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

I have read all the articles featured in Volume 17, Issue 4. Even though we are still in the middle of the COVID-19 pandemic, the topic for each article varies. There is one article discussing the development of handwriting among preschool children. I found that article interesting since it can be seen from both public health and psychology point of view. I hope there will be more interesting articles like that. **(Rebecca, Jakarta)**

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Presidential Vote Share and COVID-19 Vaccination Rate in Indonesia: A District-level Cross-sectional Ecological Study

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Abstract

Political affiliation has been reported as a determinant of COVID-19 vaccine acceptance in some countries, although few studies have examined the Asian context. This study aimed to fill this gap by employing an ecological study design using Indonesian regions as data points. Political affiliation was represented by incumbent President Joko "Jokowi" Widodo's vote share in the 2019 presidential election. Potential confounders included population density, human development index, availability of hospitals and primary health care, 2019–2020 economic growth, COVID-19 mortality rate, and proportion of Muslims in the population. The final analysis included 201 out of 501 districts and cities in Indonesia. Controlling for confounders, multivariate regression found that Jokowi's vote share was an independent predictor of vaccination rate, with standardized β and R2 values of 0.350 and 0.734 for the first dose vaccination rates and 0.251 and 0.782 for the second dose, respectively. This association may be underpinned by differences in religiosity, public trust, and vulnerability to misinformation between Jokowi's supporters and the opposition. Improving public trust in a politically polarizing society is crucial to improving future coverage of COVID-19 and other vaccines.

Keywords: COVID-19, Indonesia, politics, vaccine hesitancy, vaccine inequality

Introduction

The distribution of the COVID-19 vaccine seems to be slower than otherwise expected, and considerably unequal distribution has been observed between countries or even between regions in the same country.[1] This inequality in vaccination rate has led to the emergence of COVID-19 variants of concern, which threaten to prolong the pandemic further.[2] Inequal coverage of the COVID-19 vaccine was not limited to country-by-country variation. Inequality also exists at the subnational level. The geographic disparity is the most visible aspect of the unequal COVID-19 vaccination rate. For instance, the Indonesian figure showed that some provinces, especially developed ones like Jakarta and Bali, have reached over 100% of targeted vaccination coverage (partly due to inaccurate demographic data used in setting up the target), while others have lagged far behind.[3] The latest wave of COVID-19 cases, caused by the new Omicron variant, emphasized the need for sustained immunity against SARS-CoV-2 at the community level.[4]

There are several barriers that limit the COVID-19 vaccination rate, including structural factors, such as the policy environment and health care access, and hesitancy to receive the vaccine among the population. Prior to vaccine distribution, several studies reported that willingness to receive the COVID-19 vaccine varied between 40–70% of the Indonesian population, depending on the region.[5-7] Several factors have been identified as factors affecting COVID-19 vaccine acceptance, including sociodemographic characteristics and health beliefs regarding the vaccine.[8] Other studies also showed the importance of beliefs, including health beliefs and general worldviews, in predicting COVID-19 acceptance.[6,8,9] One aspect that remains understudied is the role of political beliefs in predicting vaccine acceptance.

A case in point was the 2020–2021 period in the United States under the Trump administration. Hesitancy played an important role here, where the Republicans, one of the main political parties, routinely undermined the vaccine and, indeed, the pandemic.[10] Multiple other studies have found that Republican voters showed higher vaccine hesitancy.[11,12] Using a method similar to the one

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used in this study, a county-level cross-sectional analysis showed that Democratic-leaning counties tend to have higher COVID-19 vaccine coverage.[13]

Despite being well documented in the international literature, few studies, if any, have reported the role of political affiliation as a determinant of COVID-19 vaccine acceptance in Asian countries. Indonesia is especially interesting, as it has a political situation similar to that of the United States. Despite the lack of a clear left–right divide among mainstream Indonesian political parties, Indonesia faces an increasingly polarized political landscape with a rising right-wing conservative faction coalescing around certain political figures.[14-16] Similar to the United States, Indonesia entered the pandemic in April 2020, fresh out of a divisive general election one year prior that included large protests against the certification of Joko "Jokowi" Widodo reelection in October 2019.[15,16] Afterward, Jokowi administration policies regarding the forceful disbandment of conservative Islamic groups, which previously supported Prabowo Subianto and Sandiaga Uno (the Subianto-Uno ticket), strengthened the anti-Jokowi sentiment among a considerable portion of the populace.[17]

Identifying the factors affecting COVID-19 vaccine acceptance led one step closer to identifying effective policies to tackle the barriers to more equitable COVID-19 vaccine coverage and inform policymakers on how to improve COVID-19 vaccination coverage for the ongoing booster campaign. As such, this study investigated the potential role of political affiliation as a determinant of COVID-19 vaccine acceptance in Indonesia based on publicly available data.

Method

Study Settings

Indonesia is an island nation with over 17,000 islands. Major landmasses include Sumatra, Java, Kalimantan, Sulawesi, and the western half of Papua. At the time of analysis, the country is divided into 34 provinces, which are further subdivided into 514 districts and cities.[18] Districts and cities were used as data points for this analysis in this study.

Political affiliation in Indonesia cannot be explained by party-line affiliation. It has been observed that there is little policy differentiation among Indonesian political parties, except concerning religious issues.[19] However, political polarization has emerged surrounding the political figures.[14] The 2019 presidential election has been noted as especially divisive and polarizing.[16] It was a "rematch" between the incumbent President Jokowi and Gen. (Ret.) Prabowo Subianto, who ran against each other in 2014. The use of personal attacks as a campaign strategy, ideological differences regarding the role of Islamic religion in governance, and general misinformation led to a climate of uncertainty and division immediately following the election.[14,16,20]

Interestingly, there have been studies that have identified religion's association not only with voting choice during an election but also with vaccine hesitancy.[9,21-23] One study identified that one of the main ideological differences between Jokowi and Subianto voters concerned their support for the wider role of Islamic religion in governance.[21] At the same time, religion has also been observed to be associated with vaccine acceptance for COVID-19 and other vaccines.[9,21,23]

Despite both Subianto and Uno eventually joining the Jokowi's cabinet, the political divide carried over well into the pandemic period and even into 2022, three years after the election. Part of the reason was the forceful disbandment of Islamic organizations, such as the Hizb ut-Tahrir Indonesia and the Islamic Defender Front, which previously supported the Subianto-Uno ticket, thus cementing conservative Islam against the Jokowi administration.[17] Another factor is the fact that Indonesia is due for another election in 2024, looking to replace Jokowi, who cannot run for another term. The lack of an obvious political successor has led to a loud and messy political situation, with various factions trying to form coalitions.[24]

Parallels between pro- and anti-Jokowi polarization with the left–right divide in United States politics can be drawn. Polarization persisted at the grassroots level, substantially fueled by the political pundits and influencers in social media (known as buzzers in Indonesia). Pundits and influencers who previously supported the Subianto-Uno ticket in the election have since shifted to simply oppose the current administration, entrenching the pro- and anti-Jokowi divide among the general populace.[25]

Regarding the COVID-19 pandemic, the Indonesian government under the Jokowi administration has been criticized for its inconsistent response in both policy and communication. The administration officials expressed dismissive comments during the early phases of the pandemic, only to later backtrack and attempt to promote awareness.[26] However, the administration has consistently supported COVID-19 vaccination efforts, with President Jokowi taking the first shot, which was aired on live television, kicking off mass vaccination in January 2021.

In stark contrast to the United States, none of the Indonesian opposition figures attempted to undermine vaccination efforts. Nevertheless, acceptance was slow, with only around 10% of the target population receiving at least one jab as late as July 2021.[3] Rapid acceleration of COVID-19 vaccine acceptance then occurred in late August and September 2021 onward, mostly coinciding with the emergence of the Delta variant, which caused a surge of COVID-19 cases in Indonesia.[3,27]

Study Design

A district-level cross-sectional analysis was conducted using association analysis between publicly available regional indicators described in previous studies.[13,28] A cross-sectional ecological study design analyzes patterns and differences at the population level (e.g., districts, cities, counties, countries) as opposed to between individuals.[13,28] Districts and cities (hereafter referred to as "districts") were used as data points in the analysis as the lowest population level with readily available data for the required indicators. The inclusion criteria were based on data availability for all indicators required. Only districts with available data for all independent, dependent, and confounding variables were included in the analysis.

Variables

The main independent variable in this study was district-level vote share for the incumbent President Jokowi in the 2019 presidential election, as obtained from the Indonesian Election Commission. The dependent variable was district-level COVID-19 vaccine coverage, as reported in the Indonesian Ministry of Health COVID-19 vaccine dashboard as of January 14, 2022.[3]

The association between presidential vote share and COVID-19 vaccination rate was controlled by potential confounders, including administrative status (districts vs. cities), health care availability, socioeconomic indicators, and COVID-19 risk, which reflected the complacency, confidence, and convenience (3Cs) model of vaccine hesitancy and determinants of COVID-19 prevention at the ecological level.[9,29]

These confounders were selected based on evidence from previous similar studies. Previous studies linked provincial healthcare availability and demographics with COVID-19 outcomes.[28] A similar study in the United States also noted the role of socioeconomic status and demographics in vaccine coverage.[13]

Diverging from previous similar studies,[13,28] the district-level proportion of Muslim residents was included as a variable due to evidence of its association with voting behavior.[21] Religion has also been associated with vaccine acceptance for both COVID-19 and non-COVID-19 vaccines.[9,23] Together, this evidence led to the inclusion of Muslim residents as a confounder in this analysis.[9,21,22]

Healthcare availability indicators represented the convenience of access to the vaccine and included the ratio of hospitals per 1 million residents as well as primary health care (PHC) per 100,000 residents. Hospital and PHC availability was selected as indicators, as they were the main implementors of COVID-19 vaccination in Indonesia. Socioeconomic indicators represented both conveniences of access to the vaccine and confidence in the science behind the vaccine and included the human development index (HDI) as well as gross regional product (GRP) growth in 2019–2020.

While, COVID-19 indicators represented complacency levels in the population and included district-level COVID-19 mortality rates in late August 2020. This period was selected because it coincided with the peak of the Delta variant wave and came immediately prior to the rapid acceleration of COVID-19 vaccination in Indonesia.[3,27]

Data Sources

All the data analyzed in this study were publicly available online. The data for vote share in the 2019 presidential election was obtained from the website of the Indonesian Electoral Commission. COVID-19 vaccination coverage data were obtained from the Indonesian Ministry of Health's COVID-19 vaccine portal. District-level socioeconomic data, including GRP and HDI, were obtained from Statistics Indonesia. Religion distribution data were obtained from the Indonesian Ministry of Home Affairs. Lastly, demographic and healthcare availability data were obtained from annual health profiles published by provincial health offices. All data sources used in this study are presented in more detail in the Supplementary Material section.

Statistical Analysis

Continuous data were tested for normality using the Kolmogorov–Smirnov test. Normally distributed data are presented as the mean and standard deviation (SD), while non-normally distributed data are represented as the median and interquartile range (IQR). Parametric and non-parametric bivariate correlation analyses were conducted depending on the results of normality tests to identify the association between the vote share for incumbent President Jokowi in 2019 and the COVID-19 vaccination rate as of January 2022. Finally, multivariate linear regression was conducted to investigate the association between vote share and COVID-19 vaccination rate, controlling for the effect of potential confounders, including administrative status, population density, HDI, availability of hospitals and PHCs, GRP growth, the proportion of Muslims in the population, and COVID-19 mortality rate. All statistical analyses were conducted using the free version of IBM SPSS 23.0 (IBM Corp, Armonk, NY, USA).

Results

The final analysis included 201 out of 514 districts in Indonesia, with detailed characteristics available in Table 1. Exclusion from the analysis was based on the unavailability of data, especially health system–related data, which was reliant on the availability of 2019 provincial

health profiles obtained from provincial government websites. The 201 districts were divided into 160 districts and 41 cities. All continuous variables were found to be non-normally distributed; hence, they were presented as medians and IQRs. Overall, the median vaccination rate was 70.25% (IQR = 58.97–79.63%) for the first dose of the COVID-19 vaccine and 44.06% (IQR = 33.16–66.06%) for the second dose. While, the median vote share for the incumbent in the 2019 presidential election was 57.75% (37.32%–73.82%).

There are considerable differences between the districts and cities, as shown in Table 1. In terms of vaccination rate, cities were likely to have higher vaccination rates for both the first and second doses of COVID-19. However, cities were likely to have a lower vote share for the incumbent president in the 2019 election. Cities seemed to be generally more developed compared to districts. Other than the obvious difference in population density, cities also had higher median HDI and health care availability and were more diverse, with a lower median Muslim population percentage. However, cities were more affected by the pandemic, with lower economic growth and higher COVID-19 mortality rates.

In Table 2, the bivariate analysis revealed a statistically significant moderate positive correlation between incumbents' vote share in the 2019 election and COVID-19 vaccination rates, both for the first and second doses, with Pearson's rho values of 0.551 and 0.545, respectively. The linear correlation is clearly visible in the scatter plot depicted in Figure 1. The bivariate analysis also found that vaccination rates were associated with all potential confounders. COVID-19 vaccination rate was positively correlated with population density, HDI, hospital availability, and COVID-19 mortality rate. While, it was negatively correlated with PHC availability, economic growth, and the proportion of the Muslim population.

Table 3 shows the results of the linear regression analyses for COVID-19 vaccination rates. The results showed that Jokowi's vote share in the 2019 presidential election was significantly associated with COVID-19 vaccination rates after controlling for the effects of potential confounders. It was also found to be the strongest predictor for the first dose vaccination rate, although the effect was weaker for the second dose. Another interesting finding was that the proportion of Muslims in the population was negatively correlated with the COVID-19 vaccination rate for both the first and second doses.

Table 1. Descriptive Data of Analyzed Variables

Variable	Total (n = 201)	Administrative Status	
		District (n = 160)	City (n = 41)
Population density (per km²)	675 (110–1,392)	556 (91–976)	4,431 (1,613–7,833)
Human development index	70.56 (68.37–74.07)	69.90 (68.06–71.91)	77.96 (74.64–81.32)
Hospitals (per 1 million)	8.92 (5.06–14.41)	19.97 (12.95–32.061)	7.19 (4.77–11.07)
PHCs (per 100,000)	3.16 (2.41–5.03)	3.16 (2.12–4.56)	3.15 (2.48–5.30)
COVID-19 mortality (per 100,000)	67.59 (36.10–115.63)	58.46 (33.59–101.30)	114.89 (69.75–166.68)
2019–2020 economic growth (%)	-0.32 (-1.59–0.49)	-0.17 (-1.54–0.70)	-0.78 (-1.68 - -0.27)
Muslim population (%)	97.44 (91.86–99.25)	97.27 (94.46–99.45)	92.47 (88.58–96.65)
Incumbent's vote share (%)	57.74 (37.32–73.82)	60.75 (37.67–75.36)	52.73 (30.77–69.97)
First-dose vaccination rate (%)	70.25 (58.97–79.63)	66.15 (57.03–74.63)	89.72 (77.48–102.40)
Second-dose vaccination rate (%)	44.06 (33.16–66.06)	40.81 (31.08–55.92)	68.08 (55.23–88.33)

Notes: PHC = Primary Health Care. All figures are presented as medians and interquartile ranges (IQRs).

Table 2. Bivariate Correlation between Independent Variables with First and Second COVID-19 Vaccination Rates

Variable	Category	First Vaccination	p-value	Second Vaccination	p-value
Administrative status	District	66.15 (57.03–74.63)		40.81 (31.08–55.92)	
	City	89.72 (77.48–102.40)	<0.001	68.08 (55.23–88.33)	<0.001
Population density		0.588	<0.001	0.609	<0.001
Human development index		0.622	<0.001	0.657	<0.001
Hospital availability		0.443	<0.001	0.457	<0.001
PHC availability		-0.313	<0.001	-0.347	<0.001
COVID-19 mortality rate		0.598	<0.001	0.636	<0.001
2019–2020 economic growth		-0.432	<0.001	-0.463	<0.001
Muslim population		-0.497	<0.001	-0.476	<0.001
Incumbent's vote share		0.551	<0.001	0.545	<0.001

Notes: PHC = Primary Health Care. All p-values were derived from non-parametric analyses.

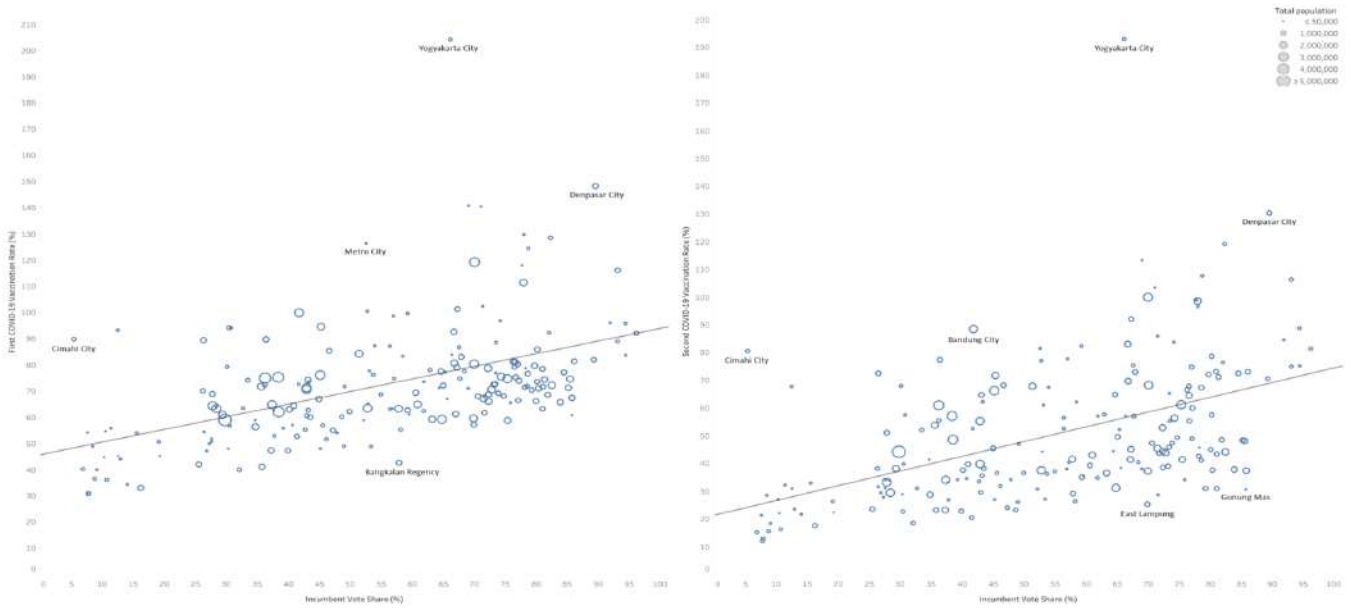

Figure 1. Scatter Plot of Incumbent's Vote Share with First (Upper) and Second (Lower) Vaccination Rates

Table 3. Multivariate Linear Regression for the Prediction of First and Second COVID-19 Vaccination Rates

Variable	First Vaccination		Second Vaccination	
	Standardized β	R^2	Standardized β	R^2
Administrative status, city, cities	0.094	0.734	-0.064	0.782
Population density	0.282**		0.281**	
Human development index	0.212**		0.313**	
Hospital availability	0.144**		0.146**	
PHC availability	-0.055		-0.091*	
COVID-19 mortality	0.129*		0.195**	
2019-2020 economic growth	-0.041		-0.041	
Muslim population	-0.106*		-0.161**	
Incumbent's vote share	0.350**		0.251**	

Notes: PHC = Primary Health Care, *p-value <0.05, **p-value <0.01.

Discussion

This study is one of the first to investigate the role of political affiliation, represented by presidential vote share, as a determinant of COVID-19 vaccination rates. The analysis showed that the district-level presidential vote share in the 2019 presidential election independently predicted COVID-19 vaccination rates in 2022. Interestingly, religious affiliation, as indicated by the proportion of Muslims in the population, was also independently associated with COVID-19 vaccination rates. These results closely resemble the situation in the United States.[30]

It is remarkable to find that the 2019 presidential vote share is associated with COVID-19 vaccine acceptance in 2021. As noted earlier, the opposing presidential candidates in the 2019 election joined Jokowi's cabinet in the months preceding the pandemic. Subsequently, the Jokowi administration, including his former rivals, attempted to dismiss the risk of the COVID-19 pandemic in early 2020.[26] Despite these developments, the analysis showed that the district-level vote share for Jokowi in 2019 remained positively correlated with COVID-19 vaccination rates.

However, the association between presidential vote share and COVID-19 vaccination rates should not be considered causal. Instead, it can be seen as the outcome of underlying differences in characteristics. Several studies showed shared characteristics among Subianto voters

in 2019 and vaccine-hesitant groups in 2021, including religiosity, distrust toward the incumbent Jokowi administration, and conspiracy beliefs.[20,31,32]

One study highlighted how Subianto supporters support a more dominant role of religion in public life, including in governance.[21] Religiosity has also been reported to be associated with attitudes toward vaccines in Indonesia.[22,23] In particular, some hesitancy toward the COVID-19 vaccine is attributable to religion, as there are concerns regarding the halal certification of the vaccine.[33] This issue tracks well with the results of this study, which found Islamic religious homogeneity in a district as an independent predictor of COVID-19 vaccination rates.

Another factor that could explain the result is the distrust toward the incumbent Jokowi administration. It is safe to assume that Subianto voters in 2019 were somewhat distrustful toward the then-incumbent candidate, Jokowi. Despite Subianto later joining Jokowi's cabinet, the distrust may have persisted and spilled over toward their responses to the COVID-19 pandemic, including the vaccination policy.[34]

At the same time, another study on the 2019 election showed that Subianto supporters were more prone to misinformation.[20] In particular, Subianto supporters' vulnerability to misinformation attacking Jokowi and his governance translated well to prevailing misinformation during the pandemic, which attacked COVID-19-related policies launched by the administration.[35] Based on this evidence, it is safe to hypothesize that distrust against the Jokowi administration combined with vulnerability to misinformation regarding COVID-19, might lead to vaccine hesitancy in Subianto-affiliated districts. Further surveys have also supported this hypothesis.[36]

Issues regarding distrust were especially crucial. The Jokowi administration has been criticized for contradictory statements regarding the pandemic, lack of transparency on COVID-19 data, and its policies at the beginning of the pandemic.[21,37,38] Another issue that fueled distrust was the perception that government policies were aimed at protecting the economic interest of the Indonesian oligarchy—if not outright self-enrichment—at the expense of ordinary people.[21]

Improving trust and combating misinformation are important issues that should be tackled on several fronts. Tracking trust in various actors and institutions may allow health authorities to select the most effective messengers for their COVID-19 vaccine promotion.[12] In Indonesia, political and religious opposition figures may be more effective in addressing vaccine-hesitant segments of society. Religious figures and institutions are especially important, as fractured messages given by different members of the religious establishment support the controversy regarding vaccine acceptability and fuel vaccine hesitancy.[39] Support from conservative religious figures would also help increase trust in the government, which would, in turn, help improve confidence in the government-run COVID-19 vaccination program.[40]

Nevertheless, this study was not without its limitations. One potential concern was the issue of data availability. As the pandemic disrupted district-level administration, it delayed the publication of district-level statistical reports, which resulted in the unavailability of data and the exclusion of several districts from the analysis. Although several confounders have already been controlled for, controlling for the possibility of vaccine supply issues contributing to variations in coverage still poses a challenge. The data presented in the Indonesian Ministry of Health dashboard show the real-time stockpile situation but do not report past scarcity events.[3] The ecological study design used in this study should also be considered in the interpretation of the results. A population-based survey should be conducted to confirm the association between political affiliation or beliefs and COVID-19 vaccine acceptance in Indonesia.

Conclusion

This study shows the importance of political beliefs, among other predictors, in facilitating vaccine hesitancy. The association between political beliefs and COVID-19 vaccination may be facilitated by religiosity, trust, and vulnerability to misinformation. Health promotions promoting the vaccine should consider this by improving public trust and incorporating the target population's belief system, including their political beliefs and affiliations, as part of the health communication strategy.

Abbreviations

COVID-19: coronavirus disease 2019; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2; PHC: Primary Health Care; GRP: Gross Regional Product; HDI: Human Development Index; SD: Standard Deviation; IQR: Interquartile Range.

