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Tuberculin Skin Test and T-SPOT.TB for Latent Tuberculosis Infection Detection in Healthcare Workers

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Abstract

Healthcare Workers (HCWs) have a higher Tuberculosis (TB) risk than the general population. This study analyzed effectiveness of Tuberculin Skin Test (TST) and T-SPOT.TB for detection prevalence of Latent Tuberculosis Infection (LTBI) among HCWs and the correlation between work locations and HCW duties. A trial study with a cross-sectional study design in Dr. Moewardi Hospital, Surakarta, in December 2018. The sampling technique used consecutive sampling with 30 subjects. Data analysis was by SPSS 21 for Windows. The appropriate levels of TST and T-SPOT indicated substantial TB ($K = 0.603$, $p < 0.001$). The sensitivity and specificity of T-SPOT.TB with close contact was 60% and 86.7%. The sensitivity and specificity of TST with close contact were 33.3% and 93.3%. T-SPOT.TB was a significant correlation between the work location, the pulmonary care ward $r = 0.436$ and $p = 0.008$ ($p < 0.05$). T-SPOT.TB has a slightly better sensitivity than TST.

Introduction

The World Health Organization (WHO) tuberculosis (TB) elimination program is called the End TB Strategy, envisioning a TB-free world (Al Abri et al., 2020). One of the ten End TB Strategy priority indicators is that more than 90% of patients with a latent TB infection (LTBI) receive treatment (Uplekar et al., 2015). Groups that have a high risk of developing LTBI into active TB include children, health care workers (HCW), people with human immunodeficiency virus (HIV) infection, those undergoing treatment with anti-tumor necrosis factor-alpha (TNF-α), and those with silicosis (Erkens et al., 2016). The WHO treats high-risk LTBI sufferers to prevent them from becoming active. The recommended examinations in determining LTBI are a tuberculin skin test (TST) and interferon-gamma release assay (IGRA) (Nayak and Acharjya, 2012).

The Centers for Disease Control and Prevention (CDC) issued guidelines to prevent TB transmission in healthcare facilities. This guideline was issued in response to the rise of TB in the United States in the mid-1980s and early 1990s (Churchyard et al., 2017). There was some documentation of improved TB health care and HIV coinfection, irregular infection control practices, delays in TB diagnosis and treatment, and increased transmission of multidrug-resistant TB strains (Jensen et al., 2005).

The Presidential Decree of the Republic of Indonesia number 22 of 1993, concerning illnesses arising from work, determines infectious diseases caused by viruses, bacteria, or parasites acquired through an occupation has an individual risk of contamination, including TB. The HCW with active TB can be a valuable source of infection in patients providing care

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and with co-workers (Nasreen et al., 2016). The HCW has a higher risk of obtaining TB than the general population. The TB risk of HCW, especially in 22 top-burden countries and low and middle-income states, covers 80% of global TB cases. Increased exposure and less than optimal infection control measures in these countries with limited resources increase the risk of occupational health workers (Horsburgh et al., 2015).

Latent TB infection (LTBI) is an individual exposed to Mycobacterium tuberculosis but does not show symptoms or transmit the disease (Setyawati, 2021). Latent TB infection can be reactivated to become active, especially in high-risk groups. One of which is health workers (HCW). The gold standard for LTBI diagnosis currently does not exist. TST and IGRA tests are used to diagnose LTBI. Still, these tests are limited in distinguishing whether the patient has recovered from TB infection, is currently in treatment, or is progressing from latent to active TB. The tuberculin skin test (TST) is a classic immunoassay test that has been used for a long time for the diagnosis of TB with relatively low specificity and accuracy due to the cross-reaction of pure tuberculin protein derivatives (PPD) with those induced by BCG (Getahun et al., 2015).

Recently, T-SPOT.TB has been developed to show higher performance for the diagnosis of Tuberculosis. It is a commercial IGRA assay that uses an ELISPOT format to diagnose LTBI. The T-SPOT.TB assay is a simplified enzyme-linked immunospot (ELISPOT) method designed to detect effector T cells responding to stimulation by specific antigen [6 kDa initial secreted antigenic target (ESAT-6) and 10 kDa protein filtrate culture (CFP10)] for Mycobacterium tuberculosis (MTB) (3,5-9). ESAT-6 and CFP10 are only found in MTB, but not in bacilli Calmette-Guerin (BCG) lines. So theoretically, the T-SPOT is assumed.TB test has higher specificity. The results of previous studies indicate that the T-SPOT.TB test can be used as a more accurate indicator of the presence of LTBI and active TB (ATB) in cases of low prevalence (Zhu et al, 2014).

Health workers have a relatively high prevalence rate of LTBI. Therefore, it is essential to analyze the effectiveness of the diagnostic value of TST and T-SPOT.TB for specific populations in the high prevalence group, namely health workers. There are differences in the specificity and sensitivity of TST and T-SPOT TB in the group with a high prevalence of LTBI, so that is important to analyze the effectiveness of TST and T-SPOT TB to detect the occurrence of LTBI in health workers. This study aims to determine the concordance of the two examination instruments, determine LTBI's prevalence among HCWs and relate it to their work location and length of time as an HCW. We also analyzed the effect of BCG vaccination history as a child on tuberculin test reactions and T-SPOT.

Methods

The Dr. Moewardi Hospital Committee for Research on Human Subjects (Medical) approved this study (No. 3/I/HREC/2019). It is a diagnostic test study with a cross-sectional design, where the independent and dependent variables are measured simultaneously to examine TST and T-SPOT. TB. This study was conducted at the Regional General Hospital Dr. Moewardi (RSDM), in Surakarta, in October 2018 until sufficient study samples were obtained. The target population of this study is the health staff of the RSDM, who have no history or current diagnosis of TB.

The subjects willing to participate in the research are asked to sign the consent form. The research subjects who met the inclusion criteria were educated on the study's purpose. Afterward, we collected the data, including identity, natural history, physical examination, TST examination, and blood samples for T-SPOT. TB examination. The research subjects must return in 48–72 hours for TST readings. The study subjects were divided into two groups: the first group was 15 nurses in the pulmonary ward, and the second group was 15 administrative staff assigned to other communities. The sampling technique using consecutive sampling with a minimum sample size required for this study was 30 subjects. Inclusion criteria: Age above 18 years, willing to participate in research. Exclusion Criteria: HCW with symptoms or clinical signs of TB, HCW with a history of suffering from TB, a history of taking antituberculosis drugs, HCW

with comorbid diseases and immunosuppressed diseases such as diabetes, HIV, kidney failure, and use of corticosteroids. Data analysis was by SPSS 21 for Windows. This study presents the analysis with frequency distribution, and the percentage continues with univariate analysis. The correlation test in this study used a non-parametric test, the contingency coefficient test. Some limitations remain because one subject that did not get a TST examination booster two steps.

Results and Discussion

This study involved 30 health staff of RSDM. TST and T-SPOT. TB examination results detected LTBI for 11 (36.7%) subjects and did not suffer from LTBI for 19 (63.3%) subjects. Positive TST examination results were obtained in 6 (20%) subjects and positive T-SPOT. TB examination results were obtained in 11 (36.7%) subjects. The characteristics of the subjects of this study are based on gender, age, close contact, length of work, and nutritional status. LTBI is more prevalent in eight female subjects (26.7%) and three (10.0%) male subjects. The subjects in this study aged <30 years were 15(50.0%) subjects and aged >30 years were 15 (50.0%). LTBI was more prevalent in subjects aged >30 years 7 (23.3%) subjects], 15 (50.0%) subjects had close TB contact, and we found LTBI positive TB T-Spot of these subjects were 9 (30.0%) subjects who suffer from LTBI. Most issues had worked there for>5 years. There were 17 (56.7%) subjects, 7 (23.3%) of whom had LTBI. Twenty-three subjects (76.7%) had a normal nutritional status (Table 1).

TABLE 1. Characteristics of Research Subjects

Variables	Total n (%)	TST (+) n (%)	T-Spot (+) n (%)
Gender			
Female	23 (76.7%)	4 (13.3%)	8 (26.7%)
Male	7 (23.3%)	2 (6.7%)	3 (10.0%)
Age (years)			
<30	15 (50.0%)	1 (3.3%)	4 (13.3%)
>30	15 (50.0%)	5 (16.7%)	7 (23.3%)
Close Contact			
Nurse (+)	15 (50.0%)	5 (16.7%)	9 (30.0%)
Admin (−)	15 (50.0%)	1 (3.3%)	2 (6.7%)
Length of work			
<5 years	13 (43.3%)	2 (6.7%)	4 (13.3%)
>5 years	17 (56.7%)	4 (13.3%)	7 (23.3%)
Nutritional status			
Underweight	2 (6.7%)	0 (0.0%)	0 (0.0%)
Normal	23 (76.7%)	5 (16.7%)	9 (30.0%)
Overweight	5 (16.7%)	1 (3.3%)	2 (6.7%)
Total	**30**	**6 (20.0%)**	**11 (36.7%)**

Source: primary data 2018

Based on table 2, there were six positive TST examinations, while positive T-SPOT.TB found 11 positive results. The cross-tabulation results of the positive TST examination with positive T-SPOT.TB of six (20%) subjects. The results of negative TST examination with positive T-SPOT.TB found five (16.7%) subjects and negative TST with negative T-SPOT. TB found 19 (63.3%) subjects. The degree of conformity obtained the kappa value of 0.603. The data show the suitability level K = 0.603, which is substantial (0.600 < K < 0.800).

Based on table 3 that showed a close contact examination with T-SPOT.TB gets a sensitivity of 60.0%, which means 60.0% of subjects with positive close contact can be detected by T-SPOT.TB and the specificity value of the T-SPOT measurement obtained in this study was 86.7%. It means that subjects who have close negative contact can probably be removed from subjects who have a positive T-SPOT.TB of 86.7%. Examination of TST in

close contact subjects received a sensitivity of 33.3%, which means that 33.3% of subjects with positive close contact could be detected with TST, The specificity of the measurement of TST obtained in this study was 93.3% meaning it was probable that close contact subjects negative that can be removed from subjects who have a positive TST of 93.3%.

Based on table 4 shows that the correlation between the length of work with the LTBI incidence was bivariate analysis. In this study, the data with a nominal scale that followed the correlation test used a non-parametric test, the contingency coefficient test. The results showed subjects who had worked at the hospital <5 years tended to have a negative T-SPOT.TB examination (30.0%), whereas subjects with a work history >5 years tend to have a T-SPOT. TB examination (23.3%). The correlation test between the length of work history with the T-SPOT examination. TB in this study obtained r = 0.106 and p = 0.558 (p > 0.05), which means there is no significant correlation, the correlation test between the length of work with the TST examination obtained r = 0.100 and p = 0.580 (p > 0.05) with a very weak correlation value with the two inspection instruments namely r = 0.106 and r = 0.100.

TABLE 2. Compatibility Level of TST Examination with T-SPOT.TB in Detecting LTBI

		TST		Total	K	p
		Positive	Negative			
T-SPOT.TB	**Positive**	6	5	11	0.603	< 0.001
	Negative	0	19	19		
	Total	6	24	30		

Note: *K* = kappa; *p* < 0.001 considered statistically significant
Sources: Primary data, 2018

TABLE 3. Close contact test with T.SPOT.TB and TST Examination

Close contact	Abbreviation (units)	Value	
		T-SPOT.TB	TST
Sensitivity	(%)	60.0	33.3
Specificity	(%)	86.7	93.3
Positive predictive value	PPV (%)	81.8	83.3
Negative predictive value	NPV (%)	68.4	58.3
Positive predictive ratio	PPR (%)	4.5	5
Negative predictive ratio	NPR (%)	0.462	0.714

Sources: Primary data, 2018

TABLE 4. Correlation between Length of Work and Close contact with T-SPOT.TB and TST examination

Examination		Positive	Negative	Total	R	p
T-SPOT.TB						
Length of work	≤5 years	4 (13.3%)	9 (30.0%)	13 (43.3%)	0.106	0.558
	>5 years	7 (23.3%)	10 (33.3%)	17 (56.7%)		
Close Contact	Positive	9 (30.0%)	6 (20.0%)	15 (50.0%)	0.436	0.008
	Negative	2 (6.7%)	13 (43.3%)	15 (50.0%)		
	Total	11 (36.7%)	19 (63.3%)	30 (100.0%)		
TST						
Length of work	≤5 years	2 (6.7%)	11 (36.7%)	13 (43.3%)	0.100	0.580
	>5 years	4 (13.3%)	13 (43.3%)	17 (56.7%)		
Close Contact						
	Positive	5 (16.7%)	10 (33.3%)	15 (50.0%)	0.316	0.068
	Negative	1 (3.3%)	14 (46.7%)	15 (50.0%)		
	Total	6 (20.0%)	24 (80.0%)	30 (100.0%)		

Sources: Primary data, 2018

The results showed that subjects with positive close contact tend to have positive T-SPOT.TB examination (30.0%), while subjects with negative close contact tended to have a negative T-SPOT.TB examination (43.3%). The correlation test between close contact with T-SPOT.TB examination in this study obtained r = 0.436 and p = 0.008 (p < 0.05), which means there is a significant correlation with moderate correlation value (r = 0.436), whereas with examination TST results obtained r = 0.316 and p = 0.068 (p < 0.05) which means there is no significant correlation with weak correlation values. Studies comparing IGRA and TST have high rates of HCW at 40%–66%, such as Lien et al. (2009) research in Vietnam, the Rangaka et al. (2015) study in Turkey, and the Murray et al. (2015). Healthcare workers have a greater risk of obtaining TB than the general population. The TB risk of HCW, especially in 22 high-burden countries, and low and middle-income countries, covers 80% of global TB cases. Increased exposure and less optimal infection control measures in these countries with limited resources increase the risk to occupational health workers. HCWs with active TB can be an important source of infection both for patients in care delivery, for colleagues, and the community.

The results of this study found a positive TST examination; there were six subjects, while positive T-SPOT.TB got more results in 11 subjects. The results of cross-tabulation of positive TST examination with positive T-SPOT. TB was six (20%) subjects and positive TST with negative T-SPOT. TB was not obtained (0.0%). The results of the positive TST and T-SPOT. TB-negative tests can be caused by a false positive TST examination that is a reactivation of the previous BCG vaccination or Mycobacterium Other Than Tuberculosis (MOTT) infection. MOTT infection can cause a false positive TST examination in areas that have a low TB prevalence and a high MOTT prevalence. Indonesia has a high TB prevalence, so the results of the positive TST and T-SPOT. TB-negative studies in this study are not false positives due to BCG vaccination and MOTT infections but LTBI-positive (Nasreen et al., 2016).

We calculated the concordance index using Cohen's kappa coefficient value of 0.603, which is substantial (0.600 < K < 0.800). TST examination has several disadvantages compared to T-SPOT.TB can occur with false positives and false negatives, but the results of this study obtained a substantial level of concordance between TST and T-SPOT.TB examination. That means that both TST and T-SPOT. TB examination can be used as an equivalent LTBI diagnostic tool. In our study, TST tests are recommended for detecting LTBI because it is more practical, inexpensive, and widely available in health facilities. A study by Cadena et al. in Germany with 333 people with a TST >10 mm induration found a strong degree of conformity (Cadena et al., 2017). Results with a high degree of conformity were also obtained in the (Rangaka et al., 2015) study in Turkey. TST tuberculin studies of HCW, all of whom use induration limits >10 mm, found the number of booster phenomena is good in countries with a prevalence of low TB, as in Kraut et al. in Canada using a history of BCG vaccination and workers born outside Canada as a strong predictor (Kraut et al., 2004).

The study results found six positive TST examinations and positive T-SPOT.TB got more results; there were 11 subjects. LTBI close contact examination with T-SPOT brings a sensitivity of 60.0%. TST and T-SPOT. TB diagnostic tools have specificity values above 85%, which means they can provide good proportions of healthy subjects who give negative diagnostic results (true negative). Based on the above results, issues with close contact with LTBI obtained many positive effects on the T-SPOT.TB examination compared to the TST examination. This is likely due to the booster phenomenon where the tuberculin test can be negative in infected individuals because the infection time is very long. Still, examining the tuberculin test will stimulate a reaction to the test so that the subsequent results will be positive. The wrong interpretation is said to be a skin test conversion, with the recommendation of the TST 2 test, the step is to repeat 1–3 weeks after the first TST is negative as recommended by PDPI and CDC (Jensen et al., 2005; Nayak and Acharjya, 2012). TST and IGRA examinations have their respective advantages and disadvantages. TST examination is still

the choice for ITBL diagnosis because it is affordable, practical, does not require skilled personnel, and is available in many health facilities compared to the IGRA examination (Setyawati, 2021).

The results of this study note that the place of work (close contact) has a significant correlation (p = 0.008), with a moderate correlation value (r = 0.436), where subjects with positive close contact tend to be positive with LTBI (30.0%). In contrast, subjects with negative close contact tended to be negative with LTBI (43.3%). The TB contact investigations program or individual investigations that contact active TB sufferers who are effective and, together with the national TB program and other services, can produce a considerable amount of case coverage. Current estimates are in a world with four million people yearly with positive microbiological examination results. Close contact is assumed to be a minimum of three people WHO estimates that 2.5% or 300,000 people are identified as close contact individuals with active TB sufferers (MacNeil, 2019). Twenty-two Molecular research in Mexico and South Africa shows that transmission may occur in social environments such as bars, cafes, and facilities such as hospitals (Mathema et al., 2017). These places are difficult to identify and require knowledge of culture and behavior patterns to focus the contact investigation.

The Centers for Disease Control and Prevention (CDC) recommends LTBI screening in individuals at increased risk of reactivation to active TB diseases, such as close contact with newly diagnosed TB patients, individuals with comorbidities, and those planning to start immunosuppressive medications such as tumor necrosis factor-alpha (TNF-α) blockers or biologics (Wang et al, 2022). The T-SPOT.TB test had a higher sensitivity than the TST. An increased TST spot size was associated with a trend toward an increased rate of T-SPOT.TB positivity. Given the comparable performance, the selection of TST or T-SPOT.TB should instead depend on other considerations, including cost, benefits, and resources (Yang et al, 2019).

The results showed that the period or length of time in which contact occurred for transmission of each individual was influenced by individual genotype factors and socioeconomic characteristics for the occurrence of Mtb transmission. Over the last decade, TB diagnosis and treatment have shifted from district-level CDC clinics to designated hospitals with state-of-the-art diagnostic equipment. Still, poor access to medical facilities remains a significant risk factor for household transmission of Mtb. Thus, there is still a need to improve the infrastructure and management of medical facilities, especially in areas with a high prevalence of TB (Cui et al, 2019). However, neither is the T-SPOT. Neither the TB test nor the TST was sufficiently accurate to detect active TB disease. The factors of sex, age, length of work, and nutritional status were not significantly related to TST and T-SPOT examination. We suggest that individuals in close contact with a negative TST examination can use the two-stage method: repeat the T ST examination 1–3 weeks later. It is related to the advice from the PDPI and CDC.

Conclusions

There is a substantial level of concordance between TST and T-SPOT.TB examination in detecting LTBI in HCW with a kappa value of 0.603 (0.600 < K < 0.800), p < 0.001. The results of close contact diagnostic testing with T-SPOT. TB gets a sensitivity of 60.0% and a specificity value of 86.7%, while the results of the close contact diagnostic test with TST get a sensitivity of 33.3% and a specificity value of 93.3%. TST and T-SPOT. TB diagnostic tools have specificity above 85%, so they are good at determining negative (true negative) results in healthy subjects. There is a correlation between the workplace location (close contact) and the T-SPOT.TB examination, the correlation value is moderate (r = 0.436) with p = 0.008.

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Mental Emotional Disorders and Coping Strategies of University Students During COVID-19 Pandemic

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Abstract

At the beginning of 2020, the world was shocked by the COVID-19 outbreak hitting almost all parts of the world. Student academic activities are faced with an online learning system and the adaptation of new habits. It caused a different response from each student. This study analyzes the coping strategy of the student-facing COVID-19 pandemic at the Public Health Faculty, Hasanuddin University. This research used a mix-method study conducted in September-October 2020 at the Faculty of Public Health, Hasanuddin University. This study used a sequential explanatory strategy where quantitative data is collected and analyzed first with 233 respondents by accidental sampling, followed by qualitative data with 12 respondents by purposive sampling. The results showed that the COVID-19 pandemic affects students psychologically. The results showed that as many as 121 people (51.9%) and there is a two-coping strategy. Problem-focused coping consists of seeking social support and planful problem solving, and Emotional-focused coping that is distancing. The government and Public Health Faculty at Hasanuddin University can maximize the assistance provided in the form of psychological and financial.

Introduction

In the middle of the COVID-19 crisis, we can observe developments in technology, business, politics, and education. We must be ready for these changes, adapt our attitudes and behaviors, and never stop learning. Indonesia is not the only country looking for ways to help students continue studying and exercise their right to an education. At the beginning of 2020, the world was shocked by the COVID-19 outbreak that attacked various parts of the world. The epicenter of the SARS-CoV outbreak was the Guangdong province of southern China. But due to air travel, it reached the other 19 countries in Southeast Asia, South Africa, North America, and Europe (Susilo et al., 2020). Over time, it infected 8,605 individuals and caused 774 deaths (CFR = 9.5%) worldwide on March 20, 2020, the World Health Organization (WHO) declared COVID-19 a pandemic. Several countries then imposed regional quarantine protocols, and various international activities were canceled. Especially in Indonesia, the government has issued a disaster emergency status from February 29, 2020, to May 29, 2020. This policy was followed by implementing Large-Scale Social Restrictions (PSBB) and adopting new habits in several areas (Kementerian Kesehatan Republik Indonesia, 2020). However, the COVID-19 epidemic startled practically everyone, including districts/cities, provinces, centers, and even the global world, when online learning emerged. It has resulted in students' academic activities faced with an online learning system, also known as e-University, which is relatively new to them (Pujilestari, 2020). Meanwhile, in their social environment, students also have to be faced with something outside of their habits, such as getting bored at

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home until they are bored (Harususilo, 2020).

Students of the Faculty of Public Health, Hasanuddin University, as the biggest in one of students in the health sector located in South Sulawesi Province, have the potential for a higher stress impact. It is related to the high number of cases in South Sulawesi, which is 12,746 and occupies the 4th highest number of cases in Indonesia as of September 8, 2020. In addition, more extensive exposure to information is also quite influential. Therefore, a coping strategy is an individual's endeavor to meet challenges or deal with shifting circumstances both inside and externally by controlling thoughts and actions in the pandemic situation is essential for students to face the new problem (Mashudi & Toanto, 2012). Studies addressing coping strategies in previous epidemic events, such as the H1N1 pandemic in 2009, showed that individuals with a high intolerance to uncertainty were more likely to perceive the pandemic as threatening and more likely to use coping strategies focused on emotions. Research conducted with university students during the 2003 epidemic of severe acute respiratory syndrome (SARS) emphasizes that coping was a fundamental mechanism against the negative impact of stressors on overall perceived health. Besides, showed that people used fewer active strategies (focused on problems) and more avoidable coping strategies (focused on emotions) in reaction to stressors related to SARS. Individuals can use two coping strategies, namely problem-focused coping and emotion-focused coping. Individuals use coping strategies to manage demands both from within and outside, which are considered burdensome or exceed the capabilities of their resources. Hence, coping with students during the COVID-19 pandemic will help them adjust to new habits that they must live as it is not sure when this pandemic will end (Hendriani, 2018).

The behavior that appears can be in negative territory or moving towards a positive environment. It depends on the strengths and barriers that exist within the individual. Therefore, analyzing the reasons behind individual behavior during this pandemic is essential. Based on these problems, the researchers tried to examine the coping carried out by students of the Faculty of Public Health, Hasanuddin University, as one of the groups that had to adapt to the COVID-19 conditions. With this research, it is hoped that it will be known how coping is done to deal with these conditions. It is worthwhile to investigate behavioral intention, causes, and problems as the potential determinants of the distance learning outcomes based on students' experiences and opinions.

Method

This research took time in September-October 2020. The location used as the research setting was the Faculty of Public Health, Hasanuddin University. Students of the Faculty of Public Health, Hasanuddin University, as one of the students in the health sector located in South Sulawesi Province have the potential for a higher stress impact. It is related to the high number of cases in South Sulawesi, which is 12,746 and occupies the fourth highest number of cases in Indonesia as of September 8, 2020. In addition, wider exposure to information is also quite influential.

This research is mixed methods research which is a form of research that combines two forms of research approaches, namely quantitative and qualitative. This study uses a sequential explanatory strategy where quantitative data is collected and analyzed first, followed by qualitative data. This study explores the coping strategies students of the Faculty of Public Health, Hasanuddin University, in dealing with COVID-19. Quantitative data is the result of measuring stress levels in students. Meanwhile, qualitative data were obtained from interviews about coping strategies and sources of support during the COVID-19 pandemic. The informant selection was by purposive sampling. Sources of information in this study were public health students in classes 2018 and 2019 who had experienced stress during the pandemic (SRQ score >6). The research was approved by the Ethics Committee of the Public Health Faculty at Hasanuddin University with approval number 7024/UN4.14.1/ TP.02.02/ 2020.

One alternative to evaluate the prevalence of risk symptoms is through the general mental disorder concept, assessed by the

Self Reporting Questionnaire (SRQ-20) 16. This study uses a cross-sectional design, while the data were collected with a Socio-Demographic Questionnaire and Self Reporting Questionnaire (SRQ-20) used by this research because it is a psychiatric disorder screening questionnaire with good validity and reliability developed by the World Health Organization (WHO) for research purposes and was used by Indonesia Basic Health Research to screening the mental health of the Indonesian population since 2007 and had through stages of validation by language translation to filter the meaning of words to be more understandable. Respondents that answered at least 6 questions with "yes" were declared to have mental disorders symptoms used as our cutoff point, which was determined by Indonesia Basic Health Research, with cutoff point 6 through a validity test with a sensitivity of 88% and a specificity of 81% and followed with a degree of significance p-value <0.005.

In quantitative data in this study, univariate analysis was carried out on the general characteristics of respondents and research variables, aimed to determine the frequency distribution of respondents based on the characteristics of respondents and the variables studied. The number of informants is determined based on the number of students from the 2018 and 2019 batches of Public Health Faculty Hasanuddin University, which is 560 people, with accidental sampling. The Slovin formula is used to determine the number of samples to become a total of 233 with google form with voluntary method without any intervention of coercion to be respondents.

The results of the study were obtained through in-depth interviews with students with mental and emotional disorders based on SRQ. Informants were limited to those who had experienced stress during the COVID-19 pandemic based on the results of the SRQ-20 questionnaire. There are 12 participants by purposive sampling method by informant consent through the text chat with the candidate before the researcher calls the selected respondent for interviewing. The characteristics of the informants studied are those second and third-year students of the Faculty of Public Health, Hasanuddin University (class of 2018 and 2019), having a stressful experience with an SRQ score> 6 during the COVID-19 pandemic and willing to be an informant and have agreed to the informed consent. The obtained data is categorized before proceeding to the elaboration of conclusions. Data collecting occurs before, during, and after the data analysis process based on the simplification and interpretation of the collected data. This method is divided up into three linked steps: data reduction, data presentation, and conclusion-making.

Result and Discussion

The characteristics of the respondents in this study were age, gender, and class year. The experience status of emotional disturbances and the distribution of respondents' characteristics can be seen in Table 1.

TABLE 1. Distribution of Respondents based on General Characteristics of Respondents

Respondents' Characteristics	Total (n)	Percentage (%)
Age		
17 years old	2	0.8
18 years old	16	6.9
19 years old	92	39.5
20 years	112	48.1
21 years old	11	4.7
Batch		
2018	121	51.9
2019	112	48.1
Gender		
Man	22	9.4
Woman	211	90.6
Experience of Emotional Disturbance		
Yes	121	51.9
No	112	48.1
Total	**233**	**100**

Source: Primary Data, 2020

Table 1 shows that most respondents were 20 years as many as 112 people (48.1%). At least 17 years old, namely 2 people (0.8%). Furthermore, for the class of students, the largest number of students was in the 2018 class, which was 121 people (51.9%), while for the 2019 class, there were 112 people (48.1%). Most gender was women, namely 211 people (90.6%) and only 22 men (9.4%). Furthermore, the number of respondents who experienced symptoms of mental-emotional disorders was 121 people (51.9%) compared to Respondents

who did not experience symptoms of mental-emotional disorders were 112 people (48.1%). The results showed that 51.9% of public health faculty students experienced symptoms of mental-emotional disorders. Those who did not was 48.1%. In general, this occurs due to rapid changes in conditions and limited interaction with the surrounding environment, which has become daily life before the COVID-19 pandemic. This study also found that the symptoms were more common in female students and younger class years.

It is per the research conducted by Dybrye et al (2007) which showed that women had higher rates of depression, anxiety, and stress. It is caused by biopsychosocial factors such as social roles and psychological status. Social difficulties, physiological factors, and stress caused by the environment are important risk factors to consider in the problem of mental disorders among women. Women are more likely to experience stress due to higher self-expectations and feelings of incompetence. In addition, women also tend to overreport medical and psychological symptoms. The findings in this study indicate that some of the informants experienced problems related to the online lecture method they were undergoing. Although several informants claimed to be interested in online lecture methods that were more flexible in terms of location, some of them still encountered obstacles. The obstacles encountered include lack of network access, boredom with lecture methods that are less varied, and lecture materials that are more difficult to understand.

The COVID-19 pandemic had affected education. These effects include switching from in-person instruction to online instruction, expanding the use of technology in the classroom, and boosting student learning autonomy (Word, 2022). Reality demonstrates that the COVID-19 outbreak is currently disrupting Indonesian educational dynamics, which has effects such as schools are moved into homes through online learning processes; there is a change in the types of technology-based learning media being used, including WhatsApp, Zoom, Google Classroom, WebEx, Youtube, and TV channels (TVRI); The demands for collaboration between parents of kids at home as a substitute for instructors to govern children's learning include adjustments to learning techniques, adjustments to learning evaluation to set standards of grade advancement and graduation (Mansyur, 2020). The COVID-19 outbreak affected many aspects of life, including education, student life, parent involvement, and the educational process. It is impossible to ignore a teacher's duty to instruct his students. Teachers need to develop effective strategies for fostering both academic and socioemotional learning. Teachers must be capable of running both live and online classes (Setyorini, 2020).

Table 2 shows the relationship between age, gender, and class year with symptoms of mental-emotional disorders in college students. The relationship between age and stress in college students is insignificant, based on a p-value of 0.471>0.05. Meanwhile, gender was significantly related to stress, based on the p-value of 0.039 <0.05. The class year was also significantly associated with stress based on a p-value of 0.014 < 0.05.

TABLE 2. Relationship of Age, Gender and Year of the Public Health Student Hasanuddin University Force with Symptoms of Mental-emotional Disorders

Respondents' Characteristics	Mental-emotional **Disorder**		**p-value**
	Yes	**No**	
Age			
16-18	10	8	0.471
19-21	111	104	
Gender			
Man	7	15	0.039
Woman	114	97	
Batch			
2018	54	67	0.014
2019	67	45	

Source: Primary Data, 2020

The results of the study were obtained through in-depth interviews with students with mental-emotional disorders based on SRQ. The scheme we have designed is related to the perceived severity of the COVID-19 pandemic on academic and non-academic life.

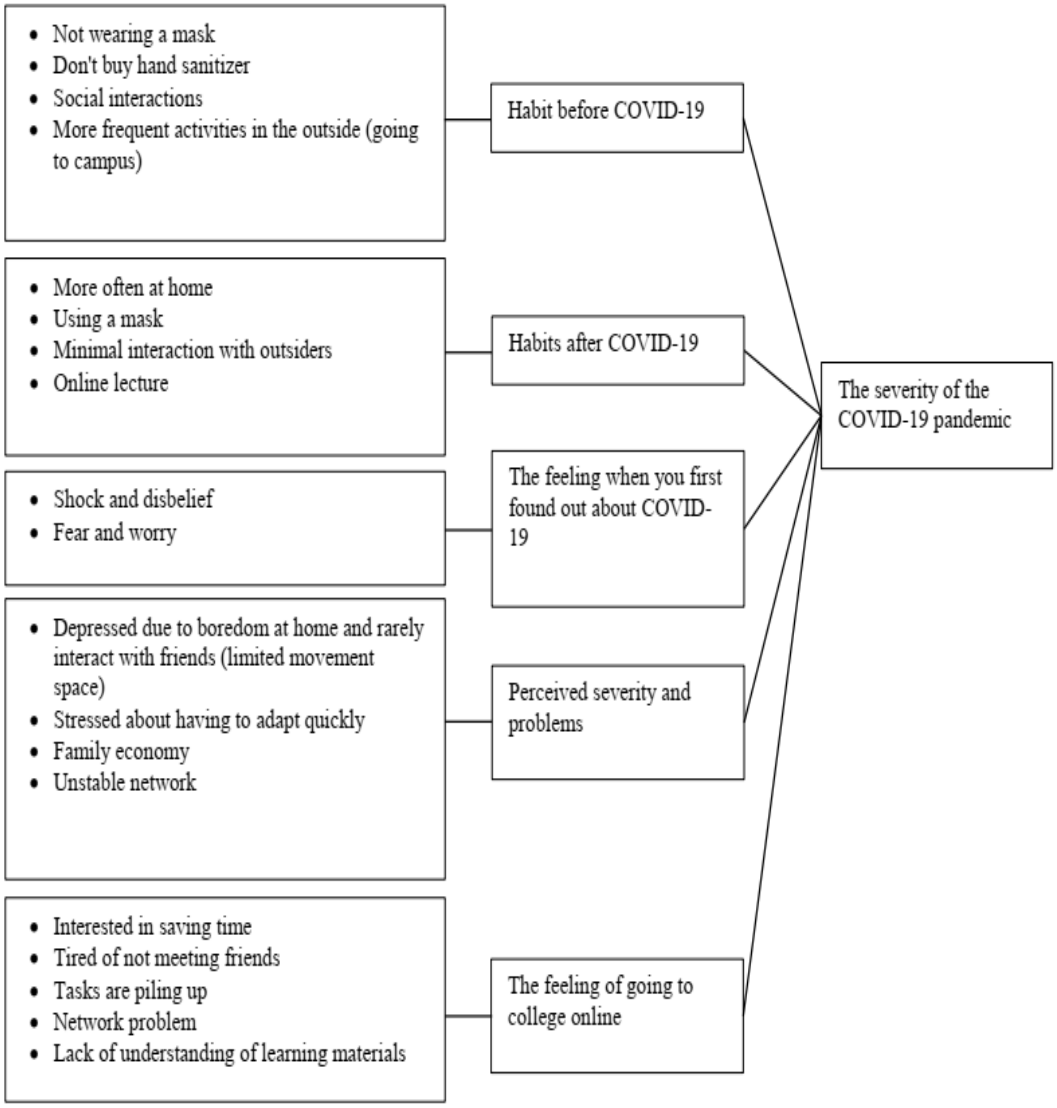

FIGURE 1. Schematic of the Results of the Analysis of Theme

In addition, the informants have varied patterns of coping behavior. It is because the chosen coping behavior is adjusted to the problem faced. Meanwhile, to adjust to the conditions of the COVID-19 pandemic, the actions taken are complying with health protocols and utilizing online platforms to continue activities such as meetings or webinars. It is expressed in the following interview excerpt:

> "What I feel when I go to college online is that I am bored because every day I do it just like that, I can't meet other friends on campus. At first it was quite difficult for me to accept" (FN, 19 years old)

However, several informants said that the coping behaviors used sometimes had negative impacts, such as difficulty sleeping and neglecting to do college assignments. It can be seen in the following interview excerpts:

> "I often do fun things that sometimes I neglect to do my homework" (YN, 19 years old)
> "I often have trouble sleeping" (AM, 20 years)

During the COVID-19 pandemic, informants have received some support. The informant stated that the assistance he received during the COVID-19 pandemic came from the government through the Ministry of Education and Culture, the campus, family, and close friends. It can be seen from the following

interview excerpts:

> "I was given financial assistance was usually from the campus committee, and the campus also reduced tuition fees for underprivileged students but somehow it's such a family burden for me with low economic status" (MR, 18 years old)

Nevertheless, several informants admitted that they still needed some other support, as expressed in the following interview excerpt:

> "Yes, I think all students who take online lectures much prefer financial assistance from campuses/schools, such as cutting tuition fees, which is expected to be more substantial" (AM, 20 years)
> "Improving internet access may also help to understand people to stay at home to prevent the spread of the virus. One more thing, maybe reduce the burden of learning that is too focused on the task" (RD, 19 years)

MATRIX 1. Categorization of Informants based on Coping Behavior in Overcoming the Impact of COVID-19

Coping Behavior	INFORMANT											
	AD (19)	**YN (19)**	**TA (20)**	**FN (19)**	**AM (20)**	**RD (19)**	**SR (21)**	**SN (20)**	**NI (20)**	**MR (18)**	**UM (19)**	**AA (20)**
Coping behavior focuses on emotions (emotional focused coping)												
To do fun thing _ like watch and cook (*distancing*)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Coping behavior focuses on the problem (problem focused coping)												
Talk to friends (*seeking social support*)	✓					✓		✓			✓	
Save expenses (*planful problem solving*)	✓	✓			✓	✓			✓	✓	✓	✓

MATRIX 2. Categorization of Informants based on Coping Behavior in Dealing with COVID-19

Coping Behavior	INFORMANT											
	AD (19)	**YN (19)**	**TA (20)**	**FN (19)**	**AM (20)**	**RD (19)**	**SR (21)**	**SN (20)**	**NI (20)**	**MR (18)**	**UM (19)**	**AA (20)**
Planful problem solving												
Wearing a mask	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Washing hands	✓	✓			✓	✓		✓	✓		✓	✓
Keep the distance	✓			✓	✓	✓		✓	✓	✓		
Using hand sanitizer	✓	✓	✓		✓	✓				✓	✓	✓

Based on the Table Matrix 1, some informants showed coping behaviors focusing on emotions and problems. The 6 informants in this study showed coping behavior focused on emotions, namely avoiding (distancing) by doing fun things at home, such as watching or cooking. Furthermore, two showed problem-focused coping. Namely planning for problem solving (planful problem solving) by saving expenses and one with coping seeking help/ support (seeking social support) by confiding in friends.

The type of problem-focused coping behavior is problem-solving in a planned manner (planful problem solving). The 6 informants in this study showed coping behavior by wearing masks when leaving the house, 5 using hand sanitizers, and 4 diligently washing their hands and keeping their distance (Matrix 1). The results showed two coping strategies used by students in dealing with feelings and problems that arise due to COVID-19, namely problem-focused coping (problem-focused coping) which consists of venting to friends (seeking social support) and saving expenses (planful problem-solving) and

emotion-focused coping (emotional-focused coping) by doing fun things such as watching and cooking (distancing).

The chosen coping behavior is affected by several factors such as demographic (income and having children), as well as adaptive and maladaptive personalities in dealing with COVID-19. Personality is indirectly related to broader demographic factors (income, age, gender, having children) with COVID-19 coping responses (Volk et al., 2021). Research conducted by Babore, et al, revealed that women are more likely to seek social support in dealing with high-stress situations caused by the pandemic (Babore et al., 2020). In addition, differences in the chosen coping strategies are also affected by the ability to manage the emotions and personality of the individual (Prentice et al., 2020).

Individuals who experience higher psychological distress tend to spend more time seeking information about COVID-19, are in locations with high exposure, adopt more negative coping styles, and receive relatively less social support. Concerns about COVID-19 transmission 19 and the economic impact of the COVID-19 pandemic makes psychological pressure even higher (Asmundson et al., 2020). Better social support will reduce psychological symptoms due to COVID-19. Specific prevention strategies at the community level, such as implementing effective communication and providing adequate psychological services must be carried out to reduce the psychological and psychosocial impact of the COVID-19 pandemic (Zhang et al., 2020). In addition, health education needs to be improved by using online methods. Social fears related to COVID-19 must be addressed quickly and appropriately. So far, stigma and discrimination are still the main challenges that create social pressure. Hospital protocols related to health emergency management need to be improved to ensure adequate health facilities managed by professionals (Özmete & Pak, 2020).

Information service center channels, internet access, social media, and special forums should be implemented to reduce the impact of self-quarantine and loneliness and allow certain populations (e.g., infected individuals in hospitals or quarantine) to communicate with their loved ones. Limited interaction between humans can be overcome by: (1) developing new spaces for inter- and intra-social communication and psychological care support tools; (2) psychotherapists training in managing online devices and applying adaptive skills; and (3) making the general public aware of telepsychology and its advantages (Qi et al., 2020). Coping strategies used in dealing with the COVID-19 pandemic tend to use emotion-focused coping strategies. It is caused by the anxiety factor due to being in an area with the highest number of cases and anxiety due to distance learning/learning from home. Another study showed that during online lectures, most of them used stress-coping strategies in the form of emotion-focused coping (Hanifah et al., 2020; Kristamuliana & Simak, 2020; Firman, 2022).

Students use adaptive (seeking social support) and maladaptive (acceptance and release) coping strategies. The results showed that students used more maladaptive coping strategies than adaptive coping strategies to deal with anxiety due to the pandemic and the effect of movement restrictions. One way that can eliminate anxiety or stress experienced by the community is relaxation (Aufar & Raharjo, 2020; Wang et al., 2020). Psychological resilience can generally be defined as the ability to support or restore psychological well-being during or after dealing with stressful conditions. Various mental health support strategies are needed in pandemic areas to facilitate lifestyle changes and activities to adapt to new habits after an outbreak (Khan et al., 2020). The inability to cope with social threats, such as pandemics, can increase the risk of developing a psychiatric condition (Chew et al., 2020).

Resilience, the adaptive coping mechanisms, and social support can all affect how one experiences COVID-19-related stress and acute stress disorder. Problem-focused treatment, social support, avoiding situations, and making the best of them are examples of possible coping mechanisms (Khan et al., 2020). Most responders listen to professional guidance and try to act calmly and responsibly, and coping mechanisms are heavily problem-focused. People understand that it will take time for COVID-19 containment measures

to work. Bulk food purchases and storage are justifiable due to convenience and a perceived need to be ready for a future quarantine (Chew et al., 2020). The positive attitude towards physical distancing introduced by the government as a strategy to reduce the transmission of COVID-19 is a form of positive coping strategy that can decrease psychological stress (Gerhold, 2020). It is also carried out in the form of particular preventive measures (eg washing hands, keeping a distance) and show an effective protection (Moore & Lucas, 2020). In addition, coping is also shown by self-isolation (Alkhamees et al., 2020). Resilience and positive coping will lead to psychological and mental health (Asmundson et al., 2020).

This research has limitations, both in distribution and questionnaires to respondents who are less than optimal. Due to COVID-19, researchers used online questionnaires through Google Forms help. The respondents either felt that they were less than optimal in filling out the questionnaire because usually, it is in the form of a print out and distributed in class and waiting by the researchers. Most likely, the respondents filled in well according to reality events experienced in the classroom. However, with this filling out the questionnaire distributed online, many students are careless in filling out the questions given by the researcher. In addition, the signal is an obstacle in the filling, where researchers cannot live one day get answers from respondents who are samples in the study this. It took one week before the respondents feedback obtained.

Conclusion

The COVID-19 pandemic affects students psychologically. The results showed that half of the respondents in this research experienced symptoms of emotional mental disorders. This psychological pressure arises because of the quarantine policy at home, the increasing burden of online learning, the uncertainty of learning outcomes, as well as family financial constraints. There are 2 types of coping strategies used, namely problem-focused coping (problem-focused coping), namely venting to friends (seeking social support) and saving expenses, wearing masks, and diligently washing hands (planful problem solving). We recommend students to recognize the symptoms better and factors that cause stress so that they can prevent and adapt during the COVID-19 pandemic. It is suggested to Public Health Faculty Hasanuddin University to maximize psychological services during the pandemic to reduce the psychosocial impact of the COVID-19 pandemic on students. We recommend the government to maximize equitable distribution of network access and financial assistance for students whose economy is affected by the COVID-19 pandemic.

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Knowledge and Perceptions Role Towards Modern Male Contraceptives Use in Indonesia

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Abstract

The use of modern male contraceptives is much lower than among women in Indonesia, and there are quite large differences when compared to several countries in Asia because the use of modern male contraceptives from 2002-2012 in Indonesia was always low due to a lack of knowledge and negative perception about Family Planning. This study aimed to determine the role of knowledge and perceptions of family planning for use of modern male contraceptives in Indonesia. This research method used a cross-sectional design on a secondary basis based on the 2017 IDHS. The result of this study is that there is a relationship between knowledge and perception of family planning in the use of modern male contraceptives after being controlled by education level, area of residence, and fertility preferences. This study concludes that married men who use modern contraceptives are those who have good knowledge and positive perceptions about family planning, found in married men who have a high level of education, live in urban areas, and do not want to have children anymore. This study recommends a particular male family planning program based on gender equality by prioritizing special substances regarding family planning knowledge and perceptions.

Introduction

Family planning services (KB), including the use of modern contraception, are on the third agenda in the fourth period of the National Medium-Term Development Plan, namely increasing access to and quality of health services (BKKBN et al., 2018). The use of contraception aims to regulate birth spacing, prevent pregnancy in women with high risk (for example, women who are too young or too old), and prevent unwanted pregnancies (KTD), where unwanted pregnancies can cause unsafe abortions and complications of pregnancy and childbirth so that This can increase maternal and child morbidity and mortality (WHO, 2019). One of the causes of unwanted pregnancy is unmet needs, where the percentage of unmet needs in Indonesia according to IDHS data for 2017 shows a percentage of 10.6% (BKKBN et al., 2018). The incidence of unmet need is not only influenced by the non-fulfillment of contraceptive use in women but can occur due to the lack of male participation in contraceptive use (Dougherty et al., 2018).

Trends in the use of modern contraception worldwide show an increase from 53% (1994) to 63% (2019). Likewise in Indonesia, it has increased from 50% (1991) to 63.6% (2017) (BKKBN et al., 2018; United Nations, 2019). Although the trend of modern contraceptive use shows an increase, the use of modern male contraception (condoms and vasectomy) is always low in the world and Indonesia. Based on

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IDHS data for 2002-2012, the use of condoms and vasectomy is below 5%. It is very different from the use of modern female contraception in Indonesia, one of which is the use of injections which has reached 30% (BKKBN et al., 2018). The use of condoms and vasectomy in Indonesia is also quite far when compared to the use of condoms and vasectomy in several Asian countries, such as the use of vasectomy in Bhutan and Korea, which have reached 8% and 9% respectively, and the use of condoms in Hong Kong and Japan respectively 34.1% and 34.9% (United Nations, 2019).

The high difference in the use of modern contraception by men and women in Indonesia can lead to gender disparities related to family planning due to the dominance of family planning services provided to women (Peter & Chinyere, 2015). Even though men need to take responsibility for forming a prosperous family by actively participating in using condoms or vasectomy, so that the use of contraception is not only borne by women (BKKBN, 2021). Based on several recent studies, the low use of modern male contraception is due to a lack of knowledge about family planning, and there are still negative perceptions about family planning, namely family planning is only a woman's business, women should be sterilized, vasectomy is the same as castration, vasectomy prohibition by religion, vasectomy can reduce male virility, and condoms can reduce sexual pleasure (Bhatt et al., 2021; Dral et al., 2018; Kabagenyi, Ndugga, et al., 2014; Kriel et al., 2019; Manortey & Missah, 2020; White et al., 2020).

The use of man modern-contraception is a good health behavior. It is affected by several factors, including knowledge and perceptions of family planning. Based on previous studies, they are those who have good family planning knowledge and positive family planning perceptions (Kamal et al., 2013; White et al., 2020). Several ways to increase the use of man modern-contraception are increasing access to male family planning services, such as increasing male family planning counseling and outreach activities, increasing the use of mass media, having male family planning groups, and having male family planning cadres, as well as the need for communication regarding KB with wife (Bhatt et al., 2021; Kabagenyi, Jennings, et al., 2014; Manortey & Missah, 2020). Based on the explanation of the problems above, this study aims to determine the role of knowledge and perceptions of family planning on the use of modern contraceptives for married men in Indonesia based on data from the 2017 IDHS.

Method

This research was quantitative and based on secondary data from the 2017 IDHS. The design of this study was cross-sectional and conducted in June 2022 in Indonesia. The population in this study were all married men in Indonesia in 2017, and the sample was married men aged 15-54 who lived in Indonesia at the time of the 2017 IDHS. The IDHS sample was taken in two stages, namely the selection of the census block by probability proportional to size and the stratification process according to urban and rural areas, which ultimately resulted in 10,009 men interviewed. Of the 10,009 men, 68 data were removed from men who were not married, as well as 1,933 missing data and 28 outliers data, so that 7,980 samples of married men with complete data were obtained. The sample is sufficient to be studied because the minimum number is 2,424 married men, obtained using the sample size formula to test the hypothesis that there are two different proportions based on the proportions from previous studies.

Data analysis used complex samples with weighting enabled, including univariate, bivariate, and multivariate analysis using SPSS 25. Bivariate analysis was by chi-square, and multivariate analysis was by multiple logistic regression with risk factor models. The dependent variable in this study was the use of man modern-contraception (using condoms or vasectomy), and the independent variables were knowledge and perceptions about family planning. The relationship between the dependent and independent variables is controlled by the covariate variables, namely age, area of residence, education level, economic status, working status, fertility preference, number of living children, family planning discussions with wives, family planning discussions with health workers, and exposure to mass media.

