PHC budget for ODF uses BOK (Health Operational Assistance) *funds, including only transport for extension officers or monitoring. Meanwhile, trigger funds have not been available since 2020." (D-1)*

Process Aspect

The village and PHC had no plans for an ODF program due to a lack of priority and budget. This signified a lack of strategies and activities to achieve ODF. The efforts currently being made are part of the stunting prevention program. At the PHC, the triggering activity plan was also never discussed at the workshop meeting due to a lack of budget.

"In the village, there are no ODF program planning meetings... preventing defecation behavior is included in the stunting program which has funding." (B-2)

"At the PHC, since 2020, there has been no trigger funding, so it was not discussed during the workshop meeting. Most of the budget is for outreach and monitoring activities." (D-1)

Both the village and PHC had no ODF program organizational structure thus, the implementation was not optimal. The implementation of triggering activities of the ODF by PHC was also no longer achieved due to funding allocation. It was important to acknowledge that education was provided through counseling to increase public awareness of stopping OD.

"No specific ODF program has been implemented. Hence, there is a lack of organizational structure, Policy, and program planning was not implemented because the program was less prioritized in the village, leading to lack of budget allocation." (B-2)

"Activities to trigger stop OD are never budgeted, but education was conducted." (E-1)

Monitoring and evaluation of ownership and access to healthy latrines was conducted by PHC sanitarian staff alongside village health workers at least once every six months. The monitoring process included visiting the homes of residents who did not have toilets in order to provide education. The distance to the village, which was quite far and difficult, was an obstacle faced by officers.

"The PHC sanitarian conducted monitoring at least once every six months to examine family latrines, with long distance and difficult conditions being the encountered obstacles." (D-1)

"Data on access to healthy latrines is presented every month for stunting reporting." (B-2)

Figure 1. Condition of Family Latrines

Product Aspect

The results showed that most villages in the PHC working areas had not achieved ODF. Among the 14 villages of both PHCs working areas, only Talang Babat, Bukit Tempurung, and Sungai Toman were designated to have ODF status. This showed that there were still numerous residents with no access to a healthy toilet or practiced OD. Educational efforts to stop defecation are part of a massive stunting prevention program.

The understanding of the public towards the importance of preventing defecation to maintain a clean and healthy environment was enhanced. Another positive impact was that cross-sector synchronization and coordination for village development was increasing. In contrast, the negative impact of the implementation of the suboptimal ODF program was the presence of residents who still suffer from illness due to poor environmental sanitation, including the discovery of stunted toddlers.

"The community becomes aware and understands the impact of OD on health. Furthermore, the assistance program for building toilets is also very helpful for the poor." (A-6)

"Government officials from the department and office often visit together to village communities to provide education, thereby improving coordination and cooperation." (B-1)

"There are still people affected by diseases caused by an unhealthy environment such as diarrhea, dysentery, ISPA, as well as stunting." (D-1)

Discussion

Numerous people practice OD, which can cause high cases of disease due to an unhealthy environment in the East Tanjung Jabung District. This condition was the background to the need for an ODF program to ensure access to healthy latrines. It was important to pursue a program to implement a clean and healthy lifestyle to avoid various diseases caused by OD, specifically diarrhea.[2,3,18] Factors associated with access to healthy latrines include economic, geographical, cultural, and low understanding. Based on data from the District Health Office, it is known that the prevalences of diseases related to the environment include ARI at 29.5%, influenza and pneumonia at 6.9%, dermatitis and eczema at 5.9%, diarrhea and gastroenteritis at 1.75%.[17] Not having a latrine was related to low income.[19] Geographical conditions were also an obstacle to building healthy latrines for people living on rivers or sea banks.[20] The practice of OD in rivers, a

hereditary habit, has hindered the success of the ODF program. Addressing this issue requires both knowledge and a positive attitude. A significant relationship exists between education, knowledge, and attitudes, as well as household ownership of a healthy latrine.[21]

The absence of a policy showed that there were no company rules for OD behavior. Furthermore, there was a lack of law enforcement and commitment to community empowerment efforts, including the construction of communal latrines. The construction process was considered the best solution to increase access to healthy latrines in riverbank settlements.[18] Therefore, it was necessary to make regulations for effective program management to create an ODF Village.[22] Support from various sectors, both government and private, was needed to stimulate community awareness and empowerment, thereby increasing access to healthy toilets. This is because the essential goal of the ODF program is to stop OD by the community independently. The government is an important factor in triggering the realization of ODF.[2] The private sector was also expected to engage in increasing public awareness to actively protect the environment, specifically in preventing OD behavior.[23]