Ethics Approval and Consent to Participate

The authors did not collect any new primary data or use individual secondary data, and this study exclusively used depersonalized aggregate data from publicly available reports. As such, this study is exempt from review by the local ethical review board.

Competing Interest

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

Availability of Data and Materials

Data sources can be seen in Supplementary Materials. It includes a list of document titles and websites where the documents can be accessed, and the date of access is visible. Some of the sources reported real-time

data that may have changed from the time of publication.

Authors' Contribution

Conceptualization: GBSW; methodology: GBSW and PPJ; formal analysis: GBSW; investigation: ICV and IGAIPR; data curation: ICV and IGAIPR; writing—original draft preparation: GBSW; writing—review and editing: NLZG, ICV, MZA, and PPJ; visualization: ICV. All authors have read and agreed to the published version of the manuscript.

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Oxidative Stress Levels of Fine Particulate Matter ($PM_{2.5}$) and Urinary Glutathione of Microbus Drivers

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Abstract

Urinary glutathione levels are known to be an early indicator of oxidative stress in travelers. This study analyzed the association between particulate matter ($PM_{2.5}$) exposure on the road and urine glutathione levels in Jakarta's microbus drivers. This cross-sectional study involved 96 microbuses (one of Jakarta's public transportations) drivers of nine routes in Kampung Melayu Bus Station, Jakarta, Indonesia. An anthropometric assessment and a structured questionnaire were employed. Along with the participants driving on the road, real-time personal equipment measuring $PM_{2.5}$ exposure concentrations was used. Total glutathione levels were measured using a colorimetric method. A correlation test and linear regression analysis were used to examine the effect of $PM_{2.5}$ exposure on total glutathione levels. The average $PM_{2.5}$ exposure concentration was 90.9±1.8 μg/m^3, with a maximum concentration of 114.7 μg/m^3. The average urinary glutathione level was 1.3±0.5 μM. The regression analysis showed that $PM_{2.5}$ was associated with urinary glutathione levels after controlling for body mass index and smoking status. To concluded, the drivers experienced exposure to an extremely high level of $PM_{2.5}$ that could influence the glutathione levels.

Keywords: driver, microbus, particulate matter 2.5, public transportation, urinary glutathione

Introduction

Particulate matter (PM) is a type of air pollution that is hazardous to human health. When inhaled, PM particles penetrate deep into the respiratory system (alveoli) and move to organs outside the lungs, including the central nervous system, due to their small size (2.5 μm or less). $PM_{2.5}$ can act as an initiator in producing reactive oxygen species (ROS).[1] It can reduce the activity of the enzyme glutathione peroxidase, resulting in oxidative stress, which is defined as an imbalance of ROS and antioxidant enzymes in the body, causing damage to tissue, proteins, deoxyribonucleic acid (DNA), and fats, all of which contribute to the occurrence of diseases in humans such as cancer, asthma, arteriosclerosis, and respiratory disease.[2,3] Glutathione (GSH) is a secondary antioxidant that prevents chain reactions by collecting free radicals, and ROS plays a function in tissue oxidative stress prevention.[4,5] A Canadian study stated that a decline in GSH was linked to a 12% increase in lung cancer fatalities.[6] When oxidant defenses are insufficient, tiny particles cause an inflammatory and cytotoxic response in the human lung, as well as systemic inflammation and thrombosis. Pollutant effects on the airways (indirect pathway) or direct systemic transport of pollutant compounds following deposition in the lungs might cause systemic oxidative stress and inflammation.[7]

The yearly averages of PM_{10} (82 μg/m^3) and $PM_{2.5}$ (45 μg/m^3) in Jakarta,[8] are significantly higher than the World Health Organization (WHO) guidelines,[9] of 15 μg/m^3 and 5 μg/m^3, respectively. In 2017 and 2018, there were 198 days and 196 days of poor air quality, respectively.[10,11] A previous study stated that the transportation sector was responsible for around 80% of air pollution in metropolitan areas.[12] Public transportation drivers on the road for lengthy periods are exposed to high levels of $PM_{2.5}$, which can cause health concerns.[13] A previous study on microbus drivers in Kampung Melayu Bus Station showed a decrease in lung function at 30.7%, with obstructive pulmonary disorders at 9.7%.[14] Kampung Melayu Bus Station is a city terminal in East Jakarta Municipality, the Special Capital Region of Jakarta, Indonesia, that serves 23 transportation routes, including large, medium, and microbuses; nine of which are microbus routes that depart and reenter the

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terminal: M01, M01A, M02, M18, M26, M27, M28, M31, and M32. This study aimed to determine whether there was an association between $PM_{2.5}$ exposure and lower urine GSH levels in Jakarta microbus drivers.

Method

A cross-sectional design was used to evaluate urine GSH levels of 96 microbus drivers as well as ambient $PM_{2.5}$ personal concentrations on nine microbus routes departing from and returning to Kampung Melayu Bus Station, M01 (14.4 km), M01A (18.4 km), M02 (20.8 km), M18 (25.8 km), M26 (34.6 km), M27 (15.6 km), M28 (28.2 km), M31 (30 km), and M32 (24.8 km). A sampling design for the correlation test was implemented to calculate the sample size. The participants in this study were selected randomly from nine microbus routes. Measurements were made on individual data and length of exposure. Individual data consisted of age, body mass index (BMI), smoking status, alcohol consumption status, and supplement intake status. The length of $PM_{2.5}$ exposure consisted of working experience (year) and working hours. Individual data were gathered through individual interviews and observations using a modified questionnaire adapted from prior studies.[15,16] Anthropometry was used to determine body weight and height. The round trip distance in kilometers for each transportation route was collected from the data presented on Google Maps.

$PM_{2.5}$ levels were measured using real-time Air Visual Pro Monitoring equipment with a one-minute interval for each round of the route. A 5-mL urine sample was collected from each participant and analyzed following the enzymatic recycling test method as stated in the manufacturer's instructions using the Glutathione Assay (Colorimetric) Kit (Cat. # 786-075, G-Bioscience Geno Technology, Inc., USA). Data were analyzed by univariate, bivariate, and multivariate analyses. The BMI, smoking, alcohol consumption, and supplement intake status were analyzed univariately. Pearson's correlation and linear regression were applied to examine the relationship between variables and the effect of $PM_{2.5}$ exposure on total GSH levels after other factors were taken into account. The p-value was <0.05 with 95% CI. The data were presented as a boxplot showing the average distribution of $PM_{2.5}$ concentrations on nine microbus routes. The correlation of independent variables ($PM_{2.5}$ concentration, age, working experience, working hours, BMI, smoking status, alcohol consumption status, and supplement intake) to total GSH was also presented in tables.

Result

The participants' $PM_{2.5}$ concentrations while driving and urine GSH levels were successfully obtained. Mean $PM_{2.5}$ levels varied from 51.10 μg/m^3 to 119.95 μg/m^3, with an average of 90.85 μg/m^3 (95% CI = 87.14–94.56 μg/m^3). The data revealed that the microbus M28 route had the highest $PM_{2.5}$ concentration (average 114.8 g/m^3) of the nine routes studied (Figure 1). Microbus M31 (30 km) has the longest round trip mileage among the nine routes, while Microbus M01 (14.4 km) has the shortest. The average urine GSH level was likewise determined to be 1.29 μM, with a range of 0.5–3.16 μM

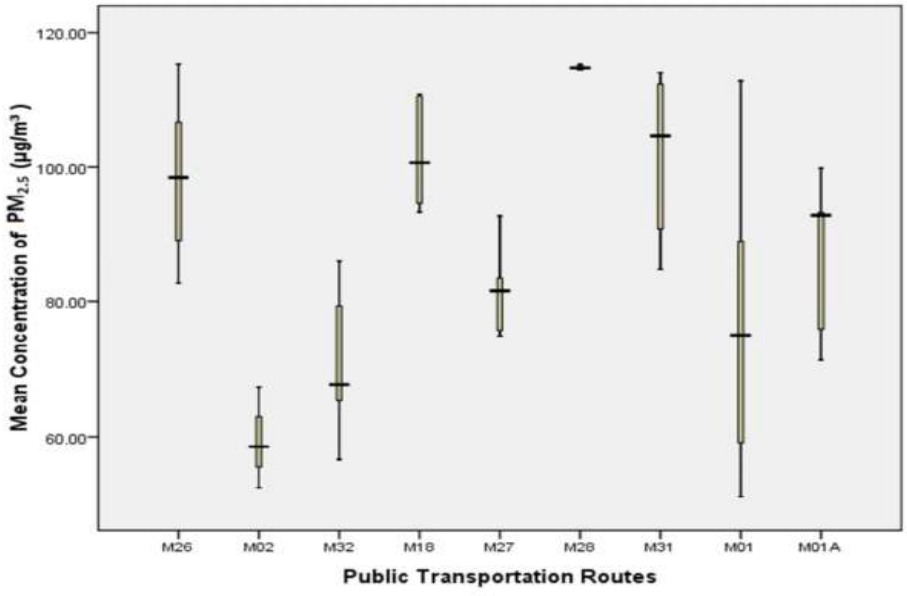

Figure 1. The Average $PM_{2.5}$ Concentration by Transportation Route

Table 1. Characteristics of the Participants

Variable	Category	n = 96	%
Body mass index	>25 (overweight)	33	34.4
	≤25 (not overweight)	63	65.6
Smoking status	Smoking	61	63.5
	Nonsmoking	35	36.5
Alcohol consumption status	Yes	14	14.6
	No	82	85.4
Supplement intake status	Yes	17	17.7
	No	79	82.3

Table 2. The Association of $PM_{2.5}$ Concentration, Age, Working Experience, and Working Hours to Glutathione Levels

Variable	r	R^2	p-value
$PM_{2.5}$ concentration	-0.208	0.043	0.042
Age	0.099	0.01	0.338
Working experience	0.130	0.017	0.206
Working hours	0.075	0.006	0.465

Table 3. The Association of Body Mass Index, Smoking Status, Alcohol Consumption, and Supplement Intake with Glutathione Levels

Variable	Category	Mean	SD	Mean diff.	p-value	95% CI
Body mass index	>25 (overweight)	1.43	0.58	0.20	0.07	-0.01–0.42
	≤25 (not overweight)	1.22	0.47			
Smoking status	Smoking	1.32	0.56	0.07	0.51	-0.14–0.29
	Nonsmoking	1.25	0.43			
Alcohol consumption status	Yes	1.25	0.65	-0.05	0.74	-0.35–0.25
	No	1.30	0.49			
Supplement intake status	Yes	1.43	0.49	-0.17	0.23	-0.44–0.11
	No	1.26	0.61			

Notes: SD = Standard Deviation, CI = Confidence Interval

(95% CI = 1.19–1.39 μM), and 39.6% of participants had GSH levels above the normal. Most individuals (63.5%) were smokers, with almost half (50.8%) smoking 10–20 cigarettes daily. More than a third of participants (34.4%) were overweight, 14.6% drank alcohol, and 17.7% took supplements or antioxidants (Table 1). The average age of the participants was 44.7 years, with an average of 16.9 years of work experience and 9.1 hours of work routine.

The statistical association between $PM_{2.5}$ levels and GSH levels had a low power (r = 0.21) and a negative trend. This result suggested that rising $PM_{2.5}$ concentrations were accompanied by lower GSH levels (R^2 = 0.04). Age, work experience, and working hours had a weak relationship with GSH levels (r = 0.09, 0.13, and 0.08, respectively) (Table 2).

There were no statistically significant relationships between GSH levels and BMI, smoking status, alcohol consumption status, or supplement intake (p-values = 0.07, 0.51, 0.74, and 0.23) (Table 3). After controlling for BMI and smoking status in an inverse relationship, the regression model revealed a 9.2% influence of $PM_{2.5}$ exposure on GSH levels. In other words, the lower the GSH level, the higher the $PM_{2.5}$ concentration (Table 4).

Table 4. Regression Model of Concentration of $PM_{2.5}$, Body Mass Index, and Smoking Status

Variable	Coeff. β	p-value	r	R^2
$PM_{2.5}$ concentration	-0.006	0.026	0.303	0.092
Body mass index	-0.222	0.043		
Smoking status	-0.098	0.362		

Discussion

The $PM_{2.5}$ concentrations on all microbus roundtrip routes to Kampung Melayu Bus Station exceeded the national air quality threshold of 55 μg/m^3 daily exposure,[17] and were found to be six times higher than the WHO 2021 daily $PM_{2.5}$ concentration recommendation (15 μg/m^3).[9] About 80% of air pollution in metropolitan areas is influenced by the transportation sector.[12] In the long term, exposure to $PM_{2.5}$ in air pollution will affect the health of public transport drivers.[13] Traveling by public transportation exposes people to extremely high $PM_{2.5}$ concentrations, with a median of 119 μg/m^3(IQR = 104–122 μg/m^3).[18] Similar risks were observed in 2017 in the Republic Democratic of Congo, where the average $PPM_{2.5}$ concentration on the highway was 94.72±27.49 μg/m^3, and in India, where the average $PM_{2.5}$ concentration on the highway was 72.13 mg/m^3.[19,20]

In this study, the high $PM_{2.5}$ concentration could be influenced by the number of vehicles on the road. The data from Statistics Indonesia in 2019 showed that the number of vehicles in Jakarta was the second highest in

Indonesia, thus it is necessary to reduce the number of vehicles on the road drastically.[21] The entry of $PM_{2.5}$ resulting from the combustion of material transportation fuel and road ash into the microbus will be influenced by the situation of public transportation with an always-open passenger door, as well as the opening of passenger and driver windows. Participants with GSH levels less than or equal to the average were found to be greater than those with GSH levels beyond the typical means, according to this study. Compared to GSH levels in people continually exposed to mercury in the village of Lebak Situ Village, Lebak District, Banten Province,[16] the results of this study were lower.

GSH levels in autistic children were shown to be lower than those who have not, which was exacerbated by an oxidative stress-inducing environment.[22] The GSH is an antioxidant in response to environmental exposure by lowering its concentration, interfering with immune cell function regulation, and causing failure to combat ROS.[23] Antioxidant enzymes (such as glutathione peroxidase/GPx) play a critical function in the cell's oxidative stress defense mechanism. According to Brucker's study, the GPx enzyme activity was statistically lower in taxi drivers than in the control group.[24]

The negative connection between $PM_{2.5}$ concentration and GSH levels found in this study suggested that high $PM_{2.5}$ exposure from microbus drivers lowers GSH levels in the body. The finding was consistent with the previous study, which demonstrated that air pollution lowers antioxidant activity in the body.[25] The GSH helps protect the body from oxidative damage caused by ROS produced by the body's metabolism when $PM_{2.5}$ is breathed into the alveoli,[25] and it can react with ROS in a nonenzymatic way. GSH is the major nonenzymatic antioxidant effective in protecting cells against reactive oxygen products and toxins, and GSH is involved in responses to various stresses. GPx uses GSH as an electron donor to reduce organic hydroperoxides, decreasing the amount of GSH in the body and thereby causing oxidative stress.[26]

Although this study included a higher proportion of smokers, no association between smoking and GSH levels were observed. The results differed from a previous study which found a decrease in glutathione S-transferase and glutathione peroxidase antioxidant activity in smokers compared to nonsmokers.[27,28] Adult male smokers produce more ROS than nonsmokers and those who have stopped smoking, resulting in lower GSH levels in smokers.[25] The non-significant association discovered in this study could be influenced by glutathione reductase activity, which is favorably correlated with smoking exposure. A study by Kamceva, *et al.*, showed a significant difference in the activity of GPx among active smokers and nonsmokers. The number of cigarettes smoked is essential in increasing oxidative damage and reducing antioxidant defense.[28]

All participants' characteristics, such as BMI, alcohol consumption, and supplement intake, had no significant relationship with their GSH levels. However, certain epidemiological and clinical investigations have discovered an association between obesity and oxidative stress, as measured by various biomarkers.[29,30] A previous study has found a positive linear relationship between obesity and oxidative stress.[31] Compared to BMI classifications of overweight and obese, people with normal and low BMI are less likely to have lipid peroxidation due to oxidative stress.[31] Although the drivers' BMIs were not overweight, their sedentary lives, lack of physical activity, and irregular eating patterns endangered their health. This study's finding supports a previous study that found no association between age and GSH levels in mercury-exposed employees.[16] The findings of this study, however, were inversely related to Venkateshappa's study, finding that GSH levels decreased with age. This condition indicates that the capacity for detoxification in cells decreases as humans age.[32]

A study in South Korea has linked elevated levels of the liver enzyme γ-glutamyltranspeptidase (γ-GTP) to an increase in $PM_{2.5}$ pollutant concentrations.[33] The levels of γ-GTP are influenced by $PM_{2.5}$ concentrations, which are higher in participants who drank alcohol once a week than those who did not. Elevated liver enzymes have been linked to an increased risk of cardiovascular disease, metabolic diseases, and diabetes.[33] A study in Turkey shows that GSH levels were significant in patients with type 2 diabetes mellitus (p-value<0.005).[34] This conflicting conclusion could be influenced by the number of drivers who did not consume alcohol which was higher than the number of drivers who did. Data on alcohol intake gathered through direct interviews with participants was deemed a taboo topic for discussion because of the negative stigma connected with it, such as being associated with sin. As a result, participants' unwillingness to further discuss this topic was this study's shortcoming.

Drivers' work experiences showed no significant relationship with GSH levels. This finding differed from a previous study by Tan, *et al.*, showing that an increase in the work time of traffic police officers by one hour per day for one year was associated with a decrease in GSH level.[4] According to a study by Ledda, *et al.*, there was a negative association between total GSH and pesticide exposure in agricultural workers after pesticide exposure. Total GSH levels were lower in workers exposed to pesticides, with an exposure duration of 3.7±1.4 hours/day, compared to organic farmers who were not exposed to pesticides.[35] According to this study's result, the average working experience of participants, was expected to be long, and $PM_{2.5}$ exposure was likely to be chronic.

However, the findings showed that tenure positively correlates with GSH levels. This was most likely because the participants were generally in their 40s, had no record of chronic diseases, and lived a non-alcoholic lifestyle. As a result, antioxidants in the body could respond to environmental exposure without being influenced by long working hours.

This study had several strengths in terms of objectives and data collection. A study examining the effect of $PM_{2.5}$ exposure on oxidative stress conditions with total GSH biomarkers conducted in Indonesia is still relatively few, especially using urine samples. Data collection using urine biomarkers, which is non-invasive sampling, minimizes the use of tools that contain organic/metal and minimizes the artificial formation of oxidative damage to the molecules in the sample. Furthermore, urinary levels of biomarkers provide a graded index of redox balance over time compared to blood levels.[36] In contrast, similar studies often use serum or plasma for total GSH testing (invasive testing).[37-39] The $PM_{2.5}$ concentration data were collected by following the driver along the transportation route departing and returning to the terminal, providing an overview of the $PM_{2.5}$ exposure drivers always receive during their activities. Total GSH analysis was carried out by experienced laboratory assistants in trusted educational laboratories. In this study, the total GSH value obtained was very good, as indicated by optimizing the linear sample with the total GSH standard curve ($R^2 = 0.9946$).[40]

The limitations of this study were time constraints that made it impossible to use a cohort or case-control design to prove a cause–effect relationship between variables in assessing $PM_{2.5}$ exposure and total GSH levels in the driver's urine. It is recommended to reduce the time spent on the road and the number of vehicles on the road to reduce $PM_{2.5}$ exposure to the drivers. Further study for analyzing the cause–effect relationship between $PM_{2.5}$ exposure concentration and GSH level by implementing a cohort design will provide insight into the finding.

Conclusion

Microbus, a public transportation in Jakarta, Indonesia, drivers are exposed to extremely high $PM_{2.5}$ levels along every nine routes, resulting in GSH levels of 0.5–3.16 μM. On-the-road $PM_{2.5}$ personal exposure influences the GSH levels of microbus drivers after controlling for BMI and smoking status. The higher the $PM_{2.5}$ exposure concentration on the road, the lower the GSH levels among those exposed to $PM_{2.5}$ for a long time. $PM_{2.5}$ exposure can harm the health of microbus drivers by causing oxidative stress and a drop in urine GSH levels. This study suggests that the time spent on the road and the number of vehicles on the road should be drastically reduced. Further study for analyzing the cause–effect relationship between $PM_{2.5}$ exposure concentration and GSH level by implementing a cohort design will clarify the finding.

Abbreviations

PM: Particulate Matter; ROS: Reactive Oxygen Species; DNA: Deoxyribonucleic Acid; GSH: Glutathione; WHO: World Health Organization; BMI: Body Mass Index; GPx: Glutathione Peroxidase; γ-GTP: γ-glutamyltranspeptidase.

Ethics Approval and Consent to Participate

Ethical approval was granted by the Faculty of Public Health, Universitas Indonesia (No.: Ket-482/UN2.F10/PPM.00.02/2019).

Competing Interest

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

Availability of Data and Materials

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

Authors' Contribution

PS contributed to conceptualizing, designing, and preparing the initial draft and framework, interpreting the data, and revising the final manuscript. AK contributed substantially to the concept. BH contributed to critically reviewing the manuscript's content and submitting and revising the manuscript.

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Information-Motivation-Behavioral Skill in Diabetes Self-management Using Structural Equation Modeling Analysis

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Abstract

Diabetes is the "mother" of various diseases increasing the risk of morbidity and mortality. Diabetes self-management, an effort made by patients to control blood sugar levels, is an important part of the management strategy. Therefore, this study analyzed information, motivation, and behavioral skills associated with diabetes self-management. Data were collected in the Special Capital Region of Jakarta, with 277 diabetic patients selected using a questionnaire by a systematic random sampling method. The analyzed variables were information (with indicator variables of information on physical activity, nutritional intake, drug consumption, and blood sugar monitoring); sociodemographic (age, sex, occupation, education level, and duration of diabetes); motivation (barrier, benefit, self-efficacy, severity, and susceptibility); and behavioral skills (new motor, self-regulatory, and social skills), which were analyzed to identify their influence on diabetes self-management using structural equation modeling. The results indicated that information and motivation significantly and positively affected behavioral skills; while, sociodemographic did not. Behavioral skills had a significant and positive effect on diabetes self-management. Accordingly, people with diabetes information, motivation, and behavioral skills need to be improved to increase the success of diabetes self-management.