The substance of male family planning knowledge was taken from 12 questionnaire questions of married men, including having heard of condoms and vasectomy, women's fertile period, condoms can prevent HIV, vasectomy makes men safe, vasectomy is effective, vasectomy surgery is safe, vasectomy is safer than tubectomy, vasectomy is inexpensive, vasectomy is cheaper than tubectomy, surgery is easy, and can give men freedom. Then the substance of family planning perceptions was taken from 9 questions in a married man's questionnaire, which included family planning is only a woman's business, vasectomy is the same as castration, women who should be sterilized, women who use contraception will change sexual partners, wives can order husbands to use condoms if their husbands have an infection sexually transmitted infections (STI), vasectomy is not beneficial for men's health, vasectomy surgery is not safe, vasectomy can reduce male virility, and vasectomy prohibition by religion. Family planning knowledge is good if the score is >2, and family planning knowledge is poor if the score is ≤2. While positive perceptions are if the score is >4 and negative perceptions are if the score is ≤4. Determination of the score is adjusted to the average condition of knowledge and perceptions of family planning among married men in Indonesia. In the variable exposure to mass media, the mass media in question is exposure to television, radio, newspapers, posters, pamphlets and the internet. In the variable, level of education, the education level is said to be low if not attending school, graduating from elementary school, and graduating from junior high school,.The education level is high, if graduating from high school and college graduate.

Results and Discussions

Based on Table 1, the participation in the use of modern male contraception is low, namely 4% (95% CI: 3.4%-4.6%), which includes the use of condoms 3.8% and vasectomy 0.2%. Then most married man in Indonesia has poor family-planning knowledge and negative family-planning perceptions. Based on the covariate variables, most married men in Indonesia are aged ≥35 years, live in urban areas, have a higher education level and upper middle economic status, are working, still want to have more children, have ≤2 living children, have family planning discussions with their wives, not hold family planning discussions with health workers, and be exposed to at least 1 mass media.

Table 2 shows a relationship between knowledge and perceptions of family planning on the use of modern male contraception in Indonesia. In the covariate variables, there appears to be a relationship between age, area of residence, education level, economic status, fertility preferences, family planning discussions with wives, and mass media exposure to male modern contraceptive use in Indonesia. After going through several stages of multiple logistic regression with the risk factor model, there were no covariate variables that interacted with the independent variables, and the confounding variables were obtained, namely the area of residence, level of education, and fertility preferences. Table 3 shows a relationship between knowledge and perceptions of family planning on men's use of modern contraception after controlling for education level, area of residence, and fertility preferences.

Table 1. Univariate Results

Characteristics of Married Man ages 15-54 Years in Indonesia		n	%	95% CI
Modern male contraceptive use				
a.	No	7.644	96	95,4-96,6
b.	Yes	316	4	3,4-4,6
FP Knowledge				
a.	Poor	4.875	61,1	59,4-62,7
b.	Good	3.105	38,9	37,3-40,6
FP Perception				
a.	Negative	4.971	62,3	60,5-64
b.	Positive	3.009	37,7	36-39,5
Age				
a.	<35 years	2.514	31,5	30,3-32,8
b.	≥35 years	5.466	68,5	67,2-69,7
Residential Area				
a.	Rural	3.708	46,5	45,2-47,7
b.	Urban	4.272	53,5	52,3-54,8
Education Level				
a.	Low	3.782	47,4	45,8-49
b.	High	4.193	52,6	51-54,2
Economic Status				
a.	Middle Low	2.507	31,4	29,9-33
b.	Average	1.715	21,5	20,3-22,7
c.	Middle Up	3.758	47,1	45,4-48,8
Occupational Status				
a.	Not work	142	1,8	1,4-2,2
b.	Work	8.838	98,2	97,8-98,6
Fertility Preference				
a.	Want more child/Not yet decide	4.348	54,5	53,1-55,9
b.	Not want more child/male or spouse has been sterilized/infertile	3.632	45,5	44,1-46,9
Number of living child				
a.	≤2 children	5.693	71,3	70,1-72,5
b.	>2 children	2.287	28,7	27,5-29,9
FP discussion with spouse				
a.	Yes	3.960	49,6	48,1-51,2
b.	No	4.020	50,4	48,8-51,9
FP discussion with health attendant				
a.	Yes	1.067	13,4	12,4-14,4
b.	No	6.913	86,6	85,6-87,6
Mass media exposure				
a.	Unexposed	2.138	26,8	25,3-28,3
b.	Exposed	5.842	73,2	71,7-74,7
Total		**7.980**	**100**	

Source: IDHS, 2017

Table 2. Bivariate Results

Characteristics of Married Man ages 15-54 Years	Modern Contraception Use on Married Man				p-value	OR (95% CI)
	Not use		Use			
	n	%	n	%		
FP Knowledge						
a. Poor	4.760	97,7	115	2,3		Ref
b. Good	2.904	93,5	201	6,5	0,000	2,881 (2,148-3,864)
FP Perception						
a. Negative	4.826	97,1	145	2,9		Ref
b. Positive	2.839	94,3	170	5,7	0,000	1,989 (1,493-2,649)
Age						
a. <35 years	2.435	96,8	79	3,2		Ref
b. ≥35 years	5.229	95,7	237	4,3	0,029	1,388 (1,034-1,865)
Residential Type						
a. Rural	3.626	97,8	83	2,2		Ref
b. Urban	4.038	94,5	233	5,5	0,000	2,530 (1,765-3,628)
Education Level						
a. Low	3.705	97,9	78	2,1		Ref
b. High	3.959	94,3	238	5,7	0,000	2,874 (2,081-3,969)
Economic Status						
a. Middle Low	2.463	98,2	44	1,8		Ref
b. Average	1.660	96,8	55	3,2	0,116	-
c. Middle Up	3.541	94,2	217	5,8	0,000	2,545 (1,884-3,438)
Occupational Status						
a. Not Work	140	98,7	2	1,3		Ref
b. Work	7.524	96	314	4	0,126	-
Fertility Preference						
a. Want more child/not yet decide	4.206	96,7	142	3,3		Ref
b. Not want more child/male or spouse has been sterilized/ infertile	3.458	95,2	174	4,8	0,002	1,489 (1,157-1,916)
Number of living child						
a. ≤2 children	5.468	96,1	225	3,9		Ref
b. >2 children	2.196	96	91	4	0,949	-
FP discussion with spouse						
a. No	3.900	97	120	3		Ref
b. Yes	3.764	95	196	5	0,000	1,698 (1,274-2,263)
FP discussion with health attendant						
a. No	6.636	96	277	4		Ref
b. Yes	1.028	96,3	39	3,7	0,629	-
Mass media exposure						
a. Unexposed	2.093	97,9	45	2,1		Ref
b. Exposed	5.572	95,4	270	4,6	0,000	2,245 (1,516-3,325)

Source: IDHS, 2017

Table 3. Multivariate Results

Variables	B	p-value	OR	95% CI
Independent Variables				
FP Knowledge				
a. Poor			Ref	
b. Good	0,704	0,000	2,021	1,495-2,732
FP Perception				
a. Negative			Ref	
b. Positive	0,343	0,017	1,408	1,063-1,867
Confounding Variables				
Residential Area				
a. Rural			Ref	
b. Urban	0,654	0,000	1,923	1,335-2,772
Education Level				
a. Low			Ref	
b. High	0,677	0,000	1,968	1,403-2,761
Fertility Preference				
a. Want more child/not yet decide			Ref	
b. Not want more child/male or spouse has been sterilized/infertile	0,358	0,006	1,430	1,108-1,846
Intercept	-4,734			

Source: Primary Data, 2021

From Table 3, a multivariate equation model is obtained, namely Logit P (Use of modern male contraception) = -4.734 + (0.704*Knowledge about family planning) + (0.343*Perceptions about family planning) + (0.654*Region) + (0.677* Education level) + (0.358*Fertility preference). Based on the multivariate equation, the probability calculation is as follows.

$$P = \frac{1}{1 + e^{-(-(-4{,}734 + 0{,}704 + 0{,}343 + 0{,}654 + 0{,}677 + 0{,}358))}} = 0{,}12$$

It means that married men in Indonesia in 2017 who had good knowledge of family planning, had positive family planning perceptions, lived in urban areas, had a high level of education, and did not want to have more children have a probability of using modern male contraception by 12% compared to married men in Indonesia in 2017 who had poor knowledge of family planning, had negative family planning perceptions, lived in a rural area, had a low level of education, and still want to have more children.

The use of modern male contraception in Indonesia in 2017 was low (4%). It was not much different from the use of modern male contraception in the 2017 IDHS report, which was 3.3%. The use of modern male contraception in Indonesia is low when compared to East Asia, which has reached 24.8%, namely the use of condoms in Hong Kong and Japan, which has reached 30%, even the use of vasectomy in Korea has reached 9% and in Bhutan (South Asia) has reached 8% (United Nations, 2019). From this comparison, the use of modern male contraception in Indonesia can be higher, like other countries in Asia, than the current data.

Several studies and the BKKBN state that the low use of modern male contraception is a lack of knowledge of condoms and vasectomy, and there is still a negative perception of family planning, that is, family planning is only a woman's business, women who use contraception will change sexual partners, vasectomy is the same as castration, vasectomy

reduces male virility, vasectomy is prohibited by religion, and condoms can reduce sexual pleasure (Bhatt et al., 2021; BKKBN, 2021; Dral et al., 2018; Manortey & Missah, 2020). Another study in Uganda showed that men still do not know the benefits, effectiveness, and disadvantages of condoms and vasectomy. Because so far, family planning services have been dominantly provided to women, and there are only two male contraceptive options (condoms and vasectomy) (Kabagenyi, Jennings, et al., 2014).

The dominance of family planning services for women causes a gender inequality related to family planning. One of the reasons for this condition is that men/husbands dominate the decision-making to determine the number of children (Peter & Chinyere, 2015). The decision to determine the number of children and those who use contraceptives is more dominantly decided by men, because there is still a patriarchal culture that makes women/wives unable to escape the power of men/husbands, so this still shows that women in Indonesia are powerless regarding family planning (Kc et al., 2021). So it is necessary to emphasize the importance of empowering women related to family planning by participating in decision-making regarding the ideal number of children and those using contraception. With that, the husband and wife will understand each other's condition, and the awareness of men regarding family planning increases that family planning is not only a woman's business, and makes women confident in making decisions regarding family planning with their husbands. So that the burden on the wife to get pregnant, give birth, and use contraception will be reduced because forming the ideal number of children and using contraception is based on a joint decision, so that the wife does not only take care of household affairs, but can continue higher education and work, where women who are empowered in terms of family planning are generally women who have higher education, work, and have the high economic status (Hameed et al., 2014; Kc et al., 2021; Peter & Chinyere, 2015).

Table 3 shows that married men who participate in using modern male contraception are married men who have good family planning knowledge and positive family planning perceptions and those with a higher education level, live in urban areas, and do not want to have more children. In contrast, married men who do not participate in using modern male contraception are married men who have poor family-planning knowledge and negative family planning perceptions, and this is found in married men who have a low level of education, live in rural areas and still want to have more children. It is per several studies in Saudi, Southern United States, Nigeria, sub-Saharan Africa, and Kenya that men who use modern male contraception are men who have good family planning knowledge, positive family planning perceptions, have a high level of education, live in urban areas, and don't want to have any more children. In these studies, the substance of family planning knowledge that is proven based on previous research is knowing or having heard of condoms and vasectomy, condoms can protect against HIV, and vasectomy is an effective method. Then the substance of the perception of family planning proven in previous studies is that family planning is only a woman's business, women who use family planning will change sexual partners, women who should be sterile, vasectomy is the same as castration, vasectomy is prohibited by religion, vasectomy surgery is not safe, and can reduce male virility so that the substance of this knowledge and perception needs to be included in the male family planning program to increase family planning knowledge and change negative perceptions to positive among married men in Indonesia (Ahinkorah et al., 2020; Karim et al., 2021; Ochako et al., 2017; Sait et al., 2021; Thummalachetty et al., 2017; Traore et al., 2021; White et al., 2020).

Men with a higher level of education are easier to accept, absorb, and are more rational in taking new information or things such as male family planning (Idris, 2019; Sait et al., 2021). Conversely, men with low levels of education can hinder their development in receiving new information or things, so educational efforts should be able to build a strong base of contraception knowledge for men (Dougherty et al., 2018). Men who don't want more children tend to seek contraceptive information to prevent pregnancy. In contrast, men who

still want to have more children do not seek contraception information because they think that children are a family asset in the future, so many men want to have many children until they are satisfied (especially boys), and men are usually happy if they have many kids. Men who still want to have more children are those who still have negative perceptions about family planning, namely family planning is only a woman's business, vasectomy is prohibited by religion, and vasectomy can reduce male virility (Sait et al., 2021; Tilahun et al., 2013; Tuloro et al., 2009).

Men living in urban areas generally have easy access to family planning services and information on male family planning (Ahinkorah et al., 2020; Shaweno & Kura, 2020). Men who live in rural areas generally have difficulty accessing family planning services, the minimum number of health workers, there is a cultural factor/belief that family planning is only a woman's business, vasectomy is prohibited by religion, there is an embarrassment when having a vasectomy done because you can no longer have children, and assume that children are family assets (especially men) (Mustafa et al., 2015; Okon et al., 2019). In substance, family planning discussions with health workers and exposure to the mass media had a significant influence on the use of modern male contraception Although, this study shows that family planning discussions with health personnel and exposure to the mass media did not play a role in the use of modern male contraception. Health attendants are the primary source of information on condoms and vasectomy through counseling or outreach (Dehlendorf et al., 2010; Kabagenyi, Jennings, et al., 2014). Regarding exposure to mass media, information on modern male contraception can reach a large audience with interesting content, increasing men's motivation to use modern contraception (Irawaty & Gayatri, 2021). The limitations of this study are that the substance of family planning knowledge is not entirely available in the 2017 IDHS married men questionnaire, such as condoms cannot be reused, condoms can be used without meeting a health worker, condoms are easy to obtain, condom price is affordable, sources of obtaining condoms, and vasectomy must be by professional medical personnel. Likewise, the substance of family planning perceptions is not entirely available in the 2017 IDHS questionnaire for married men, such as condoms can reduce sexual pleasure, vasectomy does not cause pain, and using condoms or vasectomy means that men are also responsible for family reproductive health and reduce the double burden on women in reproductive health.

Conclusions

Participation in modern contraception by married men in Indonesia in 2017 was low, namely 4%. Married men who use modern male contraception are those with good family planning knowledge and positive family planning perceptions, and are found in married men who have a higher level of education, live in urban areas, and do not want to have more children. In contrast, married men who do not participate in using modern male contraception are men who have poor family-planning knowledge and negative family-planning perceptions, and those who have a low level of education, live in rural areas and still want to have more children.

This study recommends a particular family planning program based on gender equity that is socialized to all elements of society to increase awareness of the importance of increasing male participation in contraceptive use. The program must have policy support regarding male contraception, an adequate trained health workers, adequate teaching aids, and supported advertising activities. To increase the use of modern male contraception in the program, special substance regarding family planning knowledge is needed, which includes knowledge of condoms (how to use, effectiveness, and benefits), including condoms can protect against HIV, as well as vasectomy (procedure, effectiveness, and benefits), including vasectomy is an effective method. Likewise, special substance is needed regarding the perception of family planning, which includes family planning not only for women, women using contraception will not change sexual partners, women are not entirely responsible for sterilization, vasectomy is not the same as castration, vasectomy is not

prohibited by religion, vasectomy surgery safe, and vasectomy does not reduce male virility. So that it can increase family planning knowledge and change negative family planning perceptions into positive ones. We recommend further research to increase the use of modern male contraception.

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Types and Sources of Antioxidants that Role in Determining Fertility Level

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Abstract

Lifestyle and exposure to free radicals affect a person's fertility. ROS (Reactive Oxygen Species) in excess can cause oxidative stress and DNA damage (deoxyribonucleic acid). Adequate intake of antioxidants is needed to maintain ROS levels. This review aims to determine the types and sources of antioxidants that play a role in determining a person's fertility level. This research is a narrative review by a literature review method by collecting and concluding data from previous studies. The search for research articles was carried out on Scopus, Science Direct, Clinical Key, SpringerLink, BMC, and Google Schoolar portals with keywords foodstuffs, antioxidants, and infertility which found 8,745 articles. A total of 75 articles met the inclusion-exclusion criteria for use in writing this article. The research took time in 2022. Most antioxidants take a role in determining male fertility, such as glutathione, selenium, carotenoids (beta-cryptoxanthin, lycopene, beta-carotene, and lutein), zinc, vitamin C, vitamin E, and flavonoids. NAM (Nicotinamide) and carvacrol play a role in determining female fertility. These antioxidants can be found in fruits, vegetables, protein sources, and several other plants. Consumption of antioxidant sources is highly recommended to increase fertility, especially for infertile couples.

Introduction

Infertility has the potential to affect various aspects of a person's life, including physical, mental, social health, and overall quality of life (Bakhtiyar et al., 2019). Cognitive reactions and emotional-affective reactions to infertility conditions and the therapeutic process are often experienced by infertile patients (Hasanpoor-Azghdy et al., 2014). As many as 22.3% of infertile patients had stress, with fatigue being the main complaint (38.1%). The duration of infertility showed a significant relationship with the level of stress experienced by the patient ($p < 0.05$) (Wiweko et al., 2017). High-stress levels allow a person to have infertility three times OR=3,89; CI 95%=1,04 to 14,46; p=0,046) (Indarwati et al., 2017).

Lifestyle factors have a role in determining a person's fertility (Acharya and Gowda, 2017). Long-term exposure to chemicals, such as pesticides, fertilizers, and industrial products (plasticizers and phytoestrogens) has been associated with decreased fertility through hormonal pathways (Ding et al., 2016). Free radicals had a physiological role in optimizing sperm performance (Palmieri et al., 2016). Excessive amounts of ROS (reactive oxygen species) can cause oxidative stress and then DNA damage (Cleaver et al., 2014). Nearly 10% of infertile/subfertile women are identified with DOR (Decreased Ovarian Reserve) (Pastore et al., 2014).

The quality of the diet was related to energy and nutritional sufficiency (Mardiana

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et al., 2022). Previous research had shown that healthy food intake is associated with sperm and semen quality (Efrat et al., 2018). Adequate intake of antioxidants is needed to maintain ROS levels (Liu et al., 2018). Antioxidants are compounds capable to stop the chain reaction of the oxidative stress process by capturing free radicals (Ko et al., 2014). Antioxidants act as free radical reducers, enhancing endogenous antioxidant defense systems and oxidative stress-induced gene expression (Bai et al., 2016). Antioxidant levels were significantly related to sperm concentration and count of total motile. The higher of antioxidant levels in a body, the higher the sperm concentration and total motile count (Silberstein et al., 2016). Antioxidant therapy often consumed by patients is vitamin C, vitamin E, minerals (selenium and zinc) (Bardaweel, 2014). This study will combine the results of various previous studies to know the types and sources of antioxidants that play a role in determining a person's fertility level.

Method

This Research is a narrative review using the literature review method by collecting and concluding data from previous studies. The research was conducted in April-May 2022. The search for previous research articles was carried out on Scopus, Science Direct, Clinical Key, SpringerLink, BMC, and Google Schoolar portals with keywords in the form of foodstuffs, antioxidants, and infertility. The evaluation of the articles was carried out according to the inclusion and exclusion criteria of the previous articles. Inclusion criteria were research articles on the role of antioxidants in fertility enhancement, that can be accessed on indexed international journal portals or national journal portals which are minimum accredited in SINTA 2, published in 2013-2022, and was an original article. The exclusion criteria are an article that can be accessed in abstracts and proceedings only.

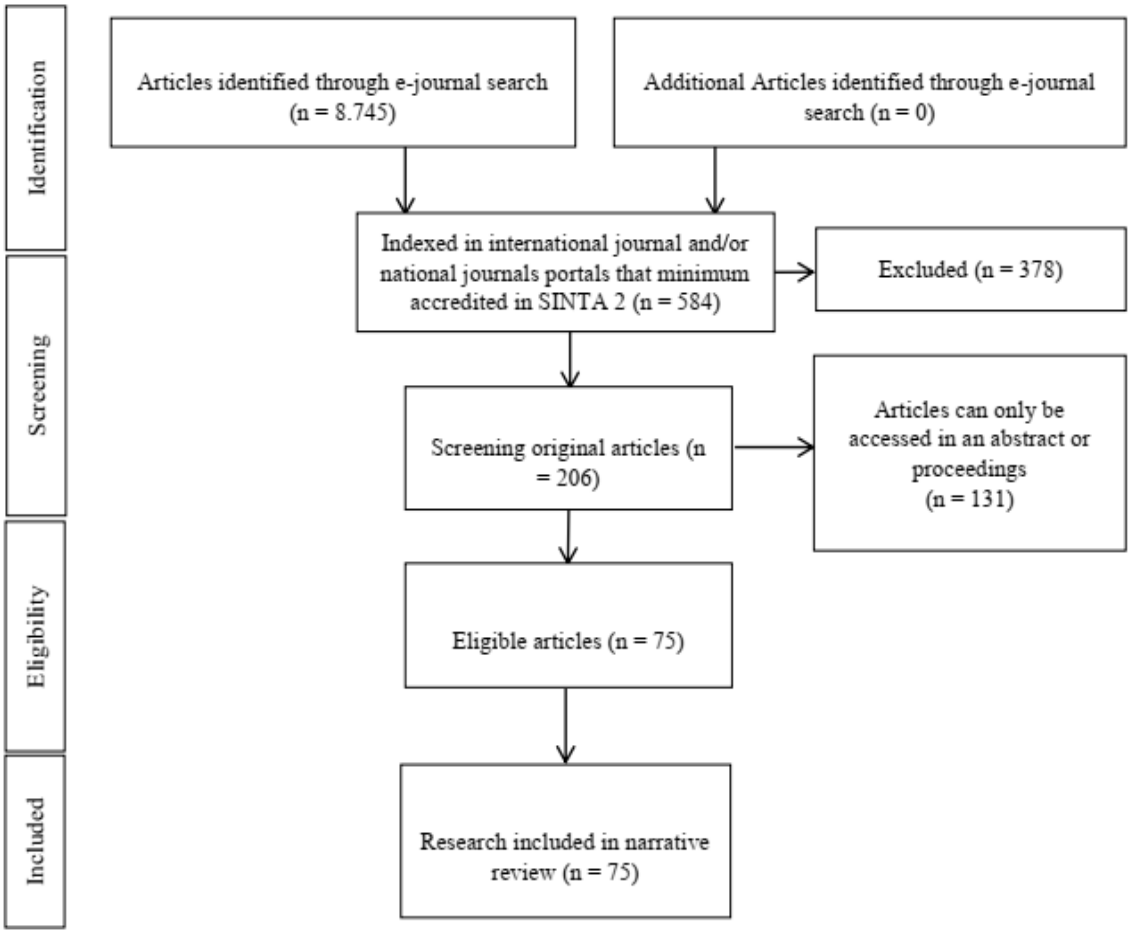

FIGURE 1. Article Selection Flowchart

A total of 584 out of 8,745 articles discussed the role of antioxidants in fertility enhancement were published from 2013-2022. A total of 206 are original can be accessed on indexed international or national journal portals that are, minimum accredited in SINTA 2. A total of 131 articles can only be accessed in abstract form. A total of 75 articles met the inclusion and exclusion criteria, so they were used in writing this narrative review that consisting of 20 articles on the Scopus journal portal, 25 articles on the Science Direct journal portal, 10 articles on the Clinical Key journal portal, 9 articles on the SpingerLink journal portal, 2 articles on the BMC journal portal, and 9 articles on the Google Schoolar with minimum accredited in SINTA 2.

Result and Discussion

Antioxidants have an important role in determining a person's fertility. Most of the antioxidants that play a role in determining male fertility. These antioxidants include glutathione, selenium, carotenoids (beta-cryptoxanthin, lycopene, beta-carotene and lutein), zinc, vitamin C, vitamin E, and flavonoids. NAM and carvacrol play a role in determining female fertility.

TABLE 1. Types of Antioxidants that Play a Role in Determining a Person's Fertility

Types of Antioxidants	Role	Referensi
NAM	NAM is positively correlated with the rate of maturation and fertilization of mouse oocytes	(Guo et al., 2022)
Glutamine	Glutamine prevents decreased sperm quality, reduces oxidative stress, inflammation and apoptosis	(Afolabi et al., 2022)
Carvacrol	Carvacrol is useful in the treatment of ovarian ischemia-reperfusion injury and infertility	(Sahin et al., 2022)
β-cryptoxanthin	β-cryptoxanthin has a positive effect on sperm motility	(Haeri et al., 2022)
Lycopene	Lycopene can protect sperm from oxidative stress and damage to sperm DNA	(Babaei et al., 2021)
	There is a positive relationship between lycopene intake and sperm morphology	(Zareba et al., 2013)
Selenium	Selenium can increase semen volume and total sperm motility	(Talebi et al., 2021)
Zinc	The effect of zinc supplementation through the pretesticular pathway can increase serum FSH, LH, and testosterone	(Shahraki et al., 2015)
Vitamin C	Vitamin C can improve the motility and morphology of spermatozoa	(Cyrus et al., 2015)
Vitamin E	Vitamin E is able to repair oxidizing radicals directly and prevent the process of lipid peroxidation	(Yan et al., 2014)
Beta-Carotene	There is a relationship between beta-carotene intake and sperm motility	(Talebi et al., 2021)
Lutein	There is a relationship between lutein intake with sperm motility and normal sperm morphology	(Zareba et al., 2013)
Flavonoids	Flavonoids can promote hydrogen ions, so they can neutralize the toxic effects of these free radicals and increase motility and morphology of normal spermatozoa.	(Jamalan et al., 2016)

Source : Primary Data. 2022

Antioxidants that play a role in determining a person's fertility can be found in foodstuffs in the form of fruits, vegetables, and protein sources. The fruits in question include watermelon, tomatoes, mango, and kiwi. The vegetables in question include banana blossoms, bamboo shoots, purple carrots, and parsley. Sources of protein in question include legumes, bay shellfish, meat and eel. In addition, antioxidants that play a role in determining a person's fertility are also found in male date flowers, mulberry leaves, sour soup leaves, and green algae.

TABLE 2. Source of Antioxidants

Source of Antioxidants	Types of Antioxidants	Reference
Banana Blooms	Phenolic	(Panyayong and Srikaeo, 2022)
Bamboo Shoots	Fenol, Flavonoids, Vitamin C	(Singhal *et al*., 2021)
Spinach	Peptide	(Fillería *et al*., 2021)
Pod	Polyphenol, Flavonoids, Saponins, isoflavonoid	(Asati *et al*., 2022)
Purple Carrots	Flavonoids	(Perez *et al*., 2022)
Soya bean	Isoflavonoiddan peptide	(Tkaczewska *et al*., 2022)
Male Date Flower	Polyphenol, flavonoids	.(Karra *et al*., 2020
Parsley	Phenolic acid, Flavones, Flavonoid, dan Carotenoids	(Ferreira *et al*., 2022)
Sorghum seeds	Phenolic	(Miafo *et al*., 2022)
Mulberry leaf	Phenolic acid, flavonoids, dan alkaloids	(Polumackanycz *et al*., 2021)
Soursop leaf	Flavonoids, chlorogenic acid	(Leal *et al*., 2022)
Green algae	Phenolic, flavonoids, Vitamin C, Vitamin D, dan Ferron	(S *et al*., 2022)
Tamarind	Papain Hydrolyzate	(Bagul *et al*., 2018)
Purple Head Broccoli	Isothiocyanates	(Chaudhary *et al*., 2018)
Watermelon	Lycopene	(Mahamat *et al*., 2021)
Tomatoes	carotenoids, lycopene, β-carotene, flavonoids, and anthocyanins	(de Souza *et al*., 2021)
Mango	phenolic, glutathione, thiobarbituric acid reactive substances (TBARS), and 8-hydroxydeoxyguanosine	(Zapata-Londoño *et al*., 2020)
Gulf shell	Selenium	(Zhang and Yang, 2014) Se-methyl-seleno-cysteine (MeSeCys
Kiwi	Polyphenol, flavonoids, flavanol, tannins, vitamin C, lutein, zeaxanthin and fiber	(Leontowicz *et al*., 2016)
Meat	Meat contains protein, ferron, vitamin B12 and other B-complex vitamins, zinc, selenium and phosphorus.	(Pereira and Vicente, 2013)
Eel	The moisture, protein, carbohydrate, fat, ash, vitamin A and vitamin E	(Wijayanti and Setiyorini, 2018)
Mushroom	Vitamin B3, nicotinic acid, nicotinamide	(Çat and Yaman, 2019)

Source : Primary Data. 2022

Glutathione is a natural antioxidant consisting of three amino acids. Namely cycteine, glutamine, and glycine (Adeoye et al., 2018). Glutathione prevented the formation of free oxygen due to the reconstruction of the thiol group (-SH)(Palani, 2018). Glutamine is an amino acid that forms glutathione, prevent a decrease in sperm quality, and reduce oxidative stress, inflammation, and apoptosis (Afolabi et al., 2022). Glutamine prevents NF-kB activation, thereby decreasing transcription of downstream pro-inflammatory genes, preventing cytokine storms, and DNA damage (Hamed et al., 2022). Glutathione plays a role in the maintenance of the thiol redox status of a cell, protection against oxidative damage, endogenous and exogenous detoxification of reactive metals and electrophiles, storage and transport of cysteine, as well as for protein and DNA synthesis, cell cycle regulation, and cell differentiation. A reduced glutathione system causes cytotoxic and destructive lesions (Fafula et al., 2017). Consumption of glutathione food sources is considered capable of maintaining sperm quality. Mango fruit contains glutathione, phenolic, TBARS, and 8-hydroxydeoxyguanosine. Daily consumption of mango juice (cv. Azúcar) increases the antioxidant capacity of plasma (Zapata-Londoño et al., 2020).

Selenium is vital in growth, immunity, reproductive system, and endogenous antioxidant system support (McLaughlin and Gunderson, 2022). Selenium can increase semen volume and total sperm motility (Talebi et al., 2021). Selenium modulates DNA repair and suppresses testicular toxicity through free radical targeting. Selenium supplementation has been shown to reduce the toxicity of non-steroidal anti-inflammatory drugs in rat testes (Sharma et al., 2020). A higher level of seminal selenium is associated with live births and a higher chance of pregnancy (Wu et al., 2020). Consumption of selenium food sources, such as meat and bay shellfish, is recommended to improve the quality of spermatozoa, especially for infertile couples. Meat and shellfish are proven to contain selenium (Pereira and Vicente, 2013; Zhang and Yang, 2014).

Carotenoids are bioactive compounds found in many fruits and vegetables. Carotenoids had many types of pigments. Beta-cryptoxanthin is a yellow pigment in the carotenoid pro-vitamin A. Beta-cryptoxanthin has antioxidant properties proven to fight free radicals (Brahma and Dutta, 2022). The ability to fight free radicals can reduce ROS, so it positively affects the percentage of sperm motility (Haeri et al., 2022). Lycopene is a red pigment in carotenoids. Lycopene intake is associated with normal spermatozoa morphology. The percentage of morphologically normal sperm among men in the highest quartile of lycopene intake was 1.7 percent higher than among men in the lowest quartile (Zareba et al., 2013). Lycopene can protect sperm from oxidative stress and damage to sperm DNA (Babaei et al., 2021). Beta-Carotene is a red-orange pigment in carotenoids. Beta-carotene acts as a potent oxidative stress mitigation agent and can modulate oxidative stress through the regulation of ROS turnover (Nishino et al., 2017). Beta-carotene intake is positively related to sperm motility (Zareba et al., 2013). Lutein is a natural carotenoid containing many unsaturated double bonds, which can prevent free radicals and can produce an antioxidant effect (Zhao et al., 2022). Lutein intake is related to sperm motility. Men with high lutein intake had a 4.4 higher percentage of progressive motility than men with low lutein intake (Zareba et al., 2013). Lutein reversed vascular endothelial dysfunction, significantly upregulated the mRNA and protein expression of SOD2 and GPx1, and down regulated the expression of NF-κB p65 and ICAM-1 (Wang et al., 2014).

Consumed carotenoid sources are recommended to increase the antioxidant capacity in the body, so that it can increase the percentage of sperm motility and normal sperm morphology. Tomato is a fruit rich in antioxidants. Tomatoes contain carotenoids, lycopene, β-carotene, flavonoids, and anthocyanins (de Souza et al., 2021). Parsley also contains carotenoids (Ferreira et al., 2022). Lycopene can be found in watermelon, which is 10.46 to 42.83 mg.kg-1 watermelon extract (Mahamat et al., 2021). Kiwi fruit contains Lutein (Leontowicz et al., 2016).

Zinc is a mineral needed by every cell in the body, including the reproductive organs. Zinc deficiency causes spermatozoa abnormalities, such as fibrous sheath hypertrophy and hyperplasia, axonema disorders, and an abnormal midpiece(Majzoub and Agarwal, 2017). Zinc increases total antioxidant activity (serum SOD/Superoxide Dismutase and -tocopherol)(Omu et al., 2015). The results of another study, zinc supplementation for 12 weeks showed an increase in the average number of spermatozoa: 14.83 million/mL (p-value < 0.01), spermatozoa motility 16.30% (p-value < 0.01), motility fast spermatozoa 11.96% (p-value < 0.01), and spermatozoa morphology: 4.26% (p-value < 0.001) (Fatima et al., 2015). In the pretesticular pathway, zinc can increase serum FSH, LH, and testosterone (Shahraki et al., 2015). Zinc played a role in the amelioration of gonadal dysfunction and decreased oxidative stress in the testes (Mohamad and Hassan, 2014). Zinc modulates the activity of Ca2+, ATPase enzymes and reduces anti-sperm antibodies, specifically Immunoglobulin G (IgG) (Zhao et al., 2016). In the testicular pathway, zinc maintains chromatin stabilization, repairs DNA damage, and plays a role in DNA transcription and translation (Zhao et al., 2016). In the post-testicular pathway, zinc regulate the growth and apoptosis of prostate epithelial cells so that the prostate can function optimally in

increasing semen volume (Zhao et al., 2016). The consumption of foods containing zinc can be an alternative to taking zinc supplements to improve sperm quality. Meat is one of the zinc sources (Pereira and Vicente, 2013). Besides that, meat is also rich in protein, iron, vitamin B12, other B-complex vitamins, selenium, and phosphor (Pereira and Vicente, 2013).

Vitamin C, or ascorbic acid, is an antioxidant with the fewest side effects (da Cruz et al., 2018). Vitamin C can improve the motility and morphology of spermatozoa (Cyrus et al., 2015). Vitamin C neutralizes free radicals, so it can prevent and/or reduce the presence of ROS (Agarwal et al., 2014). Vitamin C is able to captured hydroxyl free radicals by donating a single electron (Zhao et al., 2013). Vegetables and fruits serve as natural sources of vitamin C intake. Vitamin C is found in kiwi fruit (Leontowicz et al., 2016), bamboo shoots (Singhal et al., 2021), and green algae (S et al., 2022).

Vitamin E is a fat-soluble antioxidant. Vitamin E can repair oxidizing radicals directly and prevent the process of lipid peroxidation (Yan et al., 2014). Spermatozoa DNA fragmentation can be reduced by taking vitamin E, thus increases the morphology of normal spermatozoa(Egwurugwu et al., 2013). Vitamin E can increase semen volume and sperm motility (Muhammad, 2017). Malondialdehyde (MDA) levels decreased significantly in the vitamin C and E. supplementation groups. MDA levels are markers of oxidative stress. Decreased MDA levels is along with decreased oxidative stress (Rusiani et al., 2019). Consumption of sources of vitamin E is recommended, especially for individuals who had oxidative stress. One source of vitamin E is eel. Vitamin E content of the wild eel was 0.21%, and 0.224% of cultural eel (Wijayanti and Setiyorini, 2018).

Flavonoids are one of a compounds group. It can be used as anticancer, antidepressant, and antioxidant. Flavonoids can be found in plant extracts (Mouradov and Spangenberg, 2014). Flavonoids can neutralize the toxic effects of free radicals because they can encourage hydrogen ions to increase the motility and morphology of normal spermatozoa (Jamalan et al., 2016). Flavonoids have a strong relationship with the antioxidant test results and have a negative relationship with the concentration of ROS (Šola et al., 2018). Flavonoids-contain food is considered positive on human health (Asati et al., 2022). Parsley consumption can reduce oxidized compounds that come from oxidative processes (Ferreira et al., 2022). Beside parsley, other food that contain flavonoid compounds, such as bamboo shoots (Singhal et al., 2021), pods (Asati et al., 2022), purple carrots (Perez et al., 2022), mulberry leaves (Polumackanycz et al., 2021), tomatoes (de Souza et al., 2021), and kiwi (Leontowicz et al., 2016).

NAM or niacin or vitamin B3 is a type of B vitamin that plays a role in enzymatic reactions in carbohydrate, fat, and protein metabolism formed from nicotinic acid and nicotinamide (Çat and Yaman, 2019). Niacin can capture free radicals and reduce ROS (El Sheikh et al., 2020). The level of NAM in follicular fluid is associated with the development of larger follicles, and the level of niacin is also associated with the oocyte maturation and fertilization rate (Guo et al., 2022). Consumption of mushrooms can contribute to the need for vitamin B3 as much as 5.384 mg/100g, consisting of 66% nicotinic acid and 34% nicotinamide (Çat and Yaman, 2019).

Phenol is one type of phenolic compound with a simple group, which is beneficial for the body because of its antioxidant properties that can protect tissues from oxidative damage. Carvacrol or also known as monoterpenoid phenol, is a part of phenol that has high activity as an antioxidant, increased antioxidant defenses lead to increased immune system response (Hashemipour et al., 2014). Carvacrol has a positive impact on infertility treatment because carvacrol plays a role in the treatment of ischemia-reperfusion ovarian injury and infertility (Sahin et al., 2022). Some plants that contain carvacrol include banana blossom (Panyayong and Srikaeo, 2022), bamboo shoots (Singhal et al., 2021), pod(Asati et al., 2022), male date flower(Karra et al., 2020), parsley (Ferreira et al., 2022), sorghum seeds(Miafo et al., 2022), mulberry leaf(Polumackanycz et al., 2021), green algae(S et al., 2022), mango(Zapata-Londoño et al., 2020) and kiwi (Leontowicz et al., 2016).

Conclusion

Antioxidants can increase fertility in both men and women. Most antioxidants play a role in improving sperm quality through the ROS suppression. Antioxidants for increasing male fertility include glutathione, selenium, carotenoids (beta-cryptoxanthin, lycopene, beta-carotene, and lutein), zinc, vitamin C, vitamin E, and flavonoids. Only 2 antioxidants play a role in determining female fertility in this review, namely NAM and carvacrol. These antioxidants can be found in several sources antioxidants. Sources of antioxidants in the form of fruit, namely watermelon, tomatoes, mango, and kiwi. Sources of antioxidants in vegetables, namely banana heart, bamboo shoots, purple carrots, and parsley. Antioxidants are also found in protein sources, including legumes, bay scallops, meat, and eel. In addition to fruit, vegetables, and protein sources, antioxidants that play a role in determining a person's fertility are also found in male date flowers, mulberry leaves, soursop leaves, and green algae. Consumption of antioxidant sources is recommended to increase fertility levels, especially for infertile couples.

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Tuberculosis Research Trends in Indonesian Health Scientific Journals: From Research Design to Data Analysis

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Abstract

This study aims to analyze various tuberculosis articles published in health science journals in Indonesia. These involve the frequency of the number of publications per year, type of research, research subjects, and topics often raised by the researchers in their research. This research method used the principle of content analysis, which focused on findings from various studies on tuberculosis published in scientific journals in Indonesia. Data were from content analysis in journals related to tuberculosis. The results of the journal's content analysis published in SINTA-1 with the tuberculosis subject area in the last ten years as a whole show the progress from year to year. Four things become the subjects of study analysis, namely the number of publications per year (the publication of tuberculosis articles in the SINTA 1 journal decreased in 2019 because of the emergence of the Coronavirus in that year and began to plague in the following years); research type (in this study the results obtained that of the 27 articles analyzed, 23 of them were quantitative types). Subject (tuberculosis patients sampled in this study included the intensive phase and the advanced phase patients) and research topic (topics around knowledge are still the variables that researchers are most interested in).

Introduction

According to The World Health Organization (WHO), Indonesia ranked second highest in tuberculosis cases worldwide (Papeo et al., 2021). The government has been trying to develop a policy program related to this disease. Without the support and participation of various parties, these efforts will not get maximum results. Until 2018, the tuberculosis case did not significantly decrease due to many undetected cases. Tuberculosis infection remains one of the biggest health problems in Indonesia, which ranked second in the world on the list of countries with a high burden of TB. In numerous low and middle-income countries with high TB burdens, the government takes necessary action to stop TB spreading. Case-finding rates in the Indonesian National Tuberculosis Program have remained steady or slightly declined lately under announcement and access walls to individual installations. Tuberculosis control problems are associated with a low position of mindfulness and knowledge of TB, substantially because of a low position the community's high position of TB smirch.

All elements of society are responsible for tuberculosis management, including researchers in higher education. The researchers' contribution in handling this disease is through conducting tuberculosis research by taking various variables to produce more health articles related to tuberculosis. These results can become an interest in eradicating this disease. On the other hand, tuberculosis articles published in various

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health journals in Indonesia are still limited. The filter results conducted on the database of accredited journals according to the criteria obtained 27 articles with 9 sub-topics discussed. These results are variables of knowledge, self-efficacy, tuberculosis transmission, social support, health cadres, MDR-TB, nutrition, child TB, and stress coping. Concerning the high number of cases and mortality from this disease, reaching 98 thousand or equivalent to 11 mortality per hour (Lisum et al., 2022). More studies about tuberculosis are required by enriching the variables used.

In this study, the researcher analyzed various tuberculosis articles published in health science journals in Indonesia, including the frequency of the number of publications per year, type of research, research subjects, and topics often raised by researchers. It is expected that there will be tuberculosis research articles with more diverse variables in the coming years. In the end, the results are expected to contribute to the management of tuberculosis in Indonesia.

Method

This research method used the principle of content analysis, which focused on findings from various studies on tuberculosis published in scientific journals in Indonesia. Data were from content analysis in journals related to tuberculosis. All articles were from indexed scientific journals of Science and Technology Index (SINTA) as of September 2022. SINTA (https://sinta.kemdikbud.go.id/journals?page=2) is a platform for measuring science and technology designed and developed by the Ministry of Education and Culture of the Republic of Indonesia.

SINTA Journal Filter is based on 2 categories, namely ranking and subject area. In the ranking selected SINTA - 1 category, the subject area is health. The inclusion criteria were: 1) topics around tuberculosis; 2) an original article; 3) published in the last 10 years (2012 - 2022). While the exclusion criteria were: 1) outside the topic of tuberculosis; 2) research of case reports and review articles; 3) publication before 2012. From hundreds of articles collected, there were 31 with the theme of tuberculosis. According to inclusion criteria, 27 articles were obtained. Here's the explanation: Bali Medical Journal has 4 articles, The Sudirman Journal of Nursing has 3 articles, Nurse Media Journal of Nursing has 1 article, Belitung Nursing Journal has 5 articles, Makara Journal of Health Research has 1 article, International Journal of Public Health Science has 5 articles, Universa Medicina has 1 article, Indonesian Nursing Journal has 2 articles, Medical Journal of Indonesia has 2 articles and KESMAS: National Public Health Journal has 3 articles.

The instrument used in this study is a modified content analysis guidelines of (Susetyarini & Fauzi, 2020). There are four main aspects to review and analyze, namely: (1) the number of publications per year; (2) the research type; (3) the subject of research, and (4) the topic of research. As presented in table 1 below. Each article was classified based on pre-defined aspects. Then the data obtained are presented in bar charts

Result and Discussion

The number of published articles indicates how often a study is conducted in a period. In Figure 1, it appears that articles related to tuberculosis published in the SINTA-1 journal can be found since 2015. There is no particular shift pattern that occurs in the number of publications each year. However, referring to Figure 1, it appears that the publication of tuberculosis articles in the SINTA 1 journal decreased in 2019.

Table 1. Aspects and Categories used for Content Analysis in this study

Aspects	Categories	
Number of publications per year	2015 : 1	2019 : 3
	2016: 2	2020: 5
	2017: 4	2021: 4
	2018: 4	2022: 4
Types of research	A1. Qualitative	A2. Quantitative
Research subjects	B1. Medical record	B5. Health cadres
	B2. TB patients in health centers / hospitals	B6. Nurse
	B3. Child / Adolescent TB	B7. Hajj pilgrims
	B4. TB community	
Topics	C1. MDR TB	C6. Health cadres
	C2. Stress and coping	C7. Nutrition
	C3. Social support	C8. Variable of self-efficacy
	C4. TB transmission	C9. Knowledge variables
	C5. Child TB	

Source: Primary Data. 2022

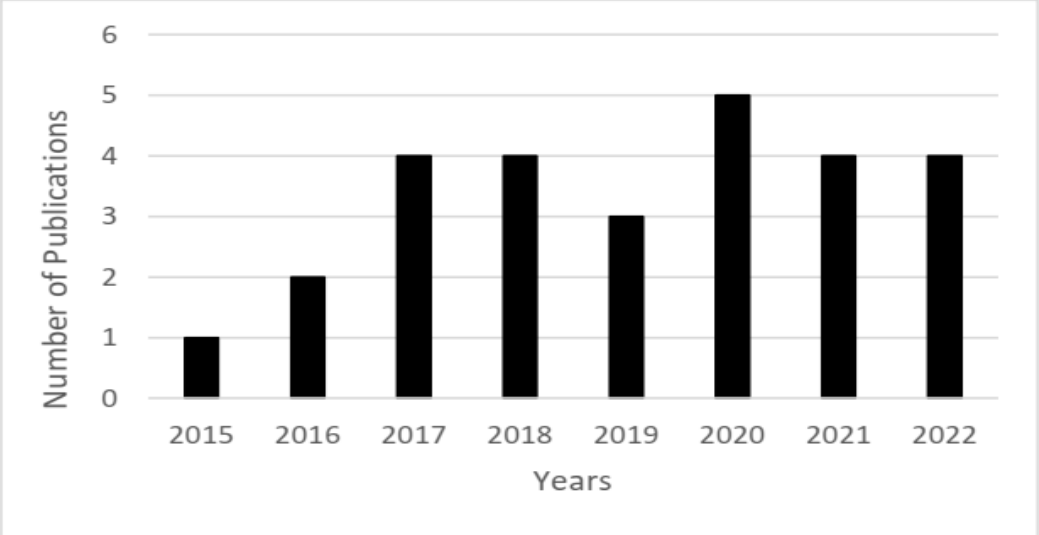

Figure 1. Number of Publications per Year

This condition is related to the emergence of the Coronavirus in that year and began to plague in the following years. However, in 2020, the number of publications showed the highest increase of 5 articles. It shows the amount of researcher enthusiasm who continues to work during the pandemic. Covid-19 indirectly affects the world of research with the emergence of research trends with the Covid-19 topics. So, other themes decreased. During the pandemic, all existing resources were diverted to handling Covid-19. It makes other programs neglected. The challenges of tuberculosis treatment in 2020 were exacerbated by the Covid pandemic case (Rita et al., 2020).

The type and design of the study determine the focus. In this study, the results obtained that of the 27 articles analyzed, 23 were quantitative types, as shown in Figure 2.

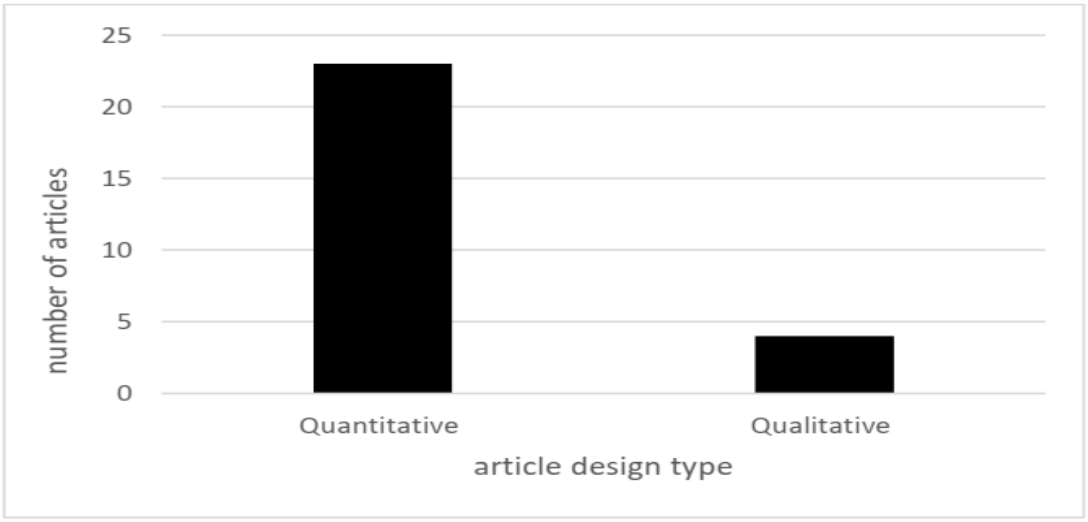

Figure 2. Types of Research

In large populations, the research used quantitative studies. Quantitative is considered a more practical method of analyzing a study with a large number of subjects. It is related to the TB and HIV/AIDS increase in developing countries in the same period (Muliawan & Sawitri, 2016). This study analyzed data from 27 articles, 23 of which were quantitative research. Here are some explanations of the article in question: research (Da Silva et al., 2016) with descriptive correlation method the number of samples of 100 people; (Sukartini et al., 2019) with cross-sectional design of the population of 77 people; (Dwidiyanti et al., 2019) with cross-sectional approach the number of samples of 45 people; (Noorratri et al., 2017) with quasi-experimental method the sample of 38 people (19 people intervention group, 19 people control group); (Yani et al., 2020) with cross-sectional approach a total sample of 52 people; (Sadipun et al., 2018) by the method of pre-experimental number of samples as many as 45 people; (Malini et al., 2021) with quasy experimental method the number of samples 29 people; (Sofiana et al., 2022) with a sample of 52 respondents; (Sari & Sari, 2020) by cross-sectional method the number of samples 45 respondents; (Rohman, 2018) by the method of cross-sectional study of a sample of 162 respondents; (Irawan et al., 2017) with observational study method the number of samples of 19 tuberculosis patients and 38 controls; and research (Nursasi et al., 2021) with cross-sectional design method involved 83 respondents.