The limited number and capacity of human resources to support the ODF program in this study was an obstacle in changing the OD behavior of people; a culture passed down from generation to generation. The role of health workers was significantly related to community participation in stopping the triggering activities.[24] While the success of the program could be hampered when facilitators at the village level by sanitarian officers.[25] All parties are expected to educate the community regarding the need for latrines that meet health requirements.[26] The sustainability of stopping OD behavior will be doubtful when there is reduced participation from the actors who motivate society.[27,28] Infrastructure, including tools, materials, transportation, and space, need to be provided to ensure the success of the ODF program.[29,30]

The main facilities needed for the program were healthy latrines, clean water, and waste processing in households. However, the availability based on the results of this study was not optimal. Equipment for triggering the ODF program at PHC was not put in place due to a lack of activity budget. Previous studies proved that healthy latrine programs fail to stop OD when the facilities are of low quality and not durable.[31–33] Economically, weak families do not prioritize healthy latrines but expect assistance from the government and others. This study explained that one of the causes of low awareness of the behavior of stopping defecation was poverty. Therefore, the financing concept needs to be integrated into the triggering method through stimulant funds for latrine construction. The success of implementing the CLTS program to stop OD behavior was influenced by the availability of government funds.[34–36] The construction of healthy latrines can be conducted in collaboration with community self-help by collecting monthly contributions as a form of empowerment.[37]

This study showed that the ODF program has not been implemented optimally, starting with planning, organizing, implementing, and monitoring evaluation. The reason is that it has not been a priority and has not been supported by an activity budget. Planning for the ODF program was necessary to understand the problems, causes, solutions, and required resources. With a well-structured framework of roles, functions, and tasks, the implementation of the program, as well as its monitoring and evaluation, can be effectively guided and facilitated. The program will be under control when conducted with appropriate policies and management as well as human resources.[22] Optimizing the performance of the healthy latrine construction program will be maximum when the ODF program is prioritized in the village.[38] It was important to pursue a program that implemented a clean and healthy lifestyle for the population in order to avoid diseases caused by a dirty environment. Hygienic behavior to improve the environment was associated with reduced disease incidence.[39,40] This study adopted perceptions of the informants' understanding and experience as a measure, which tended to be subjective and required further investigation into the actual problem. However, a strong understanding of factors limiting the successful implementation of the ODF program in East Tanjung Jabung District, Jambi Province, was provided.

Conclusion

Numerous people in East Tanjung Jabung District engage in OD due to the lack of toilets, which is attributed to economic, geographical, cultural, and knowledge factors. Both villages and PHCs had no policies and regulations for implementing the ODF program. Additionally, insufficient human resources, infrastructure, and budget are due to these issues not being prioritized and government and private support remaining limited. The village should implement the ODF in an integrated manner with the stunting reduction program, which is the government's current priority. Furthermore, the PHC was expected to optimize the ODF triggering activities further to increase public awareness about the necessity of maintaining a healthy environment.

Abbreviations

OD: open defecation; CLTS: Community-Led Total Sanitation; ODF: open defecation free; CIPP: Context, Input, Process, Product; PHC: primary health care; lokus: *lokasi fokus/*focus location; HDC: Human Development Cadres.

Ethical Approval and Consent to Participate

This study was conducted with ethical approval from the Health Research Ethics Commission of Jambi Health Polytechnic of Ministry of Health Number: LB.02.06/2/0230/2023.

Competing Interest

The authors declare the absence of 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 datasets used are available from the corresponding author upon reasonable request.

Authors' Contribution

G and RW performed the data collection and designed and drafted the initial manuscript. G, S, and H conceptualized the study and interpreted the results. G and WNER performed the statistical analysis and finalized the manuscript.