Keywords: diabetes, diabetes self-management, structural equation modeling

Introduction

Diabetes is a disease that can be the main cause of blindness, heart disease, kidney failure, and premature death. According to the 2019 International Diabetes Federation (IDF) data, there were 463 million people worldwide, or 9.3% of the population, aged 20–79 years, who had diabetes.[1] Countries in the Arab-North African region and the Western Pacific ranked first and second with the highest prevalence of diabetes in the population aged 20–79 years among the seven regions in the world, 12.2% and 11.4%, respectively.[2] The Southeast Asian region, where Indonesia is located, ranks third, with a prevalence of 11.3%.[2] The IDF also projects the number of people with diabetes in the population aged 20–79 years in several countries that have identified the ten countries with the highest number of people with diabetes. China, India, and the United States rank in the top three, with 116.4 million, 77 million, and 31 million people with diabetes, respectively.[1] Indonesia is ranked seventh among the ten countries with the highest number of people with diabetes, at 10.7 million. Indonesia is the only country in Southeast Asia on the list, proving the magnitude of Indonesia's contribution to the prevalence of diabetes cases in Southeast Asia.[1]

The results of the 2018 Indonesian Basic Health Research/*Riset Kesehatan Dasar* (Riskesdas) showed that the prevalence of diabetes mellitus in Indonesia based on a doctor's diagnosis at the age of older than 15 years is 2%.[3] Those data showed an increase compared to the 1.5% prevalence of diabetes mellitus in the population of more than 15 years in the 2013 Indonesian Basic Health Research.[3,4] However, the prevalence of diabetes mellitus, according to the results of blood sugar tests, increased from 6.9% in 2013 to 8.5% in 2018.[3,4] This case showed that only 25% of people with diabetes know they have diabetes. The Special Capital Region of Jakarta had the highest prevalence of diabetes mellitus based on a doctor's diagnosis (3.4%).[5]

The 2018 Indonesian Basic Health Research data showed that 91% of patients receiving pharmacological therapy, such as anti-diabetic or insulin, were receptive to therapy. However, the 9% did not comply with therapy because they felt healthy, did not come to health facilities, and others.[3] Based on the Indonesian Endocrino-

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logy Association/*Perkumpulan Endokrinologi Indonesia* (Perkeni) consensus, diabetes management must be jointly carried out between the provision of pharmacological interventions and the application of healthy living behaviors, that is, nutritional therapy interventions and physical activity.[6] Anani, *et al.,* identified a relationship between taking medications, physical activity, exercise, and eating habits on the blood glucose levels of diabetes patients.[7] If people with diabetes with cardiovascular diseases did not comply with dietary recommendations, physical activity, and medications, they had a two-to-four times higher risk of dying from heart complications and stroke than those without diabetes.[8] In a study by Risnasari on 57 diabetic patients, 56.14% did not comply with the diet, 57.89% of patients had complications, and a relationship between the level of dietary adherence and the emergence of complications was identified.[9]

Diabetes self-management refers to the ability of a person to manage the conditions for living with diabetes physically and psychosocially toward behavioral change. Diabetes self-management is an important strategy for empowering patients to achieve controlled blood sugar.[10,11] Diabetes self-management is a complex behavior influenced by various factors, which in turn are influenced by personal factors (knowledge of diabetes, self-efficacy, perception of disease, personality, and other demographic factors), as well as environmental factors (doctor–patient communication, family support, and policy support). Identifying these determinants is very important in the development of effective intervention models to provide good health impacts for diabetes management.[6,10]

Anani, *et al.,* provided an overview of factors related to macro and micro complications of diabetes, including patient characteristics, demographics, lifestyle, hypertension, uncontrolled blood sugar, diabetes self-management, and duration of diabetes and insulin use patterns.[7] Problems that occur in people with diabetes can be controlled if the patient independently implements good and sustainable management. A previous study found good blood sugar control results in patients using self-monitoring techniques, including food intake, physical activity, and blood glucose levels.[12]

Fisher and Fisher provided a valuable and well-tested model for designing individual-level behavioral change interventions which target reflective regulatory processes. The model is the Information-Motivation-Behavioral skills (IMB), proposing that changes in the operation of reflective systems occur when an individual is well-informed, highly motivated, and has the necessary skills to perform the desired behavior.[13] As a result, intervention designers must assess which antecedents of information, motivation, or skills are lacking in the target population and address them in interventions designed to change their behavior patterns.[13]

A study by Hariawan showed respondents with a lower level of education had a prevalence of less than 2%.[14] This can be assumed to be related to lifestyle and access to case detection in health services groups at the academy/university education levels.[14] A study by Rahayu, *et al.*,[15] identified the relationship between occupation and diabetes mellitus. This statement is also supported by Grant's work, entitled Gender–Specific Epidemiology of Diabetes, in study by Nurhidayah, *et al.*, claiming that a person's work affects their level of physical activity; thus, their health by increasing the risk of diabetes mellitus.[16] Therefore, this study aimed to determine the relationship between IMB in diabetes self-management.

Method

The analysis of this study was based on the IMB skills model combined with the Health Belief Model and sociodemographic determinants of the successful control of type 2 diabetes mellitus (T2DM). This combination was used to create a diabetes self-management model, with IMB and sociodemographic determinants related to behavioral skills toward diabetes self-management. Information was developed using four pillars of diabetes management in Indonesia: dietary intake, physical activities, medication adherence, and blood sugar monitoring.[16] For information to be interpreted as knowledge, the patient must be diligent in maintaining dietary intake, physical activity, regularly taking medication, and monitoring blood sugar.

The motivation was developed using the Health Belief Model variables: perceived susceptibility, perceived severity, perceived benefit, perceived barrier, and self-efficacy. Motivation was interpreted as internal personal drives influencing one's willingness to change behavior. The sociodemographic was based on the influence factor of behavioral skills that affect diabetes self-management, such as age, sex, education level, occupation, and duration of having diabetes.

Behavioral skills were based on the theory of skills needed to change behavior: self-regulation, new motor skills, and social skills. Self-regulation means that individual behavior is goal-directed: setting goals, assessing how close (or far) one is to achieving goals, taking action to get closer to goals, and monitoring progress. New motor skills are intended to be learning and using new tools. For instance, the consumption of certain drugs requires medication reminder devices or Android-based applications; teaching patients how to use them is necessary. Social skills are defined as the ability to negotiate changes in behavior patterns with others and seek their support. People with diabetes must control their dietary intake even when attending a large event, such as a wedding. Social skills are necessary so that people with diabetes

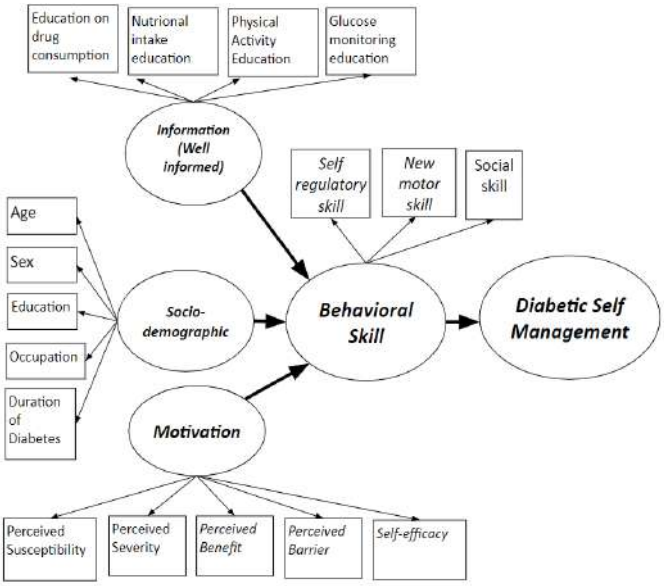
can maintain their behavior by communicating their condition to others.

Diabetes self-management is defined as the success of people with diabetes in maintaining dietary intake, physical activity, medication adherence, and blood sugar monitoring.[13] Variables and indicators directly or indirectly related to the independence of diabetes mellitus patients, namely, the variable IMB skills were analyzed to identify determinants that can influence the independent variable of diabetes patients.[13]

This study involved 277 participants of diabetes patients undergoing the Chronic Disease Management Program/*Program Pengelolaan Penyakit Kronis* (Prolanis) at five primary health cares (PHCs) of each administrative city of the Special Capital Region of Jakarta. The data were collected using questionnaires: 110 were spread directly, and 167 were distributed online via Google Forms. The data were collected from March to April 2022 when Prolanis activities were still active (with strict health protocols), even during the COVID-19 pandemic. The inclusion criteria set included diabetes patients registered as Prolanis participants, willing to sign the informed consent form, and could communicate well. While, the exclusion criteria were type 1 diabetes mellitus (T1DM) patients and others unwilling to participate. The number of samples taken in this study was adjusted to the amount recommended by Hair Jr., *et al.*,[17] in the structural equation modeling (SEM) analysis; while, the number of indicator variables added by the number of latent variables is multiplied by 5–10 so that it can be used as an estimated interpretation. The number of samples for SEM analysis can be seen as in Figure 1. The minimum number of samples in this study is: (17 + 5) x 10 = 220 respondents.[17] However, the study obtained 277 respondents for data analysis.

The questionnaire was designed based on the study framework. The sociodemographic section contains questions about age, sex, education level, occupation, and the length of time the patient had T2DM. For IMB skills, and diabetes self-management, respondents had to choose one of the following points: Strongly Agree (SA) if the statement was 76–100% following the respondent's condition/do/think; Agree (A) if the statement was 51–75% following the respondent's condition/do/think; Disagree (D) if the statement 26–50% was appropriate with respondent's condition/do/think; Totally Disagree (TD) if the statement 0–25% was appropriate (heavy disagreement) with respondent's condition/do/ think. Statements were made in both positive and negative statements, and each answer contained points ranging from 0 to 3—the more positive the respondent's answer, the more points they received.

The information contained statements regarding respondents' knowledge level and the education they had



Notes: Number of latent variables (oval shapes): information, motivation, sociodemographic, behavioral skills, diabetes self-management = 5.
Number of indicator variables (square shape): information on physical activity, information on nutritional intake, information on drug consumption, information on blood sugar monitoring, age, sex, occupation, education, duration of diabetes, barrier, benefit, self-efficacy, severity, susceptibility, new behavior motor skills, self-regulatory skills, and social skills = 17.

Figure 1. Conceptual Framework

received from the PHC where they were registered. Information was divided into four sections: dietary intake, physical activity, medication adherence, and blood sugar monitoring. Each indicator consisted of five statements. The information statement questionnaire was coded C1-20. Statements such as "controlling blood sugar levels is important so that people with diabetes do not experience complications" and "the way the officers convey the rules regarding nutritional intake are unclear" were put forth. The motivation was developed based on Health Belief Model variables: perceived susceptibility, perceived severity, perceived benefit, perceived barrier, and self-efficacy. Each had five statements, and the motivation statement questionnaire is coded D1-25. Statements such as "I do not think diabetes is a disease to worry about" and "Regular exercise helps maintain blood sugar at a normal level" were put forth.

Behavioral skills were divided into three parts: self-regulation, new motor, and social skills. Each part consisted of five statements, and the behavioral skills statement questionnaire was coded E1-15. Statements such as "I am not able to follow the rules of eating/drinking as taught by health workers" and "I am able to refrain from eating sugary foods/drinks excessively" were made. Diabetes self-management measured the compliance of people with diabetes in regulating nutritional intake, physical activity, medication adherence, and blood sugar monitoring. Statements such as "I always come to check myself at a health facility according to the schedule determined by the health officer" and "I like to forget or intentionally do not take my medication" were offered. Diabetes self-management had the questionnaire code B1-16.

Sociodemographic data were analyzed univariately using free version of SPSS 26.0 to obtain the frequency and percentage. Multicollinearity is a strong correlation or relationship between two or more independent variables in a multiple regression model. In analyzing the inner model, some assumptions need to be met, including the assumption of multicollinearity. If multicollinearity exists, then the predictive power is unreliable and invalid. A regression model can be said to have no multicollinearity if the variance inflation factor (VIF) value is less than nine. In the analysis model, multicollinearity was assumed to identify the influence of information, sociodemographic, and motivation on behavioral skills.

Validity and reliability tests determined the relationship between indicators and constructs. Validity was described based on factors related to the formed structural model, and average variance extracted (AVE) was used to measure the validity of the variables in the model. Variables with factors related to AVE>0.5 indicated that the variable has a relationship with other variables. The reliability test was carried out by looking at the composite reliability value. The results of composite reliability can be said to be satisfactory if the AVE is above 0.70. Model measurement was done to determine the relationship between indicators and the latent variable (inner model) and between latent variables (outer model) in a construct. The T-statistics were used to determine the significance level in the hypothesis testing, which made up a model by looking at the t-statistic>1.96. Decision-making was performed by examining the significance value (p-value). It is considered significant if the p-value is <0.05.

Results

Table 1 shows the univariate sociodemographic analysis of the 277 respondents. The youngest respondent was 28 years old, and the oldest was 89 years old, with an age mean of 57.7 years. Based on the age category with a range of 10 years, the age category with the most number was 51–60 years, with 60 respondents (37.4%). Most respondents were females (65%), attaining senior high school (44.6%), and housewives (49.6%). The average duration of diabetes was 5.13 years, with the most common duration of suffering found at 1–5 years in 169 participants (60.8%).

Several presumptions must be met to analyze the inner model, including the presumption of multicollinearity. Multicollinearity renders the prediction power invalid and unreliable. If the VIF value is less than nine, a regression model is considered to have no multicollinearity. The multicollinearity assumption was created in the analysis model to determine how information, sociode-

Table 1. Participants' Sociodemographic Characteristics

Variable	Category	n	%
Age	Mean = 57.67 years		
	Minimum = 28 years		
	Maximum = 89 years		
	<30 years	2	0.7
	31–40 years	15	5.4
	41–50 years	44	16
	51–60 years	104	37.4
	61–70 years	91	32.7
	>70 years	21	0.75
Sex	Male	98	35
	Female	178	65
Education level	Elementary school	48	17.2
	Junior high school	56	20.2
	Senior high school	124	44.6
	Higher education	49	17.6
Occupation	Housewife	138	49.6
	Retired	22	7.9
	Civil servant	10	7.1
	Private employee	44	15.8
	Self-employed	20	7.17
	Unemployed	33	11.87
Duration of diabetes	<1 year	1	0.3
	1–5 years	169	60.8
	6–10 years	84	30.2
	11–15 years	14	5.04

mographic, and motivation on behavioral skills. All variables in Table 2 have a VIF value of less than nine. Information and behavioral skills have a VIF value of 2.547, and motivation and behavioral skills have a VIF value of 2.610. Sociodemographic and behavioral skill has the lowest VIF value of 1.067. In brief, this model did not have multicollinearity.

Validity and Reability Test

The value of AVE ranges from 0 to 1. The validity of the variables in the model was evaluated using AVE. If the AVE value is more than 0.5, a variable is valid. Because the AVE value is more than 0.5, the variables information, motivation, behavioral skills, and diabetes self-management are valid in Table 3. Therefore, the measuring model in this study had a valid discriminant validity.

The variables and indicators in this study were valid following the validity test; thus, the reliability test was carried out. The value of composite reliability was calculated for this test. If the composite reliability results are over 0.70, they are considered satisfactory. Table 4 was produced by weighing the importance of composite reliability and Cronbach's alpha to provide the results of this

Table 2. Variable Multicollinearity Analysis

Variable	Behavioral Skill
VIF value between variable	
Information	2.547
Motivation	2.610
Sociodemographic	1.067

Note: VIF = Variance Inflation Factor

Table 3. Validity Test by Evaluating the Average Variance Extracted Score

Variable	AVE Validity	Test Criteria>0.5
Behavioral skill	0.868	Valid
Diabetes self-management	0.760	Valid
Information (well-informed)	0.682	Valid
Motivation	0.694	Valid

Note: AVE = Average Variance Extracted

Table 4. Reliability Test by Evaluating the Average Variance Extracted Score

Variable	AVE Reliability	Test Criteria>0.7
Behavioral skill	0.952	Reliable
Blood sugar monitoring	0.928	Reliable
Diabetes self-management	0.962	Reliable
Dietary intake	0.931	Reliable
Information (well-informed)	0.895	Reliable
Medication information	0.855	Reliable
Motivation	0.919	Reliable
New motor skill	0.912	Reliable
Perceived barrier	0.972	Reliable
Perceived benefit	0.938	Reliable
Perceived severity	0.945	Reliable
Perceived susceptibility	0.948	Reliable
Physical activity information	0.743	Reliable
Self-efficacy	0.937	Reliable
Self-regulation	0.962	Reliable
Social skill	0.908	Reliable

Note: AVE = Average Variance Extracted

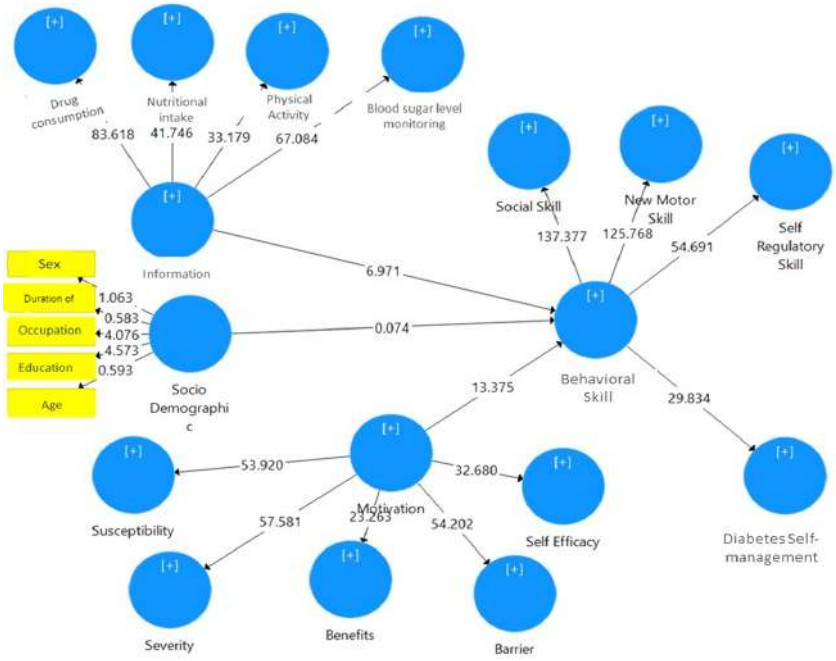


Figure 2. Results of the T-Statistical Analysis

Table 5. T-Statistical Analysis of the Inner and Outer Model (among Latent Variables)

Model	Variable	Indicator	T-Statistics (|O/STDEV|)	p-value
Inner model	Behavioral skill	New motor skill	125.768	<0.001
		Self-regulatory skill	54.691	<0.001
		Social skill	137.377	<0.001
	Information	Physical activity	33.179	<0.001
		Nutritional intake	41.746	<0.001
		Drug consumption	83.618	<0.001
		Blood sugar monitoring	67.084	<0.001
	Motivation	Barrier	54.202	<0.001
		Benefits	23.263	<0.001
		Self-efficacy	32.680	<0.001
		Severity	57.581	<0.001
		Susceptibility	53.920	<0.001
	Sociodemographic	Sex	1.063	0.288
		Duration of diabetes	0.583	0.560
		Occupation	4.076	<0.001
		Education	4.573	<0.001
		Age	0.593	0.553
Outer model	Behavioral skill	Diabetes self-management	29.834	<0.001
	Information	Behavioral skill	6.971	<0.001
	Motivation	Behavioral skill	13.375	<0.001
	Sociodemographic	Behavioral skill	0.074	0.941

study's outer model reliability test. If a variable's composite reliability value is greater than 0.7, it falls within the dependable category. According to Table 4, every variable has values greater than 0.7 and can be incorporated into the data-collecting model for analysis. Combined with the AVE table's findings, all variables were valid. Hence, all of the specified variables met the aspects of validity and reliability.

Based on Figure 2, the t-statistic results are presented in the Table 5 in which IMB skills variables have a significant influence on the constituent indicator. While, only occupation and education in sociodemographic variables had a significant effect on the constituent indicators. Behavioral skills positively affected diabetes self-management with an influence coefficient of 0.776, a t-statistics value of 29.834, and a p-value of <0.001. The information variable had a significant positive effect on behavioral skills with an influence coefficient of 0.316, a t-statistics value of 6.971, and a p-value of <0.001. Sociodemographic did not affect behavioral skills, with an influence coefficient of -0.002, a t-statistics value of 0.074, and a p-value of 0.941. Motivation had a positive effect on behavioral skills, with an influence coefficient of 0.643, a t-statistic value of 13.375, and a p-value of <0.001.

Discussion

Based on the results of this study, the information variable had a significant positive effect on behavioral skills (t-statistic: 6.971, and p-value<0.001). These findings were in line with a previous study by Sulistyanawati (p-value<0.25), stating that providing information affected the behavior of disease management in diabetes patients.[18] Providing information becomes essential when motivated and skilled people lack an understanding of their behavior or its consequences. In addition, if people are unaware that their behavior patterns can lead to long-term illness, providing information allows them to change their behavior. This shows a relationship between information and the behavior of disease management in people with diabetes.[18]

This study also showed that the information variable significantly influenced its constituent indicators: physical activity, nutritional intake, drug consumption, and blood sugar monitoring. Physical exercise is a pillar in the management of T2DM, which is accompanied by nephropathy.[19] In addition to maintaining fitness, physical exercise can help the patient lose weight and improve insulin sensitivity, improving blood glucose control.[19] The results of a systematic review and meta-analysis of clinical study regarding the effect of structured physical exercise intervention for eight weeks on average blood glucose levels in 2–3 months (HbA1c) and body mass in T2DM patients showed a significant decrease in HbA1c.[19] Significantly after the physical exercise intervention compared to the control group (7.65 vs. 8.31%, taking into account a mean difference of 0.66%; p-value <0.001). In addition, a case-control study showed that regular exercise had a favorable effect on HbA1c levels, muscle strength, and markers of inflammation in the elderly with diabetes.[19]

In this study, the nutritional intake indicator significantly affected the information variable (t-statistics = 41.746 and p-value<0.001). These findings were in line

with a previous study by Talaei, *et al.*, which stated that dairy food intake was significantly associated with reduced T2DM risk.[20] Nutritional intake is an important part of managing T2DM, and the key to success is the full involvement of team members (doctors, nutritionists, other health workers, and patients and their families).[21] To achieve this target, nutritional intake should be given according to the needs of each person with diabetes.[21] The principle of eating arrangements for people with diabetes is almost the same as eating recommendations for the public: a balanced diet following each individual's caloric and nutritional needs.[21] People with diabetes need to emphasize the importance of regular meal schedules and the type and amount of calorie content, especially in those taking medicines that increase insulin secretion or insulin therapy.[21]

The results of this study showed that motivation positively influenced behavioral skills, with an influence coefficient of 0.643, a t-statistic value of 13,375, and a p-value of <0.001. This finding was in line with a study by Ernawati, *et al.*, finding that motivation has a significant influence on the behavior of diabetic patients.[22] Furthermore, this study also revealed that behavioral skills had a positive effect on diabetic self-management with an influence coefficient of 0.776, a t-statistic value of 29.834, and a p-value of <0.001. These results aligned with a study by Nusantara, finding that behavioral skills improve self-care in diabetes patients.[23] There are three components in behavioral skills: self-regulatory skills (useful ways of thinking about self-regulation), new motor skills (learning and using new tools), and social skills (one's ability to negotiate changes in behavior patterns with others and seek support).[23]

In the occupation variable, the group of unemployed respondents had a higher prevalence of diabetes than other groups. A similar study found significant results between work status and DM.[11] The same result was also shown in study by Pahlawati, *et al.,* stating that people with a lower level of education had an increased risk of developing DM compared to people with higher education almost five times compared to people without DM with an OR value of 4.9 (95% CI = 1.82–13.12).[24] The same result was also obtained in Kusuma's study, stating that the characteristics of respondents were not related to self-efficacy except for occupation and education. Family support is known related to the self-efficacy of diabetes patients.[25]

Education level does not directly affect the incidence of diabetes mellitus; however, it supposedly affects diet by selecting the type of food consumed daily. Yuanita, *et al.,* stated that education or health education played an important role in the DM management.[26] Education for T2DM patients is important as an initial action to control DM. Diabetes mellitus self-management education (DSME) is a common and effective type of education for improving clinical outcomes and the patients's quality of life. In the DSME process, healthcare workers treating DM patients with self-care strategies control metabolism, prevent complications, and improve the quality of life of DM patients.[26] A study by Hariawan also stated that diet and physical activity had a relationship with the DM incidence (p-values of 0.02 and 0.009, respectively).[14] These results confirm that an unhealthy diet is part of a lifestyle predisposing factor for DM. A poor diet can lead to obesity, which predisposes a person to diabetes as a more significant amount of insulin is needed to regulate metabolism in obese people compared to normal people.[14] This is in line with a study in Surabaya City, that nutrition affects attitudes to functional food for the diabetics.[27]

Conclusion

This study reveals that the behavior skill variable positively affects diabetes self-management. In addition, the information and motivation variable have a significant positive effect on behavior skills; while, the sociodemographic variable does not affect behavior skill. In brief, behavioral skills significantly and positively has an impact on diabetes self-management. This study is recommended for further study related to diabetic self-reliance to control diabetes, which should quickly produce intervention models and instruments for self-reliance for diabetes patients as an effort to increase individual independence in intensive diabetes control.

Abbreviations

IDF: International Diabetes Federation; Riskesdas: *Riset Kesehatan Dasar*; Perkeni: *Perkumpulan Endokrinologi Indonesia*; IMB: Information-Motivation-Behavioral Skills; T2DM: Type 2 Diabetes Mellitus; Prolanis: *Program Pengelolaan Penyakit Kronis*; PHC: Primary Health Care; SEM: Structural Equation Modelling; VIF: Variance Inflation Factor; AVE: Average Variance Extracted; DSME: Diabetes Self-Management Education.

Ethics Approval and Consent to Participate

Ethical approval was granted by the Research and Community Engagement Ethical Committee, Faculty of Public Health, Universitas Indonesia. No.: Ket-36/UN2.F10.D11/PPM.00.02/2022.