This study found 4 articles using qualitative design as the research method. Generally, qualitative methods are used in studies that require detailed analysis, in-depth, and detailed explanation of the subjects. So not all tuberculosis studies can be explained from quantitative aspects, for example, related to the role of the family, where each family has its uniqueness in disease prevention programs (Gunawan, 2019). Another reason why researchers choose qualitative methods is that they want to know in detail about what experiences patients obtained during the treatment period, following the obstacles encountered in following the tuberculosis control program (Machmud et al., 2020). A qualitative design was also used to explore the role of health cadres in motivating patients to seek treatment, explore what factors affect the performance of cadres (Febriani et al., 2021), and used to describe the perspective of adolescents related to parents with pulmonary tuberculosis (Lisum et al., 2022). The subject of research is a factor that affects the quality of research results. Selection of the right subject can improve the quality of articles produced. In this study, several things can be learned about the type of research subjects used by the researcher, as shown in the following figure:

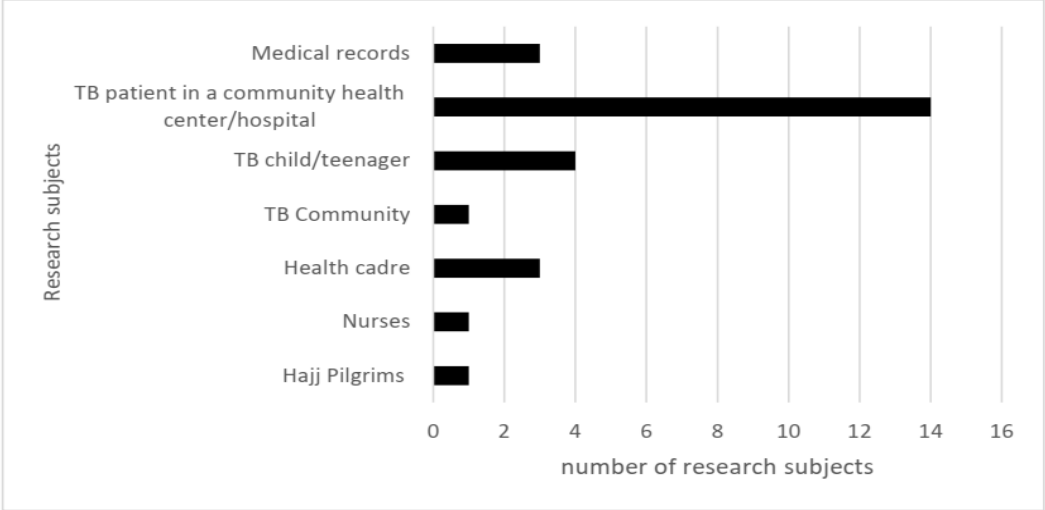

Figure 3: Research Subjects

Based on the SINTA database, 14 articles used tuberculosis patients as their research subjects, both undergoing treatment programs at health centers and hospitals. Tuberculosis patients must have a treatment course for 6 to 8 months Wulandari (2015), through the Directly Observed Treatment Shotcourse (DOTS) program, namely the tuberculosis control strategy through direct supervision of taking medication by people who have received the instruction of the Public Health Center/ hospital Papeo et al. (2021), they will often visit health care centers during this period to control and take TB medicine. Tuberculosis patients sampled in this study included the intensive and the advanced phase patients. These conditions make it easier for researchers to retrieve data related to on-going research by providing interventions according to the researcher's needs. Various interventions conducted by researchers include interviews both with patients directly and the family, observation, questionnaires and checklists, physical observation, and data retrieval from the patient's medical record and laboratory results Kusumawati et al. (2018), where the medical record data was taken from the tuberculosis registration system (Moosazadeh et al., 2021).

Tuberculosis of children and adolescents became the subject of the next most research, 4 journals used children and adolescents as subjects. Cases of childhood tuberculosis are still relatively high in the world. One million children are infected with tuberculosis annually, and there are 210.000 mortality due to this disease. The incidence of childhood tuberculosis reaches 10% of all tuberculosis cases (San-juan & Misael, 2022). As reported, children living in tuberculosis-endemic areas will experience various health problems, such as malnutrition, diarrhea, pneumonia, malaria, and HIV infection (Detjen et al., 2019). When compared with adult cases, childhood tuberculosis is more difficult to detect because there are no signs in specific symptoms (Saputra et al., 2020), and often, overlooked its occurrence (Asyary et al., 2017). This condition makes nurses, health care providers, and pediatric medicine have a vital role in improving the health and quality of children's life with tuberculosis (Lusmilasari et al., 2017).

One of the success keys against tuberculosis is community empowerment programs, an intervention involving many parties in the community (Ro'isah et al., 2022), for example, health cadres. The role of health cadres is mainly related to early detection of tuberculosis cases (Ratnasari et al., 2019). In addition, cadres are also the instructors or extension workers, referral systems, and supervisors of taking medication directly (Ratnasari & Marni, 2020). Although not fully implemented, the involvement of cadres in case discovery efforts and related sensitive to drugs has long been conducted in Indonesia (Febriani et al., 2021). In this study, out of a total of 27 articles analyzed, 3 of them used cadres as research subjects. Cadres are part of the community as

volunteers equipped with various sciences and work to inform some health-related matters to the community (Lepuen et al., 2020). Related to the existence of cadres in the community, it is expected that they can be an extension of health service providers in Public Health Center and hospitals. So that various cases of health problems in the community can be found early while avoiding the severity of the condition. In this article review, the researcher also discussed the topics often used by researchers who then published their articles, especially in the indexed journal SINTA 1 for the last ten years. The description of the topics that are trending in tuberculosis research, as shown in the following figure:

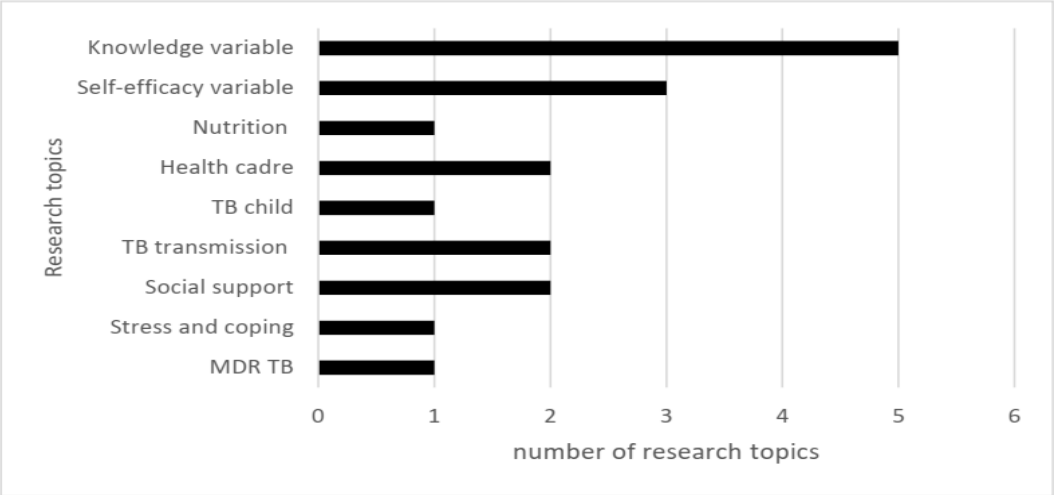

Figure 4: Research Topics

Topics around knowledge are still the variables that researchers are most interested in. In this study, there are five articles used for these variables, namely knowledge, attitudes, and ethics of cough (Yani et al., 2020); knowledge, attitudes, and behaviors of seeking health care from (Saputra et al., 2020) knowledge, employment, and family income relation to drop out of treatment (Da Silva et al., 2016); knowledge, family support/social support and self-efficacy of (Sukartini et al., 2019) and health education prevention of tuberculosis by MDR (Malini et al., 2021). Important knowledge about tuberculosis in vulnerable groups must be more intensive so that patients get the proper treatment and avoid getting late for treatment (Harstad et al., 2022). Adequate knowledge is required related to the course of tuberculosis in preventing transmission and as a determinant of the success of the prevention program (Amare et al., 2022). There are many things to know and learn about tuberculosis. Knowledge about tuberculosis must be socialized early in the community, so with adequate knowledge, a prosperous society will be developed, and later it will lead to an improvement in public health status.

The self-efficacy variable is the second largest variable of interest to researchers. Three articles used self-efficacy in their research, namely (Sukartini et al., 2019) self-efficacy and independence of tuberculosis patients (Noorratri et al., 2017), and self-efficacy and adherence to treatment (Sofiana et al., 2022). Self-efficacy can increase engagement and future success (Sánchez et al., 2012) and improve health control behavior (Sofiana et al., 2022). Someone with high self-efficacy will be more confident in learning, solving problems that arise during the educational process, and undergoing even the most difficult types of training (Ahmad & Safaria, 2013). Otherwise, a person with a negative self-concept is likely to experience failure in achieving the expected performance (Basith et al., 2020). Thus, it can be concluded that self-efficacy has a positive correlation and is also as a determining predictor of academic achievement (Basith et al., 2020)

Tuberculosis is a disease transmitted

through the air through infectious aerosols. Cough is a factor in infectious aerosols causing tuberculosis (Patterson & Wood, 2019). Smear-positive tuberculosis patients (acid-resistant bacteria) are a source of transmission of this disease, which occurs when the patient coughs or sneezes, germs will fly into the air (Gunawan, 2019). Contact with family members who live in the same house as tuberculosis patients is a source of infection that has implications for public policy (Mcintosh et al., 2019). Accurately identifying separate transmission events is more complicated in the management of tuberculosis, since its prevalence in a sufficiently large population and individual-level transmission is almost always not observed (Smith et al., 2022).

In the case of parents infected with pulmonary tuberculosis, it will affect the physical and psychosocial health of family members living together, including adolescents (Lisum et al., 2022). In addition, it also affects a person's quality of life, including physical, social psychological, and environmental health issues (Sofiana et al., 2022). Psychological problems often encountered in tuberculosis cases is the inability to control negative emotions (Sadipun et al., 2018), so that an effective coping strategy is required to overcome this problem (Sari & Sari, 2020).

There is an increase in Multidrug-Resistant (MDR) Tuberculosis every year. The rise of MDR is a new challenge related to the treatment of tuberculosis. It occurs due to several conditions, including the difficulty of establishing a diagnosis, a large therapeutic failure rate, mortality (Ratnasari, 2020), high cases of drug addicts (Salam et al., 2021), and inadequate capacity for the implementation of routine checks against drug resistance (Zignol et al., 2018). In this study, an article was found where patients with MDR tuberculosis as the subject, a retrospective study, and data taken from the medical records of previous patients (Kusumawati et al., 2018). Support provided to patients during the therapy program can improve adherence to treatment of MDR patients (Ratnasari et al., 2020).

Conclusion

The journal content analysis published in SINTA-1 with the tuberculosis subject area in the last ten years as a whole show the progress from year to year. Four things become the subjects of study analysis. They are number of publications per year, research type, subject, and research topic. The findings have several recommendations for future researchers. First, it is necessary to add tuberculosis research with qualitative methods, considering that from 27 articles, only 4 are qualitative research. So, the researcher's ability in terms of qualitative studies needs improvement. Secondly, it is necessary to conduct research with community subjects of tuberculosis, considering that out of 27 articles, only one used subjects of patients in community groups. Third, related to research topics, these need to be more developed for the selection of topics on aspects of stress and coping, nutrition, childhood tuberculosis, and MDR-TB.

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Sleep Quality Affects Humoral Response in Recipients of Two-Dose Sinovac Vaccines

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Abstract

To curb the COVID-19 pandemic, the government distributed Sinovac vaccines. Sleep mediates immune function, including post-vaccination antibody response. This study aimed to analyze whether there was a difference in post-vaccination antibody levels in Sinovac vaccine recipients with poor and good sleep quality. This study used analytical observations of recipients of the two-dose Sinovac vaccine in 2021. Primary data included age, sex, the Pittsburgh Sleep Quality Index (PSQI) questionnaire, and post-vaccination IgG-SARS-CoV-2 antibody levels. The PSQI and IgG SARS-CoV-2 antibody levels were measured a month after the second vaccination. Participants with non-reactive antibody levels before the first vaccination were included, and participants with incomplete data were excluded. The Mann-Whitney test was used to find associations between sleep quality and post-vaccination IgG SARS-CoV-2 levels. The univariate analysis showed that of 54 participants, 37 (68.5%) were male, and 28 (51.9%) had poor sleep quality. 15 participants (27.78%) were in the 36-45 age group, and median antibody levels in participants who received the second Sinovac Vaccine was 223.5 (199.01) units/mL. Post-vaccination IgG SARS-CoV-2 antibody levels were significantly associated with sleep quality (p=0.036).

Introduction

The effect of sleep on the immune system is essential to characterize in light of the COVID-19 (coronavirus disease 2019) pandemic (Cucinotta and Vanelli, 2020), which has caused changes in daily activities and sleep dysregulation. The effect of sleep on the immune system is significant to characterize in light of the COVID-19 pandemic (Cucinotta and Vanelli, 2020). It can cause changes in daily activities and sleep dysregulation. A meta-analysis found that the global prevalence of sleep disturbances during the COVID-19 pandemic was 40.49% and increased during the lockdown (Jahrami et al., 2022). Several studies show that sleep mediates immune function, including post-vaccination antibody levels. At night, during sleep, circulating B cells and T cells move into the lymph nodes, where the immune system recognizes antigens such as viruses, and an immune response is then formulated (Comas et al., 2017; Schmitz, van der Werf and Lammers-van der Holst, 2022). Short sleep duration has been found to affect the human body's immune system (Schmitz, van der Werf, and Lammers-van der Holst, 2022). Individuals with poor sleep quality are also more susceptible to infectious diseases (Kow and Hasan, 2021). To elucidate, a study found that individuals who slept ≤ 5 hours a night were more susceptible to pneumonia (Patel et al., 2012). Another study found that individuals who slept < 7 hours a night were more susceptible to colds (Cohen et al., 2009). Other researchers have also found an association between short sleep duration and lower antibody levels post-hepatitis B vaccination (Prather et al., 2012).

Sleep affects the immune system through the hypothalamic-pituitary-adrenal axis (HPA axis). The paraventricular nucleus (PVN) in the

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hypothalamus releases corticotropin-releasing Hormone (CRH), which induces the release of adrenocorticotropic hormone (ACTH), thus stimulating the adrenal glands to release cortisol, a stress hormone. Physiologically, sleep suppresses the HPA axis, which subdues cortisol release. Therefore, sleep disturbances increase cortisol levels (Balbo, Leproult, and Van Cauter, 2010), reduce CD4+ and Natural Killer cells (Asif, Iqbal, and Nazir, 2017).

COVID-19 caused by acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (Cucinotta and Vanelli, 2020) is highly infectious and has several risk factors, including advanced age and co-morbidities such as type I and II diabetes and hypertension (Wolff et al., 2021). Globally, as of August 2021, at least 208.470.375 individuals were infected, and COVID-19 is associated with 4.377.979 deaths. In Indonesia, at least 3.892.479 individuals were infected, and symptomatic patients present most often with cough and fever (Setiadi et al., 2022). To curb the COVID-19 pandemic, the Indonesian government provided Sinovac vaccines in December 2020, a whole inactivated virus that reduces transmission rates and protects against disease severity. A study in Brazil found that the Sinovac Vaccine at 14 to 30 days after administration of the second dose had an efficacy of 55% against symptomatic COVID-19 disease and 82.1% against severe infection (Cerqueira-Silva et al., 2022). So far, the effect of gender on post-vaccination antibody levels in recipients of the Sinovac Vaccine is conflicting, but age seems to mediate humoral response (Heriyanto et al., 2021; Farid, Herrera-Uribe and Stevenson, 2022). The main aim of this study is to determine whether sleep quality affects post-vaccination IgG SARS-CoV-2 antibody levels in recipients of the Sinovac vaccine. To our knowledge, this study is the first to investigate differences between sleep quality and post-vaccination SARS-CoV-2 IgG antibody levels in Indonesia.

Method

This study uses an analytical observational approach towards data (age, gender, sleep quality, and post-vaccination IgG SARS-CoV-2 levels) from a cross-sectional conducted in 2021 at a vaccine center in Jakarta. Participants came from the general population and received two doses of the Sinovac vaccine. Antibody levels were measured before the first vaccination and a month after the second vaccination. Participants with non-reactive antibody levels before the first vaccination were included, and participants with incomplete data were excluded. IgG (Immunoglobulin G) antibodies against the receptor binding protein on the Spike (S) protein of SARS-CoV-2 determination is by the electro-chemiluminescence immunoassay (ECLIA) method through the Elecys® Anti-SARS-CoV-2 S assay. It has a sensitivity of 98.8% and a specificity of 99.98%. Results were expressed in units/mL, with a range of 0.4-250 units/mL, and were considered reactive if ≥ 0.8 units/mL (Taffertshofer et al., 2022).

We gave a general questionnaire asking participants' characteristics, such as age, gender, and the Pittsburgh Sleep Quality Index. The PSQI is widely used to evaluate sleep quality over the past month and comprises seven components (subjective sleep quality, sleep latency, duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction). The scores from each component are added and given a global score with a range of 0-21, with a cut-off score of 5. Good sleep quality is defined by a global PSQI score of ≤ 5, while poor sleep quality by a global PSQI score of > 5. The PSQI has a Cronbach alpha score of 0.79, a validity of 0.89, a sensitivity of one, and a specificity of 0.81 (Ikbal Zendi Alim, 2015).

Data analysis is by the Statistical Package for the Social Sciences (SPSS), version 25 (SPSS Inc., Chicago, IL, USA). Data were considered normal if the Kolmogorov-Smirnov criteria were fulfilled. Continuous variables were expressed as mean (± SD) and also as median (interquartile [IQR]) range if skewed. Sleep quality was dichotomized as good (PSQI ≤ 5) and poor (PSQI > 5). Data analysis is by the Mann-Whitney and Kruskal-Wallis tests. Values of $p < 0.05$ were considered statistically significant.

Result and Discussion

Initial data from 85 participants were available. However, only 64 participants fulfilled the inclusion criteria, serologically

non-reactive antibody titers before the first vaccination, and a further 10 participants were excluded due to incomplete data. Hence, data from 54 participants were available to analyze.

TABLE 1. Characteristics of Study Participants According to Gender, Age, Sleep Quality, and Post-Vaccination IgG SARS-CoV-2 levels in Recipients of the Second Dose of the Sinovac Vaccine

	Total (n)	Percentage (%)
Gender		
Male	37	68.5*
Female	17	31.5
Age (Mean ± SD)		39.74 ± 11.98 years
17-25	10	18.52
26-35	10	18.52
36-45	15	27.78*
46-55	14	25.93
56-65	5	9.23
Sleep quality		
Good	26	48.1
Poor	28	51.9*
Post vaccination IgG SARS-CoV-2 levels (Mean ± SD) [Median (Interquartile range)]; Min-Max units/mL		163.72 ± 97.53 [223.5 (199.01)]; 7.2-250

*Highest percentage
Source: Primary Data, 2021

Among 54 study participants, 68.5% were male, 27.78% belonged to the age group 36-45 years with mean age of 39.74 (± 11.98) years, 51.9% had poor sleep quality, and mean post-vaccination IgG SARS-CoV-2 levels were 163.72 ± 97.53 units/mL [Median (Interquartile range) = 223.5 (199.01)] (Table 1). Most participants included in this study were male, and all were of productive age. The percentage of participants with poor sleep quality (PSQI > 5) as per a study which found that 59.5% of Indonesians had poor sleep quality during the COVID-19 pandemic (Argo et al., 2021). A meta-analysis concluded that the prevalence of sleep disturbances during the pandemic was influenced by the rate of disease transmission and government policies such as enforcing lockdowns, which caused changes in bedtime and wake time. Restriction of outdoor activities and social isolation also increased social media and technology use, and the blue light emitted from gadgets has been found to disturb the circadian rhythm (Jahrami et al., 2022).

The Sinovac vaccine was successful in producing reactive antibody levels (≥ 0.8 units/mL). A month after the second vaccination, IgG SARS-CoV-2 levels increased to 223.5 (199.01) units/mL. The lowest measured post-vaccination IgG SARS-CoV-2 level was 7.2 units/mL, and the highest was 250 units/mL (Table 1). The results of this study are similar to one whose participants received the BNT162b2 (Pfizer/BioNTech) vaccine, and as much as 90% of participants had reactive antibody levels after 21 days after vaccination (Ward et al., 2022). The Sinovac vaccine applies the traditional whole inactivated virus method, whereas the BNT162b2 (Pfizer/BioNTech) vaccine uses a novel mRNA method capable of producing higher levels of antibodies. However, the Sinovac Vaccine is easier to transport and store (Lim et al., 2021).

TABLE 2. Association Between Gender and Post-Vaccination IgG SARS-CoV-2 Levels

Post vaccination IgG SARS-CoV-2 levels		N	Mean	Std. Deviation	Median (IQR)	*p*
Gender	Male	37	162.131622	100.852346	224.3 (202.635)	0.661
	Female	17	167.177647	92.7747521	209.1 (171.62)	

Source: Primary Data, 2021

The Mann-Whitney test found no significant association between gender and post-vaccination IgG SARS-CoV-2 levels (p=0.661). However, female participants had a mean antibody level of 167 ± 92,77 units/mL and males 167 ± 92,77 units/mL (Table 2). The results of this study are per a study on Greek healthcare workers, which found no association between gender and antibody levels in 268 participants (79.9% female), when measured 30 days after the second dose of BNT162b2 (Pfizer/BioNTech) vaccines [(Median (Interquartile range) = 1288.00 (1376.95 units/mL)](Michos et al., 2021), and in a study investigating whether gender affects antibody levels in recipients of the Sinovac vaccine in Bahrain (Farid, Herrera-Uribe, and Stevenson, 2022). Another study found that of 439 participants (65.8% female), mean antibody levels measured 3-4 weeks after the second dose of BNT162b2 (Pfizer/BioNTech) were higher in females than males. However, this association was significant only in the 51-60 age group (Anastassopoulou et al., 2022).

A cross-sectional study also found that post-vaccination antibody levels after administration of BNT162b2 (Pfizer/BioNTech) vaccine were higher in females than males and was statistically significant (Ward et al., 2022). A prospective study by Tsverava et al. (2021) found that gender differences in antibody levels after infection with SARS-CoV-2 depended on the fragments of the Spike protein measured, such as the S1 protein, S2 protein, and the receptor binding domain (RBD). The RBD is found on the S1 fragment and is crucial in facilitating viral entry into target cells. Tsverava et al. (2021), found a statistically significant relationship between gender and antibody levels against the S1 protein. However, the relationship was only significant on a one-tailed test against the RBD, and no relationship was found when measured against the S2 protein. Therefore, differences in results regarding gender's influence on antibody levels may be due to the different antigens contained in the Sinovac and BNT162b2 (Pfizer/BioNTech) vaccines. As mentioned above, the Sinovac Vaccine uses the whole inactivated virus method. The BNT162b2 (Pfizer/BioNTech) vaccine uses the mRNA method, which causes the human body to produce only a fragment of the Spike protein. Little research has been done on how gender influences antibody response (Anastassopoulou et al., 2022). However, estrogen increases B cell production, and post-vaccination antibody levels negatively correlate with serum testosterone (Athanasiou et al., 2022). Females also have two X chromosomes associated with higher counts of lymphocytes (Tsverava et al., 2021). The Kruskall-Wallis test found no statistically significant association between age and post-vaccination IgG SARS-CoV-2 antibody levels (p=0.154). Age was categorized into five groups according to the 2009 classification provided by the Indonesian Ministry of Health.

TABLE 3. Association Between Age and Post-Vaccination IgG SARS-CoV-2 Levels

	Age		Post vaccination IgG SARS-CoV-2 levels					*p*
	Range	**N**	**Mean**	**Min**	**Max**	**Std. Deviation**	**Median (IQR)**	
Late adolescence	17-25	10	224.079000	31.69	250	68.8097891	250 (10.225)	
Early adulthood	26-35	10	121.356	18.63	250	98.2999112	99.130 (203.1175)	
Late adulthood	36-45	15	152.280	14.44	250	95.0139	136.3 (193.53)	0,154
Early elderhood	46-55	15	155.17	7.2	250	112.43	236.35 (233.03)	
Late elderhood	56-65	5	185.992	97.16	250	77.52	228.7 (147.37)	

Source: Primary Data, 2021

The lowest post-vaccination IgG SARS-CoV-2 levels [99.13 (203.1175) units/mL] were in the second age group (26-35 years). The lowest antibody response mounted (7.2 units/mL) was found in the fourth age group (46-55 years). However, the highest antibody level [Mean= 224 ± 68.8 units/mL, Median (Interquartile range)= 250 (10.225) units/mL] was found in the youngest age group (17-25 years) (Table 3). Michos et al. (2021) also found that IgG SARS-CoV-2 levels were higher in individuals < 60 years than in individuals ≥ 60. Anastassopoulou et al. (2022) had similar results. They found that after administration of

the BNT162b2 (Pfizer/BioNTech) vaccine, the highest antibody levels were in the youngest age group (21-30 years), and the lowest antibody levels were found in the 31-40 age group, which is similar to the results of this study (26-35 age group). Ward et al. (2022), found that antibody levels in the 70-79 age group were significantly lower when compared to the 18-29 age group. Although not much research has been done on how age affects humoral response, increasing age reduces CD4+ response and is associated with a shift towards the anti-inflammatory interleukin-2 and interleukin-10 (Zimmermann and Curtis, 2019).

TABLE 4. Association Between Sleep Quality and Post-Vaccination IgG SARS-CoV-2 Levels

Post vaccination IgG SARS-CoV-2 levels		N	Mean	Std. Deviation	Median (IQR)	*p*
Sleep quality	Good	26	194.924231	81.3427312	250 (118.4)	0.036
	Poor	28	134.745000	103.625820	118.65 (227.36)	

Source: Primary Data, 2021

The Mann-Whitney test results showed a statistically significant association between sleep quality and post-vaccination IgG SARS-CoV-2 levels (p= 0.036). Antibody levels were lower [Mean = 134,74 ± 103,63 unit/mL, Median (Interquartile range) = 118.65 (227.37)] in the group with poor sleep quality (PSQI > 5) than in the group with good sleep quality [Mean = 194.92 ± 81.34 unit/mL, Median (Interquartile range) = 250 (118.4)]. (Table 4). In recipients of the influenza vaccine, participants with poor sleep quality measured by the PSQI had lower antibody responses after administration of the vaccine (p<0.001) (Taylor et al., 2017). In Greece, study results found that participants with PSQI > 5 had lower IgG SARS-CoV-2 levels in recipients of the BNT162b2 (Pfizer/BioNTech) vaccine (p < 0.05) (Athanasiou et al., 2022). Several studies have found that other parameters of sleep, such as sleep duration, are associated with post-vaccination antibody levels. Sleep diaries and actigraphy are particularly useful in measuring sleep duration and individual variations in sleep duration before and after vaccination(Prather et al., 2012; Prather et al., 2010). According to the results of a study on recipients of the hepatitis B vaccine, acute sleep deprivation before administration was associated with lower antibody levels (Lange et al., 2003). Two nights before influenza vaccines were administered, electronic sleep diaries were used to measure sleep duration, and researchers found that shorter sleep duration was associated with lower antibody levels (Prather et al., 2021). In contrast, Athanasiou et al. (2022), measured sleep duration two nights before and a night after administration of the BNT162b2 (Pfizer/BioNTech) vaccine but found no relationship between sleep duration and post-vaccination antibody levels. During sleep, T cells introduce antigens to the body's immune system, and B cells produce antibodies (Schmitz, van der Werf, and Lammers-van der Holst, 2022). Sleep also reduces cortisol levels, which is anti-inflammatory and reduces the immune system's responsiveness (Lange et al., 2011). Sleep increases interleukin-12, a cytokine that supports T-cell and B-cell differentiation (Lange et al., 2003).

Conclusion

All participants were able to produce reactive IgG SARS-CoV-2 levels after receiving two doses of the Sinovac Vaccine, and the highest average levels were in the 17-25 age group. Sleep quality was associated with post-vaccination IgG SARS-CoV-2 levels in recipients of the Sinovac Vaccine (p=0,036). Educational institutes focusing on research and community outreach should screen antibody levels periodically and investigate their associations with physical and mental well-being. The general population should also be enlightened on the benefits of receiving COVID-19 vaccines.

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Group Discussion and Booklet for Tuberculosis Prevention in Manado

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Abstract

The study aims to determine the effect of using focus group discussions and booklets for the prevention of tuberculosis in Manado. Type of Research "A quasi-experimental design with Pre and Post Test Group ". The population is tuberculosis patients who seek treatment at the Public Health Center as many as 200 cases. Samples were taken using the Slovin formula and met the inclusion criteria of 113 respondents. Collecting data by providing counseling using booklets, and Group discussions. The data was processed using the "Wilcoxon Test" statistical test. The results showed that the gender of women was 69(61%), high school education 66(58,4%), housewife occupation 43(38,1%), average age 43,75+Std.15,095. Result of research: cause of pre test 96(85%), post test 105(92,92%) p0,000, pre test 63(55,8%) post test 90(79,64%), p0,000; source of pre-test transmission 75(66.4%) post-test 91(80.53%), p0.000, risk of pre-test transmission 67(53.9%), post-test 93(82.30%) p0.000, seeking treatment pre test 97(85.8%, post test 109(96.46%), p0.000, prevention pre test 75(66.4%), post test 101(89.38%), p0.000, recovery pre test 109(96.5%) post test 107(94.7%) p0.000, treatment 107(94.7%), post test 110(97.34%), p0.000, nutritious food pre test 100(88.5%) post test 105(92.92%), p0.000.- Conclusion: There is a significant effect between the use of focus group discussions and booklets in improving the knowledge, attitudes, and behavior of respondents. Suggestion: Continue to carry out health education to improve the knowledge, attitudes, and behavior of patients.

Introduction

Tuberculosis is a communicable disea-se still to community problem etiology of mycobacterium tuberculosis (M.TB) transmitted when an individual with TB expels the bacteria into the air through coughing. Approximately a quarter of the world's population is infected with M.TB, and it is one of the leading causes of death of ten causes of death worldwide and the leading cause of death (Jeremiah et al., 2022; Mohammed et al., 2020). Multisectoral involvement in risk factors such as poverty, malnutrition, HIV infection, diabetes, and smoking can increase morbidity and mortality (Chakaya et al., 2021; Cintron et al., 2021). TB cases in Indonesia have decreased by 200,000. The TB incidence rate in 2019 was 842,000 cases, making Indonesia the country be at the third largest TB burden in the world after India and China (Kemenkes RI, 2018). One of the efforts to control and prevent the spread of TB disease is through health promotion using a combination of lectures and audiovisual media to influence changes in knowledge and attitudes of TB patients in TB prevention (Malini et al., 2021).

Prevention of TB transmission through contact between family members is by providing education about TB disease through clean and healthy life behavior (PHBS) using posters and leaflets as well as providing additional food and masks to families showing an increase in knowledge about pulmonary TB (Malini et al., 2021). Traditional health promotion media, such as leaflets and posters, are still useful in the digital era. Especially for adult respondents.

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This form of media is more effective when combined with other media such as video, telephone interaction, games, and others (Lailatul et al., 2019).

In 2019, TB remained the most common cause of death from an infectious pathogen. Globally, an estimated 10.0 million people have TB disease, and there are an estimated 1.2 million TB deaths among HIV-negative people and an additional 208,000 deaths among people living with HIV. Adults accounted for 88%, while children, aged <15 years were 12% of all people with TB. Most people with TB in 2019 were in Southeast Asia (44%), Africa (25%), and the Western Pacific (18%), with smaller percentages in the Eastern Mediterranean (8.2%), America (2.9%), and Europe (2.5%). Eight countries account for two-thirds of the global total: India (26%), Indonesia (8.5%), China (8.4%), Philippines (6.0%), Pakistan (5.7%), Nigeria (4 .4%), Bangladesh (3.6%), and South Africa (3.6%) (Chakaya et al., 2021).

The prevalence rate of TB cases in the city of Manado is still high, namely 990 cases. The highest case notification rate is the Tuminting Health Center with 153, Ranotana Weru with 120, Paniki Bawah with 115, Tikala with only 107, and Sario 110 cases. Overall, cases of TB-positive were treated as many as 1,044, with a cure rate of 912 (87.36%). The problems identified in this study are: "Does the use of health promotion methods and media affect efforts to prevent pulmonary tuberculosis in five Public Health Centers in Manado City? The purpose of this study is to first prepare health promotion methods and media, and use health promotion methods and media to increase knowledge and change patients' attitudes and behavior about TB. In addition, the importance of this study is to disseminate information about TB, its causes, symptoms, sources of transmission, risk of transmission, treatment-seeking behavior, prevention behavior, perceptions of healing, treatment protocols, and behavior regarding the consumption of nutritious foods (Cintron et al., 2021; WHO, 2021).

Method

This type of analytic observation research, with Pre and Post Test One Group Design, took place in five health centers in Manado from January to October 2022. The population is all patients who seek treatment at five health centers as many as 200 respondents. Determination of the location using cluster sampling by dividing the population into 5 groups. Public Health Center representing the East, West, North, South, and Central regions in Manado with the highest TB cases. Sampling using incidental sampling met the inclusion criteria, namely being willing to come to the research location as amount of 113 respondents. The independent variable is the counseling method with group discussion, booklets, and the dependent variable is the change in the behavior of the patient regarding efforts to prevent pulmonary TB disease. A pre-test was conducted on the variables to be studied, then the provision of counseling and group discussion actions with booklets. Later, a post-test was carried out. The data collected are processed and presented in a frequency distribution table. Statistical analysis was by the Wilcoxon test to examine the effect of health education on changes in patient behavior. The results are presented and discussed for each variable by comparing the results of previous studies. This research has obtained research ethics feasibility with the Health Research Ethics Commission number: KEPK. 01/05/092/2022. May 25, 2022.

Results and Discussion

TABLE 1. Distribution of Gender, Education and Occupation of Tuberculosis Respondents at the Manado City Health Center in 2022

Variables	n	(%)
Gender :		
Male	44	38,9
Female	69	61,1
Education :		
Primary School	14	12,4
Secondary School	18	15,9
High School	66	58,4
University	15	13,3
Occupation :		
Household	43	38,1
Laborer	15	13,3
Student/No Working	18	15,9
Business	25	22,1
Civil Employer	12	10.6

Source: Primary Data, 2022

Table 1 above shows that most of the respondents are female, as many as 69 respondents (61.1%), most of the education level is equivalent to High School, namely 66 respondents (58.4%), and most respondents have jobs as housewives as many as 43 respondents (38.1%).

The above data shows that the average age of respondents is 43.75+Std. The deviation is 15.095, the median is 43, the minimum value is 16, and the maximum is 77.

TABLE 2. Distribution of Pre Test and Post Test Research Variables and Result Wilcoxon Test Statistics

Variables	Pretest		Posttest		Test Statistics	
	n	(%)	n	(%)	Z	p-Value
Knowing of Cause :						
a. Yes	96	85	105	92,92	-8.544b	.000
b. No	17	15	8	7,08		
Signs and Symptoms :						
a. Yes	63	55,8	90	79,64	-9.192b	.000
b. No	50	44,2	23	20,36		
Transmission Sources :						
a. Yes	75	66,4	91	80,53	-9.232b	.000
b. No	38	33,6	22	19,47		
Transmission Risk :						
a. Yes	67	59,3	93	82,30	-9.239b	.000
b. No	46	40,7	20	17,70		
Seek Behavior of Health						
a. Yes	97	85,8	109	96,46	-9.232b	.000
b. No	16	14,2	4	3,54		
Behavior of Prevention Care:						
a. Do	75	66,4	101	89.23	-9.232b	.000
b. No	38	33,6	12	10,62		
Seek Behavior of Health Care:						
a. Do	109	96,5	111	98,23	-9.231b	.000
b. No	4	3,5	2	1,77		
Can be cure						
a. Yes	107	94,7	110	97,34	-9.239b	.000
b. No	6	5,3	3	2,66		
Behavior of nutrition						
a. Do	100	88,5	105	92,92	-9.239b	.000
b. No	13	11,5	8	7,08		

Source: Primary Data., 2022

“Wilcoxon, α 0,05 *Significance p<0,05

Based on the data in table 2 regarding the results of pre-test and post-test on research variables, it shows that most respondents stated that knowing the cause of TB was 96 respondents (85%) and after giving health education actions increased to 105 respondents (92.92%), respondents knew and feel symptoms before health education by 63 respondents (55.8%), after post test to 90 (79.64%); sources of transmission were 75 (66.4), post test results were 91 (80.53%); risk of transmission of pre test results 67 (53.9%) and post test 93 (82.30%); behavior seeking treatment, the results of the pre-test respondents said that they made efforts to seek treatment at health care facilities as many as 97 (85.8%) and post-test 109 (96.46%); respondents who made efforts to prevent TB transmission from pre-test results were 75 (66.4%) and post-test were 101 (89.38%); Respondents' perceptions of TB cure before health education actions were 109 (96.5%) saying that TB could be cured, and after post test 111 (98.23%); the results of the pre test regarding behavior regarding TB treatment, most respondents carried out the treatment protocol according to the doctor's advice as many as 107 (94.7%) and increased and after the post test it was 110 (97.34); the results of the pre-test on the behavior of practicing eating nutritious food as many as 100 (88.5%) said they did, and improved after health education as much as 100 (92.92%).

This research is analytic with the "Pre and Post Test One Group Design" carried out in five Public Health Centers in Manado City for 7 months from April to October 2022. The research method used counseling methods with group discussion and booklet media. Before counseling about TB, a questionnaire was given to measure the respondents' initial knowledge, attitudes, and actions regarding TB. After that counseling was carried out using booklet media, and then the final measurement was carried out using a questionnaire. Respondents who participated in this study amounted to 113 TB patients. The variables measured in this study were the causes of TB, symptoms of TB, sources of TB transmission, risk of TB transmission, behavior seeking treatment, respondents' behavior of prevention, perceptions about TB cure, perceptions about treatment, and behavior about nutrition, as well as demographic data of respondents including gender, education, working, and age of the respondent.

Demographic data of respondents in this study showed that most were female, with as many as 69 respondents (61.1%). In contrast with (Evelyn, 2021), most education levels are equivalent to High School, as amount 66 respondents (58.4%), and most respondents have jobs as housewives, as many as 43 respondents (38.1%). The mean age of respondents is 43.75+Std. The deviation is 15.095. The median is 43, a minimum score of 16, and a maximum of 77. The results of this study, when compared with the results of research by (Evelyn, 2021), most of the age group was 46-55, as many as 18 (35,3%), with low education, as many as 18(35,3%)(Evelyn, 2021), unemployed 95(54,9) as control and case 92(53,2%) (Diriba & Awulachew, 2022), male as many as 27 (84.4%), junior high school graduates as many as 11 (34.3%), doesn't work 13 (40.6%). These results as suited to research by (Kigozi et al., 2017).

The results of the study on the knowledge, attitudes, and behavior of respondents about TB increased after health education was carried out with counseling methods and the use of booklet media where the p-value was 0.000 <p0.05., About the causes of TB, TB symptoms, TB transmission sources, TB transmission risk, behavior Seeking Treatment, Prevention Behavior, Perceptions of TB Healing, and Perceptions of Nutrition for Pre Test and Post Test. So it can be concluded that "there is an effect of using health promotion methods and media on changes in the behavior of TB respondents about the causes of TB, TB symptoms, Sources of TB Transmission, Risk of TB Transmission, Treatment Seeking Behavior, Prevention Behavior, Perceptions of TB Cure, Perceptions of Treatment and Behavior of Nutrition in five Manado City Health Centers. It is in line with the results Kigozi et al. (2017), which found that in the intervention group, there was an increase in the behavioral score of 28.46, with p0.000.-meaning that health education with audiovisual media could improve the respondent's behavior in preventing TB (Austa et al., 2022).

Respondents' knowledge about the causes of pre-test TB mostly answered correctly

96 respondents (85%) after the post-test health education increased to 113 (100%), p0.000. The cause of TB is Mycobacterium Tuberculosis (M.TB), said that TB germs (Mycobacterium Tuberculosis) are Rod-shaped and acid resistant so it is often known as Acid Resistant Basil (BTA) (Lailatul et al., 2019; Puspitasari et al., 2022; Saputra et al., 2020). TB germs are so small that TB germs in inhaled droplet nuclei can enter the alveoli and affect the lung parenchyma and cause pulmonary TB. But these germs can infect other organs (extrapulmonary TB) such as the pleura, lymph nodes, bones, and other extrapulmonary organs.

Based on the results of data collection that using a questionnaire about symptoms of TB, most of the respondents 65 respondents (55.8%) knew the symptoms of TB, after health education, there was an increase of 90 respondents (79.6%), p-value 0.000. Symptoms of TB disease depend on the location of the lesion, so it can show clinical manifestations as follows: Cough for more than 2 weeks, Cough with sputum, and cough with blood. May be accompanied by chest pain and shortness of breath with other symptoms including malaise, weight loss, Decreased appetite, Chills, Fever, and Night sweats. It may be because respondents are not aware of what is experienced as symptoms of TB, but after being given education health, respondents become understanding of the signs and symptoms of TB (Ngigi & Busolo, 2018).

Regarding the source of TB transmission, from 113 respondents who answered correctly were as many as 75 respondents (66.4%), post-test by 91 respondents (80.5%), p0.000. A significant source of transmission is the sprinkling of sputum of TB patients and equipment that has not been cleaned. Pulmonary TB transmission is related to house conditions with a solid category, and there are smear-positive pulmonary TB patients because the source of pulmonary TB transmission is smear-positive pulmonary TB patients. So not all dense residential houses are always at risk of developing pulmonary TB if there are no smear-positive pulmonary TB patients in the house. It is also possible that pulmonary TB transmission can occur in families that are not densely populated or densely populated if there are smear-positive pulmonary TB patients in the house (Asyary et al., 2017; Havumaki et al., 2021). Very significant risk factors for transmission are close contact, smoking, HIV/AIDs status, BCG immunization, income, and class I narcotics users (Diriba & Awulachew, 2022; Havumaki et al., 2021).

The pre-test on the risk of transmission was 67 (53.9%) in knowing the risk of transmission, the post-test was 93 (82.30%), and the p-value was 0.000. The most vital risk of TB transmission is people living in the same house with TB sufferers, close contact with TB sufferers, people with poor nutrition, smokers, alcohol drinkers, people with HIV/AIDs, and people with diabetes mellitus (DM). Methods Prevention of the risk of transmission through health education is very vital. Especially regarding education using video partners has been shown to increase the knowledge and behavior of respondents. Respondents who received the intervention had a higher level of knowledge and attitude scores than those who did not receive the videotaped education intervention, and this difference was statistically significant (WHO, 2021), (Lailatul , 2019; Carwile et al., 2022; Nthiga et al., 2017). The results of this study using booklets and health education are different from the research (WHO, 2021). But the increasing knowledge, attitudes, and behavior are also very significant, as well as (Diriba & Awulachew, 2022). The results of respondents' pre-test of behavior seeking treatment to health care facilities were 97 (85.8%) and post-test 109(96.46%), p0.000. It is probably because the respondents paid attention to the material provided and the motivation to use booklet media (Austa et al., 2022).

This result is also in line with the Ministry of Health saying that it is necessary to use the latest technology to monitor treatment, for example, the use of technology-based information systems such as the use of software on mobile phones, short messages as reminders to take medication, and recording internet-based TB treatment monitoring, and interactive educational materials. The use of the latest technology in tuberculosis monitoring is aimed at facilitating contact between tuberculosis patients, treatment monitors

and treatment service providers during the treatment process (Kementerian Kesehatan RI, 2020). The behavior of respondents who made efforts to prevent TB transmission from pre-test results was 75 (66.4%), and post-test was 101 (89.38%), p0.000, respondents' perceptions of TB cure before health education were 109 (96.5) %) said that TB could be cured, and after the post-test, 111 (98.23%), p0.000. The results of the pre-test regarding behavior regarding TB treatment, most respondents carried out the treatment protocol according to the doctor's advice, as many as 107 (94.7%). After the post-test, it was 110 (97.34), p0.000. The results of the pre-test on the behavior of practicing eating nutritious food were 100 (88.5%) said they did, and improved after health education was 100 (92.92%), p0.000 (Nthiga et al., 2017; Wang et al., 2022).

The results of this study when compared with existing epidemiological evidence, population characteristics and the health system carried out in Indonesia, the stakeholders have made a consensus on the order of the gaps in the prevention of tuberculosis in Indonesia as follows: Individu was diagnosed with tuberculosis but not starting treatment; People with symptoms of tuberculosis who do not seek treatment; Individu with tuberculosis who come to a health facility but are not detected of tuberculosis; People diagnosed with tuberculosis and treated by health care providers but not reported to the program; Persons with reported tuberculosis treatment but who did not recover or did not complete their treatment; People affected with tuberculosis or at high risk of becoming ill with tuberculosis (Kementerian Kesehatan RI, 2020; Malini et al., 2021; Puspitasari et al., 2022; Amare et al., 2022).

People with tuberculosis or its symptoms that have not/not accessed health services are 43%, and only 31% seek self-medication based on the results of the 2013-2014 Tuberculosis Prevalence Survey. It largely contributed to the low coverage of Tuberculosis treatment which only reached 67% (61-73%) in 2018. It means there are still around 33% (27%-39%) of tuberculosis cases that are neither diagnosed nor reported. People with symptoms of tuberculosis do not access health services due to lack of knowledge about it. Knowledge about tuberculosis is vital in affecting treatment seeking (Amare et al., 2022). Of those who reported coughing for 14 days or coughing up blood or abnormal lung radiographs, only 26% sought treatment at a health facility. 43% did not seek treatment, and 31% did self-medication. The proportion who did not seek treatment was higher in men. About the reason, 75% did not seek treatment because they felt their symptoms were not serious(Kementerian Kesehatan RI, 2020; Kigozi et al., 2017). Of those who reported coughing 14 days or coughing up blood or abnormal lung X-rays, 77% knew the main symptoms of Tuberculosis, 66% knew how it is transmitted, and 76% knew that it is curable. However, only 22% know that TB treatment is free (Kementerian Kesehatan RI, 2020; Amare et al., 2022)

Behavior about nutrition from the pre-test results, as many as 100 (88.5%) said they practice consuming nutritious food after the post-test increased by 105 (92.92%). Eating nutritious food is very important in maintaining the immune system, especially in increasing the body's immune system to fight infection with TB germs (Nthiga et al., 2017; Carwile et al., 2022; Wang et al., 2022; Tesfaye et al., 2021).

Conclusion

The use of health education methods in the form of counseling using booklet media significantly increases the knowledge, behavior, and perception of TB patients about the causes, symptoms, transmission sources, transmission risk, treatment-seeking behavior, prevention behavior, perceptions about cure of TB, treatment behavior and behavior to consume nutritious food. It is recommended for health workers, those in charge of TB transmission prevention and control programs to continue educating patients, families, and communities by disseminating information as widely as possible about TB.

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Nutrition Intake, Physical Activity, and Sleep Quality in the Month of Fast During Covid-19 Pandemic

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Abstract

Central Java is one of the provinces with the high number of positive Covid-19 cases in Indonesia, with 46,903 positive infected and a death rate of 2,110 people (4.49%). During the COVID-19 pandemic, community activities decrease, especially during the fasting month, while their diet has also changed. This study aimed to describe and analyse the relationship between nutritional intake and physical activity on people's sleep quality during the fasting month during the COVID-19 pandemic. The benefit of this research is to provide information on factors related to people's sleep quality and to improve public health. The novelty of this research is on aspects of physical activity and people's sleep quality during the fasting month during the covid-19 pandemic. This research method is observational by a cross-sectional approach. The research took time during the fasting month (Ramadan 2021) to find out the nutritional intake, physical activity, and quality of people's sleep while fasting amid the COVID-19 pandemic. This study was attended by 520 respondents, who were willing to fill out a questionnaire distributed via Googleform. Respondents in this study were limited to people who live in Central Java. The selection of respondents using the cluster sampling technique and then the snowball method. The questionnaires were the Pittsburgh Sleep Quality Index (PSQI), IPAQ and DQI. The results showed no relationship between physical activity and slept quality during the fasting month (p : 0.402). There is a relationship between food consumption, sleep quality (p: 0.0001), and physical activity (0.007) during the fasting month.