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Addressing Patient Loyalty Through Their Commitment Influenced by Electronic Word-of-Mouth and Hospital's Image

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Addressing Patient Loyalty Through Their Commitment Influenced by Electronic Word-of-Mouth and Hospital's Image

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Abstract

This article explores the influence of Electronic Word of Mouth (e-WoM) and hospital image on hospital patient loyalty, emphasizing the mediating role of patient commitment. Amidst the development of the healthcare industry sector in Indonesia, this study highlighted that e-WoM and hospital image significantly enhanced patient loyalty, with patient commitment playing an important mediating role. This article suggested practical strategies for hospitals, such as improving the quality of healthcare services, leveraging positive e-WoM, and implementing loyalty programs to elevate patient commitment and loyalty. These findings underscore the importance of hospital image and e-WoM in patient retention, providing valuable insights for strategic planning in the context of the healthcare industry.

Keywords: acceptance and commitment therapy, healthcare sector, hospital-patient relations, marketing of health services, patient navigation

Introduction

A hospital is a provider of health services to the community; therefore, hospitals must provide satisfactory medical services for patients. To maintain the quality of medical services, hospital management must be responsive to patient needs and desires so that each patient receives quality, effective and efficient services for their health improvement.[1] Improving the quality of hospital services must be followed by marketing activities so that patients are aware of the existence of hospital services.[2] The increasing number of hospitals and increasingly stringent hospital marketing regulations force hospital managers to be more creative and innovative in attracting patients. Today, the form that meets patient expectations in the hospital industry must include good physical facilities, accurate and fast service processes, and reliable employees.[3] Quality of service is the basis for the survival of a hospital. The program of improving quality and patient safety through an integrated quality management approach is an important requirement for hospitals to survive and grow.[4] Improving the quality of service has a positive impact on improving patient quality.[5]

The image of a hospital is influenced by many factors, such as good facilities, good environment, long history of the hospital, low costs, good attitude of doctors, sophisticated medical equipment, and past experience.[6] According to Grönroos, the image of a hospital is formed through what patients receive as a result of transactions between service providers and users and how they receive these services.[7] A previous study stated that factors determining a hospital's image include the quality of doctors, treatment facilities and technology, diagnostic capabilities, and overall service quality.[8] Another study stated that the dominant perception of patients towards medical personnel (doctors) is thought to have a positive impact on their assessment of the hospital's image.[9] This positive perception makes patients believe that their illness can be cured by using hospital services, stating that a hospital with a good image concept can complement a good identity and ultimately lead to patient loyalty.[10]

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Trust is the credibility, promise, and goodness of the hospital that is expected or felt by the patient. When trust is built, a committed relationship between the hospital and the patient can be mutually beneficial.[11] Substandard and discriminatory experiences with health care providers and staff can contribute to increased distrust of the hospital,[12] which can lead to decreased patient satisfaction and loyalty.[13] Conversely, higher trust was associated with better self-assessment of health status and better adherence to care plans, suggesting that overall health system strategies can be used to improve patient satisfaction and loyalty.[14] Patient loyalty is defined as the patient's efforts to remain loyal to a product through recognition, strong impressions of quality, trust and pride and then making repeat purchases.[15]

This study aimed to analyze how a hospital's image and e-WoM affected patient loyalty, with patient commitment as a mediating variable. Patient commitment is the emotional and psychological bond they have with the hospital, which influences their decision to remain loyal to using hospital services in the future. Referring to previous studies,[16,17] patient commitment can be a key factor mediating the relationship between positive perceptions (hospital's image and e-WoM) and patient loyalty. Therefore, understanding the role of patient commitment in this relationship would provide deeper insights into how hospitals could enhance patient loyalty through strategies focused on enhancing the hospital's image and e-WoM.

Method

Electronic Word of Mouth (e-WoM) refers to positive or negative statements made by potential, actual, or former patients about a product or company, which can be accessed by many people or institutions via the internet.[18] This includes all informal communications directed to consumers via internet technology regarding the characteristics of particular goods, services or sellers.[19] E-WoM involves consumers' comments or recommendations based on their experiences, significantly influencing other consumers' decision making.[20] Social media is the most commonly used platform for e-WoM activities,[21] driven by emotional attachment and the desire to belong, encouraging consumers to leave positive reviews.[22] In this study on e-WOM at hospitals, it could be measured using three indicators: Intensity, Opinion Valence, and Content.

Corporate image is the public's perception, view and opinion of a company. Formed through processing information from various sources.[23] and based on knowledge and experience.[24] Corporate image reflects the views of external stakeholders, especially patients.[25] According to various experts, corporate image is an impression or perception based on the knowledge and experience of individuals or society towards the company.[26] In hospitals, corporate image can be measured through Corporate Reputation, Personality, Values and Identity.