Competing Interest

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

Availability of Data and Materials

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

Authors' Contribution

DK conceptualized and designed the study, collected data, and performed the analysis and interpretation of the analysis results. AB and CC provided guidance on data analysis, review, and approval of manuscripts. AP and AFR provided the latest study literature and prepared draft manuscripts. AP and AFR also served as correspondence authors.

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Job Satisfaction Model of Primary Health Care Midwives Based on Indonesian Workforce Research in the Health Sector

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Abstract

Promotive, preventive, curative, and rehabilitative efforts that are comprehensive, integrated, and sustainable are employed to enhance the health state of the global population. Within this context, however, the quality of primary health care depends on job satisfaction, which leads to the happiness of human resources in the health sector. This study aimed to analyze and formulate a job satisfaction model among primary health care midwives in Indonesia. This study was an advanced secondary data analysis of a cross-sectional study conducted in 2017 by the National Institute of Health Research and Development, Ministry of Health of the Republic of Indonesia. A total of 87,341 midwives from all 9,669 primary health cares in Indonesia participated in this study. Data were collected by distributing the Minnesota Satisfaction Questionnaire, elaborating on the satisfaction level and relevant contributing factors. The prefilled Likert scale questionnaire was analyzed using logistic regression. The findings suggested a model indicating that motivation, work area (region), history of salary delay, and training received were important for their job satisfaction, whereas the motivation aspect contributed the most. Therefore, the local and central governments must consider these factors in the human resource policymaking process.

Keywords: Indonesia, job satisfaction, midwives, motivation

Introduction

The efforts to improve the global health status are carried out by integrating health activities for the entire community and including the broader community in comprehensive, integrated, sustainable, preventative, curative, rehabilitative, and promotive efforts.[1] Therefore, Indonesia has established six pillars of health transformation per Minister of Health Regulation No. 15 of 2022 to execute the Ministry of Health's vision of developing healthy, productive, independent, and fairly distributed human beings.[2] The six pillars include transformations in primary health care (PHC), referral health care, health resilience, health financing, human resources for health (HRH), and health technology. The PHC should be the foundation of Indonesian health because it is the closest to the community, providing affordable access to primary care based on practical, scientific, and globally acknowledged principles. Therefore, the implementation of PHC is essential for achieving a better health status. One method for enhancing the performance of PHC services is to focus more on the job satisfaction of the PHC's human resources.

Currently, various employment status categories for nongovernment HRH, such as provincial and district/city contract HRH, regional public service agency HRH, health operational assistance HRH, nonpermanent HRH, and volunteers working on public health facilities belonging to the regional government (provincial/district/city), are utilized to meet the demand for health services in the regions. These job categories must be readjusted to comply with Law No. 5 of 2014 Concerning State Civil Administration.[3] Government Regulation No. 49 of 2018 Concerning the Management of Civil Servantss with Employment Agreements also necessitates changing HRH's employment status.[4] These regulations have led to the widespread use of contract HRH rather than permanent employees, notwithstanding the correlation between employment status and job satisfaction.[5,6] Thus, this demands a more systematic effort to increase the job satisfaction of PHC workers.

The high maternal mortality rate (MMR) in Indonesia, which has risen from 4,627 deaths in 2020 to 7,390 in 2021, requires great attention on PHC services, specifically maternal and child health (MCH) services in

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which midwives take the leading role.[2] The MCH service performance can be improved if the midwives, as the main health providers, can perform well; thus, job satisfaction is an important factor. Furthermore, it is well-known that job satisfaction impacts the employee's physical and mental status.[7] Job satisfaction can vary from person to person, significantly affecting employee behavior and the satisfaction and loyalty of the organization's consumers.[8] In addition, it may influence the level of absenteeism, which ends up in the worker turnover rate.[8] Therefore, maintaining workers' job satisfaction is essential for the success of an institution, especially the services institution as health facilities.

Although this study cannot provide a descriptive picture of the current conditions of Indonesian PHC midwives, the massive total coverage data from 87,341 midwives in 9,669 PHC throughout Indonesia allowed this study to develop a more accurate analysis of midwives' job satisfaction as part of the aforementioned health transformation pillars. Consequently, this study's findings will contribute to optimizing the first pillar (performance of PHC services). On the one hand, the PHC's management can enhance the working conditions to meet the midwives' expectations. On the other hand, the local and central governments can harness the results to evaluate and formulate strategic interventions aiming to address health workforce issues in Indonesia. The model could be implemented in different healthcare facilities, including hospitals and clinics. Globally, this approach could be used to determine interventions regarding midwives' job satisfaction in other countries..

Method

Undertaking an advanced analysis of the first Indonesian Workforce Research in the Health Sector/*Riset Ketenagaan di Bidang Kesehatan* (Risnakes) hosted by the National Institute of Health Research and Development (NIHRD), Ministry of Health of the Republic of Indonesia, this study, was the first study conducted in Indonesia to collect data from all HRH in PHC, public hospitals, and private hospitals. A total of 249,985 individuals participated in this study, representing 14 HRH professions in Indonesia, including midwives. The report by the Indonesian Workforce Research in the Health Sector provided a descriptive analysis of all HRH types, which mainly focused on the percentage of their distribution all over Indonesia. The midwives were the second largest participants after nurses; unlike doctors or pharmacists, they were available in almost all health centers and played prominent roles in MCH as well as performed multitasking jobs in the facilities.[9]

Since the NIHRD was transformed into a policy institution in 2022, Indonesian Workforce Research in the Health Sector may have been the last to collect such extensive total coverage data. The collected data include input (workforce regulations in the health sector: types, qualifications, and the number of workers in the health sector in health service institutions and facilities: public and private hospitals and public health centers), process (workforce management in the health sector: planning, procurement, and utilization), and output (job satisfaction, motivation, retention, and responsiveness).[9]

This study was an advanced data analysis of Indonesian Workforce Research in the Health Sector, a cross-sectional study conducted by the NIHRD. In the middle of 2017, the entire coverage data of 87,341 midwives from all 9,669 PHC centers in Indonesia were collected. Despite its inability to portray the current situation, this study provided a model of job satisfaction in Indonesia. The data were requested from the head of NIHRD using a proposal supplied with ethical approval. The Data Management Laboratory of NIHRD, in charge of data handling and management, prepared the raw data and sent the data set via e-mail.

The dependent variable in this study was job satisfaction, which was elaborated through the following independent variables: sociodemographic characteristics, work-related factors, and motivation. Sociodemographic characteristics include marital status (single or married and living with their spouse), education (diploma III or minimum diploma III), region (I, II, and III based on the Ministry of National Planning and Development categorization), and age, which was defined using mean as the cutoff point. Work-related factors included work experience, years of work in current PHC, extra income generated outside job, and travel time to PHC, which are defined using mean as the cutoff; while, the history of salary delay, training, further education received, and type of PHC (with or without admission service) were other work-related factors. The motivation was also defined using the mean as the cutoff point.

Since motivation and job satisfaction were latent variables that could not be measured with a single question, this study employed a variety of constructs. Although there was no statistical validity or reliability test result, both instruments were translated and back-translated into the Indonesian language before being evaluated for readability by health professionals from NIHRD and an expert panel. In this study, motivation was assessed using a 23-item questionnaire developed by Mutale, *et al.*[10] The self-administered instrument used a Likert scale ranging from strongly disagree (1) to strongly agree (5), with a range of 23 to 115 for the overall motivation score.

Job satisfaction was measured using the self-administered Minnesota Satisfaction Questionnaire (MSQ) short form with 20 items on a Likert scale ranging from strongly dissatisfied (1) to strongly satisfied (5).[11] The two di-

mensions of the MSQ short form were intrinsic and extrinsic satisfaction. Intrinsic satisfaction comprised 12 items: activity, independence, variety, social standing, moral values, security, social service, authority, ability usage, responsibility, creativity, and achievement. The six components of extrinsic satisfaction were human relations supervision, technical supervision, firm rules and procedures, salary, progression, and recognition. While, the other two remaining items (working circumstances and coworkers) were included solely in computing the overall job satisfaction scores.

Motivation and job satisfaction scores were classified using the mean score as the cutoff. Using the free version of SPSS IBM 24.0, validity and reliability test were used to evaluate the instruments' quality. The Pearson product-moment correlation was used to test the validity of motivation and job satisfaction instruments. The r values of the items on the motivation instrument ranged from 0.048 to 0.575 (r_{table} = 0.006, p-value<0.005), whereas the r values of the items on the work satisfaction questionnaire ranged from 0.367 to 0.643 (r_{table} = 0.006, p-value<0.005). These values showed that the instruments were valid. While, the reliability coefficients were 0.81 for intrinsic satisfaction and 0.78 for external satisfaction, while the overall satisfaction was 0.88. The r values and coefficients proved that the instruments were both valid and reliable (Table 1).

Motivation and job satisfaction were defined based on the mean value of 83.18 and 70.14, respectively. Those below the mean value were considered low moti-

Table 1. Dimension and Reliability of the Job Satisfaction Instrument

Dimension of Satisfaction	Number of Item	Dimension		Coefficients Reliability	%
		Mean	SD		
Intrinsic satisfaction	12	42.64	4.83	0.81	53.9
Extrinsic satisfaction	6	20.23	3.53	0.78	50.7
Overall satisfaction	20	70.15	8.24	0.88	51.6

Note: SD = Standard Deviation

Table 2. Indonesian Primary Health Care Midwives' Characteristics (n = 87,341)

Variable	Category	n	%
Age (mean = 33.40)	<33 years (below mean)	51,371	58.8
	≥33 years	35,970	41.2
Marital status	Single	20,139	23.1
	Married and living with a spouse	67,202	76.9
Education	<Diploma III	3,590	4.1
	≥Diploma III	83,751	95.9
Region	Region I: Sumatra, Java, and Bali	62,947	72.1
	Region II: Kalimantan, Sulawesi, and West Nusa Tenggara	17,987	20.6
	Region III: East Nusa Tenggara, Maluku, North Maluku, Papua, and West Papua	6,407	7.3
Work experience (mean = 11.20)	<11 years (below mean)	54,918	62.9
	≥11 years	32,423	37.1
Years of working at the current PHC (mean = 8.20)	<8 years (below mean)	56,470	64.7
	≥8 years	30,871	35.3
History of salary delay	Yes	19,064	21.8
	No	68,277	78.2
Training received	No	46,514	53.3
	Yes	40,827	46.7
Further education received*	No	80,110	91.7
	Yes	7,231	8.3
Extra income generated outside job	≥3	695	0.8
	<3	86,646	99.2
Type of PHC	PHC with admission service	35,527	40.7
	PHC without admission service	51,814	59.3
Travel time to PHC	>27 minutes	64,718	74.1
	≥27 minutes	22,623	25.9
Work motivation	Low	46,512	53.3
	High	40,829	46.7
Job satisfaction	Dissatisfied	42,292	48.4
	Satisfied	45,049	51.6

Notes: PHC = Primary Health Care
*Opportunities to continue to a formal higher education level, either paid by the institution or out of pocket

vated and dissatisfied. The relationship between sociodemographic variables, work-related variables, motivation, and job satisfaction was analyzed using the Chi-square test. Finally, the model was generated using logistic regression analysis. The results of these bivariate analyses are displayed in Table 3, while the model is presented as an equation.

Results

About 60% of Indonesian PHC midwives were over 33 years of age, had fewer than 11 years of work experience, and had worked at PHC for less than eight years. More than 70% were employed in Region I (Sumatra, Java, and Bali). Almost all midwives needed more than 27 minutes to go from home to the workplace. Nearly 80% of midwives were married, lived with their spouses, and had no history of salary delays. Nearly half of them had their skills upgraded through the training yet lacked motivation (Table 2).

Over 90% of midwives had completed at least a Diploma III education, and a portion of this proportion had even completed a doctorate. The rest were still pursuing their diploma education as the requirement for midwives' certification in Indonesia. At the time of this research (2017), they were still called assistant health workers. More than 90% of midwives had fewer than three outside sources of income and had never received additional training from the PHC/government (Table 2).

The region, years of work in current PHC, history of salary delay, training received, further education received, and work motivation were significantly related to midwives' job satisfaction (Table 3). The sociodemographic factor associated with job satisfaction was region (p-value<0.001), while the significant work-related factor was training (p-value<0.001). Motivation emerged as the most significant factor, with a p-value of <0.001. Highly-motivated midwives were 3.206 times more likely to be satisfied with their jobs at the current PHC. In contrast, those who had the opportunity to develop their skills through training were 1.054 times more likely to be satisfied with their jobs. Current PHC midwives in Regions II and III were often more satisfied with their jobs. According to the final logistic regression model, the factors influencing Indonesian PHC midwives were region, history of salary delay, training received, and motivation. These factors explained the difference in job sat-

Table 3. Association of Demographic and Work-Related Factors with Job Satisfaction among Indonesian Primary Health Care Midwives (n = 87,341)

Variable	Category	Job Satisfaction				p-value
		Dissatisfied		Satisfied		
		n	%	n	%	
Age	<33 years (below mean)	24,907	48.5	26,464	51.5	0.662
	≥33 years	17,385	48.3	18,585	51.7	
Marital status	Single	9,596	47.9	10,483	52.1	0.126
	Married and living with a spouse	32,636	48.6	34,566	51.4	
Education	<Diploma III	1,692	47.1	1,898	52.9	0.118
	≥Diploma III	40,600	48.5	43,151	51.5	
Region	Region I: Sumatra, Java, and Bali	31,757	50.5	31,190	49.5	<0.001
	Region II: Kalimantan, Sulawesi, and West Nusa Tenggara	7,956	44.2	10,031	55.8	
	Region III: East Nusa Tenggara, Maluku, North Maluku, Papua, and West Papua	2,579	40.3	3,828	59.7	
Work experience	<11 years (below mean)	26,647	48.5	28,721	51.5	0.447
	≥11 years	15,645	48.3	1,778	51.7	
Years of working at the current PHC	<8 years (below mean)	27,461	48.6	29,009	51.4	0.098
	≥8 years	14,831	48.0	16,040	52.0	
History of salary delay	Yes	9,347	49.0	9,717	51.0	0.059
	No	32,945	48.3	35,332	51.7	
Training received	No	22,906	49.2	23,608	50.8	<0.001
	Yes	19,384	47.5	21,441	52.5	
Further education received**	No	38,868	48.5	41,242	51.5	0.059
	Yes	3,424	47.4	3,807	52.6	
Extra income generated outside job	≥3	41,956	48.5	44,690	51.5	0.998
	<3	336	48.3	359	51.7	
Type of PHC	PHC with admission service	17,152	48.3	18,375	51.7	0.488
	PHC without admission service	25,140	48.5	26,674	51.5	
Travel time to PHC	>27 minutes	22,602	48.7	11,595	51.3	0.259
	≤27 minutes	19,690	48.3	33,454	51.7	
Work motivation	Low	28,736	61.8	17,776	38.2	<0.001
	High	13,556	33.2	27,273	66.8	

Notes: PHC = Primary Health Care.
*Significant at 95% CI, **Opportunities to continue to a formal higher education level, either paid by the institution or out of pocket.

Table 4. Final Model of Indonesian Primary Health Care Midwives' Job Satisfaction (n = 87,341)

Variable	Category	Satisfied with Their Job	
		OR	95% CI
Region	Region I: Sumatra, Java, and Bali		1
	Others	1.230	3.118–3.297
History of salary delay	Yes		1
	No	1.089	1.051–1.128
Training received	No		1
	Yes	1.054	1.024–1.084
Work motivation	Low		1
	High	3.206	3.118–3.297

Notes: OR = Odd Ratio, CI = Confidence Interval

isfaction of Indonesian PHC midwives as high as 10.8%. Motivation was the primary contributing factor to job satisfaction among Indonesian PHC midwives (Table 4).

Before the regression was carried out, all independent variables listed in Table 2 were screened. As all of them had a p-value of >0.25, they were included in the initial model. Furthermore, the 13 variables were included in the logistic regression, and variables with a significance level of >0.10 were excluded from the model one by one. Therefore, the formulated final model is: Logit (dissatisfied) = -0.623 + 1.165*work motivation (low) + 0.207*region (1) + 0.052*training (no) + 0.86*history of salary delay (yes). The model was proven to be significant (p-value<0.001).

Discussion

This study's findings indicated that the sociodemographic characteristics, except work area (region), were not substantially connected with the job satisfaction of Indonesian PHC midwives. The findings were consistent with a comprehensive review of critical care nurses, which found no indication of a relationship between individual (sociodemographic) characteristics and critical care nurses' job satisfaction.[12] This comprehensive review also indicated that age, sex, and education were unrelated to work satisfaction.[13] A longitudinal study in the United States also revealed that tenure (work period/experience) does not correlate with job satisfaction.[14]

According to prior studies, demographic characteristics are considered to influence job satisfaction.[8,15-17] Sex is one of the demographic factors associated with job satisfaction.[5,6,8] However, sex has no significant effect on veterinarians' job satisfaction.[18] This study did not examine the association between sex and job satisfaction. One significantly related to job satisfaction is work tenure (work period). Employees become less satisfied as their tenure within a given organization increases.[14,17] Age also contributes to nurses' job satisfaction, but it is insignificant for veterinarians.[15,18] Marriage length may reduce job satisfaction, but the marital status does not appear to correspond much with job satisfaction.[16,18]

A contrasting result of this study was that there was no association between age and job satisfaction. The previous study demonstrated that chronological age/biological age was distinct from subjective age.[19] A previous study in Uganda also stated that age is not really important in explaining variations in individual job satisfaction.[12] Subjective age causes individuals to feel either younger or older than their biological age. The dynamic aspect of the aging process is not captured by chronological age, which exhibits relatively modest correlations with major work outcomes. Yet, some scientists have developed an "age construct" that can be reliably assessed and even modified, thus establishing a new field of organizational interventions.[19]

In this study, the work area also affected job satisfaction. Indonesia is split into three development regions according to the Minister of National Development Planning Regulation No. 14 of 2020: Region I (Sumatra, Java, and Bali), Region II (Kalimantan, Sulawesi, and West Nusa Tenggara), and Region III (East Nusa Tenggara, Maluku, North Maluku, Papua, and West Papua).[20] The divisions are based on demographic, sociological, or economic similarities between islands within a region. Geographically, each region is distinctive. For instance, the mountainous terrain of Region III may present distinct difficulties to local midwives. The less rugged terrain in Region I may have made it easier for midwives to perform their daily duties. Access to the workplace proves it, and its relation to geographical situation attributes job satisfaction as well as retention.[21]

Other contributors to employee satisfaction include position, origin, number of children, education, living distance, and working hours.[8,15,16,18,22] Professional development, pay raises, and incentives are variables which connect with job satisfaction and serve as indicators.[23] Financial and nonfinancial incentives are related to the job satisfaction of hospital HRH in South Sulawesi

Province, according to a study employing the same data from the 2017 Indonesian Workforce Research in the Health Sector for provincial levels.[24]

This study also revealed that motivation, region, history of salary delay, and training received were substantially related to job satisfaction, with motivation as the main predicting factor. In keeping with the findings of an Indonesian Regional Water Utility Company/*Perusahaan Daerah Air Minum* (PDAM), the significance level of the relationship between work motivation and job satisfaction was less than 0.001.[25] The score from that study was less than 0.05, indicating a direct relationship between work motivation and job satisfaction.[25] A study in Iraq indicated that incentives as a kind of motivation had a considerable beneficial effect on job satisfaction at the 5% level.[26] Thus, it demonstrated that motivated workers tend to accept all aspects of their work lives that make them more psychologically pleased, which leads to happiness.[27] Prior to this, Herzberg asserted that job satisfaction resulted from the presence of intrinsic motivators.[28]

This study denoted that the timely-paid salary and nonfinancial incentives, such as refreshment training, were substantial in maintaining job satisfaction. Payment delays caused a lack of resources to procure primary needs. Nevertheless, the salary was the only earning for most midwives. The training was also important in improving their competencies. Thus, it would escalate job satisfaction. According to a previous study, compensation and benefits accounted for around 68% of the entire variance in job satisfaction.[29]

Since this study harnessed the 2017 data, which might be irrelevant to the changes that occurred, the current conditions might not be well depicted. However, the use of total coverage big data in this study was a supporting factor in developing the midwives' job satisfaction model. The model might also be applicable to midwives working in different types of health facilities (hospitals or clinics) in Indonesia or other countries with similar conditions. The model implies better alternatives of intervention to be applied, which in turn positively improve MCH services.

Motivated employees tend to accept all work-related circumstances, resulting in psychological contentment. This situation subsequently leads to improved psychological well-being, sometimes referred to as happiness.[27] Herzberg maintains that job satisfaction results from intrinsic factors known as "intrinsic motivators."[28] The intrinsic aspects comprise speech/achievement, acknowledgment, responsibility, advancement, work, and self-development possibilities. The absence of these intrinsic factors does not mean that the condition is particularly unpleasant.

On the one hand, if these characteristics are present, motivation will be enhanced, resulting in superior work performance. Consequently, these intrinsic factors are frequently referred to as "satisfiers" or "motivators."[28] On the other hand, the absence of external factors causes job dissatisfaction. Extrinsic factors or "hygiene factors" in the context of work include wages, working conditions, job security (no fear of being fired), employment status (contract or permanent), workplace procedures, quality of supervision, and interpersonal relationships with coworkers, superiors, and subordinates. The presence of these things does not necessarily encourage employees. However, its absence can result in employee dissatisfaction.[28] In other words, motivation can lead to job satisfaction and happiness.[6,28,30,31]

Even though there are some differences in the results, this study reinforced the results of previous studies,[21,24-26] which prove that working location (region), training received, history of salary delays, and work motivation have a positive impact on midwives' job satisfaction. Analyzing data from 9,699 PHCs throughout Indonesia with nearly 90,000 midwives, the result of this study was the only available huge amount of human resource data. Although the data were obtained from the 2017 study, formulation of the contributing variables and its final model of job satisfaction can be a reference, especially for the government, to design strategic interventions not only for midwives, but also for other types of human resources in various health facilities. In some categories, the data were not normally distributed, such as the ratio of human resources among regions, which was a limitation of this study. Other than that, the variations of additional income are not suitable for midwives and have not been elaborated thoroughly. Future studies are recommended to utilize satisfaction questionnaires adapted to the Indonesian context.

Conclusion

Job satisfication of Indonesian PHC midwives are affected by motivation, work area (region), history of salary delays, and training received. Highly motivated midwives are three times more likely to be satisfied with their jobs under the current PHC system. The model indicates that working motivation, work area, training, and history of salary delay contributed to job satisfaction. Considering the importance of motivation, several activities to enhance its levels are recommended, including group training and personal motivational sessions by the management. On a larger scale, the government should address the gaps in job satisfaction among regions by providing incentives for remote-working midwives while maintaining timely-paid salaries. In addition, participating in training rewards midwives, which can add to their job satisfaction.

Abbreviations

PHC: Primary Health Care; HRH: Human Resources on Health; MMR: Maternal Mortality Rate; MCH: Mother and Child Health; Risnakes: *Riset Ketenagaan di Bidang Kesehatan*; NIHRD: National Institute of Health Research and Development; MSQ: Minnesota Satisfaction Questionnaire; SD: Standard Deviation; CI: Confidence Interval.

Ethics Approval and Consent to Participate

The 2017 Indonesian Workforce Research in the Health Sector/*Riset Ketenagaan di Bidang Kesehatan* (Risnakes) ethical clearance was obtained from the Health Research Ethics Commission of the National Institute of Health Research and Development, Ministry of Health of the Republic of Indonesia, No. LB.02.01/2/KE.130/2017, dated on April 5, 2017. Ethical clearance for secondary data analysis was obtained from the Research and Community Engagement Ethical Committee, Faculty of Public Health, Universitas Indonesia No. Ket-686/UN2.F10.D11/PPM.00.02/2020. Before completing the questionnaire, the respondents received informed consent to participate in the study. The authors read the informed consent form aloud and offered by health professionals the opportunity to ask questions. After comprehension and agreement, the participants signed an informed consent form. Forms of informed consent were submitted and archived at the National Institute of Health Research and Development headquarters.

Competing Interest

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

Availability of Data and Materials

Data were obtained from the National Institute of Health Research and Development and stated to be confidential.