Introduction

At the end of 2019, the world was shocked by a virus emergence that caused a disease that was quite disturbing. News of the emergence of the virus came from a Huanan Seafood Wholesale Market located in Wuhan City, the capital of Hubei Province, Central China. At the beginning of its appearance, the virus was known as the 2019 novel coronavirus (2019-nCoV) (Chen et al., 2020). The genetic structure is used to name the virus to facilitate the development of diagnostic tests, vaccines, and drugs (Bangash et al., 2020; Han et al., 2020). Coronaviruses are serologic divisions of the Coronaviruses (CoVs) subfamily (Li et al., 2020; Kumar et al., 2020; Lam et al., 2015). Coronaviruses are based on characteristics, such as a crown, sizing from 26 to 32 kilobases. On February 11, 2020, WHO formalized the use of the term Covid-19 or "the Covid-19 virus" which stands for Coronavirus Disease 2019 (Liu et al., 2020; Pan et al., 2020).

The increase in Covid-19 cases has occurred rapidly since discovering the first case in early December 2019 in Wuhan, Hubei Province, Central China. WHO declared PHEIC (Public Health Emergency of International Concern) on January 30, 2020 (Xie et al.,

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2020; Susilo et al., 2020). Infectious diseases that can spread to many regions or countries are a separate consideration in determining a pandemic. On August 10, 2020, the global Covid-19 pandemic spread to 213 countries/ territories. (Ramanathan et al., 2020). As of March 11, 2021, Covid-19 cases in Indonesia were 1,403,722 confirmed cases with 38,049 death and 1,224,603 recovered. Central Java is one of the provinces with the high number of positive Covid-19 cases in Indonesia, with 46,903 positive infected cases, with a death rate of 2,110 people (4.49%).

During the COVID-19 pandemic, community activities tend to decrease. During the month of fasting, in Indonesia, especially in Central Java, where most of the population is Muslim, some will fast during Ramadhan, so their eating patterns also change. In addition, changes in sleep patterns occur because part of the time is used to wake up and do sahur. Pandemic conditions allow people to limit activities. They only leave the house when it is necessary. Physical activities such as sports or walks are significantly reduced compared to before the pandemic. During the fasting period last year, which was during the pandemic, their eating patterns, sleeping patterns, and physical activity also experienced changes compared to standard times. Therefore, the researcher proposed a study titled "Nutrition Intake, Physical Activity, and Quality of People's Sleep in the Month of Fasting During the Covid-19 Pandemic". We hope this research will provide an overview of the community's nutritional intake, physical activity, and sleep quality during the fasting month during the COVID-19 pandemic and the correlation between these variables.

Based on the preliminary research results, during the COVID-19 pandemic, physical activity decreased due to the recommendation from the government to stay at home. During the fasting month, there are also changes in eating patterns and sleeping patterns, so the problem that will be examined in this study is how the description and relationship between nutritional intake and physical activity on the quality of people's sleep during the fasting month during the COVID-19 pandemic will occur. The research describes the community's nutrition intake, physical activity, and sleep quality during the short month of the covid-19 pandemic.

Methods

This study used an observational design with a cross-sectional method. A cross-sectional design refers to research that does not have a time dimension. The measurement of various variables is carried out once. Cross-sectional studies can find the relationship between risk factors and effects. The research took time during the fasting month (Ramadan 2021) to find out the nutritional intake, physical activity, and quality of people's sleep while fasting amid the COVID-19 pandemic. This study involved 520 respondents who were willing to fill out a questionnaire distributed via Googleform. Respondents in this study were limited to people who live in Central Java. The sampling technique in this study used cluster sampling and snowball. The cluster sampling allows respondents to be randomly selected from groups of individuals in the naturally occurring population. The snowball method allows additional samples with the characteristics desired by the researcher. The materials and tools used for the study were a modified sleep quality questionnaire using the Pittsburgh Sleep Quality Index (PSQI) Scale, International Physical Activity Questionnaire (IPAQ) to determine the respondent's activity level, and the International Diet Quality Index (DQI-I) to determine food quality. The questionnaire was distributed through the electronic media google form to be reached by respondents.

Results and Discussion

The study was conducted during the fasting month (Ramadan, 2021) to determine the community's nutritional intake, physical activity, and sleep quality during fasting amid the COVID-19 pandemic. This study involved 520 respondents willing to fill out the questionnaire. Respondents in this study were limited to those who live in Central Java. The results of processing and analyzing the inputted data can be seen in Table 1.

Table 1. Distribution of Respondents' Characteristics

Respondents Characteristics	N	Per cent
Gender		
Male	139	26.7
Female	381	73.3
Level of Education		
Low	27	5.2
High	493	94.8
Age Group		
Young adult	453	87.1
Middle adult	66	12.7
Old adult	1	0.2
Marital Status		
Not married yet	409	78.7
Married	106	20.4
Widower/widow	5	1.0
Total	520	100.0

Source: Primary Data, 2021

Based on table 1, of 520 respondents, most (73.3%) are female. In this study, the level of education is divided into 2, namely low education and higher education. A low level of education is a group of respondents who are not in school or have the latest elementary or junior high school (or equivalent). Higher education level is a group of respondents with a high school education level (or equivalent), D3, undergraduate, or postgraduate. Most (94.8%) of them have a higher education level.

In this study, age groups were divided into 3, namely young adults, middle adults, and old adults. The young adult age group is respondents aged 15-35 years. The middle adult age group is respondents aged >35 to 55 years, while the old adult age group is respondents aged >55 years. Based on Table 1, of the 520 respondents, most (87.1%) are young adults, while only 0.2% old adults. In this study, marital status was divided into 3. Namely, unmarried, married, and widow/widower. Of the 520 respondents, most (78.7%) had not married yet, while only 1% was widowers/widows. The respondents in this study were limited to those who live in Central Java. Based on the analysis of the data obtained, of the 520 respondents, the most significant percentage (13.5%) of them live in the city of Semarang, followed by the group of respondents who live in the City/Regency of Magelang (7.7%), Semarang Regency (6.9%)), and Kudus Regency (6.9%). At the same time, the rest are scattered in various districts/cities in Central Java.

Table 2. Relationship between Physical Activity and Sleep Quality

		Sleep Quality						p-value
		Good		Not Good		Total		
		f	%	f	%	f	%	
Physical Activity	High	27	19.3	113	80.7	140	100.0	0.402
	Medium	40	25.6	116	74.4	156	100.0	
	Low	54	24.1	170	75.9	224	100.0	
	Total	121	23.3	399	76.7	520	100.0	

Source: Primary Data, 2021

Physical activity was measured by analyzing the average physical activity in a week. That consists of three categories group, namely high, medium, and low, classified in table 6 of 520 respondents. The most significant percentage of respondents (43.1%) had a low level of physical activity. In contrast, the high and moderate ones were only 26.9% and 30%, respectively. Of the 140 respondents who had high physical activity, 19.3% had good sleep quality, while 80.7% had poor of the 224 respondents who had low physical activity, 24.1% had good sleep quality. In contrast, 75.9% had poor sleep quality. Based on the chi-square test's bivariate analysis, a p-value of 0.402 (> 0.05) was obtained, meaning there is no relationship between physical activity and sleep quality during the fasting month.

Table 3. Relationship between Food Consumption and Sleep Quality

		Sleep Quality						p-value
		Good		Not Good		Total		
		f	%	f	%	f	%	
Food Consumption	Good	85	34.4	162	65.6	247	100.0	0.0001
	Enough	32	12.8	218	87.2	250	100.0	
	Not enough	4	17.4	19	82.6	23	100.0	
	Total	121	23.3	399	76.7	520	100.0	

Source: Primary Data, 2021

Sleep quality in this study was divided into two, namely good sleep quality and poor sleep quality. Based on Table 3, of 520 respondents, (76.7%) had poor sleep quality. Of the 247 respondents who had good food consumption, 34.4% had good sleep quality, while 65.6% had poor sleep quality; of 23 respondents who had less food consumption, 17.4% had good sleep quality, while 82.6% had poor sleep quality. Based on the chi-square test's bivariate analysis, the p-value was 0.0001 (< 0.05), indicating a relationship between food consumption and sleep quality during the fasting month.

Table 4. Relationship between Food Consumption and Physical Activity

		Physical Activity								p-value
		High		Medium		Low		Total		
		f	%	f	%	f	%	f	%	
Food Consumption	Good	55	22.3	91	36.8	101	40.9	247	100.0	0.007
	Enough	81	32.4	59	23.6	110	44.0	250	100.0	
	Not enough	4	17.4	6	26.1	13	56.6	23	100.0	
		140	26.9	156	30.0	224	43.1	520	100.0	

Source: Primary Data, 2021

Several indicators are measured to determine the adequacy of nutritional intake, including the diversity of protein sources, consumption of vegetables, fruits, grains, fibre consumption, protein consumption, iron, consumption of calcium, and consumption of vitamin C. Each indicator is categorised into good, sufficient, and less. These indicators determine the quality of a person's food consumption. Food quality consumed was grouped into three categories. Namely good, sufficient, and poor. Based on table 4, the most significant percentage of respondents had sufficient and good quality food consumption, namely 48.1% and 47.5%, respectively. Of the 247 respondents with good food consumption, 22.3% had high physical activity, while 40.9% had low physical activity. Of the 23 respondents with less food consumption, 17.4% had high physical activity, while 56.6% had low physical activity. Based on the bivariate analysis using the chi-square test, a p-value of 0.007 (< 0.05) was obtained, indicating a relationship between food consumption and physical activity during the fasting month.

The research finds no relationship between physical activity and sleep quality during the fasting month. Different from research by Fakhan, which states that there is a positive relationship between physical activity and sleep quality in the elderly. It took place at the Posyandu Gonilan Sukoharjo (Fakhan, A. 2016). The differences between the results of this study and Fakhan's are the research respondents and the time of the study. The respondents have a productive age, while Fakhan uses the elderly. In addition, this research took time during the fasting month when people used to reduce the intensity of their physical activity.

According to the Centers for Disease Control and Prevention (CDC), sleep deprivation is a health problem. Based on data from WHO, the prevalence of sleep disorders in adolescents in America is 68.8%, where female adolescents (71.3%) have a greater risk of experiencing sleep disorders than male adolescents (66.4%). It causes more female adolescents to experience insufficient sleep than their male friends (CDC, 2017). Baso's research at SMA Negeri 9 Manado showed that

adolescents who experienced sleep disorders in the form of mild insomnia were 71%. In contrast, those who experienced severe insomnia were 29% (Baso, 2018). Several factors can affect a person's sleep quality, including physical illness, drugs, lifestyle, emotional stress, environment, physical activity, age, alcohol, and nutrition. Physical activity can affect the quality and quantity of sleep because physical activity or exercise can cause fatigue. Fatigue or fatigue can affect the quality and quantity of a person's sleep because fatigue caused by high physical activity can make a person sleep more to maintain the balance of energy expended during physical activity. People who have done physical activity and reach fatigue, then that person will be able to sleep faster because slow-wave sleep (NREM) is shortened. In addition, regular physical activity can also help regulate the heart system, blood vessels, and body weight. A standard body system can prevent the occurrence of non-communicable diseases (Lemma et al., 2012).

Currently, people are experiencing life-style changes from a traditional to a sedentary lifestyle. These changes can increase the risk of being overweight. A sedentary lifestyle is a lifestyle that is not active, and accompanied by excessive diet intake. Excessive diet intake, especially the content of carbohydrates, fats, and proteins, can trigger overweight and obesity. The increase in the prevalence of overweight and obesity can also lead to sufferers of degenerative diseases, such as type 2 diabetes mellitus, heart disease, stroke, and certain types of cancer. Based on research data, obesity and lack of physical activity increase the 30% risk of cancer (Beaulieu et al., 2016).

The majority of people currently have physical activity tending to decrease annually. The change in activity that used to involve a lot of physical activity outside the home became physical activity at home, especially during the Covid 19 pandemic. For example, nowadays, many people are playing games more often on smartphones, watching television, using computers instead of walking, cycling, or exercising. Lack of physical activity can cause low energy output, so there will be an imbalance between the energy that enters through food and the energy expended. As a result of the lack of energy that comes out of the body, the rest will be stored in the body in the form of fat. If this lasts long enough, it will cause overweight to continue to be obese (Mathieu et al., 2019). The lack of physical activity occurred in society lately will lead to a sedentary lifestyle, where most people will spend a lot of time in front of the screen, reading, sitting, and relaxing (Zhu et al., 2016). In Ramadhan, when people fasting, which is not consuming food and drinks for a full day, they can reduce the energy intake. It can be beneficial so that the remaining energy, usually excess stored in the body, can be reduced.

A sedentary lifestyle is a lifestyle that does not meet the standard of daily physical activity. Someone who has a sedentary lifestyle is someone who does less physical activity and prefers to do activities that do not require a lot of energy. It can be seen from the tendency of society. For example in children, to divert their time from playing actively outside the home to sitting passively in front of the monitor screen or watching television. This sedentary lifestyle is not always due to laziness. But also be due to a person's busy schedule with work or with his family, causing the person to have less opportunity to exercise. Several studies have shown that people with a sedentary lifestyle have a higher risk of becoming obese compared to those with sufficient physical activity.

In theory, sleep quality and physical activity are related. Poor sleep quality can cause fatigue after waking up. It will also lead to a decrease in physical activity. When the body feels tired, people tend to have a sedentary lifestyle, such as watching television or playing games/mobile phones. A sedentary lifestyle is a relaxed lifestyle that minimizes physical activity. Watching television is included in light activities because it does not use much energy. Watching television for a long time, especially by consuming energy-dense snacks, can result in an energy imbalance in the body, increasing the risk of overnutrition. Several factors can cause poor sleep quality, including social factors, such as experiencing life problems, experiencing anxiety, or tension. This social factor is more due to the physiological effects of the hormone epinephrine, where the production of this hormone can trigger an increase in the

frequency of an increased heart rate, cold sweat, or shock. Stress can stimulate the excessive release of the hormone epinephrine, causing the heart to beat harder and faster, affecting sleep quality, feeling tired quickly, easily disturbed, and headaches. Sleep quality indicators are considered reasonable if they do not wake up more than once for five minutes at night. It can be interpreted as falling asleep for less than 30 minutes or 60 minutes for ages over 65 years. To achieve such a state, one must have a relaxed feeling by listening to music before going to bed. One of the instruments that can measure sleep quality is the PSQI questionnaire, where this questionnaire can assess sleep duration data. A person's feelings or thoughts, such as stress or anxiety, can cause a decrease in sleep duration. Hanley's research on Canadian society shows that adolescents aged 10-19 years who watch television >5 hours per day are significantly more at risk of experiencing malnutrition than adolescents who only watch television 2 hours per day (Hanley, 2000).

Physical fitness is inseparable from physical activity, where every physical activity that is routinely carried out and has a stable activity will affect physical fitness. Physical fitness is a person's ability to carry out daily activities easily without excessive fatigue and still have energy remaining or reserves to enjoy leisure time or for purposes used at any time. So, physical fitness is a manifestation of a person's functional loyalty to do a particular job with good or satisfactory results (Wiklund, 2016). In general, humans need rest by sleeping to rest their organs after physical activities, such as exercising. Sleep also serves to restore body fitness. During sleep, the body has recovery process to restore the body's stamina so that the condition will return to optimal.

The research finds a relationship between food consumption and sleep quality during the fasting month. Researchers have not found similar studies. In Tovar's study, there were differences in food intake and sleep quality in the obese and non-obese groups (Tovar et al., 2012). Consumption of food (food intake) can affect obesity, whereas the incidence of obesity can later affect a person's sleep quality. Consumption of food, especially snacks, contributes significantly to energy intake and other macronutrients. Examples of snack foods in great demand by the public are cakes and fast food, where these types of food are high in energy (Eichler et al., 2019, Setyawati & Setyowati, 2015, Masthalina et al., 2015).

Carbohydrates in the body will be in the blood circulation as glucose for energy. Some of the carbohydrates will be stored as liver glycogen and muscle tissue. The rest will become fat. So no wonder someone who consumes excessive amounts of carbohydrates will become overweight. The research finds a relationship between food consumption and physical activity during the fasting month. Researchers have not found similar studies but research from Farooq & Sazonov stated a relationship between diet and adolescent nutritional status. This nutritional status will affect a person's ability to perform physical activity (Farooq & Sazonov, 2016).

Protein intake will affect the increase in energy that enters the body. If the amount of protein that enters the body is excessive, it will experience deaminase. Nitrogen will be released by the body, while the remaining carbon bonds will be converted into fat and stored in the body. It will cause an increase in fat tissue, affect weight gain, and increase the risk of overnutrition. Protein's mechanism in the body is almost the same as the excess carbohydrates in the body. Excess of both will be stored as fat in the body. Nowadays, fibre rich foods are not popular with the community, especially teenagers, who prefer foods high in calories but low in fibre. It can trigger the occurrence of more nutritional status. The dislike of consuming vegetables and fruit is a significant factor in low fibre intake. Physical activity is essential because it can reduce the risk of cardiovascular disease and type 2 diabetes and prevent obesity (Tovar et al., 2012).

Coronavirus Disease 2019 (Covid-19) is a respiratory tract infection caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), or the so-called coronavirus. This virus has a high mutation rate and is a zoonotic pathogen that can persist in humans and animals (Chen et al., 2020). Coronavirus is a positive single-strain RNA virus, encapsulated and unsegmented. Coronavirus belongs to the order Nidovirales, family Coronaviridae.

Coronaviridae is divided into two subfamilies distinguished by serotype and genomic characteristics. There are four genera namely alphacoronavirus, beta coronavirus, delta coronavirus and gamma coronavirus (Pan et al., 2020).

In COVID-19, it is not known with certainty the process of transmission from animals to humans, but phylogenetic data allows COVID-19 could be a zoonosis. Subsequent data developments show that human to human transmission is predicted through droplets and contact with viruses released in droplets. Several case reports suggest that transmission from asymptomatic carriers is suspected, but the exact mechanism is unknown. Cases related to transmission from asymptomatic carriers generally have a history of close contact with COVID-19 patients (Han et al., 2020). The implementation of the physical distancing policy has been established in several countries to prevent the transmission of the virus through droplets, including Indonesia which has begun to implement social distancing, or physical distancing, by avoiding crowds or crowds of people. Forms of physical distancing include efforts to limit work, schools, and universitie. Replacing them with online meetings to reduce face-to-face meetings between several people (Xie et al., 2020).

Good nutrition is vital for everyone. Nutrient intake is the amount of nutrients that enter through daily food consumption to obtain energy to carry out daily physical activities (Heydenreich et al., 2020). Lack of nutrients in the food consumed by workers will have poor effects on the workers' bodies, such as: decreased body defense against disease, lack of physical ability, decreased weight, thin body, pale face, lack of enthusiasm, lack of motivation, sluggish reaction and so on. others (D'Addesa, et al., 2010). Food will be broken down into nutrients and absorbed through the intestinal wall and into body fluids. General functions of nutrients include: 1) As a source of energy; 2) Contribute to body growth; 3) Maintain body tissues, replace damaged cells; 4) Regulate metabolism, balance water, minerals and acids - bases in body fluids; 5) Play a role in the body's defense mechanism against disease as antibodies and antitoxin.

Physical activity is any body movement due to skeletal muscle contraction that requires more calories than energy expenditure at rest. Physical activity that is not carried out in a structured and planned manner is called daily physical activity, as physical activity in a structured and planned is called physical exercise (Callow et al., 2020). The classification based on energy needs is light, moderate, and heavy physical activity. Light physical activity is anything similar to daily activities including walking and household chores (Colley, R., et al., 2013). Moderate physical activity is an activity that requires continuous muscle movement with light intensity, such as cycling, jogging, and brisk walking. Heavy physical activity is a body movement that requires a lot of muscle movement and burns many calories, including activities such as swimming, climbing mountains, and lifting weights (Mota et al., 2016).

Sleep quality is a measure where a person can make it easier to start and maintain sleep. A person's sleep quality can be described by the length of time and the complaints he feels while sleeping or after waking up (St-Onge et al., 2016). Sleep needs are not determined in addition to the number of hours but also by the depth of sleep (Mendonça et al., 2019). Some that affect the quantity and quality of sleep are physiological and psychological factors, environment, and lifestyle. These factors affect a decrease in daily activities, feeling weak, tiredness, decreased endurance, and instability of vital signs. Psychological factors affect depression, anxiety, and difficulty concentrating.

The fulfillment of sleep needs for each person is different. Some can fulfill it well, and even vice versa. Factors that affect sleep quality include a) Health Status. A person whose body condition is healthy allows him to sleep soundly, while someone who is not healthy (sick) and feels pain will not sleep well.; b) Environment. The environment can increase or keep a person from sleeping. In a clean environment, with a cold temperature, an atmosphere that is not noisy (quiet), and lighting that will not make a person too bright, and vice versa if the environment is dirty, with a hot temperature, a crowded atmosphere, and

very bright lighting, it can affect the quality of sleep.; c) Psychological Stress. Anxiety and depression will cause disturbances in the frequency of sleep. This is because the worrying condition will increase blood norepinephrine through the sympathetic nervous system. This substance will reduce stage IV NREM and REM (Shaheen & Shamini, 2010).; d) Diet. Foods that contain lots of L-Tryptophan such as cheese, milk, meat, and tuna can cause a person to sleep easily. On the other hand, drinks that contain caffeine or alcohol will interfere with sleep.; e) Lifestyle. The fatigue that a person feels can also affect the quality of a person's sleep. With moderate fatigue people can sleep well. Meanwhile, excessive fatigue will cause shorter REM sleep periods.; f) Drugs. Some of the drugs that a person consumes have the effect of causing sleep, while others interfere with sleep (Ohayon et al., 2017).

Conclusion

The study finds no relationship between physical activity and sleep quality during the fasting month. There is a relationship between food consumption, sleep quality, and physical activity during the fasting month. Suggestions to the community are to pay attention to their food intake, both in quality and quantity, even when fasting. It can be adjusted when breaking the fast or sahur to get good quality sleep and physical activity. The quality of sleep and good physical activity will affect a person's overall quality of life.

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Mortality of the Pregnant Women with COVID-19 at Referral Hospitals in Central Java, Indonesia

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Abstract

APregnant women have a high potential for infections, including Covid-19. This study analyses the characteristics and outcomes of 95 maternal deaths caused by COVID-19. This observational-retrospective study descriptively analysed 95 maternal deaths due to COVID-19. The study took time in June – July 2021 at the COVID-19 Referral hospitals in Central Java Province. The study found that most of these deaths occurred in women between the ages of 20 to 35, with 74% falling in this age range. Furthermore, the study found that 63.2% of the patients required treatment for more than 48 hours. The study also noted that almost all of the women who died (98.9%) had not been vaccinated against COVID-19. Of the patients who received treatment, 73.7% received standard therapy. Additionally, 55.8% of the patients had a moderate condition when admitted to the hospital. More than half of the patients (52.6%) died in the intensive care unit (ICU). Furthermore, 63.2% of the patients arrived at the hospital alone. This data may suggest that some of these women were not receiving adequate support or medical care before hospitalisation.

Introduction

Novel coronavirus infection (SARS-CoV-2) was first reported by the Chinese Government in Wuhan, Hubei, China, to the World Health Organization (WHO) on Friday, December 31, 2019. This virus is transmitted between humans, has an incubation period of 2-14 days and is potentially symptomatic or asymptomatic. This virus has spread to most countries worldwide, so the WHO on March 11, 2020, declared the new coronavirus disease (COVID-19) a global pandemic (Sharma et al., 2021). The first case of SARS-CoV-2 infection was reported in Indonesia on March 2, 2020, while the first case of COVID-19 in the city of Semarang in adults was reported on March 17, 2020, and in infants on March 6, 2020 (van Empel et al., 2020, Pramana et al., 2020, Sumarni et al., 2020). Pregnant women have a high potential for infections, including SARS-CoV-2, due to physiological and mechanical changes during pregnancy and decreased immunity. If the respiratory system is disturbed, it will accelerate the occurrence of pathological conditions of respiratory failure (Yu et al., 2020).

In the June-July 2021 period, deaths due to COVID-19 in Indonesia have increased, it is in line with the high addition of daily COVID-19 cases in Indonesia, which is more than 1000 cases per day (Widiawaty et al., 2022). One of the factors causing the soaring mortality rate in Indonesia is the delay in handling COVID-19 in hospitals. Based on the monitoring of the Ministry of Health of the Republic of Indonesia, cases of death in

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hospitals occur faster than before the spike in cases. The high cause of death indicated that the patient came late to the hospital (Sujarwoto & Maharani, 2022). It is caused by increase dead on arrival at the emergency department (IGD). In early 2021 the average COVID-19 patient died after receiving treatment in the ICU/ isolation ward and had average case fatality rate in the hospital after 8 days of treatment. However, this is different when entering the months of June-July 2021, with the average death being 3-4 days after treatment. In early 2021 on average, COVID-19 patients died in the ICU, and only 1%-2% occurred in the emergency room (IGD), but in June-July 2021, almost 20% of deaths occurred in the ER (Surendra et al., 2021). Some cases of patients dying before receiving treatment at the hospital came in conditions of low oxygen saturation (<80%) (Allotey et al., 2021). The cumulative number of deaths (pregnant and non-pregnant women) of Covid-19 during the study period has reached 32,061 cases. That number is four times higher than in June 2021, with a total of 7,913 deaths (Ekawati et al., 2022).

Pregnant women are a group that is vulnerable to contracting COVID-19, where the condition of pregnancy occurs when there is a partial decrease in immunity due to physiological changes during pregnancy and can cause serious problems for pregnant women (Pramana et al., 2020, Dashraath et al., 2021). Based on previous research, SARS and MERS viruses in pregnant women have a high risk of death, spontaneous miscarriage, premature birth, and IUGR (Intrauterine Growth Restriction) with a fatality rate of 25% and 40% with several risks such as premature rupture of membranes, premature birth, tachycardia fetus, and fetal distress (Karimi-Zarchi et al., 2020). In a detailed analysis of published reports of 38 pregnant women with COVID-19, of whom 37 had rt-PCR-confirmed SARS-CoV-2 infection, no cases of severe pneumonia or maternal death were found in the respondents (Schwartz, 2020).

Despite the presence of comorbid conditions in some women of obstetric aetiology, they do not appear to result in life-threatening maternal SARS-CoV 2 diseases. It is therefore, vital to recognize that comorbid maternal conditions, including preeclampsia, pregnancy-induced hypertension, uterine scarring, gestational diabetes, and uterine atony, do not appear to be risk factors for intrauterine transmission of SARS-CoV-2 to the fetus. The increase in the maternal and infant deaths also occurred during the COVID-19 pandemic (Allotey et al., 2021). Based on data from the Directorate of Family Health, Ministry of Health of the Republic of Indonesia, as of September 14, 2021, 1086 mothers died with positive PCR/antigen swab results (Akbar et al., 2022).

A total of 42,344,675 people have received the first dose of Covid-19 vaccination in Indonesia. An increase of 249,144 from Monday's data (July 19, 2021) shows that there are still 42,095,531 people. The recipients of the Covid-19 vaccination up to the second dose have now reached 16,451,288 people. Meanwhile, the national vaccination target is 208,265,720 (Utami et al., 2022). Based on the above problems related to cases of maternal mortality in hospitals, the researcher intends to further examine the factors that influence the mortality of pregnant women at the COVID-19 referral hospitals in Central Java Province.

Method

This research is quantitative research with an analytical descriptive approach. It took places on the COVID-19 referral hospitals in the province of Central Java, Indonesia, namely Dr. Kariadi Hospital Semarang, Dr. Moewardi Hospital Surakarta, Dr. Adyatma Hospital Tugurejo Semarang; KRMT Wongsonegoro Hospital, Semarang; Dr. Margono Hospital Purwokerto; Brebes Hospital; Dr. Soedjati Hospital Grobogan; Dr. R. Soetrasno Hospital Rembang; RAA Soewondo Hospital Pati and Kalijaga Hospital, Demak. The study involved pregnant women with COVID-19 who were treated and died in a referral hospital from June to July 2021. The independent variables in this study were susceptibility, namely the status of pregnancy at an age too young or too old (< 18 years or > 35 years) and having a history of comorbidities. Comorbidity is a condition in which a person suffers from two or more diseases. The disease is generally chronic such as hypertension, diabetes mellitus or other

diseases. The level of emergency, the status of patients when they come to the hospital (mild/moderate/severe Covid-19 symptoms; requires an isolator/without isolator room); and the provision of therapy, namely any therapy the respondent has received while in the hospital.

The subjects were 95 pregnant women who died of COVID-19 in Central Java referral hospitals during the study period from Juni-July 2021. Data obtained from the results of recording; reporting and epidemiological investigation of COVID-19 cases in 10 referral hospitals in Central Java province. Data collection was by each officer at the COVID-19 referral hospitals in Central Java province by the agreed reporting template, and coordinated with the Central Java Province COVID-19 task force team. In this study, the patient's data and information were not published and kept confidential. This study includes cases of maternal deaths with COVID-19 in June-July 2021. Patients were diagnosed with COVID-19 based on confirmation of positive RT-PCR test results. Parameters recorded were gestational age, comorbid, length of treatment, vaccination status, type of therapy, condition when the patients come to the hospital, location of the date, and referral type. Then the collected data were analysed descriptively using Microsoft Excel. This research has received approval and meets the ethical standards of research from the Ethics Committee of the Faculty of Public Health, Diponegoro University, Semarang No: 346/EA/KEPK-FKM/2021.

Results and Discussion

Table. 1 Overview of Patient Characteristics

Variable		**f**	**%**
Gestational age	**Too Young/Too Old**	24	25.3
	Safe age (20-35 years old)	71	74.7
Comorbid	**Have 1 or more comorbidities**	46	48.4
	No	49	51.6
Length of Treatment	**≤ 48 hours**	35	36.8
	> 48 hours	60	63.2
Vaccination status	**Not vaccinated yet**	94	98.9
	Vaccine dose 1	1	1.1
Type of Therapy	**Has not been recorded given therapy services**	19	20.0
	Standard	70	73.7
	Convalescent Plasma	5	5.3
	IVIG	1	1.1
Condition when the patient comes to the hospital	Not screened yet	1	1.1
	Severe	34	35.8
	Moderate	53	55.8
	Mild	7	7.4
Location of Death	**DOA**	18	18.9
	Emergency Room	6	6.3
	Isolation Room	21	22.1
	ICU non-ventilator	19	20.0
	ICU ventilator	31	32.6
Referral Type	Come Alone	60	63.2
	Public health center	16	16.8
	Another Hospital	19	20.0

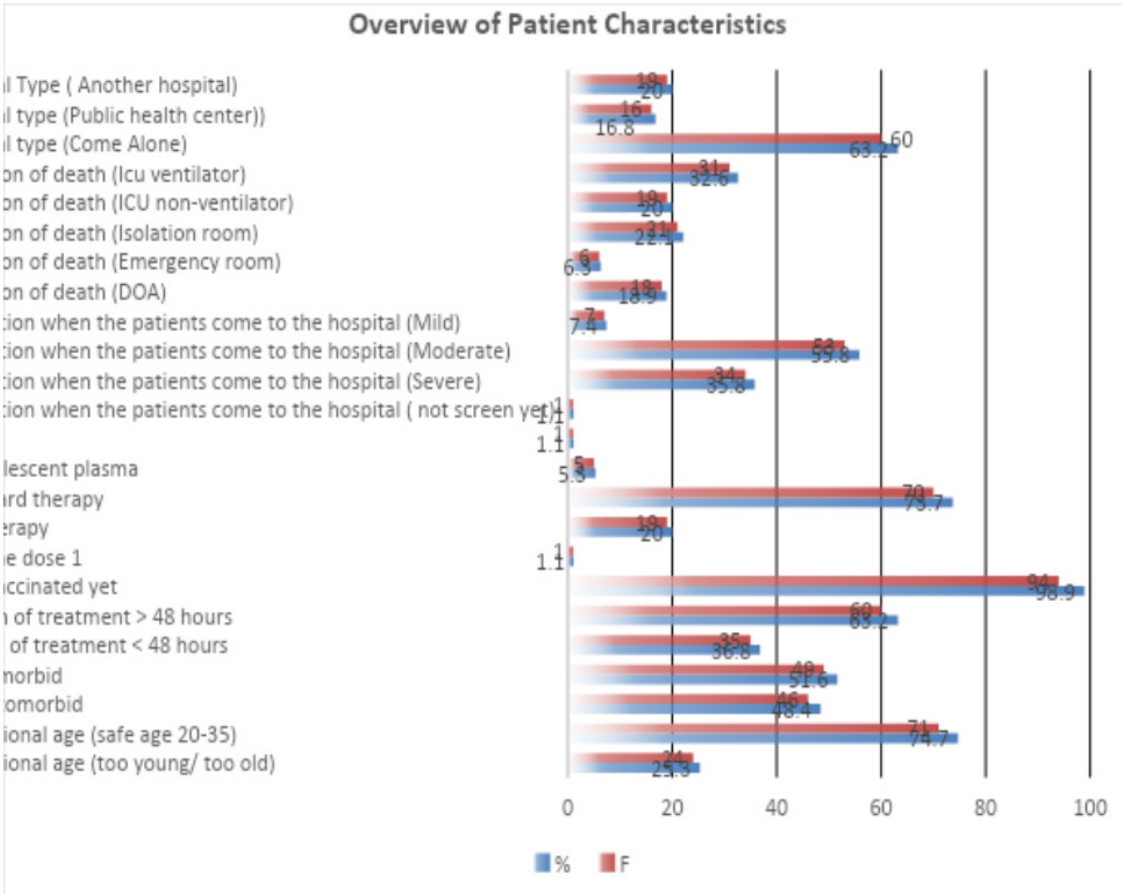

Figure 1. Describing the characteristics of the patient

Table 1 and Figure 1 show the distribution of patient characteristics. A total of 71 respondents (74.7%) had a pregnancy at a safe age (20-35 years), and 24 respondents (25.3%) had a pregnancy at a risky age (too young/too old). 98.9% of patients have not been vaccinated, and only 1.1% have received the first dose of the vaccine. The type of therapy received was 73.3% standard, 5.3% convalescent plasma, and 1.1% IVIG (intravenous immunoglobulin). Standard therapy is NaCl infusion, empiric antibiotics with levoflaxcine 1 × 750 mg, azithromycin 1 × 500 mg, and antiviral Oseltamivir 2 × 75 mg. SpO2 must be maintained at 95% saturation. If SpO2 drops below 95%, blood gas analysis is required Oxygen therapy until the target O2 saturation is at least 95%. About 20% there is no data on the type of therapy given. 55.8%, or 53 respondents, came to the hospital with a moderate illness, and 35.8% with a critical condition. We found that 18.9% of pregnant women died on arrival at the ER (dead on arrival/ DOA or died in our emergency department / ED) and died while receiving treatment in the ER (6.3%). There were 60 patients (63.2%) who came alone to the hospital, and others were referrals from Community Health Centers/ Puskesmas (16.8%) and other hospitals (20.0%).

The ability to organize surge capacity adequately in hospitals would be able to control the risk of death due to Covid-19 because the ICU does not overflow and more prepared (pandemic-ready) to provide early treatment in the form of ICU access and ventilators for critical patients due to Covid-19, such as in Singapore and Belgium (Chew et al., 2020, Taccone et al., 2021). In several hospitals in major cities in Central Java, the bed occupation ratio (BOR) of Covid patients treated in the ICU during the July-August 2021 period was reported to exceed 100%, even though based on data collection in the online Hospital Information System (Sistem Informasi Rumah Sakit/SIRS), the total capacity of 1361 beds for ICU occupied 81.63% as of July 1, 2021, and in fact, the occupancy has decreased to around 62.02% of the total capacity of 1535 beds in Central Java.

Adequate oxygen therapy is also an aspect that determines the success of saving the lives of Covid 19 patients (Ospina-Tascón et al., 2022, Yarnell & Sklar, 2022). This oxygen therapy certainly requires speed & adequacy of its supply and distribution. The problem is out of stock supplies of medical oxygen occur globally and nationally, which encourages the government to make policies to secure the adequacy of supply (Mart et al., 2022). The scarcity of medical oxygen is also experienced by most hospitals in Central Java, as reported in SIRS online for the period July – August 2021, there were fluctuations in medical oxygen stock deficits ranging from 30-45% of the total requirement of around 424,940 m3/day (Central Java Covid-19 Task Force, 2021)

Pregnant women and comorbid diseases (hypertension and diabetes mellitus) are risk factors for SARS-CoV-2 infection (Wei et al., 2021). Based on data from the Indonesian Obstetrics and Gynecology Association (POGI), as many as 13.7% of pregnant women are more susceptible to SARS-CoV-2 infection than women who are not pregnant (Purwono et al., 2023). During pregnancy, there are changes in the immune system and physiological changes in the body. Therefore, WHO recommends that if there are pregnant women with symptoms of COVID-19, should be prioritized to undergo RT-PCR examination (Mirbeyk et al., 2021). Factors that make it easier for pregnant women to become infected with SARS-CoV-2 are having a history of traveling/ living in a country/territory of Indonesia which is a local transmission, a history of contact with confirmed/probable cases of being infected with SARS-CoV-2 and a history of contact with animals infected with SARS-CoV -2 (Jamieson & Rasmussen, 2022). In addition, both normal pregnancy and COVID-19 are marked by a decrease in lymphocytes, so pregnant women are susceptible to infection with SARS-CoV-2 (Phoswa & Khaliq, 2020). In the emergency management variable, there are indicators of the patient condition coming to the hospital in a mild, moderate, severe, or critical. Our research is a case of the death of pregnant women in the second wave of the COVID-19 pandemic in Indonesia, especially those admitted to COVID-19 referral hospitals in central Java-Central province.

The Indonesian Obstetrics and Gynecology Association (POGI) noted that 20 percent of the deaths of pregnant women (pregnant mothers) in the last 17 months were those infected with COVID-19. In the era of the pandemic, maternal deaths with COVID-19 contributed 20 percent to the maternal mortality rate in Indonesia. In fact, within July 2021, it tripled (Helmyati et al., 2022). In cases of death of pregnant women due to COVID-19, it could occur due to late handling because of the labour force. Health care providers did not have much guidance on monitoring pregnant women for COVID-19 or how to care for the infected. In addition, many pregnant women did not receive optimal care when their immune systems are compromised, resulting in a critical condition for pregnant women taken to a referral hospital. Moreover, pregnant women were not served when they need hospitalisation/oxygen therapy if they are infected with COVID-19 (Villar et al., 2021).

The indicator of the length of stay is closely related to existing health service facilities. Currently, there is no specifically-designated COVID-19 hospital for pregnant women. So pregnant women still find it difficult to get help when infected with COVID-19. It is also quite hard to get help for consultation and treatment to the problem of childbirth needs in the pandemic era that causes cases of pregnant women dying. For example, in Boyolali, 18 pregnant women in Boyolali died from COVID-19, with most cases occurring in Nogosari and Sambi Districts. In Nogosari District, with 585 pregnant women, 23 pregnant women were affected by COVID-19, and 5 died. Meanwhile, in Sambi District, the number of pregnant women was 384, 14 were affected by COVID-19, and 5 died. Cases of pregnant women exposed to the Coronavirus require special handling by skilled health workers handling COVID-19 and adequate health facilities. In Boyolali, only one hospital is used as a reference for treating pregnant women affected by COVID-19, namely the Pandan Arang Regional General Hospital (RSPA) Boyolali, which is quite far from the area. So emergency handling often occurs that is less than optimal because the condition of

the patient when he arrives is already critical (Anggraeni et al., 2023). In addition, there are already evidence-based policies regarding COVID-19 in pregnant women, including the CDC (Centers for Diseases Control and Prevention), which states that pregnant women will experience more severe conditions than women who are not pregnant and thus require hospitalization, intensive care, or ventilator and other breathing apparatus (Nana et al., 2022).

A retrospective observational cohort study of pregnant and postpartum women with COVID-19 admitted to the BYL Nair Charitable Hospital, a COVID-19 referral hospital in the Mumbai Metropolitan Area, reports: The number of pregnant and postpartum women admitted to batch one was 1,143 and in batch 1 the second as many as 387 cases. Severity, ICU care and maternal mortality rates were higher in the second wave. The majority of maternal deaths are due to COVID-19 pneumonia and respiratory failure (Mahajan et al., 2021). In our study, 50 cases of death occurred in the ICU, 34 patients came to the hospital in severe condition and 53 cases were moderately ill.

A Brazilian study included 2284 hospitalised pregnant and postpartum women with severe COVID-19, those who: had received two doses of the COVID-19 vaccine had a 46% reduction in the odds of ICU admission, an 81% reduction in the likelihood of invasive ventilation support, and an 80% reduction in the likelihood of death compared to those who did not receive the COVID-19 vaccination (de Freitas Paganoti et al., 2022). Our study reported that out of 95 maternal deaths, 94 had never been vaccinated and one case had been vaccinated once.

Weaknesses in this study, it did not report the total number of pregnant women with COVID-19 who were admitted to the referral hospital, both those who were treated later healthy and those who died. The types of patient comorbidities have also not been reported in detail, such as hypertension, diabetes mellitus, lung disease, heart disease, and others. This allows future research to be carried out with more complete data.

Conclusion

In this study, we found that most patients treated at the referral hospital for COVID-19 in Central Java were aged 20-35 years, most of the patients had never received a COVID-19 vaccination and mostly died in the ICU.

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Community-Based Sanitation Management Model Using Local Aspects of Coastal Areas

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Abstract

Previous findings showed that there are only a few studies on the core problem of environmental sanitation in coastal areas. In the study by Mawar and Wahidah (2018), the coastal community of Percut Sei Tuan only uses 20% clean water, does not have a latrine 42.9%, and does not have a SPAL of 46.7%. Therefore, this study aims to examine the cultural, gender, and stakeholder aspects of community-based sanitation management (CBSM). A cross-sectional design was used, and the sample population was family heads in the Percut Sei Tuan Sub-district. The sample size used a category survey formula of 414 households from the population. The samples were selected using a simple random sampling technique, and a questionnaire instrument, tested for its validity and reliability, was used for data collection. The data were then analyzed using CFA (Confirmatory Factor Analysis) to assess the factors affecting CBSM. The results showed that gender roles significantly affect environmental sanitation management in coastal areas with a P<0.001, and culture significantly affect CBSM with a P<0.001. However, the role of stakeholders was insignificant in this study. CBSM in coastal areas was still very low in planning participation, implementation, and utilization. The involvement of women as an aspect of gender in the formation of a disciplined culture in sanitation management is vital to mobilize family members.

Introduction

Coastal areas have complex and unique issues, problems, opportunities, and challenges that are different from other regions. Furthermore, they are often characterized by a limited supply of clean water, latrines, wastewater disposal systems, landfills, and unhealthy housing (Heynnor, 2021), including in Indonesia. A previous study revealed that (Putri, Galib and Mubarak, no date), unclean water, poor sanitation, and hygiene are extremely detrimental to health and account for more than 10,000 deaths annually. Lack of attention from stakeholders (Widiastuti, 2019), poor culture (Sembiring, 2022), and gender dominance in decision-making regarding sanitation provision are some of the obstacles to creating a clean and hygienic environment (Abu, Bisung and Elliott, 2019).

A program, namely the Community Lead Total Sanitation (CLTS) was created in Indonesia to strengthen efforts to cultivate clean and healthy living, prevent the spread of environmental-based diseases, improve community capacities, and implement the government's commitment towards improving access to drinking water and sustainable basic sanitation(Muaja, Pinontoan and Sumampouw, 2020). However, the implementation of the CLTS program in coastal areas is still less effective (Andriani, 2022) because it is not focused on a sustainable basis for these regions

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(Rany and Af, 2021).

The execution process is also still on evaluating community knowledge, attitudes, and actions (Hafizah, 2022). The interventions carried out are continuously running, but the inhabitants of coastal areas believe that sanitation is not a necessity. Several studies revealed that coastal communities still have passive attitudes toward proper hygiene (Herdiansyah et al., 2021). Although the inhabitants are knowledgeable, they still practice unhealthy open defecation (Andriani, 2022). Previous reports showed that only 62.77% of coastal areas verified as Open Defecation Free (ODF) villages. (Health, 2022). Indonesia has the second worst sanitation condition in the world, and if the root cause of the problem is not found and resolved, it can become very difficult to improve.

The low level of community-based sanitation management (CBSM) is caused by cultural, gender, and stakeholder factors (Chan et al., 2020; Daniel et al., 2021; Mulopo and Chimbari, 2021). The context of healthy living is not a priority in the fulfillment of women's basic rights (Roaf, de Albuquerque and Heller, 2018). It is evident from the low access to clean water, which has not been used optimally by women on the coast (Hoque et al., 2019). Previous studies revealed that their involvement as a gender aspect is very important for the success of sanitation programs, the formation of better culture, and community participation (Mova et al., 2019). Furthermore, stakeholders are needed to make efforts to invite and influence the community to be involved in CBSM based on the unique characteristics of the area (Sulistyaningsih et al., 2021).

The Percut Sei Tuan coastal area is a community with a homogeneous religion, lifestyle, behavior, and characteristics. The people live around the sea and use marine resources as the primary source of livelihood. Furthermore, their daily needs revolve around the river due to the ease of access. In waste management, the community still collects the waste in front of the house and dispose refuse into the river. This habit has been passed down from generation to generation. Hanging latrines that are only covered with plastic, as well as emergency washing stations, are present along the river.

The influential factors inhibiting CBSM identification is important (Love et al., 2022), including the community's knowledge, attitudes, and actions (Hafizah, 2022). Other aspects, such as culture, gender, and stakeholders, need a study. They are often considered in the evaluation of approaches for the community related to environmental sanitation. It ensures that people are willing and able to participate in creating a hygienic environment in coastal areas. Therefore, this study aims to examine the cultural, gender, and stakeholder aspects of community-based sanitation management.

Method

It is a quantitative study with a cross-sectional design, which analyzed the roles of cultural, gender, and stakeholders in community-based sanitation management. This study design to obtain initial data that has never been studied, then develop them for the modeling stage. This study took place in the coastal settlement of Sei Tuan Sub-district, Deli Serdang Regency, North Sumatra Province, from January 2021 to March 2022. Geographically, this region is at 3.7 latitudes and 98.7 east longitudes, 3 meters above sea level, with an area of 1,060 ha.

The sample consists of people living in the coastal settlement of Percut Sei Tuan Sub-district, Deli Serdang Regency, North Sumatra Province. The population in this study was the coastal community of Percut Sei Tuan, Deli Serdang Regency, North Sumatra Province, as many as 4714 people. The sampling took the population mapping in the sub-district office. Furthermore, the area consists of 5 points, namely hamlets 14 to 18, located on the outskirts of the river. Respondents were based on the head of the family, namely the father, or household members, namely the wife. The categorical survey formula was used to determine the number of households (n), namely 414, where the Z value for the confidence level was 95%. The samples in this study were selected using the simple random sampling method. Sampling frames were obtained from the sub-district office, and random sampling was carried out. Data collection used a questionnaire tested for validity and reliability. Furthermore, the

respondents signed informed consent while maintaining confidentiality.

The dependent variables were community-based sanitation management, which consists of indicators of planning (consists of community meetings/deliberations to discuss environmental sanitation management, attend meetings to talk about environmental sanitation management, participate in activities that support environmental sanitation management activities), implementation (participate in joint contributions for the maintenance of shared facilities), and utilization of participation (participate in repairing public facilities if they are damaged or disturbed, and participate in the evaluation process or the evaluation of activities carried out together). The dependent variable in this study was community-based sanitation management. Each question from the variables of planning, implementation, and utilization of participation was given a score with a minimum value of 1 (never) to a maximum of 5 (very often). The questionnaires consist of 18 questions, of which 6, 3, and 7 were under the variables of planning, implementation, and utilization of participation, respectively. The answer options include Never (Ne), Rarely (R), N (Neutral), Often (O), and Very Often (VO).

The independent variables are cultural (apply religious advice, such as cleanliness as part of your faith), gender roles (given the opportunity and willing to make decisions in providing sanitation tools or equipment to the family), and stakeholder roles (the role of stakeholders, local leaders, and religious figures). The cultural variables consist of indicators of belief values (ordinal) and cultural norms (ordinal), while the gender roles contain indicators of decision-making (ordinal), involvement in planning (ordinal), and implementation (ordinal). Furthermore, the stakeholder variable consists of indicators, such as the role of government (ordinal), community leaders (ordinal), and religious leaders (ordinal).

The research model in this study consists of gender and stakeholder roles directly related to culture, followed by culture related to community-based sanitation management. The model also contains the indirect influence of gender roles and stakeholders on community-based sanitation management. H1. Gender has a significant effect on the culture of environmental sanitation management in coastal areas. It also plays a vital role in the formation of culture in these regions (Silva et al., 2020). In most societies in Indonesia, women have the primary responsibility of managing household water supply, sanitation, and health (Elysia, 2018). They are also responsible for the provision and treatment of safe and adequate water for family needs (Radonic and Jacob, 2021). Furthermore, women are the primary caregivers for children, which indicates that they have a vital role in supporting children's health.