Patient commitment is essential in relationship marketing, defined as the desire to maintain a valuable relationship.[27] It involves a belief in the importance of continuing the relationship.[28] Commitment is essential for patient retention and loyalty.[29] This commitment can be divided into Affective Commitment, Normative Commitment, and Continuance Commitment, each of which represents a different motivation for maintaining a relationship with the hospital.

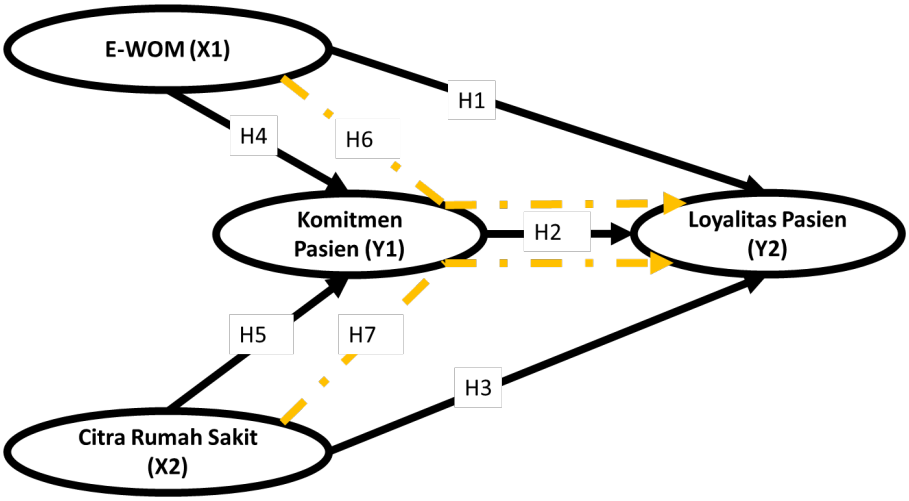
Patient loyalty has a significant impact on the future of the hospital industry. Loyal patients continue to use hospital products and services, trusting the hospital to manage their finances.[30] Loyalty is characterized by regular repeat purchases, purchases across product lines, recommending the hospital to others, and showing resistance to competitors.[31-33] Loyal patients actively promote the hospital's products and services, thereby contributing to the hospital's long-term success.

Overall, the concepts of e-WoM, corporate image, patient commitment and loyalty are interrelated and critical to the success of a hospital. Understanding and measuring these factors can help hospitals improve their relationships with patients and increase their competitive advantage.

Results and Discussion

Electronic Word of Mouth (e-WoM)

Electronic Word of Mouth (e-WoM) is a concept referring to information, reviews, or recommendations shared by healthcare users online. In the current digital era, E-WoM has a significant influence in shaping public perceptions of an institution, including hospitals. Satisfied patients often share their positive experiences through various digital platforms such as social media, health forums, or review sites. These reviews and recommendations cannot only strengthen the hospital's image, but also act as an effective marketing tool, which can attract new patients.



Notes:
e-WoM (X1) = Electronic Word-of-Mouth
Citra Rumah Sakit (X2) = Hospital's Image
Komitmen Pasien (Y1) = Patient Commitment
Loyalitas Pasien (Y2) = Patient Loyalty

Figure 1. Research Model

In the context of hospitals, e-WoM can be an important strategy to build and maintain a positive corporate image. Patients who have experienced quality services tend to share their experiences online, which can be a reference for other potential patients. A previous study shows that e-WoM has a strong influence on consumer decisions, especially in the service industry.[34] In this case, positive reviews from previous patients can increase potential patients' trust in the hospital and encourage them to choose health services at that hospital.

In addition, e-WoM can also function as feedback for hospitals to continue to improve the quality of their services. By paying attention to reviews and input from patients, hospitals can make necessary improvements, which not only increase patient satisfaction but also strengthen the overall image of the hospital. A previous study[18] also underlines the importance of e-WoM as a communication tool that can influence patient loyalty in the long term. Thus, in an increasingly digitally connected world, e-WoM can be a key to a hospital's success in attracting and retaining patients.

Corporate Image

Corporate image is the public's perception of an institution, including hospitals, which reflects the quality of service, reputation, and trust built by the institution. This perception is formed from patient experiences, public opinion, and communication carried out by the hospital through various media. In the context of hospitals, a positive corporate image is an important asset in attracting and retaining patients. This is because patients prefer to choose hospitals with a good image, which can provide a sense of security and confidence in receiving health services.