Authors' Contribution

MD conceptualized, interpreted the data, and prepared the initial draft. AB, HH, B, and YY reviewed the draft internally and completed the manuscript.

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The Determinants of Stunting in the Under-five in Three Municipalities in the Special Capital Region of Jakarta

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Abstract

The COVID-19 pandemic has impacted the global decline in public health status. This study aimed to analyze the determinants of stunting in the under-five in three municipalities in the Special Capital Region of Jakarta, Indonesia. A cross-sectional study was conducted in August-December 2020 with 460 pairs of mothers and children selected by simple random sampling. Stunting was measured using a conventional anthropometric index (length/height-for-age), and anthropometric failure was measured using the Composite Index of Anthropometric Failure. The prevalence of stunting, underweight, and wasting was 41.5%, 35%, and 19.8%, respectively, and 62% of the under-five experienced anthropometric failure. The dominant factor associated with stunting was immunization record (p-value = 0.011; AOR = 2.360; 95% CI = 1.218–4.573). Children who did not receive complete basic immunization were at a 2.4 times greater risk of stunting than children who received complete basic immunization. The dominant factors associated with underweight, wasting, and anthropometric failure were the father's educational level, mother's occupation, and balanced nutrition practice. Increasing coverage of complete basic immunization, improving balanced nutrition practices and socioeconomic conditions is necessary to prevent undernutrition, especially stunting.

Keywords: balanced nutrition practice, under-five, stunting

Introduction

Stunting is a risk factor contributing to child mortality and marks inequality in human development. It also indicates growth and development failure among the under-five.[1,2] The prevalence of stunting has decreased in recent decades worldwide. However, the stunting rate is still high, with an estimated 21.3% of the under-five globally experiencing stunting in 2019.[3] A scientific study has shown that the stunting rate is still high and rate of decline in stunting rates differs in each country.[3]

A study conducted in Maharashtra, India, in 2020 reported that the prevalence of stunting was high (45.9%).[3] The main factors causing undernutrition in urban slum areas are stunting associated with sex and type of family, wasting caused by exclusive breastfeeding, and underweight caused by low family income.[4] A study in Bangladesh also showed that the rate of undernutrition is high in urban areas (45%).[4] Undernutrition occurs among children from low-income and low education level families and whose mothers have malnutrition.[5]

Stunting is also a public health problem in Indonesia. Based on the results of the 2021 Indonesian Nutritional Status Survey, the prevalence of different types of undernutrition: stunting, underweight, and wasting, is 16.8%, 13.7%, and 6.9%, respectively, in urban areas, which includes the Special Capital Region of Jakarta.[6] Widyaningsih, *et al.*, reported that the fifth wave of the Indonesian Family and Life Survey showed that the prevalence of stunting in the under-five is higher in urban (33.7%) than in rural areas (25.0%) and that this condition is associated with economic problems and household expenditures.[7] Geographic and socioeconomic disparities are also factors causing undernutrition.[8]

Therefore, efforts to identify the problem of stunting and other problems related to undernutrition are needed so that appropriate interventions can be carried out according to the type and causes of undernutrition. This study aimed to analyze the determinants of stunting in the under-five in three municipalities in the Special Capital Region of Jakarta, Indonesia. The stunting rate in this region could indicate the health problems in Indonesia, as this region is the center of development,

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especially in the public health sector. In addition, the Special Capital Region of Jakarta could represent the diversity of sociodemographic characteristics of the population of Indonesia. As a result, this study hoped to strengthen the scientific evidence on the determinants of stunting, which can be used as a basis for proper preventive interventions to reduce the prevalence of stunting in Indonesia and globally.

Method

A cross-sectional study was conducted in August-December 2020 in three municipalities in the Special Capital Region of Jakarta, Indonesia, and 460 pairs of mothers and the under-five participated in this study. This study was conducted during the COVID-19 pandemic, hence data collection was carried out during home visits and complied with the established health protocols. The study was conducted after obtaining permission from the health office in the study location. Participants were selected using simple random sampling from three municipalities with high stunting rates compared to other municipalities in this province based on the 2021 Indonesian Nutrition Status Survey: Central Jakarta (19.7%), North Jakarta (20.4%), and East Jakarta (13.4%).[6]

The number of participants was calculated using the one-sample test of proportions with a two-sided alternative hypothesis (Formula 1) using the following assumptions: 5% level of significance, 90% power, 32.16% stunted children in Indonesian urban areas (P_0) based on previous studies, and a Pa 25% smaller than P_0, with this figure referring to data on stunting in the Special Capital Region of Jakarta in 2020.[9] An additional 10% was added to the generated number in anticipation of participants dropping out during the study. Therefore, the calculated minimum sample size was 450 mother-child pairs.

The subdistricts selected for this study were in an area designated as a stunting locus by the Provincial Health Office.[6] Eligible mother-child pairs met the inclusion and exclusion criteria. The inclusion criteria were: 1) mothers at least aged 19 years having children aged 0-59 months, 2) mothers living for at least one year in the study location so that they had the characteristics and lifestyle of urban communities, and 3) babies born at term (37-42 weeks of gestation) and with no congenital disabilities identified since birth. The sample exclusion criteria were the under-five experiencing serious diseases, including cancer and COVID-19, which required the child to be isolated or provided intensive health care. The sample selection procedure is shown in Figure 1.

Data collection was carried out by enumerators who were graduates in public health nutrition and trained in data collection techniques and procedures. The validity and reliability tests for this questionnaire were carried out in a cohort of mothers with appropriate characteristics who lived in other subdistricts (excluding study locations), with as many as 10% of the total participants. Analysis was performed using Pearson product-moment correlation and item correlation–total correlation. The r count value was matched with the product moment r table (0.291) at a significance level of 5%. The corrected item-total correlation for each question was between 0.715 and 0.742 (r count value greater than r table), and Cronbach's alpha was 0.877.

The nutrition knowledge questionnaire consisted of 20 questions covering four principles of balanced nutrition, stunting, and other undernutrition (score range of 0–20). Every correct answer was scored 1, and incorrect answers were scored of 0. The number of

$$n = \frac{\{Z_{1-\alpha/2}\sqrt{P_0(1-P_0)} + Z_{1-\beta}\sqrt{P_a(1-P_a)}\}^2}{(P_a - P_0)^2}$$

Formula 1. Sample Size Estimation

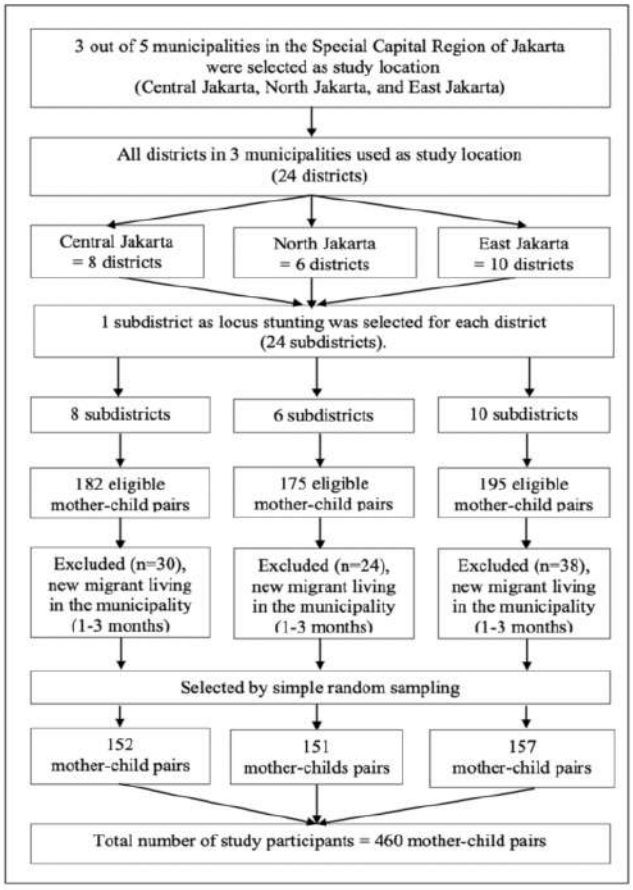

Figure 1. Participant Recruitment Procedures

correct answers was divided by the number of questions multiplied by 100% (number of correct answers/20*100%), so that the score range was 0–100. The scores were then categorized based on the mean value into 1) poor nutritional knowledge (score <70) and 2) good nutritional knowledge (score ≥70).

Parenting style in feeding included two dimensions: 1) demandingness (authoritarian parenting), which referred to the extent to which parents control their child's eating behavior, and 2) responsiveness (supportiveness parenting), or parents' provision of warmth, acceptance, and involvement in feeding. The Nutrition Parenting Questionnaire was adapted from a previous study.[8] It consisted of 24 questions using a 5-point Likert scale (never = 0, rarely = 1; sometimes = 2; often = 3; always = 4) with a total score range of 0–96. There were 17 questions to assess demandingness parenting and 7 to assess responsiveness parenting.

The scores on all questions were summed and categorized based on the median score (62) into 1) bad nutritional parenting (score <62) and 2) good nutritional parenting (score ≥62).[10] Balanced nutrition is a daily diet that contains nutrients of the type and in the amount required by the body. It was categorized into 1) less (practices two or fewer of the four principles of balanced nutrition practices), 2) quite good (practices three of the four principles), and 3) good (practices all four principles). Sanitation and hygiene measures included the availability of toilet facilities at home, clean water sources, and clean defecation habits. The questionnaire used was the 2018 Indonesian Basic Health Research questionnaire developed by the Ministry of Health of the Republic of Indonesia.[11]

Nutritional status was assessed using a conventional anthropometric index consisting of weight-for-age (WAZ), height/length-for-age (HAZ), and weight-for-height/length (WHZ). The composite index of anthropometric failure (CIAF) measures nutritional status by combining these three anthropometric indices (WAZ, HAZ, and WHZ).[12] The child's age was calculated in months using the date, month, and year of birth. The ages were categorized into 1) 0–24 months and 2) 25–59 months. Measurement of body length/height was performed twice using a seca digital length board or a stature meter with a level of accuracy of 0.1 cm. The two measurements were averaged; in all cases, the difference between the two measurements was no more than 0.2 cm. Body weight was measured using a seca digital infant scale or digital floor scale with an accuracy of 0.01 kg. Each child was weighed twice, with no more than 0.02 kg differences between the two measurements, and the results were averaged.

Data were analyzed using World Health Organization (WHO) Anthro software and categorized based on the z-score. The category of nutritional status based on the CIAF can be used to identify groups of children with normal nutritional status and six groups of children experiencing anthropometric failure (Table 1): 1) without anthropometric failure or normal (A); 2) wasting only (B); 3) wasting and underweight (C); 4) wasting, under-

Table 1. Category According Stunting and Other Undernutrition Status in the Under-five (n = 460)

Category		Aged 0–24 months	Aged 25–59 months	Male	Female	Total
		n (%)	n (%)	n (%)	n (%)	n (%)
Length/Height-for-age	Severely stunted (< -3 SD)	65 (28.8)	47 (20.1)	54 (24.8)	58 (24.0)	112 (24.3)
	Stunted (-3 SD to < -2 SD)	36 (15.9)	43 (18.4)	41 (18.8)	38 (15.7)	79 (17.2)
	Normal -2 SD to +3 SD	112 (49.6)	136 (58.1)	114 (52.3)	134 (55.4)	248 (53.9)
	Tall (> +3 SD)	13 (5.7)	8 (3.4)	9 (4.1)	12 (4.9)	21 (4.6)
Weight-for-age	Severely underweight (< -3 SD)	24 (10.6)	13 (5.6)	21 (9.6)	16 (6.6)	37 (8.0)
	Underweight (-3 SD to < -2 SD)	57 (25.2)	67 (28.6)	61 (28.0)	63 (26.0)	124 (27.0)
	Normal weight (-2 SD to +1 SD)	131 (58.0)	130 (55.6)	117 (53.7)	144 (59.5)	261 (56.7)
	Risk of overweight (> +1 SD)	14 (6.2)	24 (10.2)	19 (8.7)	19 (7.9)	38 (8.3)
Weight-for-length/height	Severely wasted (< -3 SD)	27 (12.0)	16 (6.8)	17 (7.8)	26 (10.7)	43 (9.3)
	Wasted (-3 SD to < -2 SD)	22 (9.7)	26 (11.1)	22 (10.1)	26 (10.7)	48 (10.4)
	Normal (-2 SD to +1 SD)	107 (47.3)	145 (62.0)	123 (56.4)	129 (53.3)	252 (54.9)
	Possible risk of overweight (> +1 SD to +2 SD)	29 (12.8)	24 (10.3)	26 (12.0)	27 (11.2)	53 (11.5)
	Overweight (> +2 SD to +3 SD)	14 (6.2)	11 (4.7)	11 (5.0)	14 (5.8)	25 (5.4)
	Obese (> +3 SD)	27 (12.0)	12 (5.1)	19 (8.7)	20 (8.3)	39 (8.5)
CIAF	Anthropometric failure (B+C+D+E+F+Y)	153 (67.7)	132 (56.4)	133 (61.0)	152 (62.8)	285 (62.0)
	Without anthropometric failure (A)	73 (32.3)	102 (43.6)	85 (39.0)	90 (37.2)	175 (38.0)
	Wasting only (B)	17 (7.5)	14 (6.0)	11 (5.0)	20 (8.3)	31 (6.7)
	Wasting & underweight	26 (11.5)	22 (9.4)	22 (10.1)	26 (10.7)	48 (10.4)
	Wasting, underweight, & stunting (D)	6 (2.7)	6 (2.6)	6 (2.8)	6 (2.5)	12 (2.6)
	Underweight & stunting	40 (17.7)	47 (20.0)	50 (22.9)	37 (15.3)	87 (19.0)
	Stunting only (F)	55 (24.3)	37 (15.8)	39 (17.9)	53 (21.9)	92 (20.0)
	Underweight only (Y)	9 (4.0)	6 (2.6)	5 (2.3)	10 (4.1)	15 (3.3)

Notes: SD = Standard deviation; CIAF = Composite Index of Anthropometric Failure

weight, and stunting (D); 5) underweight and stunting (E); 6) stunting only (F); and 7) underweight only (Y). To determine the total number of children who experienced anthropometric failure, the sum of the number of children in groups B, C, D, E, F, and Y was calculated.[12]

Three regional coordinators with a master's degree in public health covering the three studies and six data collectors or enumerators (two per region) who graduated from public health nutrition were assisted by cadres in each subdistrict to carry out direct measurements of mothers and the under-five through home visits. They were given training in measurement techniques and data collection for all the instruments used. Anthropometric measurement tools were calibrated, and the validity and reliability of the questionnaire were assessed before use. The study was conducted following the Declaration of Helsinki, a formal statement of ethical principles issued

Table 2. Characteristics of Mother, Child, and Sanitation and Hygiene According to Stunting and Other Undernutrition Conditions

Variable	Category	Total	Stunting	Underweight	Wasting	CIAF
		n (%)	n (%)	n (%)	n (%)	n (%)
Mother's age	<25 years	63 (13.7)	26 (14.0)	21 (13.5)	12 (13.5)	38 (13.7)
	25–35 years	263 (59.3)	115 (61.8)	96 (62.0)	53 (59.5)	169 (61.0)
	>35 years	124 (27.0)	45 (24.2)	38 (24.5)	24 (27.0)	70 (25.3)
Mother's education level	Uneducated	34 (7.4)	17 (8.9)	12 (7.5)	9 (9.9)	25 (8.8)
	Elementary-junior high school	130 (28.3)	59 (30.9)	54 (33.5)	30 (33.0)	85 (29.8)
	Senior high school	224 (48.7)	92 (48.2)	78 (48.4)	43 (47.2)	141 (49.5)
	Higher education	72 (15.6)	23 (12.0)	17 (10.6)	9 (9.9)	34 (11.9)
Mother's occupation	Housewife	369 (80.2)	152 (79.6)	136 (84.5)	82 (90.1)	233 (81.8)
	Working mother	91 (19.8)	39 (20.4)	25 (15.5)	9 (9.9)	52 (18.2)
Father's education level	Uneducated	16 (3.5)	3 (1.6)	4 (2.5)	4 (4.5)	7 (2.5)
	Elementary-junior high school	107 (23.2)	51 (27.2)	51 (32.5)	27 (30.7)	74 (26.5)
	Senior high school	275 (59.8)	114 (60.6)	93 (59.3)	53 (60.3)	174 (62.4)
	Higher education	62 (13.5)	20 (10.6)	9 (5.7)	4 (4.5)	24 (8.6)
Father's occupation	Unemployed	13 (2.8)	7 (3.7)	5 (3.1)	1 (1.1)	8 (2.8)
	Labor	97 (21.1)	31 (16.3)	35 (21.9)	27 (29.7)	58 (20.4)
	Other	350 (76.1)	152 (80.0)	120 (75.0)	63 (69.2)	218 (76.8)
Family income	<IDR 1,500,000 (<USD 105,152)	173 (37.6)	61 (36.3)	53 (38.1)	27 (34.2)	84 (33.9)
	≥IDR 1,500,000 (≥USD 105,152)	287 (62.4)	107 (63.7)	86 (61.9)	52 (65.8)	164 (66.1)
The number of children	>2	149 (32.4)	62 (33.0)	48 (30.8)	30 (34.1)	93 (33.3)
	≤2	311 (67.6)	126 (67.0)	108 (69.2)	58 (65.9)	186 (66.7)
Maternal and child health care	Never	8 (1.7)	0 (0.0)	1 (0.6)	1 (1.1)	1 (0.4)
	Midwife	317 (68.9)	146 (76.8)	124 (78.0)	69 (77.5)	216 (76.6)
	Doctor and others	135 (29.4)	44 (23.2)	34 (21.4)	19 (21.4)	65 (23.0)
Mother's nutrition knowledge	Bad (<70)	201 (43.7)	27 (14.1)	26 (16.1)	19 (20.9)	45 (15.8)
	Good (≥70)	259 (56.3)	164 (85.9)	135 (83.9)	72 (79.1)	240 (84.2)
Child's age	0–24 months	226 (49.1)	101 (52.9)	81 (50.3)	49 (53.8)	153 (53.7)
	24–59 months	234 (50.9)	90 (47.1)	80 (49.7)	42 (46.2)	132 (46.3)
Child's sex	Male	218 (47.4)	95 (49.7)	82 (50.9)	39 (42.9)	133 (46.7)
	Female	242 (52.6)	96 (50.3)	79 (49.1)	52 (57.1)	152 (53.3)
Child's birth weight	<2,500 gram	41 (8.9)	24 (12.6)	18 (11.2)	9 (9.9)	32 (11.2)
	≥2,500 gram	419 (91.1)	167 (87.4)	143 (88.8)	82 (90.1)	253 (88.8)
Child's immunization record	Not given	9 (2.0)	149 (78.0)	129 (80.6)	72 (81.8)	226 (80.4)
	Incomplete	74 (16.0)	42 (22.0)	31 (19.4)	15 (17.1)	54 (19.2)
	Complete	377 (82.0)	0 (0.0)	0 (0.0)	1 (1.1)	1 (0.4)
Early initiation of breastfeeding	No	79 (17.0)	30 (15.7)	31 (19.3)	18 (19.8)	51 (17.9)
	Yes	381 (83.0)	161 (84.3)	130 (80.7)	73 (80.2)	234 (82.1)
Early complementary feeding	<6 months	93 (20.2)	30 (16.8)	25 (16.2)	16 (18.6)	44 (16.4)
	≥6 months	367 (79.8)	149 (83.2)	129 (83.8)	70 (81.4)	224 (83.6)
Nutritional parenting	Bad	244 (53.0)	95 (49.7)	81 (50.3)	47 (51.6)	143 (50.2)
	Good	216 (47.0)	96 (50.3)	80 (49.7)	44 (48.4)	142 (49.8)
Balanced nutrition practice	Bad	302 (65.7)	111 (73.5)	90 (71.4)	55 (68.8)	161 (69.4)
	Pretty good	116 (25.2)	31 (20.5)	29 (23.0)	20 (25.0)	55 (23.7)
	Good	42 (9.1)	9 (6.0)	7 (5.6)	5 (6.2)	16 (6.9)
Toilet facility	No	15 (3.3)	8 (4.2)	10 (6.2)	4 (4.4)	12 (4.2)
	Yes	445 (96.7)	183 (95.8)	151 (93.8)	87 (95.6)	273 (95.8)
Defecation habit	Rivers and other	15 (3.3)	8 (4.2)	10 (6.2)	4 (4.4)	12 (4.2)
	Toilet	445 (96.7)	183 (95.8)	151 (93.8)	87 (95.6)	273 (95.8)
Drinking water source	Local government-owned water utility	195 (42.4)	91 (47.6)	77 (47.8)	39 (42.8)	130 (45.6)
	Branded bottled drinking water	134 (29.1)	50 (26.2)	42 (26.1)	21 (23.1)	76 (26.7)
	Refill drinking water	131 (28.5)	50 (26.2)	42 (26.1)	31 (34.1)	79 (27.7)

Notes: IDR = Indonesian Rupiah; CIAF = Composite Index of Anthropometric Failure

by the World Medical Association used as a guideline for health study to protect the human rights of study participants.

Results

Table 1 shows that among the 460 children, the prevalence of stunting was 41.5% (24.3% of children were severely stunted and 17.2% were stunted). The prevalences of underweight, wasting, and anthropometric failure were 35%, 19.8%, and 62%, respectively. The findings indicated that stunting and other undernutrition prevalences were higher in children aged 0–24 months than in children aged 25–59 months. Table 2 shows that most children suffering from stunting (61.8%), underweight (61.9%), wasting (59.6%), and anthropometric failure (61.0%) had mothers aged 25–34 years. Most of the stunted children (60.6%) had fathers whose highest level of education was senior high school. Participants generally had toilet facility and defecated in the latrine at home. Almost half of the stunted under-five (47.6%) consumed clean drinking water processed by the Local Government-owned Water Utility.

In Table 3, the significant (p-value <0.05) factors associated with stunting are shown to be family income, maternal and child health care, birth weight, immunization record, and balanced nutrition practice. Based on binary logistic regression analysis (Table 4), the dominant factor associated with stunting was immunization record (p-value = 0.011; AOR = 2.360; 95% CI = 1.218–4.573); thus, children who did not receive complete basic immunization were at an approximately 2.4 times higher risk of stunting than children who received complete basic immunization. The father's education level was the dominant factor associated with underweight (p-value = 0.026; AOR = 1.738; 95% CI = 1.068–2.828). Fathers with low levels of education were 1.7 times more likely to have underweight children than fathers with higher education.