The participation of female fishermen in decision-making is not well organized and less effective as a political force compared to males (Wuya, 2021). When women are given a place in an organization or decision-making process, they essentially bring a perspective that puts improving the quality of life and fisheries-based livelihoods as the priority (Owusu and Andriesse, 2020). H2. The role of stakeholders has a significant effect on the culture of environmental sanitation management in coastal areas. Furthermore, stakeholders include all actors or groups that influence and/or are affected by the policies, decisions, and actions of a program. They are needed to invite the community to attend and provide suggestions for every meeting held. It is because the community plays a vital role in social, institutional, and environmental conditions, and they need to understand the goals and objectives of the program (Haldane et al., 2019).

Stakeholders directly affect the culture related to environmental sanitation management in coastal areas (Mensah and Enu-Kwesi, 2019). The forms of support carried out continuously, either through policies or infrastructure, affect the cultural pattern of the community (Fatkhullah, Habib and Nisa, 2022). The culture formation is facilitated by the active intervention of stakeholders (Karanika-Murray, Gkiontsi and Baguley, 2018). H3. Environmental sanitation management culture has a significant effect on community-based sanitation management.

Coastal communities have become part of a pluralistic society, but they still have a spirit

of togetherness. Consequently, the average coastal community structure is a combination of the characteristics of urban and rural areas. It indicates that they can form cultural systems and values, which are the acculturation of each component (Diansari et al., 2020). Cultural factors that include norms and belief values are not easy to implement, especially in a certain community environment. However, they can directly affect community participation (David-Chavez and Gavin, 2018). The principles of participation must pay attention to togetherness, growing from the bottom (bottom-up), as well as trust and openness (Diab et al., 2022).

Data analysis was carried out with frequency distribution and CFA (Confirmatory Factor Analysis) using SmartPLS version 3. The data were analyzed to determine the dimensional construct of the dependent variable. The accuracy of the CFA test was used to assess the validity and reliability of the indicators forming the construct of behavioural variables based on the previous theory. Therefore, the right indicators were obtained to compile community-based sanitation management variables.

Result and Discussion

Culture and gender play a major and active role in environmental sanitation. However, the function of stakeholders in mobilizing the community to participate in these activities in coastal areas is still suboptimal, as shown in Table 1.

Table 1. Identification of Factors Associated with Sanitary Behavior.

Variable	Indicators	Frequency	Percentage (%)	95% Confident Interval
Culture	**Trust Value**			
	Never	8	1.9	0.7-3.4
	Seldom	27	6.5	4.3-8.7
	Sometimes	70	16.9	13.3-20.7
	Often	101	24.4	20.5-28.7
	Always	208	50.2	45.4-54.7
	Cultural Norms			
	Never	49	11.8	8.9-15.0
	Seldom	98	23.7	19.6-27.8
	Sometimes	67	16.2	12.8-20.3
	Often	69	16.7	13.1-19.8
	Always	131	31.6	27.1-36.5
	Decision-making			
	Never	42	10.1	7.2-13.0
	Seldom	12	2.9	1.4-4.3
	Sometimes	20	4.8	2.9-7.2
	Often	110	26.6	22.8-31.2
	Always	230	55.6	51.0-60.6
Gender Role	**Involvement in Planning**			
	Never	77	18.6	15.1-22.5
	Seldom	27	6.5	4.3-9.1
	Sometimes	30	7.2	4.7-10.0
	Often	88	21.3	17.1-25.6
	Always	192	46.4	41.8-51.0
	Involvement in Implementation			
	Never	85	20.5	16.7-24.3
	Seldom	22	5.3	3.5-7.5
	Sometimes	40	9.7	6.8-13.0
	Often	77	18.6	15.1-22.7
	Always	190	45.9	41.2-50.7

Variable	Indicators	Frequency	Percentage (%)	95% Confident Interval
Stakeholder Role	**The Role of Stakeholders (Government)**			
	Very low	82	19.8	16.2-23.4
	Low	49	11.8	9.0-15.7
	Moderate	103	24.9	20.6-29.2
	High	147	35.5	31.2-40.2
	Very high	33	8.0	5.6-10.6
	The Role of Community Leaders			
	Very low	79	19.1	15.3-22.7
	Low	80	19.3	15.5-22.9
	Moderate	94	22.7	18.6-27.5
	High	138	33.3	29.5-37.9
	Very high	23	5.6	3.1-8.0
	The Role of Religious Figures			
	Very low	109	26.3	22.2-30.9
	Low	48	11.6	8.7-15.1
	Moderate	110	26.6	22.0-31.2
	High	114	27.5	23.2-31.9
	Very high	33	8.0	5.4-10.9

Source: Primary Data, 2022

In the aspect of culture, cultural norms are not in a good range, and they have not been fully implemented. The stakeholders aspect is divided into three, namely the role of stakeholders government, community leaders, and religious figures, with percentages of 35.5%, 33.3%, and 27.5%, which was in the high category. Community-based sanitation management on the coast of Percut Sei Tuan is in a low category in terms of participation in planning, implementation, and utilization, as shown in Table 2.

Table 2. Community-Based Sanitation Management in Coastal Area

Community-Based Sanitation Management	Frequency	Percentage (%)	95% Confident Interval
Participation of Planning			
Very low	157	37.9	33.6-42.4
Low	52	12.6	9.4-16.2
Moderate	63	15.2	11.6-18.8
High	60	14.5	10.9-18.0
Very high	82	19.8	15.6-24.3
Participation of Implementation			
Very low	61	14.7	11.2-18.4
Low	35	8.5	6.0-11.1
Moderate	88	21.3	16.9-25.1
High	171	41.3	36.7-45.9
Very high	59	14.3	11.0-18.1
Participation of Utilization			
Very low	172	41.5	36.8-46.3
Low	71	17.1	13.5-21.0
Moderate	71	17.1	13.3-21.3
High	36	8.7	6.0-11.1
Very high	64	15.5	12.2-19.2

Source: Primary Data, 2022

In the coastal area of Percut Sei Tuan, two aspects were in the very low category. Namely participation in planning and utilization with percentages of 37.9% and 41.5%, respectively. Meanwhile, the implementation aspect was still in the high category, namely 41.3%. The results also showed that half of the samples had low participation.

Table 3. The result of the measurement model.

Construct	Loading	Cronbach's alpha	Dijkstra–Henseler's rho (ρA)	CR	AVE
Culture		0.601	0.655	0.829	0.709
TV	0.779				
CN	0.901				
Gender		0.869	0.921	0.920	0.795
DM	0.755				
IP	0.957				
IM	0.949				
CBSM		0.717	0.718	0.841	0.638
PoP	0.814				
PoI	0.787				
PoU	0.795				
Stakeholder		0.940	0.981	0.961	0.891
RG	0.906				
RC	0.966				
RR	0.958				

Note (s): CR = composite reliability; AVE = average variance extracted; TV = Trust Value; CN = Cultural Norms; DM = Decision-making; IP = Involvement in Planning; IM = Involvement in Implementation; PoP = Participation of Planning; PoI = Participation of Implementation; PoU = Participation of Utilization; RG = The Role of Stakeholders (Government); RC = The Role of Community Leaders; RR = The Role of Religious Figures

Source: Primary Data, 2022

In evaluating the measurement model, the reliability of the scale for each construct was first analyzed. Table 3 shows that all variables have a very high level of item reliability, which was more than 0.708. For Dijkstra–Henseler's rho (ρA), they were also all reliable with an average value of > 0.7 except for the cultural variable. However, all CR values were more than 0.7, indicating that the variables have a high level of reliability. The convergent validity was then reviewed using extracted variance (AVE). The results showed that each construct variable was greater than 0.5 with a range of 0.638-0.891.

Table 4. Discriminant validity

		Culture	Gender	CBSM	Stakeholder
Fornell–Larcker criterion	Culture	0.842			
	Gender	0.300	0.892		
	CBSM	0.374	0.349	0.799	
	Stakeholder	0.141	0.223	0.221	0.944
Heterotrait-monotrait (HTMT) ratio	Culture				
	Gender	0.402			
	CBSM	0.548	0.417		
	Stakeholder	0.179	0.239	0.270	

Source: Primary Data, 2022

The next step was discriminant validity analysis using the Fornell-Larcker criteria. The results of this study indicate that the square root of each value of the AVE construct must be higher than its correlation with other latent variables. For comparison, discriminant validity was also analyzed using Heterotrait-monotrait (HTMT) ratio. In this study, the value obtained was still below the cut-off value, which indicates very good reliability and validity, as shown in Table 4.

Table 5. Confirmatory Factor Analysis.

Hypothesis/Relationship	β	T value	95% Confident Interval	P values
H1: Gender Culture	0.282	5.425	[0.175;0.377]	0.000*
H2: Stakeholder□Culture	0.078	1.692	[0.003;0.178]	0.091
H3: Culture□CBSM	0.374	9.198	[0.298;0.446]	0.000*

Source: Primary Data, 2022

Based on the analysis, gender roles have a positive (β = 0.282; t = 5.425) and significant effect on the culture of environmental sanitation management in coastal areas (P value <0.000), as shown in Table 5. Stakeholders also have a positive effect (β = 0.078; t = 1.692) but has no significant effect (P value 0.091). Environmental sanitation management culture has a positive (β = 0.374; t = 9.198) and significant effect on community-based sanitation management (P value <0.000).

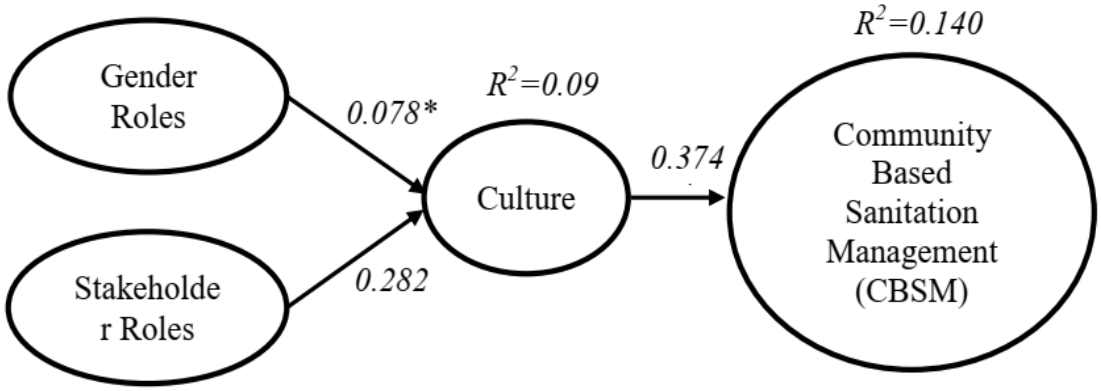

Figure 1. Community-Based Sanitation Management Model

The coastal area of Percut Sei Tuan is located in the coordinate range of 3,288.555354 m, 3.70864030 latitudes, and 98.7775970 longitudes, and it consists of the Bandar Sidora River. Indonesia is an archipelagic country with various ethnic groups (Antara and Yogantari, 2018), which led to the different cultures (Fuadi, 2020). A large number of residents are certainly balanced by the diversity of ethnicities in each region, including coastal areas. However, the culture in these areas tends to be homogeneous (Sulistiyono, 2015), which affects the habits and behavior that are almost similar among the inhabitants (Fuadi, 2020).

The coastal community of Percut Sei Tuan often throws garbage into the river, which can cause a decrease in aesthetics and environmental carrying capacity if not resolved, thereby leading to a low quality of settlements (Putri, Hadisoebroto and Hendrawan, 2019). It can also cause water pollution (Mensah and Enu-Kwesi, 2019), disease, and flooding. Several studies revealed that some poor residents do not meet their basic needs and sanitation requirement (Alam & Mondal, 2019; Sinharoy, Pittluck & Clasen, 2019; Corburn et al., 2020; Riski, 2021). For example, catching fish for a long period prevents them from contributing to environmental sanitation. They only spend a short time at home and more on the river or the sea (Equanti and Bayuardi, 2018). This condition illustrates inadequate housing and sanitation, where the Bandar Sidora River empties into the sea is an integral part of their lives.

The value of trust focuses more on

the religious aspect of the cultural variable. Cultural norms, such as gathering and discussing activities after prayer, are some time, rarely, or never found among the inhabitants, as shown in Table 1. Based on gender roles related to decision-making and involvement in planning and implementation, only half of the respondents have a good level of participation. Furthermore, the stakeholders' role was still very weak. Based on data analysis, only gender and cultural roles significantly affect environmental sanitation in the coastal area, as shown in Table 5.

Culture influences community-based sanitation management, and provides a style of experience for individuals in the society. It is a set of guidelines, which help humans adapt and deal with specific environments. The sanitation development problem is a socio-cultural challenge (Taouraout et al., 2018; Roxburgh et al., 2020; Kakwani et al., 2021) due to the community behaviour, namely defecating in any place and throwing garbage into the river (Ellis et al., 2020). This often occurs because people in the unitary tribes have their respective cultural identities and unique systems. The results showed that cultures with poor values beliefs and norms cause bad knowledge, attitudes, and actions towards environmental sanitation. These poor behaviors lead to river pollution (Wang et al., 2019), defecation in rivers (Okumah et al., 2019), as well as lack of participation in the community's management (Knickmeyer, 2020).

The inhabitants of coastal communities often have hard and unruly character. In terms of demographics, they are often residents who work as seafarers (Nurhayani and Hodijah, 2018). The acceleration of sanitation improvement is often inhibited when culture is not reformed (Nagla, 2020). The programs held by the government are insufficient to sustainable address the problem of environmental sanitation cleanliness (Van Welie, Truffer and Yap, 2019). Cultural intervention is not enough to increase knowledge (Caesar, Dewi and Husna, 2019) because people who are very knowledgeable are not necessarily willing and able to participate in overcoming these problems (Ajisuksmo and Iustitiani, 2020), especially in coastal areas (Rahman, Sididi and Yusriani, 2020). This shows that other factors, such as gender and stakeholder roles are needed (Ciftcioglu, 2021).

Coastal areas are also identical to the division of gender roles. The function of women in environmental sanitation control decisions was in the excellent category. Gender has a significant relationship with hygienic behaviour because women need high quality basic facilities (Silva et al., 2020). They are also in charge of fostering sanitation-related families as wives, household managers, mothers (successors and educators of children), breadwinners, and community members. Women interact directly with water activities and are also the dominant users in the household (Als et al., 2020). This is different from the coastal men, whose job is to find fish and fulfil economic needs.

Gender empowerment has a great influence on community behavior, especially families (Anderson et al., 2021). The gender perspective is often used with the assumption that environmental problems, especially river pollution, are getting worse. One of the causes is the occurrence of inequality in the society, including coastal communities. Women who have a positive potential to preserve the environment, and their quality of life are not priotized by he community. The role of women's groups is often ignored by the society, which makes their quality as human resources to be very effective in developing community life, while the environment is neglected. Furthermore, those who are more oriented towards the survival of family members often have a more optimistic, constructive and long-term way of thinking about environmental and community sustainability.

Stakeholders in this study had no significant effect on sanitation management, but they still play a passive role in overcoming environmental sanitation problems using the CBSM approach. A total of three stakeholders were explored in the coastal area, namely the government, community leaders, and religious leaders. The role of government and religious leaders was still in the low category at 35.5% and 27.5%, respectively, while the community leaders were high at 33.3%, a shown in Table 1.

Stakeholders as groups or individuals can influence or be influenced by the achievement of certain goals, and they have the authority

and budget to improve sanitation (Kobusingye, Mungatu and Mulyungi, 2017). Therefore, improving community environmental hygiene can easily be carried out with their participation. The main activities consist of advocacy, capacity building, and increasing partnerships between stakeholders (Singh Chouhan et al., 2022). The subject matter of this activity must be well-planned by community-based activity methods. The factor that affects the low participation of the community is that internal stakeholders are less active (Hadj, 2020). This is important because the CBSM on the coast of Percut Sei Tuan is still very low, as shown in Table 2.

Low CBSM hampers the development of sanitation in the region, especially in coastal areas (Lisafitri et al., 2021). Participation in planning and utilization are carried out to trigger the sustainability of a sanitation improvement program (Surya et al., 2021). This enables the community participate in selecting the most suitable solution and feel the benefits that have been built together (Spuhler and Lüthi, 2020). CBSM, which progressed from this study involve gender roles to form a better culture a well as increasing the active role of stakeholders.

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Conclusion

Community-based sanitation management in coastal areas is still very low in participation in planning, implementation, and utilization. Aspects of gender and cultural roles have a significant relationship with managerial activities. The involvement of women as an aspect of gender and the active role of stakeholders is needed in the formation of a disciplined culture for sanitation management. It is very necessary to mobilize family members to participate in community improvement. The community must maintain the environmental sanitation facilities provided by the local government and work together to clean and maintain the sanitary cleanliness of the surrounding environment and clean them at least once a week.

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The Maternal Sociodemographic Determinants of Low Birth Weight in Indonesia

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Abstract

LBW is one of the highest predictors of infant and child mortality. In Indonesia, more than 100 thousand newborns experience LBW cases. In addition to birth intervals, there are maternal sociodemographic factors can explain cases of LBW, such as age, parity, location of residence, marital status, education, and level of maternal welfare. For this reason, this study aims to analyze the association between birth intervals and maternal sociodemographic factors in LBW cases using the 2017 IDHS data. The study results show that 1 in 10 babies is born with LBW. More than half are found in rural areas, with secondary education of the mother, and in the poorest conditions. SRS results show that birth interval has no significant association with LBW. However, from the results of MLR, birth interval, parity, mother's age, residency, education, and the interaction between education and birth interval are significant determinants of LBW. Mothers who have children with short (<24 months) or long (>48 months) birth intervals, live in urban areas, have a lower level of education, and are under 20 or over 35 years old have a greater chance of giving birth to LBW babies. Meanwhile, mothers with more children have a slight chance of giving birth to LBW babies. These findings show the critical role of family planners in educating partners and parents in Indonesia regarding the potential risks of LBW babies according to the mother's sociodemographic condition.

Introduction

Low birth weight (LBW), defined as a baby weighing less than 2.5 kilograms at birth, is the strongest predictor of infant and toddler death (WHO, 2005). Because of this LBW syndrome, babies are at a higher risk of stunting and acquiring noncommunicable diseases like diabetes, hypertension, and heart disease as adults, as well as having a shorter life expectancy (Brumana et al., 2017; Mwabu, 2009). The birth interval, defined as the time between a live birth and the conception of a subsequent fetus by Merklinger-Gruchala et al. (2015) is one factor affecting LBW. The birth interval is associated with a more than fifty percent rise in LBW (Shah et al., 2022; Zhu, 2005).

According to data from the 2019 Directorate of Community Nutrition, 111,827 infants in Indonesia have low birth weights (Ministry of Health, 2020). Furthermore, according to data from the Ministry of Health of the Republic of Indonesia in 2019, 69% of the fatalities of children under the age of five happened during the neonatal period. LBW was the leading cause of death in all recorded newborn deaths, accounting for 7,150 instances (35.3%). The pregnancy interval, which produces low maternal nutritional status, is one of the reasons that can explain LBW instances, according to (Guevara-Romero et al., 2021). The time between births is critical in determining the baby's health. The WHO (2006) recommends a minimum of 24 months between births. Furthermore, the risk of LBW is increases during the first child's birth (Kyozuka et al., 2019).

The prevalence of LBW varies significantly according to the country's socioeconomic situation, healthcare system, maternal variables, and other empirical criteria (Habibov & Fan, 2011). In a Nepal study, Anil et al. (2020) discovered that maternal

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variables such as maternal age, LBW history, smoking during pregnancy, and health problems all enhance the risk of LBW. Bird et al. (2000) found that the mother's marital status influences LBW, with married moms having a lower likelihood of producing LBW babies than unmarried mothers (pregnant outside of marriage). Furthermore, Auger et al. (2008) claim that short birth intervals (less than 12 months) and unmarried pregnancies increase the chance of LBW newborns. Wubetu et al. (2021) found that the prevalence of LBW was highest among mothers under the age of 20 who were low-income, single, alcoholic, uneducated, and multigravida. According to these studies, researchers typically employ two to three maternal factors as model predictors, even though using maternal factors in a more sophisticated manner may result in a superior model for evaluating the incidence of LBW in Indonesia.

Several rigorous research has been done to determine the precise cause of LBW. However, the results have yet to be resolved. As a result, the primary goal of this research is to examine the relationship between birth intervals and LBW in Indonesia, a low-middle-income country with a relatively high LBW rate in the world (10th position) (Haksari, 2019). The second goal is to examine the maternal characteristics that influence the condition of LBW, specifically the mother's age, parity, education, marital status, welfare index, and home area (Habibov & Fan, 2011; Momeni et al., 2017; Ngwira, 2019; Sharma et al., 2015; Yanuar et al., 2019). The study's premise is that increasing the level of poverty, education, mother's age, and birth interval will positively improve prenatal health care utilization, increasing the likelihood of normal birth weight kids. On the other hand, parity, married status, and home location will negatively impact LBW.

Method

This paper is a quantitative study based on secondary data. The dataset utilized in this study was derived from the Indonesian Demographic and Health Survey (IDHS), which was conducted in 2017 by the National Family Planning Coordinating Board (BKKBN), the Central Statistics Agency (BPS), and the Ministry of Health (IDHS, 2017). The dataset used was 9,527 samples; the variables are listed in Table 1 below. The sample exclusively included mothers who had live-born children. Some of the literature examines the determinants of LBW using various analytical methods such as binary logistic regression, regression quintile, and two-stage least squares (2SLS) (Anil et al., 2020; Geraci, 2016; Habibov & Fan, 2011).

TABLE 1. Research Variables

Variable Name	Unit/Level of Variable	Range/Categories	Data Scale
Dependent Variable			
- Child Birth Weight (CBW)	In grams (most recent birth)	200-7.500 grams	Numeric/Ratio
Independent Variable			
- Mother's Age	Mother's age at the most recent birth	15-48 years old	Numeric/Ratio
- Parity	Number of live births of the mother	2-12 children	Numeric/Ratio
- Residence	Type of residence place of the mater	1: Urban 2: Rural	Categoric/Nominal
- Marital Status	Marital status of a mother	0: Never in union 1: In union 2: Divorced/widowed	Categoric/Nominal
- Birth Interval	Preceding birth interval (most recent birth)	0: Short <25months 1: Medium 25-48 months 2: Long ≥49months	Categoric/Ordinal
- Education	The highest educational level of the mother	0: No education 1: Primary 2: Secondary 3: Higher	Categoric/Ordinal
- Wealth	Wealth quintile of the mother	1: Poorest 2: Poorer 3: Middle 4: Richer 5: Richest	Categoric/Ordinal

Source: IDHS, 2017

This essay will estimate the socio-demographic effect of mothers on LBW cases using multiple linear regression (MLR). MLR is used to determine the effect of socio-demographic variables on birth weight to distinguish the characteristics of mothers who give birth to normal and LBW kids to prevent and avoid future cases of LBW. An interaction is generated in the regression model between the birth interval and the mother's education because, according to Howard et al. (2013), the birth interval is a risk factor that mothers can alter through educational measures. We also include the quadratic maternal age variable in the model because, according to Habibov & Fan (2011) and McGovern (2013) there is a quadratic trend in the maternal age variable, with birth weight being higher in mothers aged 20-35 years and lower in mothers aged under 20 years and over 35 years. Furthermore, this variable is employed to overcome the model's cases of heteroscedasticity (Christensen, 2019). In addition to MLR, we employ descriptive statistics and correlation analysis to summarize the data and assess the response distribution (Cleff, 2019).

Result and Discussion

The research begins by cross-tabulating the association between LBW and maternal sociodemographic determinants. Table 2 shows the distribution of LBW in each determining group. The average maternal age and number of live births among the 9,527 moms were 31.542 years (SD=5.432) and three children (SD=1.249). In general, the frequency of LBW is nearly comparable in rural and urban areas, with a 3.5% difference (Table 2). Almost two-thirds of newborns have long birth intervals (49 months). Meanwhile, the sample was dominated by mothers who were in a relationship/married (95%) and had secondary education (55.8%) based on maternal variables.

TABLE 2. Summary Statistics of Child Birth Weigth on Socio-demographic Determinants of Mothers

Variables	Frequency	%	Mean of Birth Weight	Standard Deviation	95% Confidence Interval		LBW
Birth weight	9,527	100.0	3,187.24	548.40			1,024 (10.75)
Residence							
- Urban	4,927	51.72	3,176.98	527.86	3,162.24	3,191.72	473 (46.19)
- Rural	4,600	48.28	3,198.22	569.43	3,181.77	3,214.68	551 (53.81)
Marital Status							
- Never in union	4	0.04	2,975.00	512.35	2,472.85	3,477.15	1 (0.10)
- In union	9,305	97.67	3,188.61	546.70	3,177.50	3,199.72	992 (96.88)
- Divorced/widowed	218	2.29	3,132.59	616.30	3,050.77	3,214.41	31 (3.03)
Birth Interval							
- Short <25m	965	10.13	3,171.50	558.12	3,136.28	3,206.72	117 (11.43)
- Medium 25-48m	2,441	25.62	3,217.44	549.20	3,195.65	3,239.23	238 (23.24)
- Long ≥49m	6,121	64.25	3,177.68	546.17	3,163.99	3,191.36	669 (65.33)
Education							
- No education	96	1.01	3,000.66	643.43	2,871.93	3,129.38	23 (2.25)
- Primary	2,604	27.33	3,143.28	593.12	3,120.49	3,166.06	378 (36.91)
- Secondary	5,316	55.80	3,200.29	534.75	3,185.91	3,214.67	514 (50.20)
- Higher	1,511	15.86	3,228.94	500.35	3,203.72	3,254.18	109 10.64)
Wealth							
- Poorest	2,235	23.46	3,162.50	615.02	3,137.00	3,188.00	347 (33.89)
- Poorer	1,916	20.11	3,179.20	557.16	3,154.25	3,204.15	221 (21.58)
- Middle	1,850	19.42	3,201.62	522.73	3,177.80	3,225.45	174 (16.99)
- Richer	1,784	18.73	3,203.89	519.53	3,179.78	3,228.00	144 (14.06)
- Richest	1,742	18.28	3,195.50	500.66	3,171.98	3,219.01	138 (13.48)

Source: primary data analysis from the IDHS 2017

Table 2 further shows that the average birth weight in all variables is higher than 2,500, indicating normal conditions. However, there are still many incidences of LBW in Indonesia, where one out of every ten kids is born with LBW. More than half of the LBW cases were in rural regions with lengthy birth intervals (64.33%) and moms with secondary education (50.2%). One-third of LBW instances are seen in the most vulnerable women. Then we identify the association between LBW and the maternal sociodemographic determinants. According to Cleff (2019), explanatory variables must have a high correlation with the response variable to be relevant and sufficient for identifying the model. The Pearson correlation for interval/ratio scale variables, ANOVA (F-test) for nominal scale variables, and Spearman's Rank for ordinal scale variables are employed to examine the relationship between birth weight and its statistical determinants (Cleff, 2019). Table 3 shows the results of the correlation. The test results demonstrate that although the link is very weak, the variables parity, level of education, and maternal welfare have a positive and significant correlation with birth weight. Birth weight has a negative and substantial relationship with the birth interval variable. Other variables, such as the mother's age and marital status, exhibit no significant link with birth weight. However, the residency variable is significant at the 10% level. Nonetheless, we will attempt to add these variables into the model to investigate their relationship with birth weight.

TABLE 3. Correlation Analysis Between Birth Weight and Mother's Sociodemographic Determinants

Variables	Coefficient	P-value
Pearson Correlation	1	
Parity	0.029	0.025*
Mother's Age	-0.006	0.573
ANOVA (F-test)		
Residence	3.570	0.059**
Marital Status	1.410	0.244
Rank Spearman		
Birth Interval	-0.020	0.050*
Educational Level	0.066	<0.001*
Wealth Index	0.040	<0.001*

Source: primary data analysis from the IDHS 2017

Note: *significant at the 5% level

After identifying the correlation, we construct the simple linear regression model to estimate the relationship between birth interval and LBW, the results of which are shown in Table 4 below. The study's initial hypothesis was that the birth interval had no effect on LBW. Table 4's t-test and p-values show that the relationship between birth interval and birth weight is significant at the 5% level (p=0.01). Babies born at medium birth intervals weighed 45.94 grams more than babies born at short birth intervals (p=0.028). At the same time, there was no statistically significant difference in birth weight between babies with long and short birth intervals (p=0.745). Furthermore, this model has a very low Adjusted R2 (<1%).

TABLE 4. Linear Regreesion of Birth Interval and the Child Birth Weight

Variable	Coefficient	SE	t-value	P-value	95% CI	
Model Parameter						
Birth Interval						
- Short <24 m	Ref					
- Medium 25-48m	45.940	20.844	2.200	0.028*	5.081	8.799
- Long 49+m	6.176	18.986	0.330	0.745	-31.041	43.392
Constanta	3,171.501	17.646	179.730	<0.001*	3,136.910	3,206.091
The goodness of fit model						
- F-test	5.030			0.0065*		
- R-squared	0.0011					
- Adjusted R-squared	0.0008					

Source: primary data analysis from the IDHS 2017

Note: *significant at the 5% level

In this section, we will examine the relationship between birth weight and maternal sociodemographic variables and the interaction between birth weight and the mother's education. According to Muula et al. (2011) and Sharma et al. (2015), mothers with a higher level of education are more likely to develop birth plans for their children, including birth intervals between children, to prevent pregnancy risks such as LBW. The anticipated value of each birth interval to schooling, which forms a parallel line (Figure 1.a), serves as the foundation for this model interaction, with the difference value always being the same (Table 5). The interaction result between birth interval and the mother's education is reported in Table 6.

Table 5. The Difference of Birth Interval Based on Maternal Educational Level

Difference	No Education	Primary	Secondary	Higher
Medium - Short	52.55	52.55	52.55	52.55
Long - Medium	-23.49	-23.49	-23.49	-23.49
Long - Short	29.05	29.05	29.05	29.05

Source: primary data analysis from the IDHS 2017

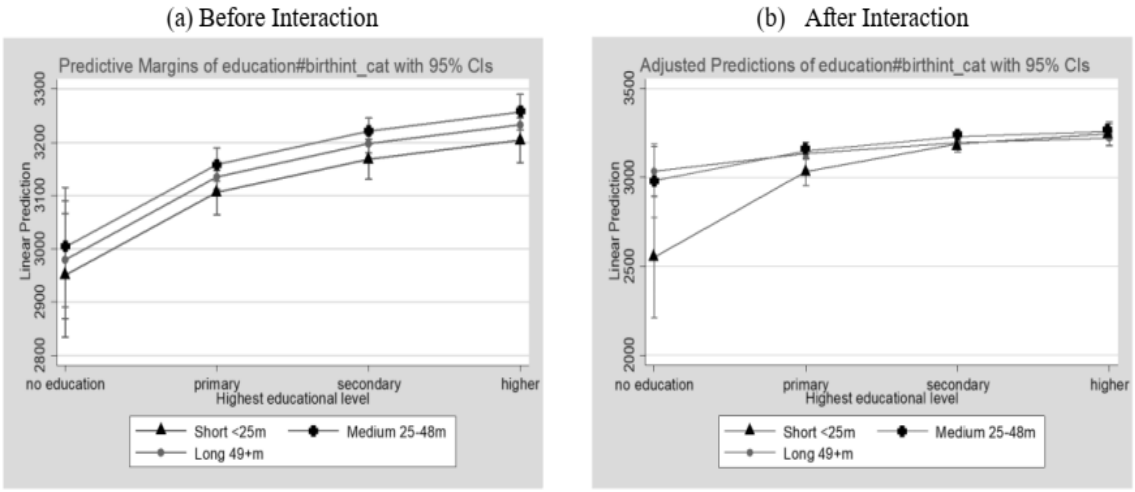

Figure 1. The Predicted Values of Birth Weight Based on Birth Interval and Mother's Education

Figure 1.b depicts MLR results with the interaction between birth interval and the mother's education. The regression line for each birth interval group is no longer parallel. Instead, it creates an interaction in which the birth weight discrepancy between short birth intervals and other categories is most significant in mothers who do not attend school. However, this gap will narrow as mothers' education increases. After equations 3-4, a detailed explanation of this interaction is provided.

The MLR findings of the two models are shown in Table 6. In the first model, we include all predictor factors, although certain variables, such as welfare level and marital status, are insignificant based on the joint F-test results. Except for the interaction parameter between the medium birth interval and elementary school (p=0.122), practically all categories in each birth weight variable were significant at the 5% level in Model 2. Meanwhile, the joint F-test revealed a significant interaction between education and birth interval at the 10% level (p=0.0605). This model's adjusted R2 value is 0.0098, indicating that all predictor variables can explain only 0.98% of the total variation in birth weight in the model.

Table 6. Multiple Linear Regression of Birth Weight and Mother's Sociodemographic Determinants

Variable	Model 1				Model 2			
	B	SE	t	P>t	B	SE	t	P>t
Parity	25.910	5.628	4.600	<0.001*	23.918	5.567	4.300	<0.001*
Mother's Age	24.439	9.946	2.460	0.014*	26.150	9.927	2.630	0.008*
Mother's Age Squared	-0.425	0.155	-2.740	0.006*	-0.446	0.155	-2.880	0.004*
Residence								
- Urban	Ref				Ref			
- Rural	45.858	12.592	3.640	<0.001*	35.992	11.548	3.120	0.002*
Birth Interval								
- Short <25 months	Ref				Ref			
- Medium 25-48 months	443.695	202.396	2.190	0.028*	442.223	202.422	2.180	0.029*
- Long 49+ months	497.413	187.188	2.660	0.008*	499.435	187.173	2.670	0.008*
Educational Level								
- No schooling	Ref				Ref			
- Primary School	482.285	177.538	2.720	0.007*	484.527	177.543	2.730	0.006*
- Secondary School	631.781	174.975	3.610	<0.001*	643.627	174.880	3.680	0.000*
- Higher (diploma or above)	682.852	177.155	3.850	<0.001*	697.644	176.905	3.940	0.000*
Wealth Index								
- Poorest	Ref							
- Poor	17.218	17.475	0.990	0.325				
- Middle	43.081	18.392	2.340	0.019*				
- Rich	43.745	19.389	2.260	0.024*				
- Richest	28.162	21.113	1.330	0.182				
Marital Status								
- Never in union	Ref							
- In union/marriage	196.836	273.585	0.720	0.472				
- Divorced/widowed	157.111	275.949	0.570	0.569				
Interaction Between Birth Interval and Education								
- Medium 25-48m#Primary	-326.590	207.636	-1.570	0.116	-321.187	207.647	-1.550	0.122
- Medium 25-48m#Secondary	-404.022	204.326	-1.980	0.048*	-401.385	204.351	-1.960	0.050*
- Medium 25-48m#Higher	-432.357	206.693	-2.090	0.036*	-429.481	206.720	-2.080	0.038*
- Long 49+m#Primary	-392.605	191.589	-2.050	0.040*	-389.660	191.586	-2.030	0.042*
- Long 49+m#Secondary	-492.032	188.793	-2.610	0.009*	-490.761	188.782	-2.600	0.009*
- Long 49+m#Higher	-515.900	191.388	-2.700	0.007*	-516.416	191.374	-2.700	0.007*
Constant	1902.232	356.145	5.340	<0.001*	2088.556	234.380	8.910	<0.001*
The goodness of Fit Model								
F-test of Model	4.78			<0.001*	6.260			0.000*
R-squared	0.009				0.0098			
Adj R-squared	0.008				0.0082			
Joint F-test								
- Wealth Index	1.84							
- Marital Status	0.82							
- Interaction	1.98			0.0647**	2.01			0.0605**

Source: primary data analysis from the IDHS 2017
Note: *significant at the 5% level, **significant at the 10% level

Equations 1-3 below illustrate the equations for each model. According to these equations, short birth intervals have the lowest slope value of 2,088.56, while medium and long birth intervals have slope values of 2,530.78 and 2587.99, respectively. This result suggests that short birth intervals are one of the factors that contribute to LBW cases.

- Short Birth Interval (Less than 24 months)

$$BW = 2088.56 + 23.92\ Parity + 26.15\ Age - 0.45\ Age^2 + 35.99\ Rural + 484.53\ Primary\ Educ + 643.63\ Seconder\ Educ + 694.64\ Diploma\ or\ above \quad (1)$$

- Medium Birth Interval (24-48 months)

$$BW = 2530.78 + 23.92\ Parity + 26.15\ Age - 0.45\ Age^2 + 35.99\ Rural + 163.34\ Primary\ Educ + 242.24\ Seconder\ Educ + 268.16\ Diploma\ or\ above \quad (2)$$

- Long Birth Interval (More than 48 Months)

$$BW = 2587.99 + 23.92\ Parity + 26.15\ Age - 0.45\ Age^2 + 35.99\ Rural + 94.87\ Primary\ Educ + 152.87\ Seconder\ Educ + 181.22\ Diploma\ or\ above \quad (3)$$

Based on equations 1-3, we know that parity has a positive relationship with birth weight, such that every extra kid held by the mother is connected with an additional birth weight of 23.92 grams, providing the other factors are constant. In their study, Oladeinde et al. (2015) and Thompson et al. (2001) explained that firstborn children had a higher risk of LBW than their siblings. It is because the mother has previously had the experience of nurturing the kid in her womb, including supplying her nutritional needs so that successive births can result in the birth of a normal-weight infant. Meanwhile, we employ prediction margins to assess the influence of the mother's age on birth weight because this variable has a quadratic effect. The margin value shows a growth pattern in birth weight from 3,100 to 3,200 grams from the mother's age of 15-30 years. However, starting at 30 and up, birth weight decreased by up to 3,050 grams at the age of 48. These findings are supported by research from Iran, where risk factors for LBW are more prevalent among young mothers in 1109 hospitals (Roudbari et al., 2007). Ngwira (2019) found that the prevalence of LBW was 37.5% higher in women aged 20 and under and 29.5% higher in moms aged 35 and up. According to Vilanova et al. (2019), adolescents aged 15-20 still need to complete their studies at the secondary and postsecondary levels. Therefore pregnancy literacy remains low. Furthermore, they are regarded as physically and intellectually unprepared (Astone et al., 2007; Liu et al., 2008)

Furthermore, after controlling for other variables, people in rural areas have a 35.99 gram greater average birth weight than people in cities. These findings differ from those of several other studies because moms in urban regions typically have easier access to prenatal healthcare (nutritionists and health experts); therefore, their chances of having LBW kids are lower than mothers in rural areas. According to Mohammed et al. (2019), mothers in rural locations may have better access to fresh agricultural/plantation items, allowing them to boost birth weight. Furthermore, medium and long birth intervals have a greater average birth weight than close birth intervals, with a difference of 442.22 and 499.43 grams. The potential of having a first child in pregnant women with short birth intervals adds stress to the mother and harms the baby's weight at delivery (Auger et al., 2008). Mothers with medium and long birth intervals may have adequate time to recover from the previous pregnancy and prepare for the next.

In terms of education, moms with higher levels of education tend to have kids with standard weights. However, elementary, secondary, and higher education mothers had babies with an average birth weight of 482.29, 631.78, and 682, respectively. This finding is consistent with earlier research that shows that a mother's higher education makes it easier to obtain information from numerous sources, particularly with the supply of nutritional nourishment for the fetus in the womb, to avoid occurrences of LBW. On the other hand, mothers with low education, knowledge, and parenting habits are obtained from parents/neighbors who may have a lower level of education and experience, increasing the likelihood of LBW offspring (Nasution et al., 2014; Ngwira, 2019; Oladeinde et al., 2015)

Based on the interaction between a mother's education and birth interval, other findings show that mothers with short birth intervals who do not attend school have babies with LBW cases. In contrast, mothers with

medium and long birth intervals who attend school have babies with an average weight of 2,500 grams. The influence of close birth intervals on birth weight decreases as the mother's education grows, with the intercept birth weight for close birth intervals exceeding 2,500 grams in the primary, secondary, and higher education categories. In all categories of mother education, medium birth intervals had a higher intercept than short and long birth intervals. The findings of this study are consistent with the findings of Kwon et al. (2012), who discovered that women's behavior during pregnancy and childbirth changes as their level of education and expertise increases. They can anticipate problematic pregnancies by increasing the utilization of prenatal health care inputs, thereby minimizing the unfavorable impacts of pregnancy and birth, such as LBW (McGovern, 2013).

In general, the predictors of LBW in developing nations (represented in this study by Indonesia) are nearly identical to those in developed countries. Several studies in industrialized countries have found that parity, education, and birth interval are essential predictors of birth weight (Mohammed et al., 2019; Vilanova et al., 2019). The difference is that the proportion of educated mothers in developed countries is higher than in developing countries; hence cases of LBW in affluent countries are six times lower than in developing ones. Furthermore, in affluent countries, most moms reside in cities, whereas in developing countries, nearly half of mothers live in rural regions. These findings highlight the critical role that family planners have in teaching couples and parents in Indonesia about the dangers of LBW newborns at short birth intervals.

Conclusion

According to our findings, the SLR birth interval model does not affect CBW. However, we discovered that birth interval, parity, mother age, residency, education, and the interaction between education and birth interval were significant drivers of LBW in the first MLR model. This finding is consistent with prior research in both developing and developed countries, indicating maternal factors play a significant impact in lowering LBW cases. LBW instances are more likely in moms with children born at either a short (24 months) or long (>48 months) interval. Mothers with previous reproductive experience (parity > 0), have a higher education level, live in rural areas, and are aged 20-35 years have a lower risk of LBW. As a result, prenatal care must be adjusted based on the mother's education level and reforms to strengthen maternal education programs because maternal education is one of the main elements in reducing the prevalence of LBW in the future. Furthermore, the birth interval must be highlighted as a critical intervention to lower the LBW rate in developing countries such as Indonesia. Of course, many other factors influence the prevalence of LBW that are not included in our models, such as the mother's income, access to prenatal health care, the mother's health condition and infectious diseases, the mother's bad habits during pregnancy, such as smoking, drinking alcohol, and poor diet, and the condition of the premature baby. In the future, researchers studying the determinants of LBW may be able to incorporate these elements to develop a better model.

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Social Determinants of Stunting in Indonesia

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Abstract

Stunting is a form of malnutrition that causes growth disorders characterized by height that is not per age. Around 8.9 million Indonesian children experience suboptimal growth. This study aimed to determine the social factors associated with the incidence of stunting in Indonesia. The method used was secondary data processing from Indonesian family data collection in 2021. The population of this data collection was 66.207.139 families from 33 provinces in Indonesia. The research samples were 38.886.147 families. The variables analyzed were indicators of pre-prosperous families, environmental facilities, and high-risk pregnancy in couples of childbearing age, with the risk of stunting. Data were analyzed using linear regression. The results showed that the determinants of stunting are maternal education, parental occupation and income, environment, social and family support, and health service factors. Based on the analysis, there is a relationship between the social determinants of health according to healthy people and the increase in stunting cases in Indonesia.

Introduction

Stunting (short) is a form of undernutrition characterized by height for age under minus two as measured by standard deviation with WHO reference (Tanjung et al., 2020). The Height/Age indicator indicates chronic nutritional problems, result of a long-lasting condition, causing growth disorders characterized by height that is not per age. Stunting is a nutritional problem in the world, 80% of stunting under-fives are spread in 14 countries worldwide, and Indonesia ranks fifth in the country with the highest number of stunting (Beal et al., 2018). Stunting data in Indonesia shows that the prevalence of stunting has increased from 35.6% (2010) to 37.2% (2013). This condition illustrates that around 8.9 million Indonesian children experience suboptimal growth, or one in three children is stunted.

Stunting in toddlers needs special attention because it can hinder the nation's future. In the short term, children can experience brain disorders, physical growth disorders, and metabolic disorders in the body (Onis & Branca, 2016; Tanjung et al., 2020). In the long term, children with stunting are more likely to grow up to become adults who are unhealthy and poor (Santosa et al., 2022; Woldeamanuel & Tesfaye, 2019). It is due to decreased cognitive abilities, low education level so that income as an adult is low, decreased immunity so that it is easy to get sick, high risk of diabetes, obesity, heart and blood vessel disease, cancer, stroke, and disability in old age, increasing the risk perinatal-neonatal disease and death, as well as uncompetitive work quality and will result in low quality of human resources (HR) which results in low productivity of the nation's economy.

The Indonesian government has issued many policies and regulations related to potential interventions to reduce stunting. Specific Nutrition Program interventions are

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carried out by the Ministry of Health (MoH) through the Community Health Center (Puskesmas) and Integrated Service Posts (Posyandu) through the First 1000 Days of Life Movement (1000 HPK). In addition, another program is the Provision of Supplementary Food for Undernourished Toddlers. The Intervention in Sensitive Nutrition, which has been carried out by the government through the relevant ministries/institutions, among others are as follows: 1) PAMSIMAS Program (Provision of Clean Water and Community-Based Sanitation); 2) Fortification of food ingredients (salt, flour, and cooking oil); 3) Providing access to health and family planning services; 4) Providing National Health Insurance; 5) Providing Universal Early Childhood Education; 6) Provide education on sexual and reproductive health and nutrition for adolescents; 7 Rice Subsidy Programs for Low-Income Communities (Raskin/Rastra) and the Family Hope Program (PKH) (Kementrian Kesehatan, 2018). Based on these programs, it appears that the government is making serious efforts to reduce the prevalence of stunting, which of course is accompanied by a large budget allocation. Data from Basic Health Research shows that the stunting prevalence rate has decreased from 37.2% in 2013 to 30.8% in 2018. However, this decline is still far from the target. The government targets the stunting rate to fall to 14% by 2024.

Previous research on social determinants of stunting was conducted by Picauly and Toy in Kupang and East Sumba. The results of this study indicate that the determinants of stunting include family income, knowledge of maternal nutrition, maternal parenting patterns, history of infectious diseases, history of immunization, protein intake, and maternal education. The risk factors for stunting are family income, working mother, knowledge of nutrition and maternal parenting, having a history of infectious disease, not having a complete immunization history, and low protein intake. Meanwhile, low maternal education is a protective factor against stunting (Picauly & Toy, 2013). Based on this background, the authors are interested in discussing stunting to analyze the social determinants of health associated with stunting in Indonesia according to the Healthy People 2030 framework.

Methods

The method used in writing this article is the analysis of secondary data from the 2021 Indonesian Family Data Collection (PK21) conducted by the National Population and Family Planning Board (BKKBN) throughout Indonesia. Family data collection is an activity of collecting primary data on population data, family planning, family development, and family member data which is carried out simultaneously by the community and the government at a predetermined time. Data collection and processing were carried out using the census method by collecting data on all families who were the target of data collection in Indonesia by conducting house-to-house visits.

The characteristics of the PK21 data include 1) using detailed micro-family-based data; 2) the latest primary data can be periodically updated; 3) field operations are used for grassroots interventions, 4) focus target segmentation can be made into family maps so that targets are more accurate; 5) community data from by and for the community as well as Real Conditions; 6) data is collected and updated by people who know the exact conditions of their area.

The population of this data collection was 66.207.139 families from 33 provinces in Indonesia. One province has not yet reported the data collection, namely DKI Jakarta Province. The research samples were 38.886.147 families. The variables analyzed were indicators of pre-prosperous families, environmental facilities, high-risk pregnancy in couples of childbearing age, with the risk of stunting. Data were analyzed using linear regression.

Result and Discussion

Based on the results of the 2021 Indonesian Family Data Collection carried out by the BKKBN, the number of target families was 38.886.147 families out of a total of 66.207.139 families in Indonesia. The number of Target Families by Screening for Potential Stunting Risk based on Indonesian Family Data Collection in 2021 can be seen in Table 1.