Previous studies have shown that corporate image plays an important role in building patient loyalty. A study revealed that a strong corporate image can influence consumer perceptions of the quality of service received.[35] In the healthcare industry, this means that hospitals with a positive image tend to be more trusted by patients, which in turn increases their loyalty to the hospital. In addition, a previous study found that a positive corporate image can increase patient trust and satisfaction, which are important factors in creating long-term loyalty.[36]

In the context of hospitals, building and maintaining a good corporate image is an important strategy in facing the increasingly tight competition in the healthcare industry. By a good reputation, the hospital can strengthen its position as the main choice for patients in the region and surroundings. With increasing competition between hospitals, a strong corporate image not only serves as a tool to attract new patients, but also to maintain the loyalty of existing patients. This is in line with the results of a previous study emphasizing that a good corporate image can be an effective differentiation in a competitive market environment.[37]

Patient Commitment

Patient commitment is a key factor in maintaining and increasing loyalty to a hospital. This commitment reflects the patient's desire to continue using hospital services in the future, and plays an important role in creating a long-term

relationship between patients and healthcare providers. In the context of hospital, the patient's commitment can be influenced by various factors, including the hospital's image and e-WoM.

A positive corporate image can increase patients' trust and confidence in the quality of hospital services, which in turn strengthens their commitment to continue choosing the hospital in the future. As revealed by Morgan and Hunt's,[16] trust and commitment are two main pillars in building a long-term, mutually beneficial relationship between an organization and patients. By a good image of hospital, patients feel more confident and satisfied, encouraging them to remain loyal and not switch to other healthcare providers.

In addition, e-WoM also plays an important role in forming patient commitment. Positive information and reviews shared online by other patients can provide confidence to prospective patients that they will receive quality services at the hospital. A previous study[38] found that e-WoM can strengthen patients' positive perceptions of an institution, which ultimately increases their commitment to continue using the service. Highly-committed patients are not only more loyal, but are also more likely to recommend the hospital to others, which expands the hospital's patient base. Furthermore, patient commitment often serves as a mediator between corporate image, e-WoM, and patient loyalty. A previous study revealed that commitment can be a bridge connecting positive patient perceptions (such as corporate image and e-WoM) with higher loyalty.[17] In this case, commitment acts as a reinforcing factor ensuring that patients not only have a positive view of the hospital, but are also moved to act on that view, such as continuing to use the hospital's services and recommending it to others. Therefore, building patient commitment is an important strategic step for hospitals in achieving long-term sustainability and growth.

Patient Loyalty

Patient loyalty means an essential element in the healthcare industry, particularly for private hospitals where the survival and success of the institution largely depend on how well they can retain existing patients and attract new patients. This loyalty reflects the patient's desire to continue using the hospital's services on an ongoing basis, as well as their desire to recommend the services to others. In this context, the hospital's image and e-WOM play an important role in shaping and maintaining patient loyalty. The hospital's image comprising reputation, quality of service, and trust built by a hospital can influence how patients perceive the hospital. When a hospital's image is positive, patients tend to feel more confident and satisfied with the services they receive, which ultimately increases their loyalty. On the other hand, e-WoM consisting of reviews and recommendations shared by patients through online platforms also has a significant impact. Patients reading positive reviews from other patients tend to trust the hospital more and choose it as their healthcare provider.

Conclusion

A hospital's image can be considered as the overall trust and commitment of patients, which ultimately leads to their loyalty. Similarly, e-WoM can influence new and old patients, encouraging them to be more committed and loyal to the hospital. Patient commitment can bridge the hospital's image and e-WoM to patient loyalty. It is expected that the findings of this study will provide practical insights for hospital management. The hospital industry as a whole, helping hospitals develop strategies to enhance patient loyalty through enhancing corporate image and effective e-WoM management. Future study is essential to measure empirical study of these variables into selected hospital subjects.

Abbreviations

e-WoM: Electronic Word-of-Mouth.

Ethics Approval and Consent to Participate

Not applicable.

Competing Interest

All authors have no conflict of interests in this article.

Availability of Data and Materials

Not applicable.

Authors' Contribution

AQ conducted secondary data collection, data processing, analysis and interpretation, and writing the first draft of manuscript. AP, SZ, and N involved in scientific inputs and review the manuscript.

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