The mother's occupation was the dominant factor

Table 3. Factors Associated with Stunting

Variable	Stunting		Underweight		Wasting		CIAF	
	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)
Mother's age	0.966	1.027 (0.705–1.495)	1.000	0.984 (0.667–1.453)	0.029	0.573 (0.356–0.924)*	0.633	0.895 (0.612–1.308)
Mother's education level	0.129	1.375 (0.934–2.023)	0.089	1.440 (0.968–2.141)	0.130	1.476 (0.92–2.357)	0.096	1.435 (0.961–2.144)
Mother's occupation	0.881	0.938 (0.590–1.492)	0.115	1.548 (0.932–2.568)	0.012	2.612 (1.258–5.425)*	0.334	1.294 (0.812–2.063)
Father's education level	0.242	1.319 (0.863–2.018)	0.001	2.077 (1.348–3.201)*	0.030	1.792 (1.086–2.954)*	0.045	1.625 (1.034–2.553)*
Father's occupation	0.116	2.525 (0.728–8.749)	0.329	1.570 (0.472–5.226)	0.323	0.397 (0.050–3.139)	0.343	1.652 (0.432–6.313)
Family income	0.008	1.832 (1.187–2.830)*	0.005	1.936 (1.243–3.014)*	0.317	1.356 (0.802–2.291)	0.009	1.909 (1.198–3.041)*
The number of children	0.441	0.835 (0.557–1.251)	1.000	0.998 (0.655–1.520)	0.527	0.825(0.503–1.354)	0.155	0.72 (0.472–1.098)
Maternal and child health care	0.009	1.785 (1.171–2.722)*	0.009	1.854 (1.187–2.895)*	0.109	1.614 (0.936–2.781)	0.000	2.268 (1.504–3.421)*
Nutritional knowledge	1.000	1.032 (0.605–1.762)	0.381	1.323 (0.771–2.271)	0.048	1.900 (1.049–3.441)*	0.179	1.539 (0.868–2.730)
Child's age	0.207	1.293 (0.892–1.875)	0.784	1.075 (0.733–1.578)	0.375	1.266 (0.799–2.005)	0.017	1.62 (1.107–2.369)*
Child's sex	0.450	1.175 (0.810–1.703)	0.309	1.244 (0.848–1.826)	0.395	0.796 (0.501–1.264)	0.763	0.926 (0.636–1.351)
Child's birth weight	0.032	2.130 (1.111–4.086)*	0.280	1.510 (0.789–2.891)	0.873	1.156 (0.531–2.516)	0.040	2.333 (1.086–5.013)*
Child's immunization history	0.016	1.890 (1.150–3.107)*	0.336	1.324 (0.800–2.193)	0.815	1.130 (0.615–2.076)	0.057	1.750 (1.016–3.013)
Early initiation of breastfeeding	0.622	0.854 (0.518–1.407)	0.413	1.273 (0.772–2.101)	0.526	1.266 (0.705–2.273)	0.596	1.187 (0.713–1.976)
Early complementary feeding	0.181	1.514 (0.872–2.627)	0.355	1.357 (0.776–2.373)	0.210	1.579 (0.841–2.965)	0.064	1.873 (1.005–3.490)
Parenting style in feeding	0.270	0.797 (0.550–1.156)	0.445	0.845 (0.576–1.240)	0.857	0.933 (0.589–1.476)	0.140	0.738 (0.505–1.078)
Balanced nutrition practice	0.004	1.976 (1.263–3.093)*	0.059	1.601 (1.009–2.542)	0.440	1.276 (0.752–2.164)	0.015	1.742 (1.132–2.681)*
Toilet facilitiy	0.498	0.611 (0.218–1.715)	0.019	0.257 (0.086–0.765)*	0.343	0.668 (0.208–2.149)	0.114	0.397 (0.110–1.426)
Defecation habit	0.498	1.636 (0.583–4.591)	0.019	3.894 (1.308–11.597)*	0.726	1.496 (0.465–4.812)	0.114	2.520 (0.701–9.059)
Drinking water source	0.068	1.444 (0.992–2.101)	0.103	1.406 (0.955–2.070)	1.000	1.024 (0.644–1.628)	0.091	1.419 (0.966–2.086)

Notes: OR = Odd Ratio, CI = Confidence Interval, CIAF = Composite Index of Anthropometric Failure
*Statistically significant (p-value<0.05)

Table 4. Binary Logistic Regression Analysis of Factors Associated with Stunting and Other Undernutrition among the Under-five

Caracteristic		Variable	p-value	AOR	95% CI
CAI	Stunting	Immunization history	0.011	2.360	1.218–4.573
	Underweight	Father's education level	0.026	1.738	1.068–2.828
	Wasting	Mother's occupation	0.009	2.652	1.273–5.525
CIAF	Anthropometric failure	Balanced nutrition practices	0.033	2.319	1.069–5.033

Notes: AOR = Adjusted Odd Ratio, CI = Confidence Interval, CAI = Conventional Anthropometric Indices, CIAF = Composite Index of Anthropometric Failure

associated with wasting (p-value = 0.009; AOR = 2.652; 95% CI = 1.273–5.525). Children with working mothers had a 2.7 times higher risk of wasting than children with housewife mothers. The dominant factor associated with anthropometric failure was balanced nutrition practices (p-value = 0.033; AOR = 2.319; 95% CI = 1.069–5.033). Children of mothers who did not practice balanced nutrition for their children had a 2.3 times higher risk of experiencing anthropometric failure than children of mothers who practiced balanced nutrition.

Discussion

This study found that the rates of stunting, underweight, wasting, and anthropometric failure were in the very high category according to the cut-off values for public health significance set by the WHO (for stunting, underweight, and wasting, the values are 40%, 30%, and 15%, respectively).[3] In this study, the prevalence of stunting in children aged 0–24 months was higher than in children aged 25–59 months. The higher stunting rate in children aged 0–24 months was associated with a lack of balanced nutrition practice. Low food intake was also associated with a higher susceptibility to infectious diseases compared to children aged 25–59 months.[13] A study in India showed that the stunting rate in children under two was 38%.[14] In addition, a study by Wali, *et al.*,[15] reported that undernutrition was higher in children aged 0–23 months than in children aged 24–59 months. The high migration rate of the rural population to the Special Capital Region of Jakarta is associated with nutritional fulfillment, limited housing, poor environmental sanitation conditions, and strain on health services that are disproportionate to the population.[16] Furthermore, the implementation of balanced nutrition practices is not optimal; specifically, there is evidence of low food diversity, unbalanced food portions, and consumption of foods high in sugar, salt, and fat.[17]

This study also revealed that stunted children were more common in families with higher income levels. A higher family income was associated with the employment status of the mother and father. Working parents entrust their children to their closest family or caregivers while they are at work. A previous study also reported that working mothers in urban areas entrust their children to their closest family while they are at work; as a result, the practice of feeding children is not always carried out by the mother.[18]

The results of this study indicated that the stunting rate was higher among children with mothers with good nutritional knowledge than among mothers with poor nutritional knowledge. Even if mothers have good knowledge, mothers in urban areas generally have time constraints in providing healthy food, especially if they are working mothers.[12] However, in this study, fathers' nutritional knowledge was not analyzed because almost all of them worked full-time, making it difficult to fill out the questionnaire. In addition, the under-five with a birth weight of <2,500 grams were at greater risk of stunting than children with a birth weight of ≥2,500 grams. Babies with low birth weights tend to have a poor immune system compared to babies with normal birth weights. They can also experience growth retardation due to digestive tract disorders, which result in a deficiency of nutrient reserves in the body, thus increasing the risk of stunting.[19-21]

Almost all mothers in this study had sanitation facilities and a habit of defecating in their homes' latrines. However, based on the observations during home visits, most toilets were in an unacceptable condition and had poor sanitation. A study by Frimawaty,[16] in an urban area showed that poor environmental sanitation conditions, especially the lack of house ventilation, were a significant factor associated with pneumonia in the under-five. Furthermore, infectious diseases directly affect nutritional status. In addition, lack of thermal comforts such as lighting and room temperature, protective types of walls, and ceilings are also sanitary factors associated with an increased risk of infectious diseases of the respiratory tract.[12,22]

The dominant factor associated with stunting in this study was immunization record. The under-five who did not receive complete basic immunization were at a 2.4 times greater risk of experiencing stunting than the under-five who received complete basic immunization. In urban areas, stunting can be caused by infectious diseases associated with incomplete immunization and lack of practice of balanced nutrition.[23] Shinsugi, *et al.*, showed that incomplete immunization coverage is the dominant factor associated with stunting, as children who did not receive complete immunization were 1.5 times more likely to suffer from stunting than children who received complete immunization.[20] In addition, strong scientific evidence shows that providing immunizations and fulfilling nutritional intake, especially intake of animal proteins through consumption of milk, meat/fish, and eggs, can prevent stunting.[24] Animal protein plays a role in the formation of body cells and tissues, strengthens bones and muscles, as a source of energy, forms enzymes and hormones in the body, and contributes to the development of the immune system.[24]

The dominant factor associated with underweight was the father's education level. Vollmer, *et al.*,[25] reported the predicted prevalence of childhood underweight for all maternal and paternal educational attainment levels based on categorical exposure. They found that parental education is associated with changes in children's health, as higher education will lead to increased parental knowledge of health and changes in parental values, increased

household income, and adequate allocation of resources for children's health.[25] A similar study showed that children whose fathers completed secondary education were less likely to be underweight than those with uneducated and had no formal schooling fathers.[26] Father's education is associated with household income because of his role as the main breadwinner; in addition, he is often the decisionmaker regarding nutrition and health.[26]

This study also showed that the availability of toilet facilities at home was a protective factor against underweight. Availability of toilets is associated with environmental cleanliness, and the safe disposal of feces is especially important to prevent the emergence of diseases caused by bacteria that cause infectious diseases such as diarrhea, as well as the occurrence of pneumonia as a result of fecal contamination in the air.[12,16]

The dominant factor associated with wasting was the mother's occupation. Working mothers have less time to prepare healthy meals and accompany their children at mealtimes.[27,28] This study's findings also indicated that maternal age was a protective factor for wasting. A maternal age of 25-35 years is associated with optimal intrauterine growth, thereby preventing low birth weight. Under this age range, mothers have higher fertility rates, adequate physical conditions to get pregnant, be more stable psychological conditions, and have a lower risk of pregnancy complications; thus, the nutritional care pattern provided to children is improved, preventing them from experiencing wasting.[12]

This study also revealed that balanced nutrition practice was a dominant factor of anthropometric failure in children. A previous study reported that poorly balanced nutrition practices during the first 1,000 days of life have an important role in causing growth failure. Unbalanced nutrition practices, which include providing food that is inappropriate for a child's age, lack of food diversity, and low food intake, may cause stunting in the under-five.[29,30]

The strength of this study was identifying undernutrition in children caused by macronutrient deficiencies using a single anthropometric index and the CIAF, which could provide comprehensive information that could serve as a basis for determining appropriate interventions based on the type of undernutrition experienced by the under-five. While, the limitation was overnutrition was not identified as a serious health problem in the urban area under study. In addition, this study did not evaluate micronutrient deficiencies that could cause hidden hunger, which was also associated with undernutrition in the under-five experienced.

A bias that might have arisen in this study was measurement bias, which included 1) bias from measurement tools and enumerators and 2) recall bias, as mothers had to remember information from the past. The bias of measuring instruments could be overcome by using the right measuring tools and calibrating them or testing their validity and reliability before use. To prevent systematic bias, enumerators were provided training in anthropometric measurement techniques/procedures. Regarding recall bias, one component of the collected data that could be impacted by bias was balanced nutrition practice, as the information provided was not about actual behavior.

In addition, the COVID-19 pandemic has resulted in behavioral changes, especially food consumption patterns; therefore, participants had to recall their food before and during the COVID-19 pandemic. This bias was overcome by explaining to the participants the importance of filling out the information they knew, explaining, and accompanying the participants while they filled out the questionnaire. Participants were also given sufficient time to complete the questionnaire and carry it out in comfortable conditions. Future studies are expected to assess overnutrition. Studies on micronutrient deficiencies also need to be carried out to prevent hidden hunger. Hence, appropriate interventions can be implemented according to the type and causes of these nutritional problems. The problem of the triple burden of malnutrition then can be handled optimally.

Conclusion

This study demonstrates that the prevalence of stunting and other undernutrition is still high in urban areas in Indonesia. Immunization record is the dominant factor associated with stunting in the under-five. Those who do not receive complete immunization are at greater risk of experiencing stunting than those who receive complete immunization. Father's education level is the dominant factor associated with underweight, while mother's occupation is the dominant factor associated with wasting. Balanced nutrition practice is the dominant factor associated with anthropometric failure. Specific interventions, including improving feeding practices and immunizations to the under-five, need to be carried out synergistically to improve families' socioeconomic conditions and optimally prevent stunting and other malnutrition conditions.

Abbreviations

WAZ: Weight-for-Age; HAZ: Length/Height-for-Age; WHZ: Weight-for-Length/Height; CIAF: Composite Index of Anthropometric Failure; WHO: World Health Organization; SD: Standard Deviation; AOR: Adjusted Odds Ratio; CI: Confidence Interval.

Ethics Approval and Consent to Participate

This study was approved by the Health Research Ethics Commission, Faculty of Public Health, Universitas Muhammadiyah Jakarta, with approval number 10.152.B/KEPK-FKMUMJ/VI/2020.

Competing Interest

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

Availability of Data and Materials

The data supporting this study's findings are available on request from the author due to privacy/ethical restrictions. The data are not publicly available because they contain information that could compromise the privacy of research participants.

Authors' Contribution

Conceptualization: TAEP; data curation: TAEP, YCH; formal analysis: CNS, MFZ; data collection: HDJ, LHR; supervision: ADR; writing—original draft: TAEP; writing—review and editing: TAEP. All authors have reviewed and approved the manuscript.

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Developing a New Tool for Early Detection of the Nutritional and Health Risk Factors of Urban Workers' Productivity

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Abstract

Nutrition and health play vital roles in work productivity. This study aimed to develop a risk self-assessment tool called *Deteksi Dini Faktor Risiko Gizi dan Kesehatan* (DDR-GizKes) for early detection of the nutritional and health risk factors of urban workers' productivity. This study was conducted in two stages: 1) the development of the tool to determine the nutritional and health risk factors affected productivity based on literature reviews and scoring systems; and 2) the testing of validity and reliability. Finally, the tool contained 63 items, including 28 items on nutritional risk factors and 35 items on health risk factors. The validity of the tool was assessed using the content validity index (CVI): item-level CVI (I-CVI) and scale-level CVI (S-CVI) and face validity index (FVI), and its reliability was using Cronbach's alpha coefficient. Preliminary versions of this tool showed a high content validity (I-CVI = 1.00; S-CVI based on the average method = 1). The face validity index among urban workers was at least 0.90, and the overall Cronbach's alpha coefficient was 0.70. The tool developed is acceptable, but revisions are still needed, and sample sizes must be increased.

Keywords: health, nutrition, productivity, urban workers

Introduction

Increasing work productivity has become the most important goal for sustainable economic growth. Accordingly, there is a growing interest in what determines work productivity and how to increase it.[1] A previous study found that physical inactivity and unhealthy eating behaviors are responsible for the loss of productivity from two sources: absenteeism (due to illness or disability) and decreased productivity while working.[2] Furthermore, an unhealthy diet and a sedentary lifestyle are risk factors for the emergence of noncommunicable diseases (NCDs). These diseases are a crucial factor that may reduce worker's productivity.[3] In addition, many workers experience both overnutrition and undernutrition, impacting the workers' health and risk of work accidents and cardiovascular disease.[4]

Diet without considering nutritional adequacy can cause obesity, including central obesity, which is also a risk factor for the emergence of NCDs such as cardiovascular disease, type 2 diabetes mellitus, musculoskeletal disorders (especially osteoarthritis), and several types of cancer.[5] The coronavirus disease (COVID-19) pandemic has exacerbated NCDs. Furthermore, COVID-19 patients with NCDs are much more likely to develop a more severe illness than average patients and to die than patients without NCDs.[6]

The NCDs also negatively impact patients, caregivers, and the community in terms of the quality of life and economy.[7] Patients spend heaps of money on nursing and treatment. A systematic review has shown that the average total costs per year for a patient/household in low- and middle-income countries concerning chronic obstructive pulmonary disease, cardiovascular disease, cancer, and diabetes mellitus were USD 7,386.71, USD 6,055.99, USD 3,303.81, and USD 1,017.05, respectively.[8]

Currently, the most significant challenges that may increase the incidence of NCDs are urbanization, diet, work, and lifestyle.[9] Urban environments in low- and middle-income countries face a triple health burden of communicable diseases, NCDs, mental health problems, and injuries, which could be worse in the future and accelerate the increase in the incidence of overweight and obesity over the past few decades.[10] This increase has

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been triggered by rising urban incomes, and changes in consumption patterns wherein urban consumers consume more sugar, fat, oil, and processed foods.[11] In addition, urban environments are also associated with a sedentary lifestyle and fewer opportunities to practice physical exercise.[12]

The NCDs kill 41 million people yearly, equivalent to 74% of all deaths globally.[13] Each year, 17 million people die of NCDs before the age of 70 years; 86% of these premature deaths occur in low- and middle-income countries.[13] The NCDs may reduce workers' productivity,[3] because sickness or work absenteeism owing to illness hinders the achievement of workplace organizational goals. The workplace then experiences losses, impacting national economic conditions.[14] Conversely, workers' lifestyles may also trigger the emergence of NCDs. A previous study has reported a few NCD risk factors among working women,[15] including low physical activity, sedentary lifestyle, and poor dietary habits, such as skipping breakfast, frequent snacking, junk food consumption, and low intake of vegetables and fruits.[15]

Early detection of nutritional and health status conditions can identify the onset of diseases that impact workers' productivity. Furthermore, impacts and problems related to nutritional status and fatigue experienced by workers affect productivity in the short, medium, and long terms.[16] Existing studies in the literature are limited to cross-sectional studies of the relationship between nutritional and health factors and NCDs and workers' productivity.[9,17,18]

Deteksi Dini Faktor Risiko Gizi dan Kesehatan (DDR-GizKes) is a tool containing questions on the nutritional and health factors that affect urban workers' productivity. It was developed by three lecturers at STIKes Panti Rapih Yogyakarta based on previous findings for early detection of the nutritional and health risk factors of urban workers' productivity. The tool was based on the World Health Organization STEPwise approach to surveillance (STEPS).[19] In this study, the following nutritional factors were added to the tool: dietary diversity, food adequacy, variations in protein consumption, sugar consumption, and breakfast habits, in addition to a health factor—sleep duration at night. These factors, related to NCDs and workers' productivity, are excluded in the STEPS. This study also developed a scoring system to determine nutritional and health risk scores, which aimed to develop a risk self-assessment tool, named DDR-GizKes, for early detection of the nutritional and health risk factors of urban workers' productivity. Detection, screening, and treatment of NCDs are key components of the response to NCDs.[13] Therefore, this study is urgently needed and can be a preliminary study for future studies.

Method

This study used a cross-sectional survey design. The population was civil servants in the Yogyakarta City, particularly staff of service and district officials. Permanent workers aged ≥20 years who were not on a diet for certain diseases and not pregnant (for female workers) were included. A total of 220 staff participated in the reliability test of the tool. The sample size was calculated based on sample size tables for Cronbach's alpha test. The alpha coefficient was 0.05; power, 90.0% (nb); the number of items, 60; Cronbach's alpha coefficient in the null hypothesis (CA0), 0.50; and Cronbach's alpha coefficient in the alternative hypothesis (CA1), 0.65. Based on the table, the minimum sample size required was 170. A total of 220 participants were included and filled in the data completely. The face validity test was conducted before the reliability test. Of 20 educators at STIKes Panti Rapih Yogyakarta with different locations of residence (urban or rural), levels of education, and types of work were selected via purposive sampling for initial testing of the face validity to understand the items.

The sampling technique used was multistage random sampling consisting of random clusters and simple random sampling. Random cluster sampling was used to select service and district office clusters. Eight service offices (Tourism Office; Education, Youth, and Sports Office; Social, Workforce, and Transmigration Office; Library and Archives Office; Population and Civil Registry Office; Public Works, Housing, and Residential Area Office; Land Registry and Spatial Planning Office; and Fire Fighting and Rescue Office) and two district offices (Pakualaman and Gondomanan District Offices) in Yogyakarta City were selected for the sampling. Moreover, random sampling was considered based on a list of names of staff from each office. However, several offices could not furnish a list of staff; therefore, only those who met the inclusion criteria were included.

There were two main variables in this study: nutritional and health factors, which were measured by determining the sub-variables, indicators, and items. This study developed a tool for the early detection of the nutritional and health risk factors of urban workers' productivity. The tool was developed based on previous literature examining the relationship between nutritional and health factors and NCDs,[9,17] nutritional and health factors affecting productivity,[18] aspects of nutrition and health in urban areas,[11] and STEPS.[19] The tool contained items on nutritional and health risk factors. Each item was tested for its content validity, face validity, and reliability.

The sociodemographic characteristics of the participants evaluated in the reliability test included age (20–29, 30–39, 40–49, and ≥50 years); sex; education (did not complete elementary school, completed elementary school, completed junior high school, completed senior

high school, completed a diploma program, completed bachelor's program, completed master's program, and completed doctoral program); monthly income (IDR <2,000,000; 2,000,000–3,999,999; 4,000,000–5,999,999; 6,000,000–7,999,999; and ≥8,000,000); and marital status (married and single/divorced). A structured questionnaire was used to collect data on these sociodemographic characteristics.

The study was conducted in two stages. The first stage was developing the risk self-assessment tool and risk scores. The tool was developed based on existing studies, including those 1) identifying research variables; 2) dividing these variables into sub-variables/dimensions; 3) identifying indicators/aspects of each sub-variable; 4) formulating the descriptor of each indicator; 5) formulating each descriptor into question items; and 6) equipping the instrument with charging instructions and prefaces.[21-23] The items were developed based on existing indicators. Items on nutritional factors were developed based on previous findings, and items on health factors based on question items previously developed, such as physical activity and alcohol consumption.[19,24] The physical activity and alcohol consumption items were translated into the Indonesian language by the Language Unit at the Faculty of Education, Universitas Negeri Yogyakarta. The risk score was developed using the category of each indicator.

The DDR-GizKes consisted of items on nutritional factors (dietary diversity, food adequacy, variety of protein sources, amount of sugar consumption, frequency of high-sugar food or drink consumption, amount of salt consumption, frequency of high-salt food or drink consumption, frequency of breakfast, type of food for breakfast, amount of water consumption, abdominal circumference, waist circumference, hip circumference, and body mass index) and health factors (physical activity, smoking behavior, alcohol consumption, and sleep duration). The scoring system used was a three-level category (0, 5, and 10).[25] For the nutritional risk factors, a score of 0 with each indicator indicated a risk of undernutrition; 5, normal nutrition; and 10, a risk of overnutrition associated with NCDs. For the health risk factors, a score of 0 with each indicator indicated a low health status; 5, good health status; and 10, high health status related to NCDs.

The second stage was testing the validity and reliability of DDR-GizKes. Both content and face validities were assessed. Content validity generally refers to the validity estimated by testing the feasibility or relevancy of test contents through rational analysis by a competent panel or expert judgment.[26] The content validity was evaluated in six steps, as previously described.[22] First, a validity form was prepared to ensure that expert panel reviewers clearly understood the task assigned by the authors. Thereafter, each indicator was assigned to help experts assess the question items based on the indicator definition. Second, expert reviewers were selected. The expert panel must have included at least three reviewers, had experience of at least 10 years, and been experienced in conducting surveys and questionnaires and/or utilizing substantive materials.[23,27]

Third, the content validity was assigned by the expert reviewers. Typically, the content validity could be evaluated face-to-face or non-face-to-face with a panel of experts.[22] This study adopted both approaches. Two expert reviewers were met directly, and one was sent a review format. Fourth, the domain and item in question were reviewed. The expert reviewers were asked to critique the domain reviewed and its items before assigning a score to each item and providing a written comment to increase the item's relevance to the target domain. Fifth, each item was assigned a score, and sixth, the content validity index (CVI) was calculated. The face validity reflected the clarity and understandability of question items. Herein, the workers were asked to score from 1 (item not clear and not understandable) to 4 (item very clear and understandable) based on the clarity and comprehensibility of the items in DDR-GizKes.[28] Cronbach's alpha coefficient was used to assess reliability.