Table 1. Number of Target Families by Screening for Potential Stunting Risk

Province	Number of Family	Number of Target Family	Target				Family Category Potential Stunting	
			Have Children		Couples of Childbearing Age	Pregnant		
			0-23 Months	24 - 59 Months			Risk	No Risk
Aceh	1,196,842	783,810	118,371	247,047	773,590	44,152	630,404	153,406
Sumatera Utara	3,337,404	1,877,033	206,615	485,089	1,855,245	68,721	1,529,081	347,952
Sumatera Barat	1,201,691	717,975	106,863	205,370	709,389	36,134	605,384	112,591
Riau	1,385,549	920,306	103,390	230,840	911,400	35,211	752,782	167,524
Jambi	919,705	603,634	68,115	141,958	598,306	22,734	491,953	111,681
Sumatera Selatan	2,102,355	1,331,566	141,976	317,769	1,318,466	44,257	1,105,478	226,088
Bengkulu	516,748	331,537	34,166	78,491	328,796	12,597	264,391	67,146
Lampung	2,158,048	1,340,013	135,783	311,600	1,329,045	43,624	1,071,994	268,019
Kepulauan Bangka Belitung	390,497	236,135	28,272	56,191	233,364	7,878	189,124	47,011
Kepulauan Riau	424,596	298,166	37,663	76,632	294,526	11,377	238,267	59,899
Jawa Barat	13,283,382	7,931,586	1,061,389	2,038,806	7,822,002	309,508	6,493,908	1,437,678
Jawa Tengah	10,679,773	5,930,140	759,869	1,419,781	5,870,344	209,074	4,708,531	1,221,609
D.I. Yogyakarta	1,080,421	530,124	64,359	117,422	525,968	18,720	408,590	121,534
Jawa Timur	11,848,066	6,373,612	683,028	1,331,341	6,309,132	187,189	5,065,076	1,308,536
Banten	2,658,505	1,763,211	206,408	443,814	1,741,025	61,249	1,373,383	389,828
Bali	1,048,611	603,905	57,898	124,968	600,733	16,129	496,046	107,859
Nusa Tenggara Barat	1,528,192	942,204	143,387	259,677	925,538	47,800	799,235	142,969
Nusa Tenggara Timur	1,057,231	640,414	116,150	202,672	623,734	28,191	603,893	36,521
Kalimantan Barat	1,082,393	697,637	72,413	169,086	688,997	23,382	640,618	57,019
Kalimantan Tengah	510,206	343,875	37,018	77,370	340,332	11,563	291,957	51,918
Kalimantan Selatan	1,051,582	644,292	74,561	146,125	635,477	22,905	535,976	108,316
Kalimantan Timur	792,046	508,351	63,216	128,885	501,372	18,218	406,202	102,149
Kalimantan Utara	125,675	84,104	11,010	22,097	82,790	3,043	71,982	12,122
Sulawesi Utara	640,530	334,382	36,821	74,161	328,217	8,644	272,556	61,826
Sulawesi Tengah	733,776	452,713	65,179	118,498	445,164	17,342	390,608	62,105
Sulawesi Selatan	2,145,260	1,217,795	171,785	313,706	1,197,914	49,272	1,039,979	177,816
Sulawesi Tenggara	604,791	380,662	59,492	111,964	373,044	17,305	320,807	59,855
Gorontalo	329,539	200,333	29,665	49,528	196,453	8,034	171,934	28,399
Sulawesi Barat	287,945	189,696	29,824	56,401	186,406	9,357	169,363	20,333
Maluku	288,831	171,886	23,132	48,332	167,742	6,264	147,657	24,229
Maluku Utara	237,528	158,838	17,416	36,757	156,656	5,622	135,172	23,666
Papua	476,620	296,461	21,369	49,335	290,249	11,525	278,861	17,600
Papua Barat	82,801	49,751	6,380	13,730	48,306	1,774	45,006	4,745
	66,207,139	38,886,147	4,792,983	9,505,443	38,409,722	1,418,795	31,746,198	7,139,949

Source: Indonesian Family Data Collection, 2021 (BKKBN)

From these results, data on the number of Indonesian families at risk of stunting were 31,746,198 families or 81.64% of the total families in the data. It is, of course, very worrying. Based on data from the Indonesian Toddler Nutrition Status Survey (SSGBI) in 2021, the current prevalence of stunting is still at 24.4% or 5.33 million children under five. The prevalence of stunting has decreased from previous years but still has not reached the WHO standard, where the incidence of stunting in a country must be below 20%. From these data, continued analysis of the effect on the screening variable and the risk of stunting using regression analysis and then supported by the literature review. In this study, several variables were obtained from the social determinants of health according to healthy people that were stunting, as shown in Table 2.

Social Determinants of Stunting in Indonesia based on the Healthy People variable are: 1) Economic Stability (Family income and Parents' Jobs), 2) Education (Mother's education), 3) Social and Communication (Social and family support, Culture, and lifestyle, and Parenting pattern), 4) Condition of

Home and Surrounding Environment (Source and access to clean water, and Sanitation & Hygiene), 5) Health and Health Services (Pregnancy Condition, Pregnancy checkup, and Nutrition Services). Based on these determinants, the researcher then conducted a regression analysis of the screening variable for the Indonesian Family Data Collection associated with the risk of stunting. The screening variables taken were economic stability (pre-prosperous family status, having children aged 7-15 years not attending school, not having a source of income to meet basic needs, and not being able to eat a variety of foods at least twice a day), mother's education at least junior high school, Condition of House and Surrounding Environment (no source of drinking water, no latrine, no decent house), health (risk of pregnancy too young, too old, too close, and too much).

Educational level is the stage of education that is determined based on the level of development of students, the goals to be achieved, and the abilities developed. In this study, it was divided into 3 levels. Primary Education (low level), Secondary Education (middle), and Higher Education (high level). Primary education is the initial education level for 9 (nine) years, namely Elementary School (SD) for 6 years and Junior High School (SMP) for 3 years. Basic education is a compulsory education program. Secondary education is a level after the basic, namely Senior High School (SMA) and Vocational High School (SMK) for 3 years of education. Higher education is a level of education after secondary education which includes diploma, bachelor, master, doctoral, and specialist education programs organized by universities.

Based on data regression analysis, there is a positive influence between positive education between mother's education with a maximum of junior high school and families at risk of stunting (99.03%). It means that the more mothers with low education in an area, the more families at risk of stunting in that area will be. Scatter Plot Education of Mothers and Families at Risk of Stunting can be seen in figure 1.

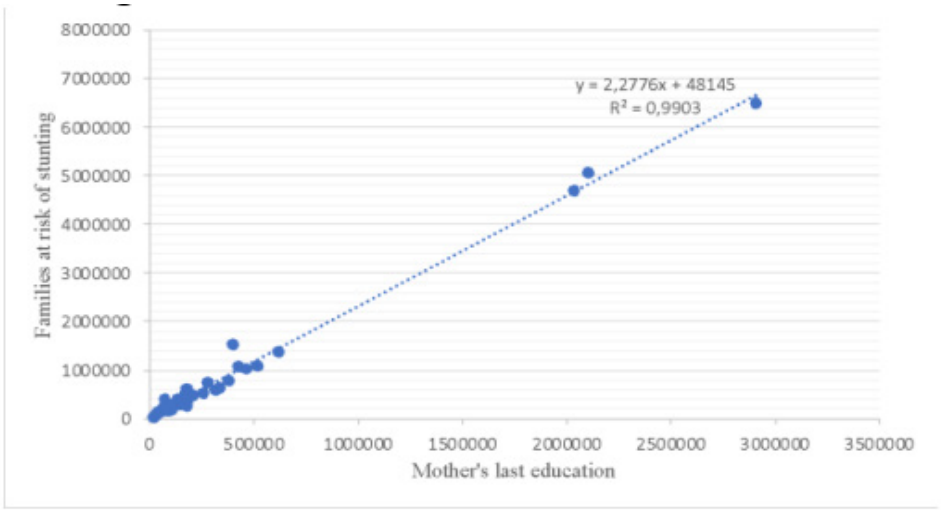

Figure 1. Scatter Plot Education of Mothers and Families at Risk of Stunting

Low maternal education is the primary cause of stunting in school children and adolescents. More educated mothers are more likely to make decisions that will improve the nutrition and health of their children (Novitasari & Wanda, 2020; Rakotomanana et al., 2017). Mother's education level is the last formal education completed. The function of education for mothers is to develop children's insight into themselves and the environment. Mothers with low education will find it difficult to receive information, so children who live in families with basic education levels tend to experience slow growth because of the parenting pattern given to their children (Sari & Sartika, 2021). A mother's education level affects children's food consumption caused of mindset and experience. Mothers with a high

level of education will prefer food of better quality than those with a low level of education. Mothers with higher education will prefer foods that have a high nutritional content following available food and eating habits since childhood so that nutritional needs are met (Cameron et al., 2021; Damanik et al., 2020).

In addition, mothers with junior high school education tend to be better at parenting and better at choosing the type of food for their children. It is because mothers with junior high school education have a higher opportunity to access information about the nutritional status and health of children so that their knowledge increases. Then it is put into practice in the child care process, which will affect nutritional status and better health of children. The level of education, especially the mother's, affects the health status. It is related to the role that plays the most in the formation of children's eating habits because it is the mother who prepares the food starting from setting the menu, shopping, cooking, preparing food, and distributing food (Rizal & van Doorslaer, 2019).

The problem of stunting, in general, is a problem with a fairly high prevalence compared to the problem of overweight or wasting. Various aspects that can affect the occurrence of stunting include economic, political, health services, education, social, cultural, and environmental aspects. The economic factors that influence it. Such as work, income level, education, and knowledge of parents. Low economic status can cause inaccessibility in the fulfillment of daily nutrition and health services for pregnant women and children under five (McGovern et al., 2017).

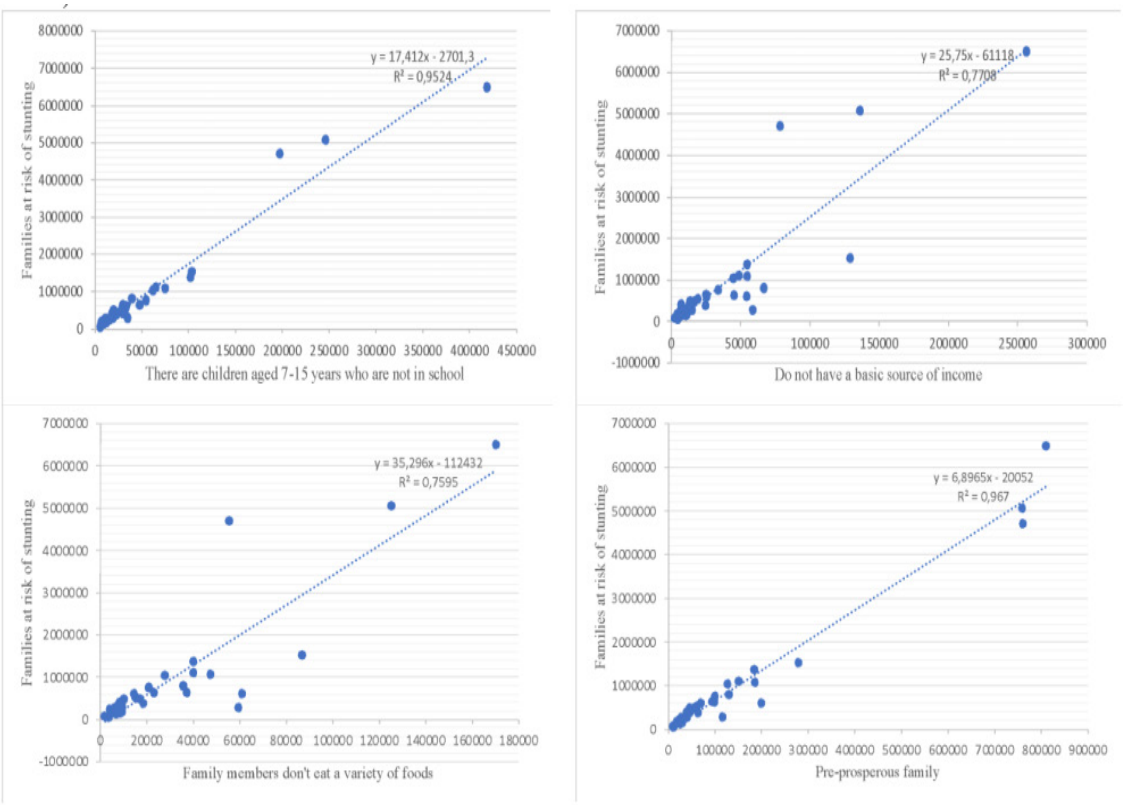

Figure 2. Scatter Plot of Economic Factors and Families at Risk of Stunting

The scatter plot of each variable is shown in Figure 2. Based on data regression analysis, it can be seen that there is a positive influence between the ownership of children aged 7-15 years who are not in school (95.24%), not having income to meet basic needs (77.08%), families do not eat varied foods at least twice a day (75.95%), and pre-prosperous family status (96.7%) with the risk of stunting in the family. Economic factors here play a close role as a trigger for stunting in a family. One of the influential economic factors is family income.

Family income is the income received by the household concerned, both from the income of the head of the household and the income of household members. Household income can come from remuneration for labor production factors (wages and salaries, profits, bonuses, etc.), capital remuneration (interest, profit sharing, etc.), and income from gifts from other parties (transfers).

Family income will affect a person's ability to access food. It will affect the nutritional status of children. Usually, families with lower incomes will consume cheaper and less varied foods. A low-income level is a factor in the incidence of stunting which has a 2.3 times greater risk of having stunted children than than families with sufficient income. A high income will allow the fulfillment of the food needs of all family members (Sari & Sartika, 2021). In addition, the work of parents, especially fathers, also has a vital role in determining the quality and quantity of food needed for all family members. This job will determine the amount of their income.

From this description, it can be grouped that from an economic point of view, there are several factors that influence the incidence of stunting in a family, including the work of parents, parents' income, parental education, and parenting in the family. All of these factors turned out to be interrelated with each other. Education will have an influence on the type of work which will also affect the income of a family. Income will determine how the family meets the nutritional needs of the family and health services for stunting prevention.

There are two factors that affect the nutritional status of children, these factors are direct and indirect factors. Culture is one of the indirect factors that can cause stunting. Existing culture, traditions, or habits such as dietary restrictions, and wrong eating patterns can lead to nutritional problems, especially for toddlers. This can have an impact on the growth and development of toddlers, which is one of the indirect factors that influence the mother's attitude in undergoing pregnancy, undergoing the delivery process, as well as in child care patterns. Problem analysis with a cultural approach is needed as an effort to identify the relationship of health problems according to cultural background to the prevalence of stunting (Soekatri et al., 2020).

Social and family support factors are the most influential factors on the provision of specific nutrition interventions. Basically, the family has an important role in shaping the culture and daily health behavior (Raharjo, 2016). Each family member has several roles in the family, including as a motivator, educator, and facilitator. Social support is the ability of families and communities to provide time, attention, support in the form of physical, mental, and social. Social support includes attention or family support for mothers in feeding, psychosocial stimulation, and practices in infant health (Ponum et al., 2020; Wati, 2022). The higher the family support, the better the mother's motivation in child care. However, there are still many mothers who have sufficient social and family support but are not good at providing specific nutritional interventions (Aryotochter, 2018). This is because there is a culture in the family that is not beneficial for health but is still followed. Especially the role of a grandmother in directing a mother in breastfeeding and feeding patterns to children (Aguayo & Menon, 2016; Febriana & Nurhaeni, 2019).

In addition to social and family support, indirect factors that influence the provision of specific nutrition interventions are culture and lifestyle. Culture is a complex whole, which includes knowledge, belief, art, morals, law, customs, and other capabilities and habits acquired by humans as a society. Meanwhile, culture is the view of life of an individual or group with reference to values, beliefs, norms, patterns, and practices that are learned, shared, and passed on between generations. Usually it is parents who teach their children's cultural values and lifestyles from generation to generation, including teaching cultural values and lifestyles in society (Mulyaningsih et al., 2021). Habits that are formed based on culture can affect nutritional status and cause malnutrition. In this study, respondents who have babies are still limited by culture, habits, customs, and beliefs that have become the life customs of a region. Most of the factors of cultural values and lifestyles owned by respondents tend to be unfavorable to health. One of the cultures

that is still inherent in the community is giving coconut water to newborns with the aim of making babies healthy and strong, giving smooth bananas to babies before the age of 6 months so that children are not fussy, consuming lots of rice and a little protein. This has a high potential for stunting in children (Ciptanurani & Chen, 2021).

Good parenting habits are carried out by the mother herself with the maximum time a mother has in accompanying her toddler on a daily basis. Parenting done by the mother herself is certainly different from parenting done by others such as grandmothers or baby sitters. Because mothers can supervise, give full attention, and affection to their children for 24 hours. The full time that mothers give to their toddlers will provide a sense of comfort and good attention from mothers so as to support efforts to maintain health, nutritional status of toddlers, and create closeness between mothers and children. The results of this study are in line with the results of Turnip's (2008) research in Sidikalang District which states that there is a significant difference between parenting habits and children's nutritional status. Families who apply bad parenting habits have 9 times the chance of poor child nutritional status. A close and intimate relationship between parents and children is an absolute requirement to ensure harmonious growth and development, both physically, mentally and psychosocially. Mothers who provide good psychosocial stimulation to children have a positive effect on children's nutritional status. On the other hand, if the child's psychosocial condition is bad, it can affect the nutritional status and development of the child. The bad psychological condition of children looks like feeling depressed, stress and depression will affect consumption patterns, as well as absorption of nutrients in children (Sari & Sartika, 2021; Soekatri et al., 2020).

Environmental factors that become the focus of attention of researchers in relation to stunting under five were water, sanitation, and hygiene (WASH). Thus, research scoping examines these aspects. The WASH concept is applied by WHO in an effort to prevent diarrhea, although in general it can be applied to the prevention of other diseases including enteropathy and malnutrition (WHO, 2014).

Access to clean water is generally not only used for drinking and cooking purposes, but also for bathing and other water purposes. However, there are differences in the types of water sources studied, namely clean water sources and drinking water sources (Headey, D., Hirvonen, 2016). Access to drinking water specifically for family drinking purposes (sari & Sartika, 2021). Sources of clean water and protected drinking water are those that flow to the household level through pipelines including tap water, public taps, public hydrants, water terminals, rainwater reservoirs, or protected springs and wells, drilled wells or pumps that are at least 10 meters away from sewage, waste collection and garbage disposal.

It was found that research discusses the relationship between sanitation and the incidence of stunting under five. The variables measured related to sanitation were the ownership of latrines, wastewater treatment facilities and sanitation facilities, with inconsistent results. There is not a single article that explains how access and sanitation facilities and wastewater treatment facilities are assessed. It was only explained that the variable was a dichotomy variable with yes/no answers and qualified/unqualified answers. In addition, it is not explained whether the access and sanitation facilities are specifically owned by themselves or are shared facilities.

Hygiene practice is known to be an important aspect in maintaining the health of toddlers. There are four articles that measure aspects of hygiene practice, namely washing hands with soap and running water. Only one article describing handwashing time was assessed, namely a study in Central Sulawesi which included washing hands before preparing food, before breastfeeding and after defecating. Hand washing practice is consistently associated with stunting in this article, with an AOR of more than one. Hygiene behavior that is measured in addition to washing hands is defecation behavior, namely in the research in Banggai and Sigi (sari & Sartika, 2021).

Environmental risk factors that were also found were regarding waste management. Aspects of waste management are found in two articles. However, only one study has statistically significant results, namely the

research on the results of IFLS data processing (Irianti, S., Prasetyoputra, P., Dharmayanti, I., Azhar, K., Hidayangsih, 2017). In addition, a variable regarding exposure to cigarette smoke was found in one article with insignificant results. Another environmental aspect that is assessed is the housing factor, where what is measured includes the type of wall of the house and the type of floor of the house. The type of wooden house walls and thatched roofs as well as earth floors as in the Mozambique study were significantly related to the incidence of stunting.

Environmental factors have an important and significant role in the occurrence of stunting in toddlers. A number of existing research results can be used as a basis for planning stunting interventions through modification of environmental factors, which so far have mostly been stunting interventions through supplementation.

Based on the regression analysis related to the condition of the mother with pregnancy at risk, it was found that there is a positive influence between pregnancy at a young age (90.61%), pregnancy at an old age (99.69%), pregnancy with birth spacing that was too close (87.12%), and pregnancies in which too many children have been born (93.17%), with families at risk of stunting. Scatter Plot of Pregnancy Status and Families at Risk of Stunting can be seen in figure 3.

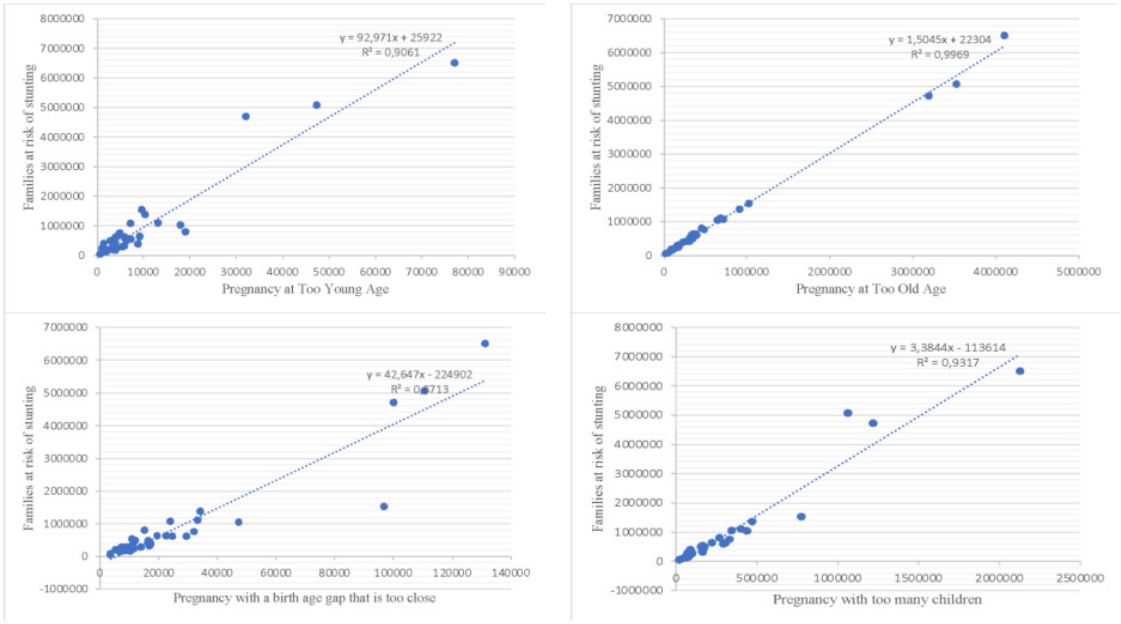

Figure 3. Scatter Plot of Pregnancy Status and Families at Risk of Stunting

Teenage pregnancy increases the prevalence of stunting. Accoding to Simbolon (2021), stunting prevalence is higher in toddlers of married mothers of adolescents compared to mothers of married mature. The stunting prevalence was also higher in children under five years from adolescent pregnant women compared to mothers who were of sufficient age. A married teenage woman is 1.2 times at risk, and a woman who is less than 20 years pregnant is 1.3 times at risk of having a stunting toddler.

Health services are an indirect cause of stunting. The existence of health services is a step in an effort to reduce nutritional problems and also improve the health status of the community. Nutrition services in this health service include immunization, weighing children, pregnancy checks including antenatal care, and facilities such as posyandu and health centers. Antenatal Care / ANC is often referred to as prenatal care. The frequency of antenatal care visits (ANC) is one of the risk factors for toddlers experiencing stunting, this is because when ANC visits are carried out regularly, the risk of pregnancy in a mother can be detected early, especially those related to nutritional problems. According to (Mulyaningsih et al., 2021), ANC visits are a risk factor for stunting under five in the working area of the Dasan

Agung Health Center. In this study, it was found that mothers with non-standard ANC visits had a 2.3 times risk of having stunting under five compared to mothers with standard ANC visits.

The standard of ANC visits is seen from the frequency of visits by pregnant women to check their pregnancy with health workers with a minimum number of visits 4 (four) times during pregnancy with a distribution of visits in the first trimester, once in the first trimester, once in the second trimester and twice in the third trimester. So that pregnancy problems, especially those related to nutritional problems in pregnant women, can be identified early, the community, especially pregnant women, can take advantage of pregnancy examination facilities as much as possible so that interventions can be carried out earlier.

Conclusion

The social determinants of stunting according to the Healthy People Framework was parental education factors, economic factors, social factors, environmental factors, and health service factors. Economic factors and environmental factors are two factors that have a large enough impact on the occurrence of stunting. Based on data regression analysis, there is a positive influence between positive education between mother's education with a maximum of junior high school (99.03%), the ownership of children aged 7-15 years who are not in school (95.24%), not having income to meet basic needs (77.08%), families do not eat varied foods at least twice a day (75.95%), and pre-prosperous family status (96.7%), pregnancy at a young age (90.61%), pregnancy at an old age (99.69%), pregnancy with birth spacing that was too close (87.12&), and pregnancies in which too many children have been born (93.17%), with families at risk of stunting.

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The Levels of Cholinesterase Enzyme and Hemoglobin in Linggasari Village's Farmers

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Abstract

Farmers in Linggasari Village often mix pesticides, not using pesticides that follow the dose, not using PPE completely, eating, drinking, or smoking, did not clean themselves after spraying. Some types of pesticides can reduce cholinesterase enzyme and hemoglobin levels. The study aimed to analyze the factors correlated with the cholinesterase enzyme and hemoglobin levels of sprayer farmers. It was a cross-sectional study conducted from March to April 2022. The population of this study was all farmers who use pesticides. As many as 30 farmers qualify the inclusion criteria, namely male spraying farmers aged over 18 years, maximum last contact time with pesticides was two months before the study. The independent variables were age, BMI, working period, spraying frequency, duration of spraying, and PPE usage score. The dependent variables included cholinesterase and hemoglobin levels. Bivariate analysis was assessed with Pearson Correlation Test or Spearman Correlation Test, while multivariate analysis used linear regression. The results showed that age (p=0,032, r=0,391) and BMI (p=0,036, r= 0,385) correlated with cholinesterase enzyme, and age (p=0,000, r=0,615) correlated with farmers' hemoglobin levels. The results of multivariate analysis, the most influential factor on cholinesterase enzyme and hemoglobin levels was age.

Introduction

Pesticides are widely used in the agricultural sector to eradicate pests so that the quality of agricultural production can be abundant and good quality. However, if pesticides are used unwisely, there will be negative impacts on the environment, farmers' health, and public health in general. Exposure to pesticides in preparing equipment, mixing pesticides, spraying, cleaning tools and work clothes, cleaning grass and pests, watering plants, and harvesting can cause poisoning. The global pesticide poisoning rate reached the highest value of 385 million cases, with an estimated death of 11,000 per year (Boedeker et al., 2020).

The National Poisoning Information Center (2016) noted that the incidence of pesticide poisoning in Indonesia was 771 cases and is expected to increase annually. The incidence of pesticide poisoning in several areas in Indonesia is very high. Based on monitoring of the cholinesterase enzyme in 347 farm workers in Central Java, 23.64% of workers were moderately poisoned, while 35.73 were severely poisoned (Anam et al., 2015).

The community of Linggasari Village, Kembaran District, Banyumas Regency work as farmers with as many as 489 people (7.9%) and is the second largest group of workers after casual daily workers, namely 1,116 people (18.13%). It is supported by an area of 235 hectares of lowland rice and 182 hectares of corn. The use of pesticides by farmers in

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Linggasari varies widely, including carbamates, pyrethroids, paraquat, organochlorines, and organophosphates. Farmers use pesticides according to pest attack, where the number of pesticides used by farmers ranges from 2-3 types during one planting period. However, in its use, farmers often mix pesticides, not following the dose, do not use Personal Protective Equipment (PPE), and unsafe behavior after spraying, such as eating, drinking, and smoking without cleaning themselves.

Organophosphates act as cholinesterase inhibitors so that they can reduce cholinesterase levels in the blood. Organophosphate pesticides can also reduce the number of erythrocytes, hemoglobin levels, leukocyte counts, and lymphocytes (Shamoushaki, 2012). Excessive exposure to pesticides can interfere with the nervous system cancers, diabetes, and reproductive disorders (Mostafalou and Abdollahi, 2013), and the effect on children's IQ impaired (Suwondo et al., 2021). Although pesticide exposure and its effect on health, studied in several areas in Indonesia, no research has been conducted on the negative impact of pesticide use in Linggasari Village, Kembaran District, Banyumas Regency. The study aimed to analyze the factors that correlated with levels of the enzyme cholinesterase and hemoglobin of spraying farmers in Linggasari, Kembaran, Banyumas Regency.

Method

This study was a cross-sectional study, aiming to analyze the factors correlated with the levels of cholinesterase enzymes and hemoglobin in spraying farmers in Linggasari, Kembaran, Banyumas Regency. As many as 30 farmers qualify the inclusion criteria, i.e., males, aged over 18 years, who sprayed using synthetic pesticides, the last contact time with pesticides was a maximum of two months before the study. The independent variables were age, BMI, working period, spraying frequency, duration of spraying, and PPE usage score. The dependent variables in this study were levels of the enzyme cholinesterase and hemoglobin.

Data collection includes respondent characteristics, history of pesticide exposure, and use of PPE carried out through interviews. BMI was calculated based on a standardized formula i.e., body weight (in Kg) divided by height (in meters) squared. Cholinesterase and hemoglobin levels were measured by taking 3 ccs of venous blood samples. Then the blood samples were taken to the Prodia Purwokerto Laboratory. The cholinesterase enzyme was measured by the kinetic photometric method using the semi-auto chemistry analyzer model Biolyzer 100. Hemoglobin was measured using the SLS method Hemoglobin with an automated hematology analyzer. Data analysis was by univariate, bivariate, and multivariate analysis. Bivariate analysis was assessed using the Pearson Correlation Test or the Spearman Correlation Test. Multivariate analysis to find out which factors have the most influence on the cholinesterase enzyme and hemoglobin levels.

Result and Discussion

Linggasari Village is one of the villages that has a relatively large area compared to other villages in the Kembaran District. It is about 239.811 hectares. The area covers an area of technically irrigated land of approximately 0.70 hectares, rainfed rice fields covering an area of 167.688 hectares, dry land or settlements covering an area of 60 hectares, land for public facilities covering an area of 7.20 hectares, a field of 1 hectare, village government offices covering an area of 0.70 hectares. Roads and rivers are around 5.513 hectares (Mutahir, 2021).

TABLE 1. Results of Univariate Analysis on Spraying Farmers in Linggasari

Variables	Mean ± Standard Deviation	Minimum-Maximum	Unit
Age	61.93 ± 9.798	36-84	year
BMI	22.41 ± 2.991	17.79-28.58	-
Working Period	32.17 ± 15.976	3-57	year
Frequency of Spraying	4.67 ± 5.175	1-30	per month
Duration of Spraying	2.617 ± 1.986	0.5-10	hour
PPE Usage Score	15.67 ± 4.894	6-24	-
Cholinesterase Enzyme Levels	9,850 ± 2,142	6,738-15,319	U/L
Hemoglobin Levels	14.6 ± 1.1	11.9-16.5	g/dL

Source: Primary Data, 2022

Table 1 showed the youngest respondent was 36 years old, the oldest was 84 years old, and the average age was 61.93. Productive age is in the range of 18-54 years. The results indicate that the average age of the respondents was elderly. The minimum BMI was 17.79, and the maximum was 28.58, with an average of 22.41, so most respondents' BMI was normal. Respondents in this study had the lowest working period of 3 years and the longest of 57 years, with an average was 32.17 years. The lowest frequency in this study was one spray per month, and the highest frequency was 30 sprays per month, with an average was 4.67 per month. The minimum duration of spraying was 0.5 hours, and the maximum was 10 hours, with an average was 2.617 hours. The minimum PPE usage score was 6, and the maximum was 24, with an average was 15.67. The minimum cholinesterase enzyme level was 6.738, and the maximum was 15.319, with an average was 9.850 U/L.

The results of laboratory examinations showed that 28 people (93,33%) had cholinesterase levels in the normal category, namely at levels of 6.738 – 12.887 U/L where the normal value was 4.260 –11.250 U/L for age < 40 years and 5.320 – 12.920 U/L for age > 40 years. In this study, two people (6,67%) with high cholinesterase levels above 12,920 U/L. The average hemoglobin level was 14.6, with a minimum of 11.9 and a maximum of 16.5 g/dL. Anemia in women if the hemoglobin levels are less than 12,0 g/dL, while in men, less than 13,0 g/dL (Cappellini and Motta, 2015). The results showed that 4 people (13,33%) experiencing anemia.

TABLE 2. Results of Bivariate Analysis of Age, BMI, Working Period, Frequency of Spraying, Duration of Spraying, and PPE Usage Score with Cholinesterase Enzyme and Hemoglobin Levels.

Variables	Correlation coefficient (Cholinesterase Enzyme)		Correlation coefficient (Hemoglobin)	
	p	r	p	r
Age	0,032	-0,391	0,000	-0,615
BMI	0,036	0,385	0,054	0,355
Working Period	0,673	-0,080	0,470	-0,137
Frequency of Spraying	0,756	-0,059	0,579	-0,106
Duration of Spraying	0,299	0,196	0,261	-0,212
PPE Usage Score	0.703	0.073	0,179	0,252

Source: Primary Data, 2022

There was a significant correlation between age and cholinesterase levels (p-value=0.032). The Pearson correlation value was 0.391, which indicates a weak correlation. The correlation showed a negative sign, meaning that as the age increases, the respondent's cholinesterase levels decrease. This study is in line with the study in East Kalimantan (Ramdan, Candra and Purwanto, 2020). Older age experiences cumulative pesticide exposure,

which can affect farmers' health. Health risks increase in older farmers with time of exposure and aging. Older age is also associated with neurological deficits (Moza et al., 2021). With increasing age, especially at age ≥ 65 years, cholinesterase levels decrease (Matsuo and Tazawa, 2019). The results of this study indicate that elderly tend to experience a decrease in the cholinesterase enzyme, so they are very susceptible to pesticide poisoning. So farmers should be more aware of decreasing levels of cholinesterase enzymes caused by exposure to pesticides, especially with increasing age.

There was a significant correlation between age and hemoglobin levels of spraying farmers (p-value=0,000). A Pearson correlation value of 0.615 indicates a strong correlation with the direction of the correlation is negative, which means that the older the respondent's hemoglobin level decreases. In this study, all respondents who experienced anemia were elderly. They are at risk for anemia due to physical, psychological, physiological, functional, and metabolic changes (Lopes et al., 2022). Anemia in elderly can be caused by nutritional problems such as malnutrition which is caused by anorexia, lack of appetite, difficulty chewing or swallowing, dental and mouth problems, and nausea (Braz, Duarte and Corona, 2019).

Other common causes of anemia in the elderly are chronic kidney disease, chronic inflammation, and blood loss from the gastrointestinal (GI) tract due to GI pathology (Lanier, Park and Callahan, 2018), parasitic infections, hemoglobinopathies, and lead poisoning (Shaw and Friedman, 2011). Other factors also influence the incidence of anemia is education. The education of respondents who have anemia was elementary school. Kim and Son (2019) stated that patients who graduated from elementary school only or had no education were more likely to experience anemia than those who graduated from junior high school or higher (Kim and Son, 2019). In the elderly, anemia is a risk factor for cardiovascular disease, fatigue, reduced cognitive function, physical function, and quality of life, and indicates vulnerability (Onem et al., 2010). Neurologic complications due to anemia cause a decrease in physical ability, which results in falling easily (Gabrilove, 2005).

There was a significant correlation between BMI and cholinesterase levels (p-value = 0.036). A Pearson correlation value of 0.385 which indicates a weak correlation. The correlation showed a positive sign, which means that the higher the BMI, the higher the level of the cholinesterase enzyme. BMI was significantly associated with organophosphate poisoning. Obese patients who experience poisoning require prolonged hospital stays (Jung et al., 2014). Organophosphates are lipophilic. Therefore they are thought to have a large volume of distribution and are rapidly distributed into tissues and fat.

This study is per a study in China (Han et al., 2019) and Saudi Arabia (Hamouda et al., 2019). Over-nutritional status causes pesticides to be stored in body fat as residue, so they can be at risk of acute and chronic pesticide poisoning. Poor nutritional status causes a decrease in body resistance and protein so that it is susceptible to infection and disturbances in the formation of cholinesterase enzymes (Kurniasih et al., 2013). Thus, farmers should keep their BMI within the normal range to prevent a decrease in the cholinesterase enzyme.

There was no significant correlation between BMI and hemoglobin levels of respondents (p-value = 0.054). Pearson correlation value was 0.355, which showed a weak correlation, the direction of the correlation was positive, which means the higher the BMI, the higher the hemoglobin levels. Poor nutritional status causes low hemoglobin levels and lowers body resistance and susceptibility to infection, so people with poor nutritional status are susceptible to disease or poisoning. Poor nutritional conditions cause the protein in the body to be very limited, so it interferes with the formation of the cholinesterase enzyme (Kurniasih, Setiani and Nugraheni, 2013).

The working period is the number of years a person has worked as a farmer. There was no significant correlation between the working period and levels of the cholinesterase enzyme (p-value = 0.673). The Pearson correlation value was 0.080, which indicated a very weak correlation. The correlation showed a negative sign, which means that the longer the working

period, the lower the level of the cholinesterase enzyme. In this study, farmers sprayed in the morning or evening, which is the optimal time for spraying. The best spraying time is in the morning before 11.00 and evening after 15.00. Spraying during the day causes the pesticides to evaporate and decompose, thereby increasing farmers' exposure to pesticides by inhalation or through the skin which can cause pesticide poisoning (Suparti, Anies and Setiani, 2016). However, it is necessary to be aware that the longer the working period as a farmer, the more exposed to pesticides, so the greater the risk of poisoning. There was no significant correlation between the working period and hemoglobin levels of respondents (p-value=0,470), with a weak correlation (r=0,137), and the direction of the correlation was negative, which means the higher the working period, the lower the hemoglobin level.

The length of the working period is related to the risk of pesticide poisoning, which can cause low hemoglobin levels. In this study, low hemoglobin levels in farmers can be caused by other factors. Factors affecting hemoglobin levels include age, gender, race, nutritional and environmental factors, altitude, smoking habits, drugs consumed, and parasitic infections. In addition, there is no correlation between working period and hemoglobin levels. It could be because farmers have applied the practice of spraying according to the direction of the wind. Farmers who spray against the wind will be more exposed to pesticides, so poisoning is easier to occur.

The frequency of spraying is the number of days of spraying during the last month. There was no significant correlation between the frequency of spraying and levels of the cholinesterase enzyme (p-value = 0.756). The correlation value was 0.059, which indicated a very weak correlation. The correlation showed a negative sign, meaning that the more frequency of spraying, the lower the level of the cholinesterase enzyme. This study was different from research in Gawu-Gawu Bouso Village North Gunungsitoli Sub-District, Gunungsitoli City (p-value=0,012) (Hotang, Ashar and Hasan, 2020).

The frequency of spraying increases the risk of exposure to pesticides. In this study, the average respondent sprayed was 4 times a month. These conditions can allow for an increase in the cholinesterase enzyme. A one week's rest, minimum, can increase cholinesterase activity in the blood of farmers. Bioaccumulation of pesticide residues due to frequent spraying has the potential to reduce hemoglobin levels. Spearman test results obtained p value = 0,579, which means no significant correlation between frequency of spraying and farmers' hemoglobin levels. A correlation value of 0.106 indicated a weak correlation, while the direction of the correlation was negative, meaning that the more frequency of spraying, the lower the respondent's hemoglobin level. Infrequent contact can reduce the risk of anemia in farmers. Other factors that may affect the hemoglobin level of the respondent include the characteristics of the respondent and adequate rest, which causes the farmer to have a good hemoglobin level.

There was no significant correlation between the duration of spraying and levels of the cholinesterase enzyme (p-value=0,299). The Spearman correlation value was 0.196, which indicated a very weak correlation. The direction of the positive correlation means the longer the duration of spraying, the higher the level of the cholinesterase enzyme. This result can be because the average farmer uses pesticides for less than 5 hours. Based on WHO, the duration is five hours per day or thirty hours per week (Yushananta, Ahyanti and Anggraini, 2020). The duration of spraying is related to the amount of time in contact with pesticides. The longer the spraying, the more contact time with pesticides increases. The risk of poisoning and the accumulation of pesticides is also increasing. Madaan's research showed lower cholinesterase in spray workers compared to non-spray farmers.

To restore the activity of the cholinesterase enzyme, farmers can rest first after spraying. Plasma cholinesterase levels will return to normal within 3 weeks, while blood cholinesterase enzymes will take 2 weeks without exposure. Although the acute effect of acetylcholinesterase enzyme activity is only temporary and usually only lasts 1-2 weeks, acute pesticide poisoning can cause neurological disorders in the long term due to the inhibition

of the cholinesterase enzyme continuously (Samosir, Setiani and Nurjazuli, 2017). There was no significant correlation between spraying time and farmers' hemoglobin levels (p-value = 0.261). The correlation value of 0.212 indicated a weak correlation, the direction of the correlation was negative, which means that the longer the spraying duration, the lower the respondent's hemoglobin level. The duration of spraying is related to the length of work that allows farmers to come into contact with pesticides. In this study, the average farmer sprayed for 2,617 hours, so it was still within a safe time limit.

PPE can prevent pesticides enter the body so that it can avoid poisoning. In this study, the use of PPE was outlined in the form of scoring. The more complete the PPE used, the higher the score. The results showed that the average PPE usage score, minimum and maximum score, respectively, was 15.67, 6 and 24. There was no significant correlation between the use of PPE and cholinesterase levels (p-value = 0.703. Pearson's value of 0.073 indicated a very weak correlation, and the direction of the correlation was positive, indicating that the higher the APD score, the higher the level of the cholinesterase enzyme.

PPE for spraying farmers are masks, hats, goggles, gloves, boots, and aprons to avoid exposure to pesticides on the skin and body (Damalas and Abdollahzadeh, 2016). The routes of entry of pesticides are through the skin, mouth, inhalation and eyes. Skin exposure is affected by pesticide residues, pesticide formulation, amount, and duration of exposure, presence of other substances on the skin, temperature, humidity, and use of PPE (Kim, Kabir and Jahan, 2017). Oral exposure usually occurs accidentally, for example, with carelessness or intentional reason. Farmers can get poisoned by not washing their hands before eating or smoking after spraying. The potential exposure to pesticides through inhalation is due to volatile substances in pesticides. Pesticides can also enter through the eyes due to not wearing glasses or face shields.

There was no significant relationship between the PPE usage score and the hemoglobin levels of respondents (p-value = 0.179). Pearson correlation value was 0.252, which showed a weak correlation, the direction of the correlation was positive, which means the higher the PPE usage score, the higher the hemoglobin level. In red blood cells, pesticides can form sulfhemoglobin and methemoglobin, which causes hemoglobin levels to decrease. The sulfur content in pesticides causes the formation of sulfhemoglobin, while methemoglobin is formed due to oxidized iron or nitrite bonds with hemoglobin (Yushananta, Ahyanti and Anggraini, 2020). Reducing health risks due to exposure to pesticides can be done by applying the correct spraying practices, namely by paying attention to the spraying time and wind direction. The best time for spraying is in the morning or evening because the temperature is lower than in the afternoon. Pesticides evaporate quickly at temperatures above 30°C, so farmers are advised not to use them during the afternoon (Kim, Kabir and Jahan, 2017). The best spraying practice is in the same direction as the wind.

Multivariate analysis was carried out on factors with a p-value ≤ 0.25 from the bivariate analysis. The results of multivariate analysis using the backward linear regression method showed that the most influential factor on cholinesterase enzyme and hemoglobin levels in farmers was age with a p-value and correlation value respectively (p-value = 0.032, r 0,391), (p-value=0,000, r=0,615). The results of the multivariate analysis can be concluded, as age increases, the levels of cholinesterase enzymes and hemoglobin decrease. It can be attributed to the fact that in old age, there has been a decrease in body function due to degeneration, nutritional problems, and psychological problems. This decrease has made elderly farmers very vulnerable to pesticide poisoning and anemia. Such conditions can also affect the quality of life of farmers. Research showed that elderly tobacco farmers who were still active in agricultural activities experienced a decline in health and quality of life (Susanto and Widayati, 2018). In addition, the results of other studies showed that farmers in older age were significantly related to the risk of injury (Heaton et al., 2012). Therefore, it is necessary to have special treatment or prevention for elderly farmers to increase their safety and quality of life.

Conclusion

Based on the bivariate analysis, there was a significant correlation between age and BMI with cholinesterase enzyme levels in Linggasari Village farmers. There was no significant correlation between working period, frequency of spraying, duration of spraying, PPE usage score, and levels of cholinesterase enzyme in Linggasari Village farmers. The result of multivariate analysis, the most influential factor on cholinesterase enzyme was age. There was a significant correlation between age with hemoglobin levels. There was no significant correlation between BMI, working period, frequency of spraying, duration of spraying, PPE usage score, and hemoglobin levels in farmers. The result of multivariate analysis, the most influential factor on hemoglobin level was age.

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Stunting in Toddlers (6-60 Months): Parenting, Mother's Education, Infectious Diseases, and Breastfeeding

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Abstract

Stunting is a form of failure to thrive which reflects chronic and multidimensional nutritional problems. This study aims to analyze the relationship between a mother's education level, exclusive breastfeeding, and a history of infectious disease on stunting at the age of toddlers (6-60) months. The research design was cross-sectional with a purposive sampling technique. This study was conducted on mothers with toddlers aged (6-60) months in the working area of the Seberang Padang Health Center as many as 60 people. Data collection techniques in this study were through survey methods and direct interviews with mothers who have toddlers. Data were analyzed using the chi-square test. The results showed a significant relationship between exclusive breastfeeding (p-value = 0.001; 0.067) and a history of infectious disease (p-value = 0.028; 0.218) with stunting. However, there is no significant relationship between a mother's education level and stunting. This research finds that exclusive breastfeeding and a history of the disease are the risks of stunting. The need for special attention and improvement of health promotion and education programs for the Seberang Padang Health Center in preventing stunting in toddlers.

Introduction

One form of undernutrition based on height for age is stunting. Stunting is a form of growth failure that reflects chronic and multidimensional nutritional problems in the first 1000 days of life, affecting the human resources produced. In addition, TB/U describes a person experiencing chronic nutritional problems. Poverty, lifestyle, and parenting are some of the causes of a toddler experiencing stunting. Decreased cognitive function, increased mortality, and the future onset of metabolic syndrome diseases are considerable effects of stunting. Prolonged malnutrition will cause a person to experience growth failure or stunting (Thurstans et al., 2022, Beal et al., 2018).

The problem of stunting usually occurs in poor and developing countries (Achmad, 2022). Stunting can disrupt toddlers' cognitive development in adulthood, reducing productivity and growing bodies that do not reach their adult potential (Koshy et al., 2022). " Window of opportunity" where the first two years of life are vital and short period and cannot be repeated, which is also a critical period in the growth and development of toddlers (World Health Organization, 2018). The main agenda of public health problems in the world is to reduce the prevalence of stunting by 2030 to 17.5% (Laksono et al., 2022).

Indonesia, like other developing countries, has common nutritional problems in infants and young children (Diana et al., 2022), such as stunting, wasting (Titaley et al., 2019), iron deficiency (Manikam, 2021), poverty (Hidayat and Erlyn, 2021), and low birth weight (Hayudanti et al., 2022). Malnutrition in the first two years of life can cause mortality and morbidity in childhood and is one of

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the preventable risk factors. Childhood malnutrition is still a health problem in Indonesia today. Stunting is a serious problem and is related to optimizing the quality of human resources (Wulandari et al., 2022).

The Global Health Observatory shows that of nearly 150 billion children under the age of 5 worldwide, 21.9% are still in the stunting category (World Health Organization, 2018). Indonesia is a country that has a high prevalence of stunting even compared to various countries in the South Asia region. Based on Riskesdas 2007, 2013, and 2018 data, the prevalence of stunting in Indonesia is 36.8%, 37.2%, and 30.8%. Although it has decreased, it is still above 20%, the threshold for stunting prevalence according to WHO, which is also still in the high category. It can illustrate that 1 in 3 babies born in Indonesia is stunted. In addition, the data also interpreted that 34 provinces and 541 cities in Indonesia have an average stunting prevalence rate between 17.6% - 42.3% (Kusrini and Laksono, 2020).

West Sumatra, based on the Rakerkesda (regional health work meeting) in 2019 and guided by WHO criteria 3 targets, undernutrition and malnutrition reducing by <10%, stunting by <20%, and thin and very thin by <5%.6 The prevalence of stunting in toddlers in West Sumatra based on Nutrition Status Monitoring (PSG) was 25.5% in 2016, and in 2017 it increased to 30.6%. The Padang City Health Office report found an increase in the incidence of stunting in Padang City. The prevalence of stunting in 2016 decreased from the previous year, although it was still above the World Health Organization (WHO) criteria threshold of 21.1% in 2018, it increased to 22.6%.

Chronic malnutrition in toddlers is characterized by growth failure, metabolic disorders in toddlers, especially in the first 1000 days of life, and failure to develop or known as 3G, commonly known as stunting (Soliman et al., 2021). Several factors can affect the condition of toddlers later experiencing stunting, namely direct and indirect factors. Direct factors are maternal factors, genetic factors, infectious diseases, exclusive breastfeeding, and nutritional intake obtained from food consumed (Titaley et al., 2019). In addition to direct factors, indirect factors of stunting are the level of education, the attitude of families, and maternal knowledge (Rachmawati et al., 2021).

Parenting during toddlerhood affects the development of toddler growth and development, both in terms of care, love, care, and how nutritional intake is obtained by the toddlers who are cared for by their mothers (Yang et al., 2021). Parenting and toddler care are affected by the mother's education level, which directly affects the occurrence of stunting in toddlers (Colo and Manongga, 2022). The mother's education level will affect the mother's knowledge and absorption of nutritional information.

Usually, mothers with a high level of education are better at absorbing information, so they have a good understanding than mothers with low education. Maternal nutrition knowledge can hinder nutrition improvement efforts in the family and community if it is not optimal. The provision of ingredients and the right meal menu for toddlers to improve nutritional status in toddlers will be different for mothers who have a high education compared to low education (Kusrini and Laksono, 2020).

Exclusive breastfeeding has been recommended by the World Health Organization (WHO) since 2001, where up to 6 months of age without complementary food and continued until the child is 2 years old. Exclusive breastfeeding is also stipulated in the Government Regulation (PP) of the Republic of Indonesia number 33 of 2012 that the Indonesian government guarantees the fulfillment of the right of infants to receive exclusive breastfeeding from birth until 6 months of age along with attention to infant growth and development and provides protection to mothers when providing exclusive breastfeeding to their babies. Globally, increasing breastfeeding rates can save the lives of more than 820,000 children under the age of 5 each year, most of whom (87%) are under the age of 6 months. In addition to improving child survival and protecting against life-threatening and chronic diseases, exclusive breastfeeding promotes healthy growth and early child development (UNICEF, 2018, Sari, 2022).