A univariate analysis was performed to evaluate the participant characteristics, which were described in frequencies and percentages. The content validity was assessed using the CVI which is the recommended and most commonly-used parameter for quantitatively calculating content validity.[26,28] Three expert reviewers rated each item on a Likert scale ranging from 1 (e.g., irrelevant or non-representative) to 4 (e.g., highly relevant or highly representative). Before the CVI was calculated, the relevance rating was re-encoded as 1 (relevance scale 3 or 4) or 0 (relevance scale 1 or 2). Items with a rating of 1 and 2 were considered invalid, while items with a rating of 3 and 4 were considered valid.[22,29] Two forms of the CVI were utilized: item-level CVI (I-CVI) and scale-level CVI (S-CVI). The S-CVI was calculated using the universal agreement (UA) among experts (S-CVI/UA) and the average CVI (S-CVI/Ave). An I-CVI of 0.78 and S-CVI/Ave of ≥0.90 indicated good content validity.[28]

The face validity index (FVI) assessed the completeness and clarity of each item. Before the FVI was calculated, the comprehension rating was re-encoded as 1 (comprehension scale 3 or 4) or 0 (comprehension scale 1 or 2). For the FVI, ratings of 3 and 4 were recategorized as 1 (clear and understandable) and ratings of 1 and 2 as 0 (unclear and understandable).[28] The formula used for calculating the FVI was FVI = (summation of FVI score)/(max score*number of raters).[29]

Internal consistency was measured to determine the reliability of the two variables of DDR-GizKes using Cronbach's alpha coefficient for the subscale and overall scale. Data from the 220 participants were entered into

the statistical analysis data software. Cronbach's alpha coefficients of ≤0.60 indicated low reliability and were considered unacceptable; 0.60–0.80 indicated moderate reliability and was considered acceptable; 0.80–1.00 indica-

Table 1. Sub-Variables, Risk Factors, Criteria, and Scoring of the Tool Items

Variable	Sub-variable	Indicator/risk Factor	Scoring Criterion	Score
Nutritional factor	Dietary diversity[31]	Poor dietary diversity	<4 types of food group/day	0
			≥4 types of food group/day	5
	Food adequacy[31]	Inadequate carbohydrate intake	<3 servings/day	0
			3–4 servings/day	5
			>4 servings/day	10
		Inadequate animal protein intake	<2 servings/day	0
			2–4 servings/day	5
			>4 servings/day	10
		Inadequate vegetable protein intake	<2 servings/day	0
			2–4 servings/day	5
			>4 servings/day	10
		Inadequate fruit intake	<3 servings/day	0
			≥3 servings/day	5
		Inadequate vegetable intake	<3 servings/day	0
			≥3 servings/day	5
	Variety of protein source[31]	Invariable consumption of protein-source foods	<3 different sources/day	0
			≥3 different sources/day	5
	Amount of sugar consumption[31]	Excess sugar consumption	≤4 tablespoons/50 g	5
			>4 tablespoons/50 g	10
	Frequency of high-sugar food or drink consumption	High frequency of consumption of high-sugar packaged foods or beverages	Always/often	10
			Sometimes, rarely, never	5
	Amount of salt consumption[31]	Excess salt consumption	≤1 teaspoon (2,000 mg)	5
			>1 teaspoon (2,000 mg)	10
	Frequency of high-salt food or drink consumption	High frequency of consumption of high-salt packaged foods or beverages	Always/often	10
			Sometimes, rarely, never	5
	Frequency of breakfast	Low frequency of breakfast	Always/often	5
			Sometimes, rarely, never	0
	Type of food for breakfast[31]	Poor dietary diversity for breakfast	<3 types of food group/day	0
			≥3 types of food group/day	5
	Amount of water consumption[31]	Less water consumption	<8 glasses	0
			≥8 glasses	5
	Abdominal circumference[32]	Abdominal circumference	Male >90 cm	10
			Male ≤90 cm	5
			Female >80 cm	10
			Female ≤80 cm	5
	Waist circumference[33]	Waist circumference	Male >94 cm	10
			Male ≤94 cm	5
			Female >80 cm	10
			Female ≤80 cm	5
	Hip circumference[33]	Hip circumference	Male >102 cm	10
			Male ≤102 cm	5
			Female >88 cm	10
			Female ≤88 cm	5
	Body mass index[31]	Body mass index	<18.5: underweight	0
			18.5–22.9: normal	5
			23.0–24.9: overweight	10
			≥25: obesity	10
Health factor	Physical activity at work[19]	Insufficient physical activity at work	Low physical activity	10
			Moderate physical activity	5
			High physical activity	0
	Physical activity for transport[19]	Insufficient physical activity for transport	Low physical activity	10
			Moderate physical activity	5
			High physical activity	0
	Physical activity during leisure time[19]	Insufficient physical activity during leisure time	Low physical activity	10
			Moderate physical activity	5
			High physical activity	0
	Smoking behavior	Duration and quantity of smoking	Light smoker (0–199 cigarettes)	5
			Moderate and heavy smokers (>200 cigarettes)	10
	Alcohol consumption[24]	Alcohol consumption	Low risk (score: 0–7)	5
			Increasing risk (score: 8–20)	10
	Sleep duration[34]	Short duration of sleep at night	<7 hours	0
			7–8 hours	5
			>8 hours	10

ted very good reliability.[30]

Results

Stage 1: Development of the Risk Self-Assessment Tool and Risk Scores

The tool was developed based on previous literature.[9,11,17-19] Ultimately, it contained 14 sub-variables and 18 indicators of nutritional risk factors and six sub-variables and six indicators of health risk factors. From these indicators, 63 items were obtained, including 28 items on nutritional risk factors and 35 items on health risk factors to develop early versions of DDR-GizKes (Table 1).

For the nutritional factors, the maximum score was 145, which was the combined score of each indicator. The normal value was calculated using the median value from the combined scores of all indicators. The categories of the nutritional risk factors were as follows: 0–72, risk of undernutrition; 73–90, normal nutrition; and 91–145, risk of overnutrition.

For the health factors, the maximum score was 40, which was the combined score of four indicators. Of the three indicators of physical activity, only one was considered according to the condition of the participants. The normal value was calculated using the median value from the combined scores of all indicators. The categories of the health risk factors were as follows: 0–19, low health status; 20–21, good health status; and 22–40, high health status related to NCDs.

Stage 2: Validity and Reliability Test

The content and face validities were assessed. The results of the CVI and FVI analysis are presented in Table 2. As shown in Table 2, both the I-CVI and S-CVI were 1. This finding indicated that this tool had excellent content validity because the I-CVI meets the criteria of a minimum I-CVI of 1 for three experts. While, the S-CVI/Ave and S-CVI/UA met a satisfaction level of more than 0.90. The inter-worker FVI was 0.9–1, and the average S-FVI was 0.99. The results indicated good FVI.

Finally, at the end of the content and face validity tests, this tool was prepared with 63 items for the next steps. For the reliability test, the abdominal circumference, waist circumference, hip circumference, and body

Table 2a. Content Validity and Face Validity of the Tool

Component		Item	Input	I-CVI among Experts (n = 3)	UA	I-FVI among Employees (n = 20)
Nutritional factor	Dietary diversity	G1		1	1	1
		G3		1	1	1
		G5		1	1	1
		G7		1	1	1
		G9		1	1	1
	Food adequacy	G2		1	1	1
		G4		1	1	1
		G6		1	1	1
		G8		1	1	1
		G10		1	1	1
	Variety of protein source	G11		1	1	1
		G12		1	1	1
		G13		1	1	1
		G14		1	1	1
		G15		1	1	1
	Amount of sugar consumption	G16		1	1	1
		G17		1	1	1
	Frequency of high-sugar food or drink consumption	G18		1	1	1
	Amount of salt consumption	G19		1	1	1
		G20		1	1	1
	Frequency of high-salt food or drink consumption	G21	Add "salty snacks"	1	1	1
	Frequency of breakfast	G22		1	1	1
	Type of food for breakfast	G23		1	1	1
	Amount of water consumption	G24		1	1	1
	Abdominal circumference	G25		1	1	1
	Waist circumference	G26		1	1	1
	Hip circumference	G27		1	1	1
	Body mass index	G28		1	1	1
			S-CVI/Ave	1		-
			S-CVI/UA		1	
			S-FVI-Ave			1

Notes: I-CVI = Item-level Content Validity Index, UA = Universal Agreement, I-FVI = Item-level Face Validity Index, S-CVI = Scale-level Content Validity Index, Ave = Average, S-CVI/Ave = Scale-level Content Validity Index based on the Average Method; S-CVI/UA = Scale-level Content Validity Index based on the Universal Agreement Method; S-FVI = Scale-level Face Validity Index.

Table 2b. Content Validity and Face Validity of the Tool

Component		Item	Input	I-CVI among Experts (n = 3)	UA	I-FVI among Employees (n = 20)
Health factors	Physical activity at work	K1		1	1	0.95
		K2		1	1	1
		K3		1	1	1
		K4		1	1	0.90
		K5		1	1	1
		K6		1	1	1
	Physical activity for transport	K7		1	1	1
		K8		1	1	1
		K9		1	1	1
	Physical activity during leisure time	K10		1	1	1
		K11		1	1	1
		K12		1	1	1
		K13		1	1	1
		K14		1	1	1
		K15		1	1	1
	Smoking behavior	K16		1	1	1
		K17		1	1	1
		K18		1	1	1
		K19		1	1	1
		K20		1	1	1
		K21		1	1	1
		K22		1	1	1
		K23		1	1	1
		K24		1	1	1
	Alcohol consumption	K25		1	1	1
		K26		1	1	0.95
		K27		1	1	0.95
		K28		1	1	1
		K29		1	1	0.95
		K30		1	1	1
		K31		1	1	1
		K32		1	1	1
		K33	Add “physically injured”	1	1	1
		K34		1	1	1
	Sleep duration	K35		1	1	1
			S-CVI/Ave	1		-
			S-CVI/UA		1	-
			S-FVI-Ave			0.99

Notes: I-CVI = Item-level Content Validity Index, UA = Universal Agreement, I-FVI = Item-level Face Validity Index, S-CVI = Scale-level Content Validity Index, Ave = Average, S-CVI/Ave = Scale-level Content Validity Index based on the Average Method; S-CVI/UA = Scale-level Content Validity Index based on the Universal Agreement Method; S-FVI = Scale-level Face Validity Index.

mass index were excluded as they were the results of direct measurements. Therefore, only 59 items were included in the reliability test.

Internal Consistency Reliability

A total of 220 workers participated in this study. Their sociodemographic characteristics are shown in Table 3. Table 3 shows that the number of female and male in this study is almost equal (50.5% and 49.5%, respectively). Most respondents are aged 40–49 years (30.5%), have completed a bachelor’s program (40.9%), earn a monthly income of IDR 2,000,000–3,999,999 (54.5%), and were married (68.6%).

As shown in Table 4, the overall Cronbach’s alpha coefficient was 0.70, whereas the specific alpha coefficients for the nutritional and health factors were 0.649 and 0.707, respectively. The overall and variable-specific Cronbach’s alpha coefficients exceeded 0.6, which was considered acceptable.

Discussion

This study examined and assessed the content validity of DDR-GizKes in terms of the nutritional and health factors of the productivity of urban workers. DDR-GizKes is a risk self-assessment tool that can help detect early nutritional and health risk factors associated with NCDs. Work productivity is influenced by factors with a significant and determining role: nutritional adequacy and health degree.[4]

In this study, dietary diversity, food adequacy, variations in protein consumption, sugar consumption, and breakfast habits, which were excluded in the previous li-

Table 3. Sociodemographic Characteristics of the Participants in the Internal Consistency Reliability Test (n = 220)

Variable	Category	n	%
Age	20–29	58	26.4
	30–39	58	26.4
	40–49	67	30.5
	≥50	37	16.8
Sex	Male	119	50.5
	Female	109	49.5
Education	Do not complete elementary school	1	0.5
	Complete elementary school	1	0.5
	Complete junior high school	2	0.9
	Complete senior high school	47	21.4
	Complete diploma program	61	27.7
	Complete bachelor's program	90	40.9
	Complete master's program	18	8.2
	Completed doctoral program	0	0.0
Monthly income	IDR >2,000,000	12	5.5
	IDR 2,000,000–3,999,999	120	54.5
	IDR 4,000,000–5,999,999	59	26.8
	IDR 6,000,000–7,999,999	21	9.5
	IDR ≥8,000,000	8	3.6
Marital status	Married	151	68.6
	Single/divorced	69	31.4

Table 4. Cronbach's Alpha Coefficients for the Tool Subscale (n = 220)

Variable	Alpha Coefficient
Nutritional factors	0.649
Health factors	0.707
Overall	0.700

terature,[19] were added as nutritional factors. The previous studies are limited to cross-sectional studies for assessing the relationship between nutritional and health factors and NCDs and workers' productivity, not developing the tool.[9,17,18] DDR-GizKes was developed based on previous literature.[11,17,18,31] Therefore, this study provided strong evidence for assessing the content validity of the tool.

Herein, 24 indicators were obtained from 63 question items. DDR-GizKes was developed for the urban worker population, and other elements such as motivation, skills, and income level were not considered. This tool assessed two crucial productivity determinants: nutritional and health factors. This study could serve as a preliminary investigation for future study.

The validity test was employed to evaluate the content validity of the tool in this study. Generally, the measurement of this parameter remains necessary as the initial step in an instrument's development.[26] This study showed that the I-CVI, S-CVI/Ave, and S-CVI/UA were equal to 1, indicating that the tool items were legitimate among the three experts. Based on the test's intended goal, the developed items could characterize the substance. The results proved that the tool contained a sufficient number of questions and revealed that nutritional and health risk factors affected the productivity of urban workers. This study met the minimum criteria for the number of experts involved in assessing content validity: two or three experts. Further, the expert reviewers met the criteria established by previous studies.[23,27]

A total of 63 tool items were developed with good operationalization and conceptualization, which could be used for pilot studies. However, further studies need to involve more experts to solidify the relevance of the question items. Panels must consist of survey and questionnaire experts and substantive experts/materials to develop good questionnaires and question items.[23,27] Herein, there were difficulties in recruiting expert reviewers who were experts in the field of occupational nutrition with at least ten years of experience and developing questionnaires. Six experts who were contacted were not willing to participate as experts.

The FVI indicated the ease of comprehension of question items. In this study, the FVI ranged from 0.95 to 1. Several questions might be challenging to comprehend, such as K1, K4, K26, K27, and K29. Some revisions were made by adding information and modifying sentences. The alpha coefficient of the nutritional factors was lower, whereas that of the health factors and the overall score were higher. The alpha coefficients of more than 0.6 shows an acceptable internal consistency.[30] A low alpha coefficient could be attributed to a small number of questions, poor interrelatedness between items, or heterogeneous constructs. Herein, the low alpha coefficient could be related to the small number of questions; hence, some items needed to be either revised or deleted.[35]

In this study, the questions on nutritional factors (24 items) were fewer than those on health factors (35 items). However, increasing the number of questions may increase the total number of questions, which might cause respondents to feel bored in answering the questionnaire. Thus, developed questions may be revised, or the minimum sample size may be increased. The minimum sample size was met in this study; however, a larger sample size is recommended. The overall score was 0.70, which indicated an acceptable internal consistency.

The strength of this study was that it succeeded in developing a tool and scoring system for early detection of the nutritional and health risk factors of productivity of urban workers. This study added nutritional and health factors for NCDs that have not been used in previous studies. Therefore, it can be a preliminary study for subsequent similar studies. The weakness of this study was an insufficient minimum of sample size; therefore, it is necessary to include more experts in the assessment.

Conclusion

DDR-GizKes is a valid and acceptable tool for the

early detection of the nutritional and health risk factors of urban workers' productivity. The items developed are acceptable, but revisions are still needed. Future studies must optimize the predictive accuracy of DDR-GizKes by involving more experts and participants.

Abbreviations

NCD: Noncommunicable Disease; COVID-19: coronavirus disease 2019; DDR-GizKes: *Deteksi Dini Faktor Risiko Gizi dan Kesehatan*; CVI: Content Validity Index; FVI: Face Validity Index; I-CVI: Item-level Content Validity Index; S-CVI: Scale-level Content Validity Index; UA: Universal Agreement; Ave: Average; S-CVI/Ave: Scale-level Content Validity Index based on the Average Method; S-CVI/UA: scale-level Content Validity Index based on the Universal Agreement Method; I-FVI: Item-level Face Validity Index; S-FVI: Scale-level Face Validity Index.

Ethics Approval and Consent to Participate

This study obtained protocol and procedure approval from the Research and Community Engagement Ethical Committee of Health Science of Respati University of Yogyakarta (No. 120.3/FIKES/PL/VIII/2022). Permission to collect data in the ten offices was obtained from official authorities. Respondents who agreed to participate in this study were asked to sign an informed consent form.

Competing Interest

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

Availability of Data and Materials

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

Authors' Contribution

Conceptualization: HMEN, AKE, and CRW; Data curation: HMEN, AKE, and CRW; Formal analysis: HMEN and AKE; Methodology: HMEN and AKE; Validation: HMEN, AKE, and CRW; Writing—original draft: HMEN; Writing—review and editing: HMEN, AKE, and CRW. All authors have read and agreed to the published version of the manuscript.

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The Effect of COVID-19-related Occupational Stress and Burnout in Referral Hospital Nurses

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Abstract

Nurses' continuous contribution to patient health makes them prone to occupational stress, which has been exacerbated during the COVID-19 pandemic. Occupational stress that lasts for a long time and is not resolved may cause burnout. Burnout experienced by nurses can impact patients, hospital services, and themselves. This study aimed to determine the effect of occupational stress on the incidence of nurse burnout during the COVID-19 pandemic. It used a quantitative approach with a cross-sectional design. The study sample was 235 nurses in six COVID-19 referral hospitals in West Sumatra from a proportional random sampling technique. Data were collected using a digital questionnaire distributed via a Google Forms link from February to April 2022. The results showed that the stress level of nurses was most commonly moderate (68.1%), and the burnout level was most commonly low (82.1%), with a significant effect of occupational stress on burnout. This study revealed the effect of occupational stress on the burnout of nurses treating COVID-19 patients.

Keywords: burnout, COVID-19, nurses, occupational stress

Introduction

The large increase in hospital coronavirus disease 2019 (COVID-19) cases and many health workers died of COVID-19 have directly impacted nurses, both physically and mentally.[1] The physical impacts experienced by health workers have included fever (85%), cough (80%), weakness (70%), chest pain (7%), hemophilia (7%), headache (7%), and diarrhea (7%).[2,3] Common psychological impacts are symptoms of depression, anxiety, fear, insomnia, and stress.[4] Up to 75.2% of nurses working in one of Egypt's COVID-19 specialist hospitals reported experiencing stress.[5] According to an online survey by the American Nurses Association, 82% of US nurses reported feeling stress at work during the COVID-19 pandemic.[6] COVID-19-related stress has affected 55% of health workers in Indonesia.[7] As a result, nurses experience high stress levels due to the pandemic.

Recent study have investigated the impact of occupational stress among nurses, showing a significant relationship with burnout.[8] Such extreme changes in the working environment and the complexity of this new disease have left nurses feeling uncertainty and fear. The staggering changes in nurses' situations during this crisis must be acknowledged and documented. Examining burnout during the health crisis is necessary to manage future strategies to decrease the negative outcomes of such situations. Most studies have determined that occupational stress affect burnout in only non-COVID-19 survivors.[5] This study broadened the analysis to nurses who had experienced COVID-19 as individuals or were known COVID-19 survivors. It examined the differences in occupational stress and burnout in nurses who were survivors of COVID-19 or had not been infected.

Nurses experiencing COVID-19-related occupational stress need immediate serious help as the major factor causing occupational stress for nurses handling these patients is the perception that COVID-19 is negative and dangerous.[9] This anxiety about danger positively correlates with individual stress and worry.[10] If left unchecked, it may affect the nurse's mentality, quality of work, and patient safety, such as increasing the risk of procedural error that results in disability or death of the patient.[10] Hence, fast and appropriate handling of nurses' occupational stress may prevent losses for indivi-

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dual nurses, hospitals, and patients.

The continuous occupational stress faced by nurses as frontline health workers during the COVID-19 pandemic has the potential to cause burnout. Burnout syndrome occurs when a person has high and unresolved occupational stress, resulting in physical and mental fatigue and boredom.[11] Jobs that trigger stress continuously until it accumulates can make a person burned out.[12] Burnout among nurses in Indonesia has not only occurred during the COVID-19 pandemic. Arisani, Arif, and Wijaya reported in 2019 that 49.1% of nurses working at public hospitals experienced burnout, and 47.2% of burnout occurred in nurses working at private hospitals.[13] Therefore, even in normal situations without high occupational stress, burnout has already become a serious problem in nursing.

Under the situation worsening during the pandemic, nurses in Indonesia have encountered an additional workload to respond to this distinct and complex condition. The rapid changes in regulations and working environment policies have also confused nurses and challenged their adaptability and resilience. Irregular staff circulation and replacement due to COVID-19 infection have also complicated the situation. This situation may decrease the quality of nursing care due to nurses experiencing physical fatigue, stress, insomnia, depression, and irritability.[9] During the COVID-19 pandemic, when healthcare providers must deal with a high workload, burnout may occur and escalate.[14]

A survey by the Indonesia National Nurses Association, found that 60% of nurses experienced burnout, depression, and anxiety.[15] A study in Wuhan, China, found that half of the nurses (n = 600) experienced moderate or high burnout.[16] In another study of 376 healthcare professionals in Italy, 1 in 3 people scored the highest for burnout.[17] Another study found high burnout in 51% of participants.[18] Burnout has a significant direct and indirect effect on willingness to leave nursing often referred to as turnover intention. Hospitals' limitations have resulted in the inability of nurses and other healthcare providers to be protected from stress while dealing with COVID-19. Neglecting this issue affects nurses' fatigue, which can negatively impact hospital performance.[19] This study aimed to examine the characteristics of nurses in each hospital, determine their level of occupational stress and burnout, relate these to demographic characteristics and investigate the effect of occupational stress on burnout in nurses providing services to COVID-19 patients. The novel contribution of this study was showing how occupational stress and burnout are represented in nurses who have been survivors of COVID-19 versus those who have not been infected.

Method

This study used a cross-sectional design, and its sampling method used a proportional random sampling technique. The reason for selecting this cross-sectional design was to collect data from many participants and compare the different characteristics of each participant at the same time. The participants were nurses treating COVID-19 patients. The study locations were six COVID-19 referral hospitals in the West Sumatra Province, Indonesia, based on the decrees of the Minister of Health of the Republic of Indonesia and the Governor of West Sumatra.[20] The total population was 412 nurses. The sample was calculated using the Lemeshow formula for estimating the population proportion, which gave a sample of 235.

The data were collected from February to April 2022 using the Occupational Stress Inventory–Revised Edition (OSI-R™) questionnaire and the Maslach Burnout Inventory (MBI) questionnaire. The questionnaires were distributed using a Google Forms link via WhatsApp. The demographic data collected were age, sex, education, employment status, length of work as a COVID-19 nurse, length of work as nurse, marital status, children, and records of COVID-19 infection. The nurses' stress was measured using the OSI-R™ questionnaire translated into the Indonesian language. This questionnaire consisted of 25 indicator variables of occupational stress, each with a score of 1–5. The total score was classified as low, moderate, or high. The nurses' burnout was measured using the MBI questionnaire translated into the Indonesian language. This questionnaire consisted of 22 indicator variables of burnout with answer options of never, rarely, often, and always. The total score was classified as low, moderate, or high. The validity and reliability tests were conducted on 30 nurses at different hospitals, using Cronbach's alpha. The test results showed that both questionnaires used were valid and reliable, with values of 0.91 and 0.93. Following approval by each hospital, the study process was then explained to the heads of the installation and the hospital ward.

This study had an independent variable (occupational stress) and dependent variable (burnout). The independent and dependent variable data were based on the experience and judgment of the participants when treating COVID-19 patients. Because the data were not collected at the start of the pandemic, the participants' answers were not representative of the actual situation, and bias could occur. The demographic data describing participants' characteristics (age, sex, education, employment status, working period as a COVID-19 nurse, working period as nurse, marital status, children, and records of COVID-19 infection) were analyzed descriptively, and the crosstab analysis of the characteristics of

each variable and each hospital were performed.