Infectious diseases in toddlers are one

of the factors that influence the incidence of stunting in toddlers (Santosa et al., 2022). Usually, most stunted toddlers have a higher rate of infectious diseases. The result of repeated infectious diseases can worsen nutritional status and trigger inflammation in the body and cause stunting. The first 2 years of age is a condition that is quite risky for children exposed to infectious diseases, frequency of diarrhea (Arini and Faradilah, 2020), and ARI are those that often occur in toddlers (Arini et al., 2020). Infectious diseases can interfere with growth, development, and toddlers' nutritional status. Disturbances in nutrient absorption, food intake that is not optimal, and elimination of useful nutrients for the body are the direct impacts caused by infectious diseases. Inadequate nutritional intake and infectious diseases are interrelated factors in causing stunting in toddlers directly (Fatimah and Wirjatmadi, 2018).

Community Health Center (CHC) Seberang Padang has the highest prevalence of stunting, based on the description, researchers are interested in knowing the relationship between maternal education level, exclusive breastfeeding, and history of infectious diseases on the nutritional status of toddlers in this case stunting in the working area of CHC Seberang Padang, Padang City.

Method

This research is explanatory research with a survey method and is quantitative research with a crossectional design approach where data collection is at the same time. The population of this study was mothers who had toddlers aged (6-60) months in the working area of IPS Seberang Padang, where the sample was part of the population of mothers who had toddlers aged (6-60) months by purposive sampling. The selected sample has met several criteria, namely inclusion and exclusion criteria. The number of samples in this study was 181 samples. The data used were the results of the nutrition program planning survey. Namely: age, education level, mother's occupation, and nutritional status of children under five.

In addition to secondary data, this study also used primary data collected through interviews using questionnaires. Data were analyzed using SPSS 21 software. Bivariate analysis used the Chi-Square test. The expected value of less than five and or the expected value of each cell that is less than five should not be ≥ 50% is a requirement of the chi-square test. Bivariate analysis by the Fisher Exact test was performed if the Chi-Square test conditions were not met.

Results and Discussion

The characteristics of this study sample were the mother's age, gender, nutritional status, and birth weight. The sample in this study was mothers with toddlers totaling 60 people. Table 1 shows that 60 sample in this study were dominated by mothers aged 20-34 or women of childbearing age (50%). The sample's distribution of the toddler group aged (6-60) months was almost half male (56.7%). While (20%) of toddlers in this study had to stunt nutritional status. Based on birth weight, there were more normal toddlers (80%) than those with LBW (20%). Table 1 below shows the distribution of sample characteristics in the Seberang Padang Health Center working area.

Table 1. Characteristics of Stunted Toddlers and Families

Characteristics	Frequency (n)	Percentage (%)
Mother's Age		
<19 Years	1	1.7
20-34 Years	30	50
>35 Years	29	48,3
Gender		
Female	26	43.3
Male	34	56.7
Nutritional Status		
Normal	48	80
Stunting	12	20
Birth Weight		
< 2500	12	20
≥ 2500	48	80

Source: Primary Data,

Table 2 shows mothers with low education level have more stunted toddlers (23.1%) than those with high education (17.6%). Stunted toddlers are more common in mothers who do not provide exclusive breastfeeding (52.9%) than those who give exclusive breastfeeding (7%). Stunted toddlers with a history of infectious disease are (32.1%) more than toddlers who never had a history of infectious disease (9.4%). The Chi-Square statistical test showed a p-value <0.05 indicating a significant

relationship between exclusive breastfeeding and a history of infectious disease against stunted toddlers. In addition, the analysis also showed no significant relationship between the mother's education level and the incidence of stunting. It can be explained by the results of statistical tests obtained by the value of p>0,05.

Table 2. Relationship between Mother's Education Level, Exclusive Breastfeeding, and Infectious Diseases with the Incidence of Stunting in Toddlers Aged (6-60 months)

Variable	Incidence of Stunting				Total		POR (95%CI)	P-value
	Stunting		Normal					
	F	%	f	%	f	%		
Mother's Education Level								
Low	6	23.1	20	76.9	26	100	0.714	0.845
High	6	17.6	28	82.4	34	100	(0.201-2.54)	
Exclusive Breastfeeding								
Not Exclusive Breastfeeding	9	52.9	8	47.1	17	100	0.067	**0.001**
Exclusive Breastfeeding	3	7	40	93	43	100	(0.015-0.302)	
History of Infectious Disease								
Ever Infected	9	32.1	19	67.9	28	100	0.218	0.028
Never Infected	3	9.4	29	90.6	32	100	(0.52-0.912)	
Parenting Pattern								
Mother	7	9.2	69	90.8	76	100	3.94	**0.001**
Other than Mother	30	28.6	75	71.4	105	100	(0.627-9.556)	

**Chi-square test*

Source: Primary Data,

Through bivariate analysis, it can be interpreted that the POR value = 0.067 which means that toddlers who do not get exclusive breastfeeding are at risk of stunting 0.067 times compared to toddlers who are given exclusive breastfeeding. The results of bivariate analysis also show that the POR value = 0.218 which explains that toddlers who have a history of infectious disease are at risk of 0.218 times experiencing stunting compared to toddlers who have never had a history of infectious disease.

Inadequate growth faltering and catch-up growth conditions illustrate the inability of the body to grow optimally, resulting in stunting. The best indicator of whether or not there are quality inequalities in achieving optimal under-five health is through linear growth curves by age. Unmet nutrition due to insufficient food and the emergence of infectious diseases are the direct and most frequent causes of growth failure in children under five. Stunting is a chronic malnutrition problem caused by a lack of nutritional intake for a long time, resulting in impaired growth and development in toddlers, this can be seen from lower or shorter height (short) than age standards (Kusrini and Laksono, 2020, Marbun et al., 2022).

Linear growth in early childhood is a strong marker of healthy growth, as it is associated with risk of morbidity, NCDs (non-communicable diseases), mortality, learning capacity and productivity later in life. It is also closely related to child development in several domains including cognitive, sensory and motor skills and language. The WHO identifies poor maternal health and nutritional status, infectious diseases, and inadequate infant and young child feeding practices as causes of stunting in children under 5 years old (World Health Organization, 2018),(Huo et al., 2022).

The results of the analysis show that there is no relationship between maternal education level and the incidence of stunting in toddlers (6-60) months at CHC Seberang Padang. However, it can be seen that the lower the mother's education level, the toddler has a greater risk of stunting. Highly educated mothers are expected to have more insight and receive nutritional information more quickly. The incidence of stunting in toddlers is related to nutritional intake in toddlers. The daily intake of nutrients eaten by toddlers depends on the mother so the mother has a vital role in changing the intake of nutrients in toddlers. Mothers with a better level of knowledge are more likely to apply their knowledge in caring for their toddlers, especially by providing food that is in accordance with the nutrients needed by toddlers so that toddlers do not experience a lack of food intake. Mothers who have good knowledge are expected to apply it in their daily

lives (Marbun et al., 2022).

This result is in line with the results of a study in Malawi which found that maternal knowledge was also a predictor of undernutrition in infants. Better maternal knowledge reduces the risk of undernutrition in infants. In line with the results of the Malawi study, findings in India also found the same thing. Women's education can reduce stunting in children under five. However, this study also shows that mothers with higher education also have stunted toddlers. The cause, for example, is that mothers are less active in Integrated Service Post (ISP) activities and routinely check the growth and development of toddlers so that the health of toddlers is less monitored (Walters et al., 2019, Pillai and Maleku, 2019). On the other hand, this study found two variables associated with stunting in toddlers (6-60) months in the Seberang Padang Community Health Center area. These variables included exclusive breastfeeding and infectious diseases.

The bivariate test results show that the exclusive breastfeeding variable affects stunting in toddlers, which is 0.067 times that toddlers who are given exclusive breastfeeding are at risk of stunting compared to toddlers who get exclusive breastfeeding. According to this study, research conducted in Pudun Jae Village, Padang Sidempuan City, shows that toddlers who do not receive exclusive breastfeeding have a 0.070 times greater risk of stunting than toddlers who receive exclusive breastfeeding (Hadi et al., 2023). Exclusive breastfeeding was also linked to stunting in toddlers, according to research conducted at Karanglewas Health Center (p=0.004) (Triana and Haniyah, 2020).

Exclusive breastfeeding has a significant association with stunting among children under five (6-60) months. Antibodies and calcium content in breast milk have high bioavailability and can help optimal absorption in bone formation in infants. Stunting can be prevented in several ways such as through exclusive breastfeeding. Providing nutritious food according to the needs of the body, getting used to clean behavior, doing physical activity, balancing energy expenditure and nutrient intake into the body, and monitoring child growth and development regularly are also needed in preventing stunting in children. The first hour of birth, given exclusively for six months, and continued up to two years or beyond with safe and appropriate complementary feeding is one of the most powerful practices to improve child survival and well-being (UNICEF, 2018).

Furthermore, infectious diseases with stunting in toddlers through a history of infectious diseases can also be estimated. Explains how toddlers in Southern Pakistan with a history of tuberculosis infection have a significant (p-value = 0.03) relationship with the incidence of stunting in that area (Saleem et al., 2023). In Aileu Country, Timor Leste there is linear relationship between infectious diseases and low income family with stunting incident on toodlers (do Rosario Pacheco et al., 2017). Research conducted in the Curug village of Karawang also shows that there is a significant relationship between infectious diseases and the incidence of stunting. Children who have infectious diseases have a risk factor for stunting 0.521 times higher than children who do not experience infectious diseases (Linawati, 2022).

Toddlers who have a history of infectious diseases have a higher risk of stunting. Infections that occur repeatedly and for a long time have an impact on inhibiting child growth, so children become short compared to other normal children (Marniati and Andika, 2022). Moreover, there is an interaction between toddlers who have infections with malnutrition, where which can make appetite reduced, and the malabsorption of food nutrients, while the body's immune system decreases when experiencing malnutrition so that infectious diseases will get worse. The body's defense system will respond when experiencing infection by increasing pro-inflammatory cytokines, namely TNFα, IL-1 (especially IL-1β), and IL-6. Decreased chondrocyte proliferation by cytokines thus suppressing the growth of chondrocytes (Das et al., 2022). This study has the disadvantage that data from cross-sectional studies are observational in nature without temporal sequencing, making it difficult to make strong causal claims on the results of the study.

Conclusion

Based on the research conducted, exclusive breastfeeding and infectious diseases are significantly associated with the incidence of stunting in toddlers. However, there is no significant relationship between maternal education level and stunting. The need for special attention and increased health promotion and education programs for Community Health Center (CHC) Seberang Padang in preventing stunting in toddlers. Further research is needed by expanding the research area to capture more samples so that the data generated is better and the addition of other factors.

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Maternal Anxiety and Sleep Quality Affects of Neonatal Brain-Derived Neurotrophic Factor

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Abstract

Anxiety conditions and sleep disorders in pregnant women will affect the Brain-Derived Neurotrophic Factor (BDNF) level of the baby's umbilical cord blood, which will then affect the growth and development of the baby. This study aims to assess the relationship between maternal anxiety and sleep quality with neonates' BDNF levels. The research design was a cross-sectional study. Pregnant Women who gave birth by cesarean delivery method with a gestational age of ≥ 37 weeks, Totally 78 pregnant women involved. Anxiety levels and sleep quality were assessed by questionnaire, and BDNF levels were taken from the umbilical cord blood and then checked using the ELISA method. Data were analyzed by One-Way-Anova and Independent T-test. There was a significant association between anxiety levels and sleep quality with Neonatal BDNF levels (p = 0.000). The results obtained for pregnant women without anxiety, the mean level of BDNF is 2.017 ± 0.138 ng /ml. Mild anxiety, the mean value of BDNF level is 1.792 ±0.134 ng/ml. Moderate anxiety, the mean value of BDNF level is 1.708±0.177 ng/ ml. Severe anxiety, the mean value of BDNF levels was 1.585±0.257 ng/ml . Pregnant women with good sleep quality had the mean BDNF level of 1.969±0.211 ng/ml, while the mean BDNF level of poor sleep quality was 1.673 ±0.188 ng/ml. Conclusion: The higher the anxiety level of pregnant women, the lower the average Neonatal BDNF level is. The worse the sleep quality of pregnant women, the lower the average Neonatal BDNF level is.

Introduction

The future of a nation depends on the success of children in achieving optimal growth and development. The fetal period, the first years of life, is essential in the growth and development of children (Kemenkes, 2016). The development of a child's nerves and brain occurs from the moment in the womb, namely the embryonic period, to prenatal and postnatal. The prenatal and postnatal periods are critical periods in which the fetal brain can be changed and shaped(De Vincenti, Ríos, Paratcha, & Ledda, 2019). World Health Organization reported that 10% of children experience developmental and emotional disorders(WHO, 2021). Global research conducted in 195 countries by Olusanya et al. (2018) in The Lancet Series on child development disorders also reported an increased potential for developmental disorders in as many as 632 million children under five years. These child development problems include delays in motor development, language development, autism, hyperactivity, cognitive and intellectual disorders, and emotional disorders (Herba, Glover, Ramchandani, & Rondon, 2016; Olusanya et al., 2018).

Developmental disorders in children under five years occur primarily in developing and low-income countries, with a prevalence of more than 50 million (Olusanya et al., 2021). The majority of cognitive and socio-emotional

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developmental disorders in children under five years in the South and Southeast Asia region was 31.5%. Cognitive and socio-emotional developmental disorders in children under five years in Indonesia were 23.8% (Langgapin, Sirithongthaworn, Yang, & Reddy, 2019). The interference problem of the development of children under five years in Indonesia is still severe, consisting of 701 cases of autism per 100,000, intellectual development disorders as many as 1,244 per 100,000, hyperactive children as many as 85 per 100,000(Langgapin et al., 2019). Developmental disorders in children can be affected by the formation of neural circuits and suboptimal brain development that starts in the prenatal period (Kadic & Kurjak, 2018). The process of neurogenesis is influenced by several proteins that stimulate neurons' growth, development, plasticity, and endurance. This group of proteins is neurotropic. One of the neurotrophic groups that has an essential role is the Brain-Derived Neurotrophic Factor. BDNF is expressed in the hippocampus, cortex, cerebellum, and amygdala (De Vincenti et al., 2019).

Research by Ghassabian et al. (2017) stated that high Brain DeriBrain-Derivedhic Factor (BDNF) levels could significantly reduce failures in child development. Low neonatal Brain-Derived Neurotrophic Factor is associated with developmental domain failure (Ghassabian, 2017). A study by Skogtrand et al. (2019) stated that reducing BDNF levels in newborns could significantly increase the occurrence of neurodevelopmental disorders by 1.15 times higher than in normal conditions (Skogstrand et al., 2019). Low levels of Brain-Derived Neurotrophic Factor can affect brain development, causing hippocampal atrophy. Hippocampal atrophy will impact the development and intelligence level (Scheinost, Spann, McDonough, Peterson, & Monk, 2020).

Brain-Derived Neurotrophic Factor levels in the fetus are influenced by the intrauterine environment and psychosocial stressors (Flock et al., 2016; Herba et al., 2016). Fetal exposure to psychological disorders in pregnant women can interfere with optimal brain development. Psychological disorders can induce epigenetic modifications in BDNF, resulting in changes in BDNF gene expression (K. W. Chen & Chen, 2017). Research by Fung et al. (2015) stated that anxiety and stress disorders experienced during pregnancy or before delivery could cause a decrease in cord BDNF levels 1.6 times lower than in healthy mothers(Fung et al., 2015). Sonmez et al. (2019) showed that cord blood BDNF levels in mothers who experienced anxiety and depression were significantly lower than cord blood BDNF levels in infants of healthy mothers. BDNF levels decreased from 2.08 ng/ml to 0.98 ng/ml(Sonmez et al., 2019).

The results of a study by Monteiro et al. (2017) stated that someone with anxiety and stress disorders often experiences sleep disturbances. Poor sleep quality can also cause stress, suppressing the secretion of Brain-Derived Neurotrophic Factors. This study stated that there was a causal pattern between sleep deprivation, BDNF levels, and depression (Monteiro et al., 2017). Sleep disturbances can modulate stress and then activate the hypothalamus-pituitary-adrenal (HPA) axis, which causes an increase in cortisol secretion. Increased cortisol concentration can suppress BDNF production (Fan et al., 2019). In line with research conducted by Kriengtuntiwong, Zaw et al. (2021) in Thailand stating that apart from stress and anxiety levels, BDNF levels were also affected by sleep quality. Research by Fan et al. (2019) said that poor sleep quality makes BDNF levels three times lower than those with good quality sleep (Fan et al., 2019). In contrast to the results of the study by Deuschle et al. (2018), which stated that there was no significant difference in BDNF levels in patients with sleep disorders(Deuschle et al., 2018).

The intrauterine environment and psychosocial stressors influence developmental disorders in children in the womb. Still, health workers focus more on prevention, treatment, and intervention in pregnant women's physical and intrauterine environments. Psychological problems and sleep disturbances are often overlooked and rarely given attention. Many studies have assessed the relationship between BDNF levels and other factors in pregnant women. Research examining the relationship between psychological disorders (anxiety level and sleep quality) and BDNF levels of the baby's umbilical cord blood in mothers giving birth is rarely done in Indonesia. Based on this,

the researchers were interested in conducting this study to determine whether there is a relationship between anxiety levels and brain levels (BDNF) of the baby's umbilical cord blood in mothers giving birth.

Methods

This research was an observational study with a cross-sectional design. It took time from November 2021 to June 2022 and was approved by the Andalas University research ethics committee with number 677/UN.16.2/KEP-FK/2022. The inclusion criteria in this study were women giving birth with a gestational age ≥37 weeks with the Caesarean section delivery method without complicating diseases and willing to participate as research subjects. Exclusion criteria in this study were pregnant women with pre-eclampsia/eclampsia, pregnant women with diabetes, pregnant women who were obese, pregnant women with systemic infections, pregnant women with anemia, pregnant women who were active smokers, and pregnant women who consumed alcohol.Patients who met the requirements were identified as research subjects through collaboration in three medical institutions in Padang, West Sumatra, Hermina Hospital, Reksodiwiryo Hospital, Andalas University Hospital. To determine the minimum sample size, a sample size formula was used for single population data to estimate the average (Hardisman, 2021).

$$n = \frac{Z\alpha^2 \times S^2}{d^2}$$

Based on the procedure and standard deviation, we got a large sample, namely 78 respondents. Maternity mothers who met the requirements and agreed to participate in this study signed informed consent. Anxiety level assessment used the Zung Self Anxiety Scale questionnaire. Evaluation of sleep quality using the Pittsburgh Sleep Quality Index (PSQI) questionnaire, was carried out when the mother was in the obstetrics/delivery room before delivery, then taking the baby's cord blood from the maternal department in the operating room during the process of cesarean section delivery. After the baby's umbilical cord blood was obtained, we processed it with a centrifuge (separating the blood into serum). After all the samples were collected, the BDNF levels were checked at the Biomedical Laboratory, Andalas University, Padang, using the enzyme-linked immunosorbent assay (ELISA) method. The One Way Anova statistical test was used to assess the relationship and differences between anxiety levels and the average BDNF level. In contrast, the T-Independent test was used to determine the relationship between sleep quality and cord blood BDNF levels using the SPSS version 26 program.

Results and Discussion

Based on Table 1, the results of statistical analysis showed that of the 78 pregnant women nearing delivery at the Padang city hospital, 12 (15.4 %) pregnant women did not experience anxiety, then the statistical results showed that there were 66 (84.6%) pregnant women who experienced anxiety. Pregnant women who experienced anxiety consisted of 8 pregnant women (10.3%) with mild anxiety, 34 pregnant women (43.6%) experienced moderate, and as many as 24 pregnant women (30.6%) experienced severe anxiety. It shows that many pregnant women experience psychological disorders, especially anxiety problems, in Padang city hospitals. It was known that of 78 pregnant women nearing delivery at the Padang city hospital, 15 women (19.2%) experienced good sleep quality. As many as 63 pregnant women (80.8%) experienced poor sleep quality in Padang City Hospital.

Table 1. Frequency Distribution of Anxiety Levels and Sleep Quality in Pregnant Women at Several Hospital in Padang City

Anxiety Levels	**F**	**(%)**
Without Anxiety	12	15.4
Mild Anxiety	8	10.3
Moderate Anxiety	34	43.6
Severe Anxiety	24	30.7
Total	78	100%
Sleep Quality		
Good	15	19,2
Poor	63	80,8
Total	78	100%

Table 2. The Relationship between anxiety levels and Neonatal BDNF levels

Anxiety Level	Neonatal BDNF Level				p- *Value*
	n (%)	Mean	SD	F	
No Anxiety	12(15.4)	2.017	0.138	16,196	0.000
Mild Anxiety	8(10.3)	1,792	0.134		
Moderate Anxiety	34(43.6)	1,708	0.177		
Severe Anxiety	24(30.7)	1.585	0.207		
Amount	78(100%)	**1,726**	**0.224**		

Table 3. The Relationship between Sleep Quality and Neonatal BDNF Levels

Sleep Quality	Neonatal BDNF Level				P *Value*
	n(%)	Mean	SD	T	
Poor	15(19.2)	1,673	0.188	-4,851	0.000
Good	63(80,8)	1,949	0.199		
Total	78(100)				

One-Way-Anova statistical analysis showed a difference in anxiety level with the average Brain-Derived Neurotrophic Factor (BDNF) level. So, we can conclude a significant relationship between the anxiety level and Brain-Derived Neurotrophic Factor (BDNF) levels in cord blood baby centers for mothers giving birth. It can be seen from the p-value < 0.05, namely p = 0.001. Where the higher the level of anxiety of the study subjects, the lower the average BDNF level is.

T-Independent analysis results, different tests on the average BDNF levels based on the sleep quality group, showed differences in the mean Brain-Derived Neurotrophic Factor (BDNF) levels based on the sleep quality group. We can conclude that there is a significant relationship between sleep quality and the levels of Brain-Derived Neurotrophic Factor (BDNF) in the baby's umbilical cord blood in mothers giving birth. It can be seen from the p-value < 0.05, namely p = 0.000. Where the poorer the quality of sleep of the study subjects, the lower the average BDNF levels.

From the results of the study, we know that many pregnant women experience psychological disorders, especially anxiety problems, at the Padang city hospital. In this study, the researchers used the Zung self-anxiety scale research instrument to assess maternal anxiety. The questions in this questionnaire already described somatic symptoms and psychological symptoms. Research subjects (pregnant women) who experienced anxiety in this study were followed by somatic clinical symptoms such as many pregnant women experiencing respiratory problems, digestive disorders, dizziness, palpitations, paleness, fatigue, and others. In addition, in this study, research subjects who experienced anxiety were also followed by psychological problems, such as irritability, more sensitivity, crying easily, anxiety, feelings of worry, lack of enthusiasm, and feelings of excessive fear.

The results of the study by Luo et al. (2022) explained that risk factors that were significantly related to depression and anxiety in pregnant women during the COVID-19 pandemic were the age of pregnant women, education level, number of children/parities, employment status, chronic disease, physical activity, social support and family income (Luo, Zhang, Huang, & Qiu, 2022). Research by S. Chen, Zhuang, Chen, & Tan (2020) reported that what caused anxiety during pregnancy was 72.67% of anxiety caused by fear of whether the child could be born safely and smoothly, 38.1% of anxiety about the pain of labor, anxiety about changing roles, figures, and activities after giving birth 18.79%, anxiety about the possibility of being infected with the COVID-19 virus 18.62%, anxiety because economic pressure after giving birth 18.02%, the anxiety of not being able to take care of children and work at the same time was 16.98% (S. Chen, Zhuang, Chen, & Tan, 2020). In line with the results of research that researchers conducted in several hospitals in the city of Padang, where it was

found that pregnant women experience anxiety caused by anxiety related to their pregnancy, anxiety related to their health, concern about labor pains, worry about the health of their unborn child, especially during the COVID-19 pandemic. They were more afraid to leave the house, interact with others, and carry out social activities.

The anxiety problem is because many pregnant women fear the physical changes they experience, such as excessive weight gain during pregnancy. Pregnant women are often anxious to fulfill responsibilities, and their role as a parent is related to work and the number of children they have. Mothers who have never had children before tend to experience more anxiety about physical changes and changes in roles and responsibilities than mothers who have had children before. In contrast, multigravida mothers often experience anxiety caused by many children or the close age gap, as well as the age factor that causes them to worry about not being able to take care of their children properly.

Meanwhile, social problems can be caused by a lack of support and attention from husbands, family support, and social support for pregnant women. In addition, anxiety is also influenced by financial problems, especially during the COVID-19 pandemic affecting family income. Some respondents who did not have jobs and were unstable and low-income tended to be more anxious. Meanwhile, working mothers also experience anxiety because they are worried they can't take good care of their babies. Anxiety during pregnancy is also because of obstetric history or bad experiences related to previous pregnancies. Mothers with previous poor obstetric history tend to experience anxiety. They are afraid of the baby's condition and its condition. In addition, we also found that the age factor influences it. Women younger or older during childbirth are more prone to anxiety problems related to their physical condition and coping mechanisms.

The results of the One-Way-Anova analysis, different tests on the average BDNF levels based on the anxiety level group. Where the average level of BDNF was higher in the group without anxiety at 2.017 ± 0.138 ng/ml, followed by the average level of mild anxiety at 1.792 ± 0.134 ng/ml, the average level of BDNF in moderate anxiety level 1.708 ± 0.177 ng/ml, and with the lowest mean BDNF levels were in the group with severe anxiety levels, namely 1.585 ± 0.205 ng/ml. It showed a significant relationship between anxiety levels and Brain-Derived Neurotrophic Factor (BDNF) levels in babies' umbilical cord blood in mothers who gave birth. We can see from the p-value < 0.05, $p = 0.000$.

Mothers who experience anxiety, stress, and depression during pregnancy can result in disturbances of monoamine neurotransmitters and decreased serotonin which can trigger inflammatory reactions and suppress BDNF levels. In addition, there is an increase in maternal glucocorticoid levels or cortisol levels of the fetus(McGowan & Matthews, 2018). In line with recent studies showing that the hypothalamic pituitary adrenal (HPA) axis plays a role in mediating the effects of maternal anxiety and stress on the fetal brain. Prolonged stress exposure causes disruption of the HPA axis and then increases the concentration of glucocorticosteroids/cortisol in the blood and has a negative/destructive effect on cells of the nervous system, which can stimulate a decrease in BDNF levels. Low levels of BDNF can cause the hippocampal volume to decrease and cause neurodevelopmental disorders (Murawska-Cialowicz et al., 2021).

Neurobiologically, anxiety causes noradrenergic, GABAergic, and serotonergic disturbances and involves the frontal lobe and limbic system. The higher the level of anxiety, the lower the BDNF level is. It indirectly affects cognitive parameters, including spatial learning and memory, as well as the emotional development of the fetus in the future (Porcher, Medina, & Gaiarsa, 2018). Miguel et al. (2019) showed a decrease in volume and thickness in the frontal, temporal, and limbic areas (with MRI) and an increase in frontal activation in children whose mothers had higher prenatal anxiety. In addition, there is more excellent functional connectivity between the amygdala and the left temporal cortex, indicating an acceleration of the connectivity pattern observed in people with anxiety or depressive disorders (Miguel, Pereira, Silveira, & Meaney, 2019).

Christian et al.'s study (2016) showed that

maternal BDNF levels at the circulation level were the same as fetal brain levels. These data support that if the mother experiences anxiety and depression, the BDNF levels will decrease, affecting the fetal BDNF levels. It shows that mood, anxiety, and stress affect BDNF levels (Christian, Mitchell, Gillespie, & Palettas, 2016). This study also shows that pregnant women in their third trimester or near delivery are prone to experience anxiety and depression, which can induce changes in BDNF levels.

Mothers who experience anxiety, stress, and depression during pregnancy can result in disturbances of monoamine neurotransmitters and decreased serotonin which can trigger inflammatory reactions and suppress BDNF levels and cytokine release by microglia. Anxiety and stress reduce the production of TNF-α and interleukin-1β (IL-1β) while also increasing the output of pro-IL-1β, IL-6, and TNF-α. Psychosocial stressors can activate the hypothalamus-pituitary-adrenal (HPA) axis and sympathetic nerves, then glucocorticoids and noradrenaline increase in the brain. Glucocorticoids and noradrenaline regulate cytokine release from microglia. Glucocorticoids suppress cytokine release from microglia by suppressing NF-Kb. Stress reduces BDNF expression in the hippocampus and prefrontal cortex. One of the mechanisms that cause a decrease in BDNF is caused by an inflammatory reaction, namely microglial, due to a reduction in the binding of cAMP response element binding protein to the promoter area of the BDNF gene due to excessive NF-κB activation (Enomoto, 2022).

Symptoms of maternal anxiety and depression increase the child's risk of experiencing various emotional, behavioral, and cognitive problems, which can affect the brain and behavior of future offspring. The results also report maternal anxiety and stress are associated with changes in limbic and frontotemporal networks and functional and microstructural connections present in the brain (Lautarescu, Craig, & Glover, 2020). Psychological disorders such as stress, anxiety, and chronic depression reduce the expression of BDNF, increase apoptosis and decrease the regeneration of neurons in the hippocampus, and reduce the expression of BDNF in the brain.

In addition to anxiety problems in pregnant women, out of 78 pregnant women respondents who were nearing the time of delivery at the Padang City Hospital, 15 pregnant women (19,2.%) experienced good sleep quality, then 63 pregnant women (80.8%) experienced poor sleep quality at the Padang city hospital. Then, we concluded that many pregnant women experienced poor sleep quality at the Padang city hospital. Based on the results of research related to the assessment of sleep quality for mothers in labor using the Pittsburgh Sleep Quality Index questionnaire, which not only assesses sleep quality and sleep duration but also sleep latency, sleep efficiency, sleep disturbances, dysfunction of daytime activities, and use of sleeping pills. In this research, the researchers found that many pregnant women have poor sleep quality, and their sleep duration was less than 7 hours.

Many pregnant women experience sleep latency disorders or difficulty getting to sleep. Most pregnant women say it is difficult to start sleeping because they have physical problems such as shortness of breath, low back pain, difficulty finding a comfortable position, and frequent urination. Pregnant women find it difficult to start sleeping due to psychological problems such as experiencing anxiety, thoughts, and fears related to pregnancy or other personal issues. Hence, they divert by playing on their mobile phones, making it more difficult to fall asleep. The sleep efficiency of pregnant women is also disrupted. They often wake up at night because they need to urinate or because the mother still has a toddler and the discomfort of other physical changes related to pregnancy. From the research results, no pregnant women used sleeping pills to fall asleep. Despite the short amount of sleep they were getting, they were still trying to fall asleep naturally.

A statistical analysis of the Independent T-test showed that pregnant women with good sleep quality had an average BDNF level of 1.949 ± 0.199 ng/ml. In comparison, poor sleep quality had an average BDNF level of 1.673 ± 0.188 ng/ml. There was a difference in the mean BDNF levels in the sleep quality category, where the worse the sleep quality of pregnant women, the lower the BDNF levels

were. It could be concluded that there was also a significant relationship between sleep quality and infant cord blood BDNF levels (p=0.00). In line with the study of Monteiro et al. (2017) that serum BDNF levels were related to sleep. Sleep disturbances can cause physical and mental problems because sleep deprivation is usually followed by increased susceptibility to stress, which can reduce BDNF production(Monteiro et al., 2017). Lack of sleep is often followed by higher stress susceptibility, reduced environmental adaptation, and cognitive impairment; this is caused by disruption of various endocrine, physiological, and nervous functions (Giese et al., 2013).

Brain-Derived Neurotrophic Factor (BDNF) plays a role in sleep homeostasis. An interaction was found between stress, anxiety disorders, and sleep disturbances affecting serum BDNF levels. This result was in line with the assumption that stress or anxiety affects sleep and BDNF levels and vice versa sleep impacts the relationship between stress and BDNF (Giese et al., 2013). This study also indicated that sleep is a crucial mediator between stress and BDN. Sleep quality is highly correlated with symptoms of depression and anxiety disorders. A person with poor sleep quality can activate the HPA axis response to physical and psychosocial stressors.

The HPA axis is also linked to stress, anxiety, and depression, which leads to corticotropin (ACTH) release from the pituitary gland and cortisol from the adrenal glands. Sleep disturbances and depression may participate in the manifestation of an abnormal HPA axis and elevated cortisol levels.This increase in cortisol levels can suppress the production of BDNF levels (Bao et al., 2022). Brain-Derived Neurotrophic Factor (BDNF) can influence sleep quality by binding to TrkB, which sends signals to the pedunculopontine tegmental nucleus, which plays an essential role in developing REM sleep homeostasis. An animal study showed a significant positive relationship between REM sleep homeostatic drive and BDNF expression levels (Kriengtuntiwong, Zaw, & Taneepanichskul, 2021).

According to the research that researchers have done, many pregnant women say they often experience sleep disturbances caused by the workload during pregnancy, which makes them sleep less, the number of children, and the spacing of children. In addition, many pregnant women have toddlers, so they often wake up when the toddlers cry and wakefulness. Sleep disturbances also often occur due to the increasing gestational age, so physical and hormonal changes during pregnancy cause discomfort during sleep. Furthermore, pregnant women are prone to experiencing sleep problems during pregnancy which are closely related to depression and anxiety because they think about pregnancy conditions, economic issues, work problems, and social problems. Therefore, sleep must be considered because sleep problems are closely related to pregnancy-related psychological issues that impact pregnant women's welfare and their fetuses.

Conclusion

Pregnant women who do not experience anxiety have higher levels of BDNF in their baby's cord blood than pregnant women who experience anxiety. The higher the anxiety level of pregnant women, the lower the level of BDNF in the cord blood of the baby they have. This proves that psychological problems affect BDNF levels in the baby's cord blood. Based on the research results that the researchers have done, it was also found that if the quality of the mother's sleep during pregnancy is good, it can increase the baby's BDNF levels. However, if a mother's sleep during pregnancy is poor, this can lower BDNF levels. Good sleep quality is thought to handle stress and overcome mental disorders. A lack of quality sleep makes one prone to stress and anxiety and can increase cortisol production; thus, the BDNF level is also affected and decreases. The low neonatal BDNF levels are due to symptoms of anxiety and sleep disturbances. It can increase the risk of neurodevelopmental disorders, with decreased hippocampal volume in the brain, cognitive impairment can experience various emotional problems, and future hereditary behavior. Based on these findings, it is hoped that health workers, especially midwives, will improve the quality of ANC so that they do not only focus on physical and obstetric care but also increase promotive, preventive, and

even support efforts related to psychological problems and sleep disturbances in pregnant women during antenatal care visits.

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Factors Associated With Caring Among Nursing Students in Rural Area, Indonesia

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Abstract

Caring becomes an essential concept in fundamental nursing and affects the quality of health services and nursing practice. However, factors in educational level among nursing students contribute to shaping and creating good caring behavior among nurses in clinical settings. The purpose of this study aimed to explore factors associated with caring among nursing students. This study used a survey with a cross-sectional study. It involved nursing students in a clinical phase amount of 256 respondents. The sampling technique was quota sampling. The questionnaires were used to assess caring and organizational factors. The Chi-square test and binary logistic regression were employed to explore the determinant factors of care behavior. Most nursing students' care behavior was 50% good category, mostly aged 17-25 years (49.4%) and female (51.2%). Emotional (OR=3.49; 95% CI=1.45-8.44) and quantitative workload (OR=0.29; 95% CI=0.10-0.84) were significantly related to caring behavior among nursing students. The proportion of nursing students with good and poor care behavior was equal. Moreover, significant results were also noted between emotional workload and caring behavior. Providing quality education is necessary to ensure nursing students can improve their ability to care for patients.

Introduction

Caring is a core value in nursing, defined as human acts in doing something with others, for people, and as people. It represents an attitude of work, responsibility, care, and affective engagement with others (Watson, 2013). In discussions of philosophies and theories developed by Watson, Swanson, Leininger, and Boykin, caring is a part of the essence of nursing and a key element in the process of nurse and patient interaction that creates effective and high-quality care (Létourneau, Cara and Goudreau, 2017). High-quality nursing care supports the quality of services in the healthcare sector because it can influence patient satisfaction (Calong and Soriano, 2018; Suprajitno, Sari and Anggraeni, 2020). Nurses are the health workers with the highest proportion in health services, and their roles are an essential part that needs to be considered. Nurses have a professional responsibility to provide high-quality nursing care to ensure better patient outcomes. Previous study explains that rural areas have several challenges, such as increasing global mobility, demand, and decreasing the supply of nurses. These challenges are exacerbated by significant reductions in rural conditions due to the limited provision of local health services (Humphreys et al., 2017; Kyle, Beattie and Smith, 2020). All actions and interventions of the nurse are verified through caring behaviors (Suliman et al., 2009; Oluma and Abadiga, 2020).

Several studies showed that caring of nurses is still low (Kartini and Putri, 2019; Lukmanulhakim, Afriyani and Haryani, 2019; Ukum, 2021). According to a previous study in Ethiopia, as many as 48.3% of nurses had low

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caring behavior in inpatient departments in public hospitals (Kibret et al., 2022). Another study conducted in Indonesia resulted in 45% of nurses having poor caring behaviors (Kartini and Putri, 2019). The care behavior of nurses in the inpatient room is sufficient (52.1%), with an assessment for the fulfillment of basic human needs 73.2%, client beliefs and expectations 47.9%, and sensitivity to oneself and others 50% (Noprianty and Karana, 2019). Lack of caring is expressed by patients with unfriendly nurses, anger, unresponsiveness to patient complaints, and poor communication while providing care in health care. At the same time, patients in ill conditions need more attention to get services. Hopefully, nurses can listen to their complaints, feeling, and fulfill their health needs (Skar and Soderberg, 2018; Kartini and Putri, 2019). This situation is aggravated by the emergence of the Coronavirus Disease 2019 (COVID-19). Nurses have higher challenges in caring for patients, such as fatigue, discomfort, anxiety, fear of contracting, and stress (Wahyuningsih et al., 2020; Cho and Kim, 2021; Irandoost et al., 2022). This condition may affect patient satisfaction, quality of care, and the healing process (Kol et al., 2018).

Various factors are believed to be related to nurses' caring behavior, including job satisfaction, professional satisfaction, nurse management, workload, and student performance (Lee, 2014; Oluma and Abadiga, 2020; Kibret et al., 2022). These studies are students' beliefs and perceptions closely associated with caring behavior. High awareness of nursing students will improve their ability to interact and care for patients (Lee, 2014). Preliminary study showed that 30% of students never see a patient during service, 20% did not respect patient rights, and 10% did not listen to patient complaints. These results illustrate that caring behaviors in students still tend to be lacking. Based on interviews conducted with students, this happens because of fear, insecurity, lack of communication skills, and bad experiences of students.

Nursing students, as prospective nurses in the future, are expected to provide good performance. In education level, experience and support contribute to the career pathways of nurses, especially in rural areas (Kyle, Beattie and Smith, 2020). Moreover, it needs to improve the quality of care and satisfaction of the nursing process and caring behavior in clinical and community settings. Caring behaviors can provide a sense of comfort and security, which can affect the healing process and patient satisfaction (Ariani and Aini, 2018). The development of self-confidence during nursing education, ensuring opportunities for empathy, and the development of the concept of nursing care are elements applicable to improve the care of students to create professional nurses (Konuk and Tanyer, 2019). This study aimed to analyze factors associated with caring among nursing students in rural areas in Indonesia.

Methods

This study used a cross-sectional design using primary data through an online survey. Data were from three educational institutions in Jember Regency, East Java, Indonesia, and conducted from May to July 2022. The characteristics of rural areas in this study are sparsely populated places. Around, there are still places such as rice fields, ponds, and others. There are five-stage methods implied in this study, including problem identification, data collection, data evaluation, data analysis, and presentation of results.

The sample of this study involved students in the nursing profession degree who enrolled in 2022. This study took place in rural areas, especially in Jember Regency. Only students who meet the inclusion criteria eligible to participate. A total of 256 nursing students were in the final survey. The inclusion criteria were being registered as nursing students in Jember regional institutions, coming from rural areas, and willing to be respondents. To determine the minimum size for this study, we used G-power software. The sampling technique was quota sampling. To avoid a bias, the researcher defines a target and makes a scheduled online survey as accessible as possible by the researcher.

There were several variables, including the demographic characteristic of respondents and organizational factors (workload). The respondents' characteristics included age, gender, and marital status. While workload consists of physical, cognitive, time pressure, emotional, qualitative, and quantitative. The

workload assessment used questionnaire consists of 20 question items that each question can be assessed with 1= not being a workload, 2= light workload, 3= medium workload, and 4= heavy workload. Then the researcher categorized into three, namely high (score 76%-100%), medium (score 56%-75%), and low (score ≤ 55%).

Descriptive analysis was used to describe the data for each variable. A bivariate analysis using a Chi-square test was employed, followed by a binary logistic regression test with significance at p-values of <0.05. The SPSS version 25 software was used to perform the analysis. Before collecting data, we asked the respondents to fill the informed consent in the beginning before they participated in the survey. Inform consent contains information related to our research, such as explanations, objectives, participants, anonymity, and willingness to participate in this survey. We confirmed it is voluntary, and they can withdraw at any time. This study was approved by the Health Research Ethics Commission of the Faculty of Nursing, Universitas Jember, with number 049/UN25.1.14/KEPK/2022.

Results and Discussion

Out of the 256 respondents, some of them had good caring (50%). Almost all respondents aged 17-25 years were 249 (97.3%), 80.1% female, and 93.4 % single. Most workload factors were in the low category, such as physical (84.4%), cognitive (56.6%), time pressure (61.4%), and qualitative factors (49.2%). Meanwhile, the majority of emotional factor was in the medium category amounting to 48.4% (Table 1).

Bivariate analysis in Table 2 showed that the only significant factor related to caring was an emotional factor, with a significance value of 0.001. Table 2 also contains results of binary logistic regressions to determinant factors associated with caring. Two factors, including the emotional and quantitative factors, associated with caring among nursing students. Respondents with low emotional factors were 3.5 times more likely to have good caring behavior compared with high emotional (OR=3.49; 95% CI=1.45-8.44). Although, students who have low quantitative factors were 0.3 less likely to have good caring than high quantitative factors (OR=0.29; 95% CI=0.10-0.84).

According to this study, the nursing students with a high level of caring behavior was 50%. This finding indicates that the proportion of students with good caring and low caring is the same results. It is in line with a study conducted in Indonesia that only 55.3% of clinical nursing students have highly caring behavior (Sukartini, Asmoro and Pradana, 2019). Skill and intelligence are factors related to care behavior among nursing students. Students with good skills and intelligence during education result in adequate behavior and performance (Gibson et al., 2012). We argued that most of the nursing students in this survey were young adults (17-25 years), and the level of caring was still in the low category. Age has a vital personal factor for the formation of maturity in nurses and more stable patterns in their life. Increasing age will increase the level of responsibility for work and caring for a patient (Prompahakul and Nilmanat, 2011).

An emotional factor was associated with caring behavior among nursing students. This result aligned by previous studies that emotion is significantly associated with the frequency of care behavior (Papathanasiou et al., 2021). Higher emotional intelligence directly has a high sense of the nurse's ability to empathize with clients, be responsive to patient needs, and improve caring behavior (Oyur Celik, 2017; Herlina, Harmuni and Hikmah, 2020). Emotional intelligence is the capability of nurses to control their reflections and emotions toward others. The concept includes four basic abilities. Such as emotional expression and perception, way of thinking, emotion management, and understanding (Nightingale et al., 2018). Furthermore, it is essential to provide the understanding and emotional abilities to nursing students at the educational level that can impact caring behavior in clinical and community settings.

Table 1. Sociodemographic Characteristics of Respondents

Variables	N	%
Age (Years)		
17-25	249	97.3
26-35	6	2.3
36-45	1	0.4
Gender		
Male	51	19.9
Female	205	80.1
Marital Status		
Married	17	6.6
Single	239	93.4
Physical Factors		
Low	216	84.4
Medium	39	15.2
High	1	0.4
Cognitive Factors		
Low	145	56.6
Medium	82	32.0
High	29	11.4
Time Pressure Factors		
Low	157	61.4
Medium	82	32.0
High	17	6.6
Emotional Factors		
Low	72	28.2
Medium	124	48.4
High	60	23.4
Qualitative Factors		
Low	126	49.2
Medium	87	34.0
High	43	16.8
Quantitative Factors		
Low	118	46.1
Medium	114	44.5
High	24	9.4
Caring		
Good	128	50.0
Poor	128	50.0

Source:

Table 2. Multivariate Analysis of Factors Associated with Caring among Nursing Students

Variables	Caring				X^2	OR	Sig.	95% CI	
	Poor Caring		Good Caring						
	n	%	n	%				Lower	Upper
Age (Years)									
17-25	126	50.6	123	49.4	0.427	0.00	1.000	0.00	0.00
26-35	2	33.3	4	66.7		0.00	1.000	0.00	0.00
36-45	0	0.0	1	100		Ref			
Gender									
Male	28	54.9	23	45.1	0.434	0.631	0.203	0.311	1.282
Female	100	48.8	105	51.2		Ref			
Marital Status									
Married	9	52.9	8	47.1	0.802	0.330	0.106	0.086	1.267
Single	119	49.8	120	50.2		Ref			
Physical Factors									
Low	105	48.6	111	51.4	0.405	0.00	1.000	0.00	0.00
Medium	22	56.4	17	43.6		0.00	1.000	0.00	0.00
High	1	100	0	0		Ref			
Cognitive Factors									
Low	64	44.1	81	55.9	0.100	1.38	0.528	0.52	3.71
Medium	47	57.3	35	42.7		1.17	0.760	0.43	3.15
High	17	58.6	12	41.4		Ref			
Time Pressure Factors									
Low	71	45.2	86	54.8	0.144	0.92	0.885	0.30	2.84
Medium	48	58.5	34	41.5		0.67	0.501	0.22	2.12
High	9	52.9	8	47.1		Ref			
Emotional Factors									
Low	23	31.9	49	68.1	0.001***	3.49	0.005**	1.45	8.44
Medium	70	56.5	54	43.5		1.12	0.755	0.56	2.21
High	35	58.3	25	41.7		Ref			
Qualitative Factors									
Low	58	46.0	68	54.0	0.332	0.80	0.578	0.36	1.76
Medium	49	56.3	38	43.7		0.81	0.606	0.37	1.77
High	21	48.8	22	51.2		Ref			
Quantitative Factors									
Low	56	47.5	62	52.5	0.096	0.29	0.023*	0.10	0.84
Medium	64	56.1	50	43.9		0.37	0.056	0.13	1.03
High	8	33.3	16	66.7		Ref			

*p <0.05; **p <0.01; ***p <0.001

Source:

Moreover, nursing students with a low emotional workload were 3.5 times higher to have good caring behavior than those with a high emotional workload factor. This finding is similar to an earlier study in Ethiopia mentioned those with lower workloads were more likely to have good caring behavior (Kibret et al., 2022). It showed that extremely imposed time pressure, mental, and emotional effort in nurses harmed patient outcomes and the healing process (Koinis et al., 2015; Dall'Ora et al., 2020; Kibret et al., 2022). Emotional exhaustion is a manifestation of an emotional workload characterized by poor mental health and psychological conditions (Maslach and Leiter, 2016; Baeriswyl et al., 2017; Edu-Valsania, Laguia and Moriano, 2022). Good performance of nursing students will not be generated if they experience emotional exhaustion and are unable to fulfill responsibilities in their work that affect their caring behavior.

The quantitative workload was also associated with caring behavior among nursing students. Students with a low quantitative

workload were less likely to care compared with a high quantitative workload. The quantitative workload is the number of tasks that nurses do during work. It is contradicted by a previous study that nurses with lower workloads have good caring behavior (Kibret et al., 2022). The workload can be defined as a process of a determinant number of people's hours of work to complete their job within a certain period. Workload influences employee occurring burnout (Talachi and Gorji, 2013; Selvarajan, Singh and Cloninger, 2016). It could be assumed that our study showed different findings because of respondents of this study were students, and it is different from the previous studies using clinical nurses. Furthermore, only a few nursing students rated themselves as having a high quantitative workload compared to a low and medium quantitative workload.

There are several limitations to this study. First, this study only used a cross-sectional design, and the causality cannot be confirmed and generated in a global population of nursing students. Secondly, the research took place in one regency. We believed it should be extended to a wider area to get more complete information about this topic. Additional study is needed to explore other factors related to caring among clinical nursing students. Despite these limitations, these findings contribute to sharing advanced information to capture caring behavior among clinical nursing students. These results can be the basis for educational institutions to develop curricula to create orientation programs and continuous professional education programs for clinical faculty especially. The adoption of mentoring programs and the value of caring can be implemented to ensure the quality of teaching education.

Conclusion

In conclusion, the factors related to caring among nursing students were emotional and quantitative workload. The nursing student's characteristics, such as age, gender, and marital status did not associate with caring behavior. Caring among nursing students can improve and stimulate them by building psychological health and readiness to work in clinical settings. A direction nursing policy in educational institutions concerning care behavior is needed to ensure capability among students and produce graduates who can improve patient health outcomes.

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Trial of Student Filariasis Vector Control Educational Model Class V Elementary School in Pekalongan City

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Abstract

In Pekalongan City, from 2004 to 2017, the number of clinical cases or positive containing microfilaria was 417 people, while 40 were chronic. In 2018, 6 people were infected with microfilaria at the age of fewer than 12 years from SDJ, with 306 samples in the Kertoharjo sub-district. The prevalence rate of microfilaria in children aged ≤ 10 years and > 15 years is proven to be 20%. The study aimed to try out the Tic Tac Toe game to control the Filariasis Vector. The trial research design used cross-sectional, with 30 students in grade 5 at SDN 1 X in Pekalongan City. The bivariate test used the Independent t-test and Wilcoxon test. The results of the research variable knowledge, attitude, and practice have significant differences, and napping behavior has no significant difference (p-value 0.073). The results of the evaluation of the game media showed an average range of values between 90.70 and 95.00, with the lowest average score being for the welcome book design 90.70, and a standard deviation of 11.50. The highest average score is for board game design which is 95.00, and a standard deviation of 10.40. The results show the effectiveness of media games in health education and are well received by students.

Introduction

Understanding is the ability to capture the meaning and definition of the material studied. Understanding a concept is very important because by understanding a concept, students can interpret or describe it broadly and clearly (Grillich et al., 2016). The educational process primarily has goals and objectives to develop every potential possessed by humans. It is also inseparable from the children's educational process, basically cannot be separated from the environment in which children grow and develop. Education has a vital role in childhood because the development of personality, mental, intellectual, and social attitudes are generated at the early age (Evans et al., 2016). The world of children is a world of play. Whenever there is an opportunity, occasion, and time they always play. By learning while playing, children feel happy and cheerful. Playing is an activity that they do all day long. Since for children playing is life, and life is a game (Hedges et al., 2013).

Through playing, children will try, feel, search, and find, so something new is obtained from activities in play (Tan et al., 2022). Playing in learning activities is not only liked but is also very beneficial for children's development. It includes motoric, affectivity, cognitive, spiritual, and balance benefits (Hedges et al., 2013). In principle, the learning objectives are so that students can understand the material according to the indicators made. It is because in a class there are students with different potentials in terms of talent, intelligence, and learning speed (Dormann et al., 2020). Therefore it is necessary to group learning materials so that all students can master all the indicators of the lesson according to the expectation and the time set (Grillich et al., 2016). In addition to grouping learning materials, what also needs to be paid

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attention to is the way of teaching that is per all the characteristics of the students in the class (Chang et al., 2012)

School-age children are the nation's next generation who must be equipped with knowledge so that they are expected to be able to form healthy and productive behaviors. So that it can avoid disease and disability due to micro filarial. Regulation of the Minister of Education and Culture of the Republic of Indonesia No. 65 of 2013 concerning primary and secondary education standards that health education can be integrated into the relevant subject matter, and students are taught in collaborative groups with problem-solving strategies that refer to process standards (Jayatilleke & Shah, 2020)..

Elephantiasis is a chronic disease in which swelling occurs in the legs and can be transmitted through mosquito bites (Famakinde, 2018). In medical terms, this disease is known as filariasis. Filariasis is a parasitic disease caused by microscopic worms. 3 (three) filarial worms species can cause lymphatic filariasis in humans. However, most infections are caused by Wuchereria bancrofti. In Asia this disease can also be caused by Brugia malayi and Brugia timori. Filariasis infection spreads through mosquito bites (Rao et al., 2006). Adult worms usually live in human lymph nodes. In an infected person, the worms will multiply and produce millions of microscopic worms or also known as microfilariae. Microfilariae are present in the blood of an infected person. If a mosquito bites an infected person, the mosquito will contain microfilariae in its body (Graves et al., 2013).

Microfilariae grow and develop in mosquitoes. When the mosquito bites another person, the worm larvae transfer from the mosquito to the human skin and travel to the lymph vessels. The larvae will grow into adult worms which usually takes 6 (six) months or more. Adult worms live for about 5-7 years. In 2018, 6 people were found to be infected with microfilaria at the age of less than 12 years from SDJ, with 306 samples in the Kertoharjo sub-district. The prevalence rate of microfilaria in children aged ≤ 10 years and > 15 years is proven to be 20%.

Research conducted by Arum et. al. in Kuripan, Kertoharjo Village, showed that 17 respondents had "adequate" knowledge about preventing the filariasis transmission. 6 people with "bad" environmental conditions (35.3%) and 11 people with "good" environmental conditions (64.7%). Of the 53 respondents who had "good" knowledge about preventing the transmission of filariasis, there were 15 people had "bad" physical environmental conditions (28.3%), and 38 people had "good" physical environmental conditions (71.3%). Risk factors for the existence of vectors in the house, environmental improvement, presence of ditches, ditches, stagnant water, predators, livestock, bushes, water plants, rice fields, and swamps (Siwiendrayanti et al., 2020).

The preparation of modules has a vital role in learning. It includes the functions, objectives, and benefits of the modules. Not only used as independent material but modules can also be used as a teacher's tool or substitute teacher to evaluate student learning outcomes for mastery of the material available in the module (Megan Macklin et al., 2018). The creation of this game module and media is a continuation of the initial research stages and data collection to solve existing problems.

The analysis results of the need for educational media and the characteristics of the games chosen by grade 5 students in 9 elementary schools in Pekalongan City found several problems related to learning media for endemic diseases occured in the city. The selection of types of games liked by children, as a result of the measurement is a row (Tic Tac Toe) of 122 students (67.22%) of 180 school students. The results of the focus group discussion with the grade 5 teachers indicated that the design of the tic tac toe game was modified with other games. Educational media and game media are considered suitable for the target characteristics of school-age children who like to play, move, work in groups, and carry out direct activities. To solve these problems, researchers are trying to design a learning media in an educational game tool Tic Tac Toe for controlling Filariasis. The learning media consists of a guidebook for filariasis vector control, a guidebook for the game of Tic Tac Toe, Chess Pieces, 3 x 3 boards, and question cards.

One of the games used in learning and successfully applied by previous researchers is

the Tic Tac Toe game (Hooshyar et al., 2023). Based on research by Farida & Rini, 2013 the game Tic Tac Toe in the field of mathematics can increase learning motivation in cycle I by 83.88% and by 85.85% for cycle II. According to Dirgahayuning, 2017, the Tic Tac Toe game can increase learning activities so that student learning outcomes increase, namely in cycle I by 62.29% and in cycle II by 80.95% in acid and base solutions. Based on the research, the researcher wants to develop the Tic Tac Toe game as a learning medium for students.

The choice of the Tic Tac Toe game as a learning medium is due to its simplicity in playing and easy application so that it is favored by students, as evidenced by the fact that 85.7% of students know and have played the Tic Tac Toe game (Watson, Arnold and Tanenhaus, 2009). The game difference between this research to previous research is in two aspects. First, the procedural aspect of using the Tic Tac Toe game, in the previous one, was played by two people. But in this study, it can be played by more than two people or based on the explanation above. This article aims at cooperative learning of the TGT (Time Games Tournament) type. Second, the media aspect of the Tic Tac Toe game has a 5x5 order, while previous research only had a 3x3 order, and the game media used was made of wooden boards, which can also be a place to store symbols (X & O), game cards, point cards, and books. Game guide, whereas in previous studies, the media was made of paper. This study describes the feasibility of playing Tic Tac Toe on filariasis vector control.

Method

This vector control educational media trial was the result of an analysis of the needs of an educational model for filariasis vector control in Pekalongan City for 180 grade 5 students in 9 elementary schools in Pekalongan City. This research includes the type of research and development (R&D). Development of an educational tool for the Tic Tac Toe game for controlling the Filariasis vector, consisting of several tools for learning and playing. Media Module for student self-study containing vector control, question cards about vector control, tic tac toe deck, red and green pawn pieces to play in series, as well as a game guidebook.

Each participant was divided into two, learned to balance the subject matter with gameplay, and explored the rules and techniques of board design. Students learn to draw vector control materials with characters and practice writing the game narratives. They experimented with reconstructing classic games like Tic Tac Toe, adding new aspects to see if the game still played well. Students also participate in peer reviews of each other's games. It allows them to critique and resolve any issues with the game as it is being made and also fosters constructive criticism and teamwork. In the finished product, each game created for participants provides a socio-ecological perspective on health issues and vector control.

Media evaluation is by asking for expert judgment or expert validation. Expert validation is by material experts, health experts (doctors), and P2P professionals from the Pekalongan city health office. Media experts are visual communication design experts from academics and educational game experts from health and recreation physical education professionals so that they get the appropriate media. Assessment through Focus Group discussion is through 2 stages of media assessment obtained notes, comments, and suggestions to obtain the valid one. The field trials were adjusted as expert advice. Then field trials were carried out to evaluate vector controlling health education game products for the prevention of filariasis by students. The trials was done by the fifth-grade elementary school students, at public elementary school X, Pekalongan City. The design of the trial research uses quasi-experimentation. This method is based on the consideration that educational media trial research should be natural, and students do not feel that they are being experimented on. This educational media trial used a sample of 30 students in the class. The data type in this study is the results of students' conceptual understanding tests. The data collection instrument used in this research is a conceptual understanding test sheet that has been tested for validity and reliability (Zain et al., 2020). The data collection technique uses the test method for students' concept understanding test sheets. The effectiveness

of the data analysis technique was from the concept of the understanding test (pretest and posttest) and analyzed for improvement. Data analysis of the Tic Tac Toe game media trial looked at the concepts of the level of knowledge, attitude, and behavior of filariasis vector control using the Independent t-test and the Wilcoxon test.

Results and Discussions

The product developed is the Tic Tac Toe game, which has specifications consisting of a Tic Tac Toe board, symbols of red and green chess pawn players, question cards, game manuals, and filariasis modules. The Tic Tac Toe game product is a modification of the original (Gibson, Cornell and Gill, 2017). There are two differences. Firstly, in this study, there is a 3x3 order using Tic Tac Toe board media, symbols of red and green chess pawn players, question cards, game manuals, and filariasis modules. In Rosiana's research, the media aspect of the Tic Tac Toe game contained a 5x5 order using wooden planks and symbol storage (X&O) (Watson, Arnold and Tanenhaus, 2009). Second, the aspect of the Tic Tac Toe game procedure, the use of the Tic Tac Toe game in this study was only played by two people. But in previous research, the game was played by more than two people or in groups. John von Neumann, a mathematician, launched the field of game theory in 1928 when he published his analysis of two-player "zero-sum" games, such as chess and tic-tac-toe. In a zero-sum situation, there is a p number of squares as a measurable reward that must be divided between the parties. In such a situation, it would be impossible for one side to advance its position without the other side suffering a corresponding loss. In the game of tic-tac-toe (also called noughts and crosses; and hugs and kisses), for one player to win, the other must lose (Coates, Chin and Chung, 2011).. The product of the Tic Tac Toe game can be seen in the image below:

Figure 1. Product Book Welcome to the world of Filariasis Vector control

Figure 2. Tic Tac Toe Filariasis Game Guidebook Products

Table 1. Recapitulation of Health Education Test Scores for Filariasis Vector Control Effectiveness of Tic Tac Toe Games

Variables	Pretest		Post-test		p-value	Test
	mean	SD	mean	SD		
Knowledge Value	25.100	3.925	28.430	2.128	0.002	Wilcoxon
Attitude Value	81.400	7.309	85.270	5.552	0.036	Wilcoxon
Breeding place in the house	10.000	2.889	14.000	1.661	0.001	T dependen
Breeding place outside	6.370	2.220	8.930	1.507	0.001	Wilcoxon
Mosquito's rest place	6.370	1.650	8.770	1.455	0.001	T dependen
Mosquito net application	4.570	1.977	6.400	1.976	0.001	T dependen
Mosquito repellent application	2.700	1.343	4.300	1.179	0.001	Wilcoxon
Out of the hourse habit	2.030	1.299	3.170	1.117	0.002	Wilcoxon
Take a nap habit	0.870	1.224	1.600	1.812	0.073	Wilcoxon

Source: Primary Data, 2022

Table 2. Results of Game Media Assessment According to Grade V Elementary School Students

Media Assessment	Mean	SD
Welcome to the world of Filariasis module design	90.70	11.50
Game guide module design	91.33	10.95
Question card design	92.83	9.96
Tic Tac Toe board design	95.00	10.40
The process of learning and playing	91.22	12.66

Source: Primary Data, 2022

Table 2 shows that before using the Tic Tac Toe game, as many as 30 students, most of the assessment variables showed a p-value <0.05, at an α value of 0.05, meaning a significant difference between the pretest and post-test. Only the napping behavior variable had no significant difference (p-value 0.073). According to Sudjana (Sari, 2019), the purpose of media in learning is to generate student motivation. Significant improvement in both online educational approaches and game-based virtual reality telephone applications compared to traditional education and traditional laboratory classes (AL-Mugheed et al., 2022). Based on this description, interactive learning media is very much needed during the learning process. It will be able to create reciprocal relationships and access to ease of learning. As for students, with interactive learning media, they have the independence to learn in any situation and condition. This description is one of the reasons for the development of interactive media with the Powtoon application. Interactive media with the Powtoon application developed in the form of images, text, and objects (Hedges et al., 2013).

The use of games generates new desires and interests, as well as motivation and stimulation of learning activities, which will positively influence (Tan et al., 2022). It can be interpreted that the higher the learning motivation, the greater the positive influence on students. The educational games is an fun form of learning that can increase students motivation to understand the concept of the material studied better (Campbell et al., 2012). Like the Alberta Project Promoting Living Active and Eating Healthy (APPLE) program utilizing "School Health Facilitators", individuals stationed in each school to address specific school environments include facilitators and barriers to healthy policies, practices, and behaviors and engage stakeholders at all levels, from parents, students, to staff (Burke et al., 2014).

Table 2 shows the results of the media evaluation by respondents. The assessment uses a percentage value based on the maximum value contained in the research instrument. Based on the results, the average score ranges from

90.70 to 95.00, with the lowest average score for the welcome book design, which is 90.70, and a standard deviation of 11.50. The highest average score is the board game design, which is 95.00 and a standard deviation of 10.40.

The learning method uses games aims to help facilitate the process, make learning fun, and even increase learning effectiveness (Wood, Gladwell & Barton, 2014). It is in line with Maiga's opinion (2009:198), which says that playing is a viral part of the learning environment because it can enhance memorable learning experiences, enhance mood and make learning effective. This game-based learning model is a type of learning model that is often used and implemented in the classroom by teachers (Hedges et al., 2013). In general, this learning model is designed to balance the learning material taught by the teacher by playing and students' abilities related to the application to the real world (Staiano, 2014). With this learning model, students can train their focus to solve problems. Budiono et. al. research obtained the same results regarding the effectiveness of the game model developed in improving the students' nutritional status and physical fitness, with the prevalence of overweight occurring in research subjects being high. The prevalence of excess nutrition before the intervention was 29.6%, and after the intervention was 25.9% (Anwar MC, Budiono I, 2019). Therefore, this game-based learning can attract students' interest in learning. Most students focus on educational media during gameplay. This media explains that a player must consider the game important, useful, interesting, and fun and that there must be variety and novelty to attract sustainable gameplay (Staiano, 2014). These results also suggest that acoustic excellence is the result of a speaker- and listener-centered process (Watson, Arnold and Tanenhaus, 2009). Providing learning activities that are packaged in a fun way, in this case by using the Tic Tac Toe game, make students more motivated to participate in learning. The purpose of using the Tic Tac Toe game, is to increase students' understanding of filariasis prevention in the material on filariasis vector control. From the results of the discussion above, the Tic Tac Toe game can be said to be effective, so it is suitable for use as a learning medium for fifth-grade elementary school students.

Conclusion

The conclusion from the results of the analysis and discussion of the research conducted by the researcher, the Tic Tac Toe game is appropriate for use in Health Education learning for Filariasis vector control has a very effective category in terms of effectiveness, when viewed based on indicators of understanding the concept, a p-value <0 is obtained, 05, at an α value of 0.05, there is a significant difference between the pretest and post-test.

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Model of Hospital Infectious Waste Control on Site Pandemic COVID-19 Padang City Based on Dynamic Systems

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Abstract

Padang City is the epicenter of the spread of COVID-19 in West Sumatra, with the highest cases of COVID-19. As a result of which, infectious waste in hospitals has increased. This study aims to build a model for controlling hospital infectious waste in Padang City based on a dynamic system and formulate scenarios and policy recommendations for controlling hospital infectious waste in Padang City based on a dynamic system. This type of research is quantitative with a system-dynamic approach. The research location is in Padang City from March 2020 – July 2022. Descriptive data is presented in the form of tables and graphs. Dynamic system modeling used Powersim Studio 10. The infectious waste control model for hospitals in Padang City based on the dynamic system of the COVID-19 pandemic case obtained simulation results from a population of 909,040 people in Padang City, there were 57.38% of the population exposed, 10.06% positive for COVID-19, 71.9% self-isolation, 28.1% hospitalized, and 1.27% death. Vaccination simulation obtained 85% vaccination 1, 69.69% vaccination 2, and 11.73% booster vaccination. From the hospital infectious waste simulation, there was an increase in the generation of infectious waste by 100% compared to before the pandemic. Model validity test obtained AME declared valid (< 10%) (4) Policy recommendations for controlling infectious waste in Padang City hospitals based on the dynamic system of the COVID-19 pandemic case are with the vaccination scenario, health protocols, and PSBB, will optimistically reduce positive COVID-19 cases, treatment and the generation of infectious waste in Padang City hospitals.

Introduction

West Sumatra Province is included in the province with the highest number of confirmed positive cases of COVID-19 in Indonesia. Data on the spread of COVID-19 as of Monday, April 11, 2022, totaled 103,653 positive confirmed cases of COVID-19, with 2,328 deaths in West Sumatra (Website Corona Sumbar, 2022). Padang City is the epicenter of the spread of COVID-19 in West Sumatra because it has the highest number of COVID-19 cases of all districts/cities in West Sumatra. Data on the spread of COVID-19 in Padang City as of April 3, 2022, as many as 7,305 people were confirmed positive for COVID-19, with 42 deaths (DKK Kota Padang, 2022).

Based on the case data above, there is a strong possibility that the increase in hospital patients' number correlates with the increase in medical waste generation (Sarkodie & Owusu, 2021b), especially infectious waste characterized as material suspected of containing pathogens that can trigger disease (Yong et al., 2009). Even though a COVID-19 infectious medical waste control system already exists, the most important thing is that the

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COVID-19 infectious medical waste control system must be implemented comprehensively. Control is not only carried out internally in the hospital, but also in all components, both policy stakeholders and the community. The ultimate goal is to reduce the number of COVID-19 cases so that COVID-19 infectious waste decreases (Sharma et al., 2020).

Regarding this problem, the dynamic system is considered appropriate for solving this problem because the system-dynamic method has a close relationship with the feedback structure representing the causal loop (causal circle) (Chaerul et al., 2008; Forrester, 1994). The expected results can make emphasis and control infectious medical waste. From the case data above, this research uses a system-dynamic approach to describe the hospital's infectious medical waste system.

This dynamic system method deals with trend questions or a dynamic pattern of behavior of a complex system. It is a method used to assist in decision-making to find policies and decisions that are profitable and can be implemented properly within a certain period and time. The dynamic system is a methodology used to study and manage complex feedback systems. It can be a useful analytical tool for evaluating the impact of policies in the short or long term. The ultimate goal of creating a simulation model is to validate the model and scenario decisions. Validation aims to make the model close to the original and credible system. The model's credibility can be stated from the verification and validation. It can be simulated using computer-assisted predictions to see results quickly (Hasan et al., 2015).

The dynamic system is effectively used on systems that require a good level of data management in large quantities. Based on the flexibility, it will provide convenience in carrying out the process of model formulation, determining model boundaries, model validation, policy analysis, and model application. Stages in the system dynamic approaches, namely: Identification and problem definition, system conceptualization, model formulation, model simulation, model verification and validation, policy analysis, policy implementation (Mundra & Hirijanto, 2020).

Method

The location of this research purposively was at Dr. Rasyidin Regional Public Hospital, Universitas Andalas Hospital, Semen Padang Hospital, Reksodiwirjo Hospital, and Dr. M. Djamil Central General Hospital because it is a COVID-19 referral hospital in Padang City. The population of this study is all infectious waste generated at the COVID-19 referral hospital and residents of Padang City. The types of data used in this research are primary and secondary data. The primary data source was obtained through the questionnaire given to 11 Sub-District Heads throughout Padang City via the Microsoft Forms platform. The questionnaire was validated by 2 validators who were experts in their fields. They are Dr. dr. Linda Rosalina, S.Ked, M.Biomed as head of the COVID-19 Task Force, and Dr. Zikri Alhadi, S.IP, MA as a public policy expert.

Secondary data sources were official publication documents and literature as well as official records from city government agencies consisting of the Padang City BPS, the Padang City Health Office, the Padang City COVID-19 referral hospital, and the Central Laboratory for Diagnostic and Infectious Disease Research, Faculty of Medicine in Universitas Andalas. The collected data and information were analyzed quantitatively. Quantitative analysis is used to compile the needs of each stakeholder and the infectious waste control strategy. Quantitative data processing is done either manually or with the help of the R Studio computer program. Quantitative analysis is used to explain causal relationships between variables in the model. The secondary data obtained became the material for system conceptualization producing a causal loop diagram. The conceptual system was developed into a quantitative model in the form of a stock-flow diagram using Powersim Studio 10 to simulate (Mundra & Hirijanto, 2020).

The stages in creating a model using the system-dynamic methodology is begin with understanding and reviewing the system. In this step, the boundaries of the model studied must first be defined before the model is studied. The boundary separates the processes that cause expressed internal tendencies from those that represent exogenous influences. The

model boundaries will describe the analysis scope and then, based on the issues addressed. It will include all causal interactions related to the issue. The following steps are to develop a causal diagram (causal loop) of the system. After the model boundaries can be defined, a diagram structure interacting feedback (feedback loops) can be formed. The feedback structure is a model building block expressed through closed circles. In this study, the formulation of infectious waste control policies in the Padang City COVID-19 referral hospital was formulated in the form of a Causal Loop Diagram in FIGURE 1 below.

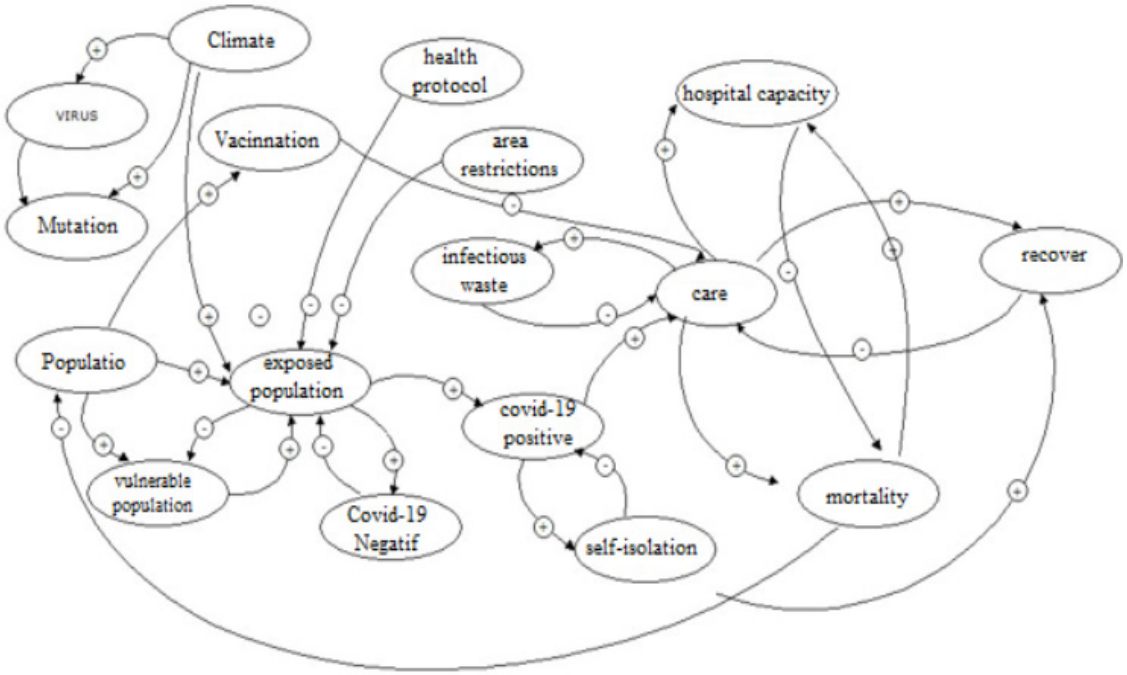


FIGURE 1. Causal Loop Diagram of COVID-19 Infectious Waste Control
Source: Variable Processing Results with Powersim Studio 10

Based on the causal circle, level and rate diagrams of the system are constructed. It will describe various interactions/relationships between entities in the system. The development of level and rate diagrams is carried out with the help of the Powersim software. Develop a model of the system formulated as a representation or abstractions of all interactions occur in the system under study. After an explicit model of a problem is formulated, a series of tests is carried out on the validity of the model, and at the same time, gain an understanding of the internal tendencies of the system. Model validation is carried out in several validation stages, including: (a) Theoretical validation of the first model structure (CLD = Causal Loop Diagram), (b) Validation of the second model structure data (SFD = Stock Flow Diagram), (c) Validation of model behavior. In the model behavior validation stage, statistical tests of deviations and tests of average and variance deviation tests of the data are used. The average deviation test is the absolute means error (AME) test, which is the deviation (difference) between the average (mean) value of the simulation results and the actual value, which is calculated using the formula:

$$\text{AME} = \frac{|Si-Sr|}{Sr} X\ 100\ (\%) \qquad \text{(a)}$$

Description:
Si: average of simulated data
Sr: average of reference data
| | sign means the absolute price used to cancel the minus sign of the reduction result. Data declared to be valid from the results of calculations with a dynamic system when the AME is below 10%

The variance deviation test is the absolute variance error (AVE), namely the deviation of the simulated variation value against the actual calculated using the formula:

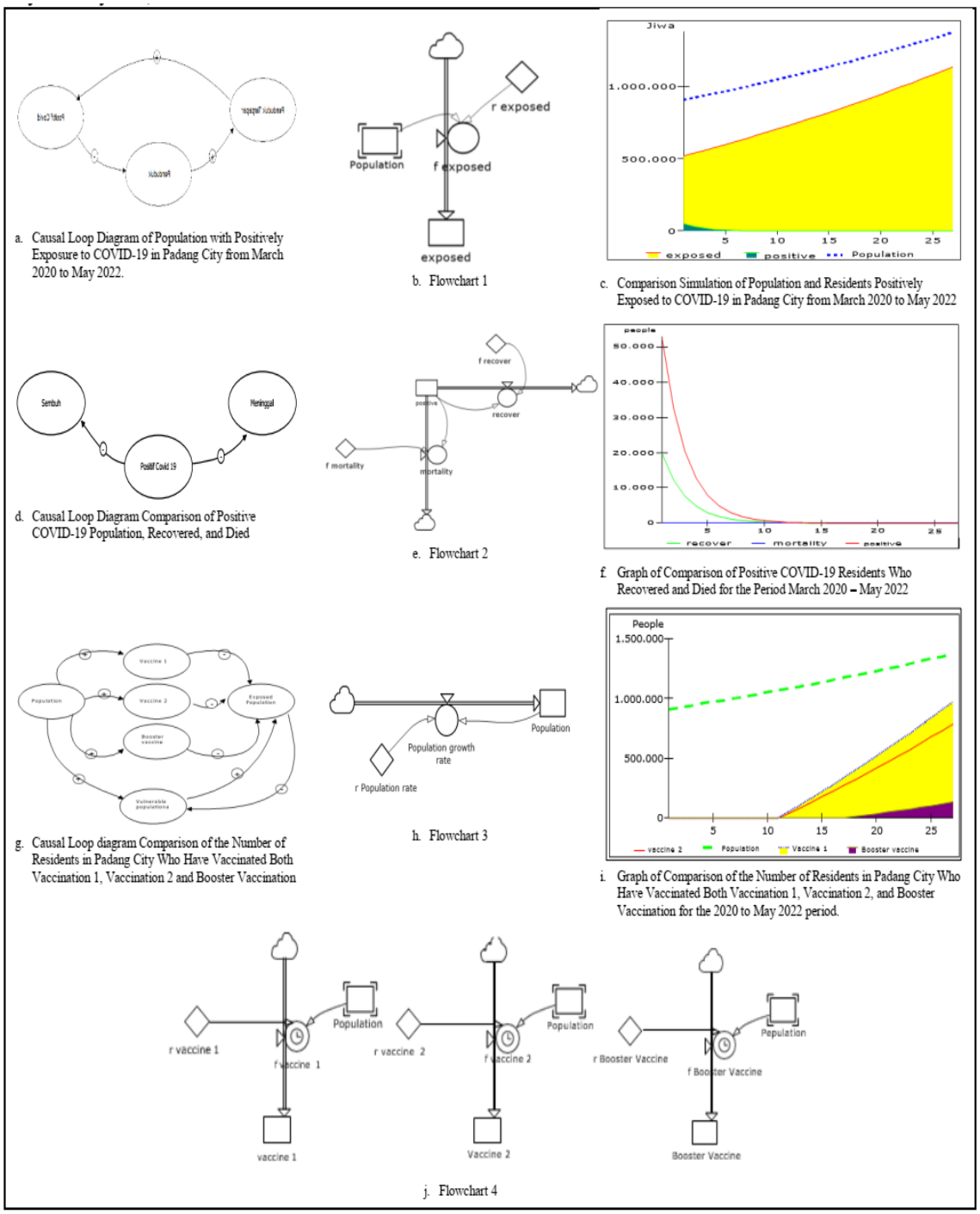
$$AVE = \left[\frac{(Ss-Sa)}{Sa}\right] \quad \text{(b)}$$

Description:
Ss: ((Si – Si)2N) = Simulation value deviation
Sa: ((Sr – Sr)2N = Actual value deviation

Then do a simulation to assess the impact of parameter changes on the studied system. Based on the simulation results, appropriate policy recommendations will be produced to achieve system objectives, namely policy recommendations for controlling hospital infectious waste in Padang City in the case of the COVID-19 pandemic.

Result and Discussion

Based on research done to find out how the control model is obtained with the stages in making a model that uses a dynamic system, can be seen in FIGURE 2.



a. Causal Loop Diagram of Population with Positively Exposure to COVID-19 in Padang City from March 2020 to May 2022.

b. Flowchart 1

c. Comparison Simulation of Population and Residents Positively Exposed to COVID-19 in Padang City from March 2020 to May 2022

d. Causal Loop Diagram Comparison of Positive COVID-19 Population, Recovered, and Died

e. Flowchart 2

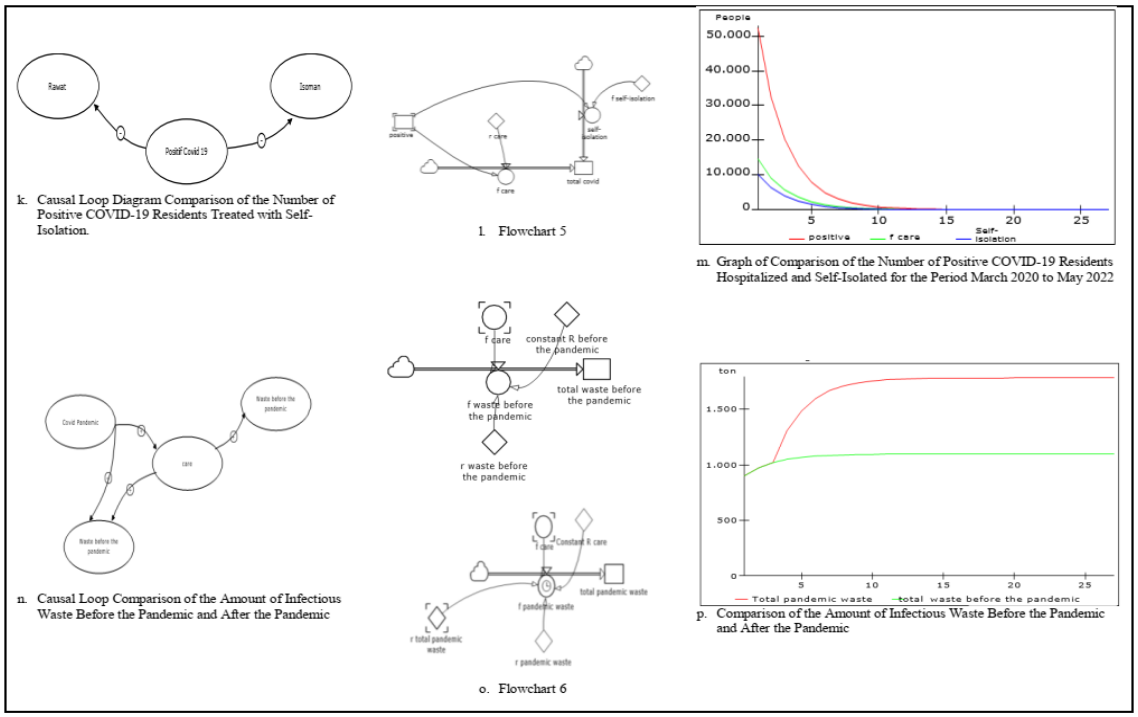
f. Graph of Comparison of Positive COVID-19 Residents Who Recovered and Died for the Period March 2020 – May 2022

g. Causal Loop diagram Comparison of the Number of Residents in Padang City Who Have Vaccinated Both Vaccination 1, Vaccination 2 and Booster Vaccination

h. Flowchart 3

i. Graph of Comparison of the Number of Residents in Padang City Who Have Vaccinated Both Vaccination 1, Vaccination 2, and Booster Vaccination for the 2020 to May 2022 period.

j. Flowchart 4



k. Causal Loop Diagram Comparison of the Number of Positive COVID-19 Residents Treated with Self-Isolation.

l. Flowchart 5

m. Graph of Comparison of the Number of Positive COVID-19 Residents Hospitalized and Self-Isolated for the Period March 2020 to May 2022

n. Causal Loop Comparison of the Amount of Infectious Waste Before the Pandemic and After the Pandemic

o. Flowchart 6

p. Comparison of the Amount of Infectious Waste Before the Pandemic and After the Pandemic

FIGURE 2. Causal loop diagrams, flowcharts, and graphical models Padang City Hospital Infection Waste Management Model Based on Dynamic Systems

Stock Flow Dynamic (SFD) Model for Infectious Waste Control at Padang City Hospital Based on a Dynamic System (COVID-19 Case) can be seen in FIGURE 3.

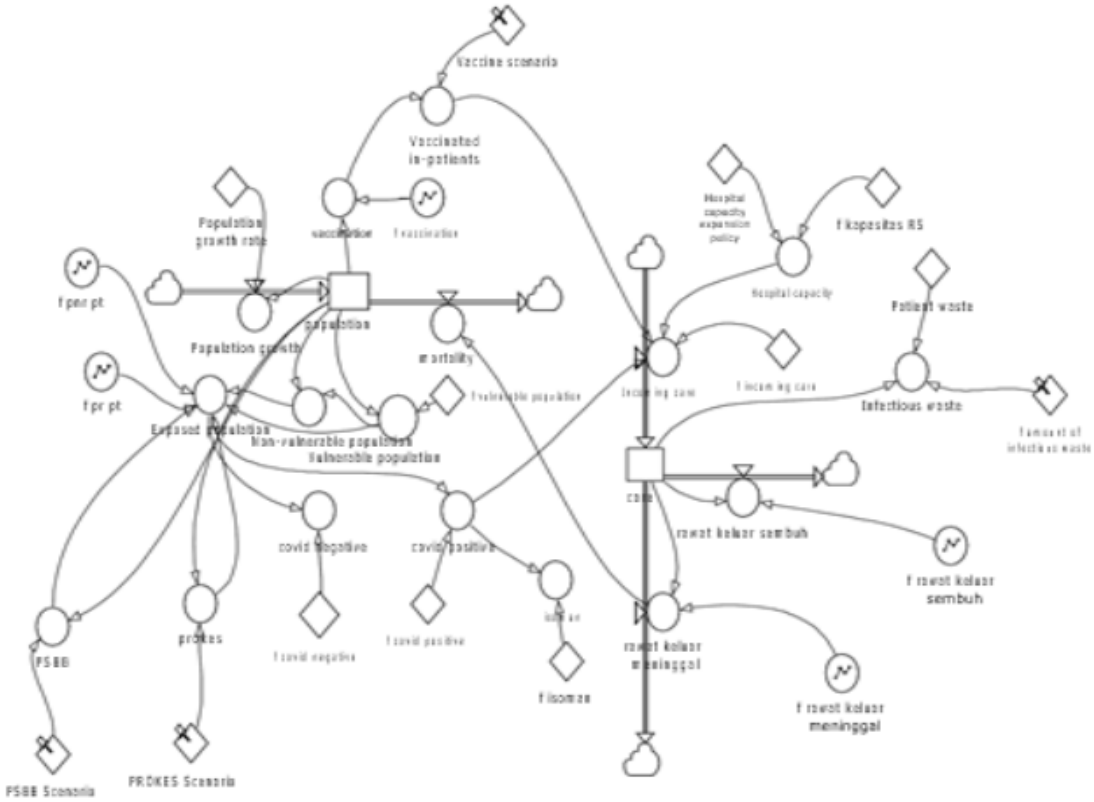


FIGURE 3. Stock Flow Dynamic (SFD) Infectious Waste Control Model for Padang City Hospital Based on Dynamic System (COVID-19 Case)

This SFD shows a series of all interrelationships to explain where infectious waste comes from. Explaining the number of residents in Padang City, the number of vulnerable residents, the number of exposed residents, and the number of positive COVID-19 sufferers. Then of the positive COVID-19 patients, some are self-isolating, and some are hospitalized. Those who are hospitalized led to an increase in infectious waste after the pandemic.

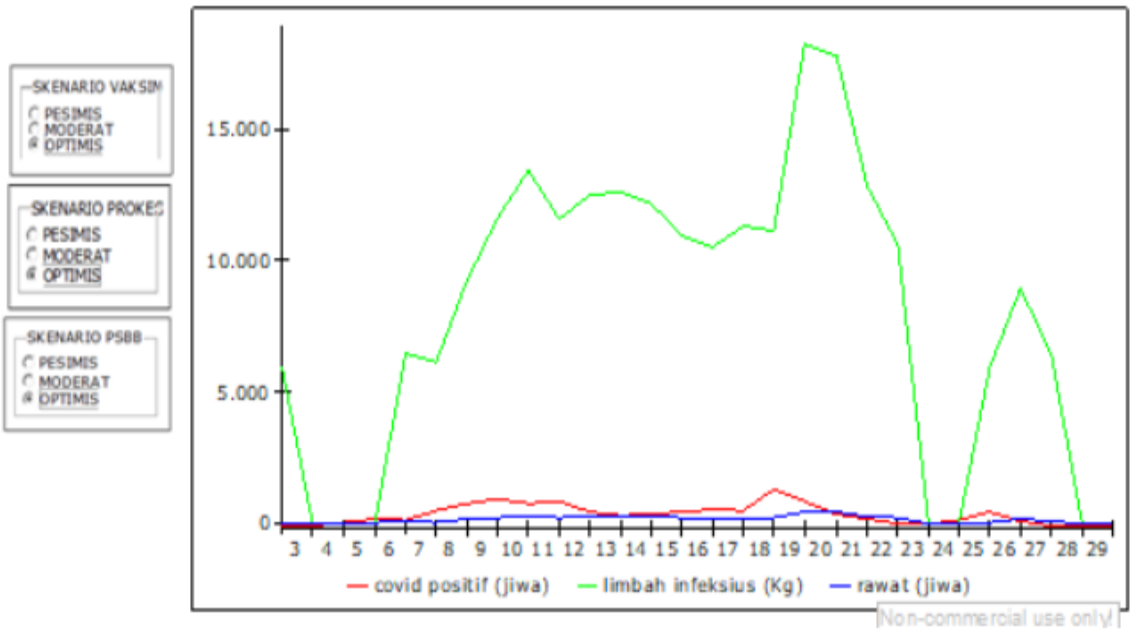


FIGURE 4. Policy Recommendations for Infectious Waste Control at Padang City Hospital Based on Dynamic Systems (COVID-19 Cases) with optimistic scenarios of vaccination, health protocols, and PSBB

From the scenario graph in FIGURE 4 above, the policy recommendations for controlling infectious waste at the Padang City hospital based on a dynamic system (the COVID-19 Pandemic Case) are obtained by having an optimistic vaccination scenario, an optimistic health protocol scenario, and an optimistic PSBB scenario that can suppress and reduce the positive number of COVID-19, the number of treatments and reduce the amount of infectious waste. Initially, the Coronavirus Disease 2019 (COVID-19) virus-infected animals, such as bats and camels. It then mutates and infects humans. This virus spread quickly and widely, resulting in a global pandemic continuing to this day. The COVID-19 virus spreads quickly from human to human through direct contact. COVID-19 can be transmitted in various ways, such as through droplets or liquid droplets coughed or sneezed, direct contact such as touching or shaking hands with a COVID-19 patient and touching objects contaminated with the COVID-19 virus, then hands touching mouth, ears, and eyes before washing hands (Sarkodie & Owusu, 2020).

An exposed population, more commonly known as a suspected case, is someone with a history of contact with a confirmed case of COVID-19 and has symptoms of acute fever with cough, anosmia, and ageusia. From the exposed population, there will be two possibilities to be tested positive and negative through the Rapid Diagnostic Test Antigen (RDT-Ag). Residents who test positive will undergo further tests through PCR testing. If the first examination is declared negative, it is carried out on the second day. If the results are positive, the patient is declared positive and recommended to be hospitalized according to the patient's management based on symptoms. In Padang City, from BPS 2021 data, with a population of 909,040 people, 57.38% were declared as exposed residents of the existing population and confirmed positive 10.06% of the exposed population. The number is measured by the vulnerability of the

community, one of which is population density, where the denser, the greater the potential for exposure to the COVID-19 virus.

Based on the positive population, some people have recovered and died. Residents are said to have recovered from positive COVID-19 when they have received treatment according to the level of symptoms experienced depending on the infecting variant. Someone without symptoms needs time to recover faster than patients with mild, moderate, severe, and acute symptoms. All of the patients above can be declared cured if they meet the criteria for completion of isolation, and a statement letter for completion of monitoring is issued, based on the doctor's assessment at the health care facility where the monitoring was carried out or by the doctor in charge of the patient (KEMENKES RI, 2021). When the symptoms are severe and even acute, cannot be treated with hospitalization, and complications occur. It can cause the patient to die. Hosts of COVID-19 are humans, especially vulnerable groups who have low immunity. The physical environment of the COVID-19 virus is like poor environmental sanitation, the biological environment, for example population density, virus virulence, and the socio-cultural environment such as behavior, economic environment, and politic. Transmission of COVID-19 from person to person or level of mobility can be minimized by adhering to health protocols so that the vulnerability of an area is also influenced by the level of community compliance in implementing health protocols (Gandamayu et al., 2022).

In Padang City, 53,024 people recovered from a positive population of 10.06%, where the number of people who recovered was more than the number of positive residents in Padang City. It was happened due to the data on the number of recovered, included data from patients referred to all referred hospitals in Padang City. The number who died was 670 people (1.27%) of the positive population. The number of exposed residents is measured by the vulnerability of the community, one of which is population density, where the denser, the greater the potential for exposure to the COVID-19 virus. To reduce the risk of morbidity and mortality from COVID-19, an effective and safe vaccine must be administered quickly and widely to the public. However, the availability of vaccines itself is not enough to guarantee broad immunological protection, vaccines must also be accepted by both the health community and the general public. Vaccine hesitancy is a primary barrier to vaccine uptake and achieving community immunity, which is necessary to protect the most vulnerable populations. Depending on a variety of biological, environmental, and socio-behavioral factors, the threshold for herd immunity to Covid-19 may be between 55% and 82% of the population (Sanche et al., 2020).

Various kinds of COVID-19 vaccines used worldwide, tested for safety, and the results include Sinophram, Pfizer, AstraZeneca, Moderna, Jessen, and Sinovac (World Health Organization, 2022). Indonesia used various COVID-19 vaccines, including Sinovac, Moderna,and Pfizer. The vaccination has three stages. Namely vaccination 1, vaccination 2, and Booster vaccination. Vaccination 1 starts in early January 2021, vaccination 2 starts at the end of January 2021, and Booster vaccine starts in July 2021. Booster vaccines meant to increase immunity and be able to reduce risks for high-risk groups with comorbidities or groups with a high risk of exposure, such as the elderly and health workers (Jung, 2021).

In Padang City, with a population of 909,040 people, 85% have had vaccine 1, 69.69% have had vaccine 2, and residents that received booster vaccines are 11.73%. From the data above, many residents of Padang City have not been vaccinated and there has not been an even distribution of vaccines 1, 2, and Booster. It is due to various factors, one of which is the large number of people who still refuse to be vaccinated. The public's rejection of the COVID-19 vaccination occurred due to doubts and anxiety due to insufficient information about the COVID-19 vaccination, as well as a large amount of information circulating containing hoaxes that scared the public to vaccinate. It is hoped that the need for improved communication between the government and the community (Paul et al., 2020).

Residents confirmed positive for COVID-19 have various symptoms, ranging from asymptomatic, mild, moderate, severe,

and acute symptoms, where generally asymptomatic patients are advised to self-isolate at home. For patients with mild symptoms, some are recommended to take home isolation, some are hospitalized, and patients who have moderate, severe, and even acute symptoms are recommended to undergo hospitalization. Especially for patients who are confirmed positive for COVID-19 with comorbid must receive intensive care at the hospital. COVID-19-positive patients with acute symptoms are usually comorbid patients, such as hypertension, diabetes mellitus, cardiovascular disease, chronic obstructive pulmonary disease, chronic liver disease, and cancer. Usually, the treatment and care need to be done more intensively because of the possibility of a high risk of failure. In Padang City, 52,492 people who are positive for COVID-19, 71.9% of whom are self-isolating and 11.73% hospitalized. It happens because many people who are self-isolating according to the symptoms experienced are mostly without symptoms and mild symptoms. Meanwhile, those who are hospitalized are few, depending on the symptoms experienced. Hosts of COVID-19 are humans, especially vulnerable groups who have low immunity. The physical environment of the COVID-19 virus is like poor environmental sanitation, the biological environment, for example, population density, virus virulence, the socio-cultural environment such as behavior, economic, and politics (Susanti, 2022).

The increase in the generation of infectious waste during the pandemic occurred in all countries (Sarkodie & Owusu, 2021a), including Indonesia, with a scale of 12,740 tons of medical waste after the first infection case was announced (Mihai, 2020). It also happened in Padang City, where the number of treatments correlated closely with the amount of infectious waste 100 – 200% before the COVID-19 pandemic in this dynamic system simulation. The increase in the generation of infectious waste during the COVID-19 pandemic was caused by all the waste generated from attributes used in handling COVID-19, such as personal protective equipment, face masks, gloves, etc., as well as food waste originating from the COVID-19 inpatient room (Aldaco et al., 2020; Sangkham, 2020). If this infectious waste is not controlled, then the presence can cause transmission of deadly diseases, especially COVID-19, because waste acts as a vector for the corona virus disease, which lasts up to 7 days in COVID-19 waste such as masks (Ilyas et al., 2020; Nzediegwu & Chang, 2020).

To control infectious waste during the COVID-19 pandemic, it is necessary to handle it from upstream through compliance with health protocols, PSBB policies issued by the government, and mandatory vaccinations. With optimal control of the generation of infectious waste during the COVID-19 pandemic, it will directly reduce the costs and activities of processing the infectious waste itself. In Padang City, the treatment is managed by a third party (transporter/carrier) to be destroyed on the island of Java. During the transportation period, infectious waste potentially spreads the virus, because third parties do not have complete control over the time factor while traveling.

For this reason, it is necessary to have models and policy recommendations for the sustainability of hospital infectious waste control in Padang City based on the dynamic system during the COVID-19 pandemic (Ding et al., 2016), namely by optimizing vaccinations, health protocols, and PSBB. With this model and policy recommendations, infectious waste can be reduced and controlled. The COVID-19 pandemic has become a global crisis that can disrupt the achievement of the Sustainable Development Goals (TPB/SDGs). The pandemic created tension on a global level. On the one hand, it causes countries to close borders, limit the movement of people and goods, and make authoritarian policies, but on the other hand, global cooperation is needed to tackle a pandemic that is inherently global (Shulla et al., 2021). The pandemic poses a challenge to the global community to work collaboratively with many ways being explored and stakeholders involved to find solutions due to commonalities and interrelated goals (van Zanten & van Tulder, 2020).

Achieving the Sustainable Development Goals will take longer. For developing countries, it will be difficult to create policies aligned with the Sustainable Development Goals in the wake of the COVID-19 pandemic and grow towards

the seventeen Sustainable Development Goals (Nundy et al., 2021). The environmental pillar as the third of the four Sustainable Development Goals, precisely on the goals of (6) Clean Water and Adequate Sanitation, (11) Sustainable Cities and Settlements; (12) Responsible Consumption and Production; (13) Climate Change Handling; (14) Ocean Ecosystems; and (15) Mainland Ecosystems. This research produces models and policy recommendations for controlling hospital infectious waste in Padang City based on system dynamics during the COVID-19 pandemic, so it can be concluded that this research directly contributes to the goals in the environmental pillar.

Conclusion

Policy recommendations for controlling infectious waste in Padang City hospitals based on the COVID-19 Pandemic case dynamic system are optimizing vaccination scenarios, optimizing health protocol scenarios, and optimizing PSBB scenarios that can suppress and reduce the positive number of COVID-19, the number of treatments and reduce the amount of infectious waste generation in the Padang City hospital.

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