The crosstab analysis was presented as frequency and percentage. The effect of stress on burnout was analyzed using inferential statistics (structural equation model–partial least square; (SEM-PLS)). The SEM-PLS analyzes the significance level and the relationship between variables and aims to maximize the variance explanation of the dependent variable and minimize unexplained variables. The advantages of this method included that the normality of the data distribution was not assumed; data can be analyzed by SEM because the application method was non-parametrical. The data analysis steps using SEM-PLS were:

1. Designing a structural model or inner model.
   The inner model is a structural model to predict causality relationships between latent variables.
2. Designing a measurement model or outer model.
   This model specifies the relationship between latent variables and their indicators. The outer model defines how each indicator relates to its latent variables and aims to assess its validity and reliability.
3. Outer model evaluation using convergent validity, discriminant validity, and composite reliability.
   In the evaluation, the convergent validity could be assessed based on the correlation between the component score (item score or component score) and the value of the counter; in other words, it could be judged based on the loading factor. A correlation meets convergent validity if it has a larger loading value, from 0.5 to 0.6. The evaluation of the discriminant can be assessed based on validity, comparing the square root value of the average variance extracted (AVE). If the AVE value is greater than the correlation value between latent variables, then the discriminant validity could be considered fulfilled. The validity of the discriminant is achieved if the AVE value is greater than 0.5. The evaluation of composite reliability is based on a composite reliability value greater than 0.7 and a Cronbach's alpha value greater than 0.7.
4. Inner model evaluation using path coefficient, R^2, and hypothesis testing.[21]
   The value of R^2 was used to measure how much influence the independent latent variables have on latent dependent variables. A result of $R^2 = 0.67$ indicated that the model was good, and a higher value of R^2 means a better prediction model. This measurement was used to determine the magnitude of the

Table 1. Demographic Characteristics and Distribution of Participant (n = 235)

Variable	Category	The Hospital's											
		1 (n = 102)		2 (n = 54)		3 (n = 30)		4 (n = 19)		5 (n = 13)		6 (n = 17)	
		n	%	n	%	n	%	n	%	n	%	n	%
Age (years)	17–25	2	2.0	2	3.7	9	30	0	0	1	7.7	1	5.9
	26–35	58	59.6	37	68.5	17	56.7	12	63.2	10	76.9	11	64.7
	36–45	41	40.2	15	27.8	4	13.3	7	36.8	2	15.4	5	29.4
	46–55	1	1.0	0	0	0	0	0	0	0	0	0	0
Sex	Male	19	18.6	21	38.9	13	43.3	5	26.3	2	15.4	6	35.3
	Female	83	81.4	17	61.1	17	56.7	14	73.7	11	84.6	11	64.7
Education	Diploma in nursing	62	60.8	15	27.8	9	30	9	47.4	7	53.8	9	52.9
	Bachelor in nursing	40	39.2	39	72.2	21	70	10	52.6	6	46.2	8	47.1
Employment status	Civil servant	53	2	32	59.3	0	0	9	47.4	9	69.2	10	58.8
	Non–civil servant	49	48	22	40.7	30	100	10	52.6	4	30.8	7	41.2
Working period as a COVID-19 nurse (months)	6–12	42	41.2	33	61.1	19	63.3	9	47.4	9	69.2	7	41.2
	13–18	14	13.7	8	14.8	10	33.3	4	21.1	2	15.4	3	17.6
	19–24	46	45.1	13	24.1	1	3.3	6	31.6	2	15.4	7	41.2
Working period as nurse (years)	0–1	7	6.9	7	13.0	14	46.7	1	5.3	2	15.4	0	0
	1–2	5	4.9	8	14.8	3	10	0	0	0	0	0	0
	3–4	12	11.8	5	9.3	4	13.3	1	5.3	0	0	3	0
	>4	78	76.5	34	63.0	9	30	17	89.5	11	84.6	14	82.4
Marital status	Married	95	93.1	44	81.5	9	30	18	94.7	12	92.3	14	82.64
	Single	7	6.9	10	18.5	21	70	1	5.3	1	7.7	3	17.6
Having children	No	19	18.6	13	24.1	21	70	7	36.8	3	23.1	2	11.8
	Yes	83	81.4	41	75.9	9	30	12	63.2	10	76.9	15	88.2
Infected with COVID-19	Yes	61	59.8	9	16.7	21	70	10	52.6	6	46.2	3	17.6
	No	41	40.2	45	83.3	9	30	9	47.4	7	53.8	14	82.4
Occupational stress	Low	22	21.6	16	29.6	3	10.0	4	21.1	0	0	0	0
	Moderate	63	61.8	37	68.5	26	86.7	15	78.9	14	76.9	11	64.7
	High	17	16.7	1	1.9	1	3.3	0	0	3	23.1	6	35.3
Burnout	Low	96	94.1	37	68.5	22	73.3	18	94.7	12	92.3	10	58.8
	Moderate	6	5.9	17	31.5	8	26.7	1	5.3	1	7.7	6	35.3
	High	0	0	0	0	0	0	0	0	0	0	1	5.9

Table 2. Distribution of Occupational Stress and Burnout Based On Participant's Demographic Characteristics (n = 235)

Variable	Category	Occupational Stress (%)			Burnout (%)		
		Low	Moderate	High	Low	Moderate	High
Age (years)	17–25	20	80	0	73.3	26.7	0
	26–35	17	70.7	12.3	81.0	18.3	0.7
	36–45	20.8	59.7	19.5	86.1	13.9	0
	46–55	0	100	0	100	0	0
Sex	Male	21.2	63.6	15.2	69.7	30.3	0
	Female	17.2	69.8	13	87	12.4	0.6
Education	Diploma in nursing	15.9	68.2	15.9	86.7	13.3	0
	Bachelor in nursing	20.5	68	11.5	77.9	21.3	0.8
Employment status	Civil servant	23.5	62.6	13.9	81.7	17.4	0.9
	Non–civil servant	13.3	73.3	13.4	82.5	17.5	0
Work period as a COVID-19 nurse (months)	6–12	18.3	65	16.7	77.5	21.7	0.8
	13–18	7.5	92.5	0	80	20	0
	19–24	24	60	16	90.7	9.30	0
Working period as nurse (years)	0–1	15.6	75	9.40	75	25	0
	1–2	25	68.8	6.20	80	20	0
	3–4	20	68	12	83.3	16	0.7
	>4	17.9	66.7	15.40	82.2	17.4	0.4
Marital status	Married	17.8	66.0	16.2	83.2	16.8	0
	Single	20.5	77.3	2.2	77.3	22.3	0.4
Having children	No	17.9	77.6	4.5	80.6	17.9	1.5
	Yes	18.5	64.2	17.3	82.7	17.3	0
Infected with COVID-19	Yes	14.7	69.7	15.6	87.2	12.8	0
	No	21.4	66.7	11.9	77.8	21.4	0.8

influence, test the hypothesis, and determine the significance level. Hypothesis testing in this study was carried out by examining the t-statistics values and p-values. The study's hypothesis can be accepted if the p-values are less than 0.05. Paths that have a significant influence are based on the t-statistic value: if it is higher than 1.96, it is positive, and if it is 1.96, it is negative.

The data analysis used the free versions of SPSS 23 and Smart PLS software.

Results

This study involved 225 nurses working at six COVID-19 referral hospitals in the West Sumatra Province, Indonesia. Most were aged 26–35 years (62.6%), female (71.9), and attained a bachelor's degree in nursing (51.9%). The most common employment status was a non-civil servant with a working period as a COVID-19 nurse of 6–12 months. Almost all the nurses (81.4%) were married, and 71.5% had children. Of all the nurses, 46.4% had been infected with COVID-19. The occupational stress for nurses was mostly in the moderate category (68.1%), and burnout was mostly (82.1%) in the low category (Table 1).

The nurses experiencing severe occupational stress were mostly aged 36-46 years old, male, civil servants, married, had worked as nurses for more than four years, attained a diploma in nursing, had children, and had been infected with COVID-19. The nurses who experienced high burnout were mostly aged 26-34 years, female, civil servants, attained a bachelor degree in nursing, worked as COVID-19 nurses for 6-12 months, had been nurses for 3-4 years, and had never been infected with COVID-19 (Table 2).

Table 3. Outer Loading Test

Variable	Indicator Variable	Factor Loading	Description
Occupational stress	ST 5	0.724	Fulfilled
	ST 12	0.722	Fulfilled
	ST 14	0.805	Fulfilled
	ST 15	0.852	Fulfilled
	ST 17	0.676	Fulfilled
	ST 20	0.708	Fulfilled
Burnout	BN 4	0.725	Fulfilled
	BN 6	0.675	Fulfilled
	BN 9	0.711	Fulfilled
	BN 15	0.708	Fulfilled
	BN 17	0.649	Fulfilled
	BN 18	0.702	Fulfilled
	BN 19	0.738	Fulfilled
	BN 20	0.765	Fulfilled
	BN 21	0.755	Fulfilled

Notes: ST = Stress, BN = Burnout

SEM-PLS Analysis

A. Outer Model Analysis

This study examined the outer model by analyzing the values contained in the results of the occupational stress and burnout variable data processing. The outer model was examined using convergent validity, discriminant

validity or AVE, and composite reliability values.

Outer loading was carried out three times because the variable stress and burnout indicators were found invalid. Table 3 and Figure 1 show that all indicators of the stress and burnout variables are valid and ideal as the outer loading values were more than 0.50. The composite reliability test is ideal if the value of the data processing result is ≥0.80.[21] Cronbach's alpha assessment is valid and ideal if the value of each variable is ≥0.70.[21] Table 4 shows that the AVE value, composite reliability, and Cronbach's alpha met the predetermined criteria, meaning that the stress and burnout variables in this study were reliable.

B. Inner Model Analysis

The inner model is a structural model for predicting causality relationships between latent variables, evaluating the effect of constructs between latent variables, and testing hypotheses. The structural model is evaluated with the coefficient of determination (R^2), which is a method to assess how much the exogenous construct can explain the endogenous construct in the sense of how much influence the independent variable has on the dependent variable.[21]

Analysis of variance (R^2), or test of determination, was an analysis to determine the influence of the independent variables on the dependent variable. Table 5 shows that the R^2 value of the burnout variable is 0.85. Thus, 85% of the burnout variable could be explained by the occupational stress variable; the remaining 15% was explained by other variables that were not examined. This measurement was used to determine the magnitude of the influence, test the hypothesis, and determine the significance level. Hypothesis testing in this study was carried out by examining the t-statistic values and p-values. The hypothesis is accepted if the p-value is less than 0.05. Paths that have a significant influence are based on the t-statistic value: if this is >1.96, it is positive, and if it is 1.96, it is negative.

This study hypothesized that stress significantly affected burnout in COVID-19 nurses during the COVID-19 pandemic. Based on Table 5, the original sample was positive, with a value of 0.292. These results indicated that the direction of the relationship between occupational stress and burnout was positive. The mean sample value was 0.305, showing that every 1-unit increase in stress increases burnout by 0.305 times. The significance value was 0.000 (<0.05), and the t-statistic value was 7.092 (>1.96), thus stress had a significant effect on burnout, and the hypothesis was accepted.

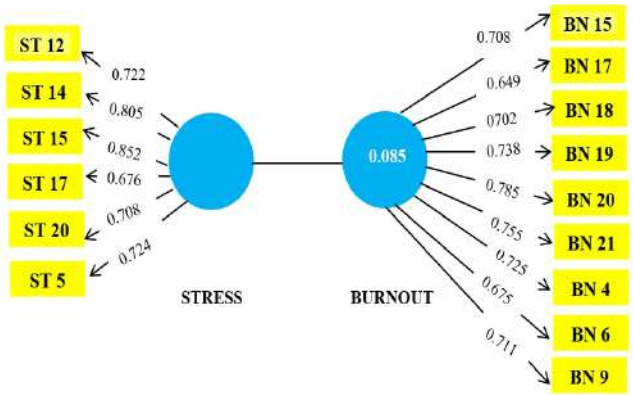

Figure 1. Result of the Structural Model of Occupational Stress and Burnout

Discussion

Most nurses (68.1%) assigned to treat COVID-19 patients at the six referral hospitals in the West Sumatra Province, Indonesia, experienced moderate levels of occupational stress. Previous studies conducted at hospitals dealing with infectious diseases have also shown that nurses experienced moderate occupational stress. A study in Pekanbaru, Banda Aceh, Dumai, and Medan, Indonesia, found that the level of occupational stress experienced by most nurses was moderate.[22-24] A study in Wuhan, China, found that less than 60% of health workers, predominantly nurses, felt moderate or severe stress while caring for patients with COVID-19.[15] This moderate occupational stress experienced by nurses is a form of increasing awareness of COVID-19 exposure in

Table 4. Average Variance Extracted Score, Composite Reliability, and Cronbach's Alpha

Variable	Cronbach's alpha	Composite Reliability	AVE
Occupational stress	0.890	0.905	0.515
Burnout	0.845	0.885	0.563

Note: AVE = Average Variance Extracted

Table 5. R2 Value Results and Hypothesis Testing

R^2 Value Result			Hypothesis Testing						
Variable	R^2	R^2 adjusted	Hypothesis	Original Sample	Mean Sample	SD	t-statistic	p-value	Description
Burnout	0.85	0.82	Occupational stress affects burnout	0.292	0.305	0.041	7.092	0.000	Data support the hypothesis

Note: SD = Standard Deviation

the work environment. It is also caused by insufficient information and support in completing nursing work.[25]

The demographic characteristics of nurses also affected their occupational stress. Most nurses in this study were aged 26–35 years. According to previous studies, the average age for experiencing occupational stress is 30 years.[26] The majority of COVID-19 nurses in this study were females, and their stress levels were higher than those of males. Women have a higher risk than man of experiencing stress because they have the main family caregiver role and are vulnerable to social isolation.[27] A previous study reported that women are more vulnerable to stress because they have a higher stress response system, and working women face role conflicts as workers and housewives, coupled with the job's demands.[28] The cross-tabulation results showed that the rate of moderate occupational stress among nurses was not much different between diploma three graduates (68.1%) and bachelor's degree graduates (68%). Most COVID-19 nurses working in the COVID-19 room for 6–12 months (65%) experienced moderate stress levels.

Occupational stress experienced for a long time without stopping due to COVID-19 can trigger complications such as decreased performance, depression, burnout, and the desire to stop working.[29] Unmanaged occupational stress may cause emotional exhaustion, cynicism, and decreased achievement.[29] Social workers such as health workers, especially nurses, are vulnerable to experiencing pressure due to the COVID-19 pandemic because they must provide professional services to patients in critical and difficult conditions.[30] Nurses, as the front line handling COVID-19, are most at risk of experiencing burnout.[31]

The majority of burnout experienced by the nurses at the six COVID-19 referral hospitals in the West Sumatra Province, Indonesia, was low. Similar studies were conducted at three hospitals in Mataram and one in Surabaya, Indonesia, where 62.4% and 69% of nurses experienced low burnout.[32,33] It means that most nurses during the COVID-19 pandemic have remained able to control fatigue and overcome stressors which could affect performance.

However, other studies show that during the COVID-19 pandemic, nurses have experienced burnout, depersonalization dimensions, and decreased self-esteem.[34] In this study, 18.4% of nurses aged 26–35 years experienced moderate burnout, as did 12.4% of women. Female nurses showed a greater incidence of burnout than male because women are more prone to experiencing emotional exhaustion.[35] A previous study has reported that sex is related to burnout in health workers.[36] This result is in line with a study in Portugal, finding that female had an average burnout 4.52 times higher than male.[37] Nurses who are married and have children also potentially to experience burnout.[38] Another study has reported that marital status is related to burnout.[39] This study's cross-tabulation of the demographic table results found that 16.8% of COVID-19 nurses who were married and 17.3% of those with children experienced moderate burnout.

Work experience is associated with burnout in health workers.[16,36] Burnout does not follow a specific working period. However, the longer the individual's working period, the more experienced they are in carrying out their duties, and the more boredom occurs due to monotonous work. The new findings in this study were that heavy occupational stress occurred more frequently in nurses who had been infected with COVID-19 compared to nurses who had not. Still, the highest burnout incidence (0.8%) occurred in the latter. Almost all the nurses who were survivors of COVID-19 (87.2%) experienced low burnout.

The mean sample value in this study was 0.305, with a significance value of 0.000 (<0.05) and a statistical t-value of 7.092 (>t-table 1.645), so that occupational stress had a significant effect on burnout. The result was similar to a study by Agustina, *et al.*, that found that occupational stress had a significant effect on nurse burnout.[8] Another study found a relationship between occupational stress and burnout during the COVID-19 pandemic, in which the higher the occupational stress, the more likely burnout would occur.[7]

However, the results of this study showed that the effect of occupational stress on burnout for COVID-19 nurses was low. Another study shared the same result and reported that nurses working under stressful conditions for a short time do not necessarily suffer from burnout.[40] It means that if the occupational stress of nurses is not handled immediately, they may experience burnout.[26] These findings can be used as a basis for hospital policymakers in managing health resources in dealing with crises such as COVID-19. The appropriate policy will make it easy for hospitals to overcome the consequences of a health crisis such as COVID-19 so that the mental health of nurses can be maintained, nurses can improve their work performance, and the prolonged effects of stress and burnout cannot occur.

The strength of this study was that it used SEM-PLS, as a growing model, for direct and indirect data analysis. The limitation of the study was participants from several hospitals faced job transfers during the pandemic. This condition could have led to bias by affecting participants' real-time situation of burnout and occupational stress, and it was important for them to remember the relevant situation. To minimize bias, nurses were instructed to complete the questionnaire based on the situation while treating COVID-19 patients.

Conclusion

The effect of occupational stress on the burnout of nurses caring for COVID-19 patients at six referral hospitals. The occupational stress and burnout level of nurses is moderate and low, respectively. Hospital management must address this crucial situation during a health crisis and arrange possible strategies to deal with occupational stress, which will prevent negative outcomes such as burnout and turnover.

Abbreviations

COVID-19: coronavirus disease 2019; OSI-R™: Occupational Stress Inventory-Revised Edition; MBI: Maslach Burnout Inventory; SEM-PLS: Structural Equation Model–Partial Least Square; AVE: Average Variance Extracted.

Ethics Approval and Consent to Participate

This research was assessed by the Ethics Committee of RSUP Dr. M. Djamil Padang (number: LB.02.02/5.7/94/2022). The test carried out fulfilled the established criteria. The criteria include explaining the benefits of research, explaining the rights of respondents, protecting the privacy of respondents, upholding aspects of fairness, and upholding the principle of openness by explaining research procedures and informed consent. Written informed consent was given to participate.

Competing Interest

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

Availability of Data and Materials

Data and materials are available for sharing according to procedures and regulations.

Authors' Contribution

YA and MF designed the study, collected samples, conducted quantitative data analyses, and drafted the manuscript. YA gave feedback and revised the manuscript. All authors read and approved the final manuscript.

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Obesity and Asthma Risk in Indonesian Adults: Findings from the 2018 Indonesia Basic Health Research

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Abstract

Obesity and asthma are both global public health challenges. Mounting evidence suggests that obesity may increase asthma risk in adults; however, the association by sex remains uncertain. This study examined the association of obesity with asthma risk in Indonesian adult men and women. Data were obtained from the 2018 Indonesia Basic Health Research. The analysis included 299,837 men and 333,218 women aged ≥18 years. Asthma was identified by the self-report of a doctor's diagnosis. Obesity was defined as a body mass index ≥30 kg/m^2. A logistic regression was used for data analysis. Asthma prevalence was 2.7% (2.5% in men and 2.8% in women) and was higher in obese than non-obese adults. The adjusted odds ratio (aOR) of having asthma-related obesity was 1.22, 95% Confidence Interval (CI) = 1.17–1.28 (aOR = 1.25, 95% CI = 1.21–1.34 in women and aOR = 1.14, 95% CI = 1.05–1.25 in men). In conclusion, asthma prevalence is relatively low in Indonesian adults and slightly higher in women than men. Both men and women have a slight increase in the odds of having asthma-related obesity. Longitudinal studies are needed to understand better the causality association of obesity with asthma in adults.

Keywords: adults, asthma, Indonesia, obesity

Introduction

Asthma affects about 262 million people globally,[1] and is among adults' most frequent chronic respiratory diseases.[2] The recent findings from the Global Asthma Network Phase I study, a multi-country population-based survey, reported that asthma prevalence among adults differed significantly within and between countries.[3] Although its global prevalence has decreased,[4] the burden of asthma remains substantial on healthcare systems and the community.[5,6] Findings from a systematic analysis of the 2017 global burden of disease study indicated that asthma was the second most common cause of death among chronic respiratory diseases.[4] In fact, the majority of deaths from asthma occurred in low and lower-middle-income countries.[7,8] In Indonesia, the prevalence of self-reported, doctor-diagnosed asthma had significantly increased from 1.9% in 2007,[9] to 2.4% in 2018.[10] In 2018, asthma prevalence among Indonesian adults ranged from 2.2% to 5.1%.[10] In addition, asthma prevalence in 2018 differed by sex, with a prevalence of 2.3% in men and 2.5% in women.[10]

Obesity has become another global public health concern in adults.[11] In Indonesia, obesity prevalence is higher in females than males, and obesity prevalence in adults has increased over the past two decades.[9,10] Obesity has been associated with many chronic diseases, including asthma.[12] The increase in obesity prevalence has implicated obesity-related diseases and health economics, subsequently burdening the healthcare system.[13] A review of obesity and asthma in adults reported a higher asthma prevalence in obese women and a predominantly positive association in women.[14] In addition, increased odds of having asthma were shown among obese adults in some cross-sectional studies.[15-17] A meta-analysis of Mendelian randomization analysis suggested an increased risk of asthma associated with a higher genetically predicted body mass index (BMI) in European adults; however, individual studies showed mixed results.[18] The role of sex in the obesity-asthma association remains controversial. For example, several studies reported a significant association only in females,[19,20] but another found a similar association between sexes.[21] Other studies found a stronger association in females than males.[22,23] Two population-based Indonesian studies showed positive associations of obesity with asthma in men and working women,[24] and non-working

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women.[25]

Given the increasing prevalence of both obesity and asthma in Indonesia and the prevalence differed by sex,[9,10] it is essential to assess the association between these conditions for preventive measures. Many studies in other countries reported inconclusive results regarding the potential role of sex on the association of obesity with adult asthma[20,22,23]; however, evidence from Indonesia is limited. A better understanding of the sex differences in asthma prevalence in adult populations and its association with obesity can benefit its management. Thus, this study aimed to examine the association of obesity with asthma in Indonesian adults, using national data from the 2018 Indonesia Basic Health Research.

Method

Data were derived from the 2018 Indonesia Basic Health Research,[10] a national survey with multi-purposes to evaluate Indonesian health status. The 2018 Indonesia Basic Health Research was a cross-sectional survey conducted in 34 provinces, 416 districts, and 98 cities in Indonesia. Data were collected in March 2018 by the Indonesian Ministry of Health. To assess the asthma situation, the 2018 Indonesia Basic Health Research interviewed a representative sample of 1,017,290 individuals of all ages consisting of 510,714 males and 506,576 females.

In this study, the inclusion criteria included individuals aged ≥18 years with information on doctor-diagnosed asthma. A data set request proposal was submitted to the Data Management Laboratory, the Indonesian Ministry of Health, to obtain data set according to the inclusion criteria and proposed variables. Of the 641,951 individuals who met the inclusion criteria, 8,896 were excluded due to missing data on BMI and other covariates. The final analytic sample included 633,055 adults, of which 299,837 were men and 333,218 were women.

The National Institute of Health Research and Development Ethics Committee, the Indonesian Ministry of Health, approved the 2018 Indonesia Basic Health Research with the letter LB.02.01/3/KE.024/2018. Written informed consent was obtained from participants by interviewers of the National Institute of Health Research and Development of the Indonesian Ministry of Health.

Asthma was determined through a question, "Have you ever been diagnosed with asthma by a doctor?". Asthma prevalence was calculated by dividing the number of adults with asthma by the total number of corresponding individuals. Anthropometrics data were obtained by measuring height and weight. The BMI was estimated by dividing body weight (kg) by height (m^2). Obesity was determined as a BMI≥30 kg/m^2 according to World Health Organization's (WHO) classification.[26]

Information on covariates (age, residential area, marital status, education level, smoking status, physical activity, and history of hypertension and diabetes) was obtained from the 2018 Indonesia Basic Health Research questionnaire responses. Age was grouped into 18–44 years, 45–64 years, or ≥65 years. The residential area was classified as rural or urban areas. Marital status was categorized into single, married, or divorced. Education level was grouped into primary if the highest education was middle school, secondary if the highest education was high school, or higher education if the highest education was university. Information on smoking status was ascertained by asking individuals whether they had smoked daily in the past month. Smoking status was then categorized as never, former, or current smoking. Physical activity was categorized into active if individuals performed moderate physical activities for ≥150 minutes/week or vigorous physical activities for ≥75 minutes/week, or less active if individuals did not meet the WHO recommendation.[27] Self-report of a doctor's diagnosis was used to define hypertension and diabetes.

Data analyses were independently done for both sexes. Data were presented in mean ± standard deviation for continuous variables and proportion for categorical variables. Microsoft Office Excel 365 for the web was used to draw a figure on the distribution of obesity according to asthma status. Variables significantly associated with asthma at a p-value of less than 0.05 in bivariate analysis were selected as covariates in multivariate analysis. Multivariate analyses were performed using a logistic regression test to examine the association of obesity with asthma in adults. In multivariate analysis, adjustment was made for age, residential area, marital status, education level, smoking status, physical activity, and records of hypertension and diabetes mellitus. The odd ratios (OR) and 95% confidence intervals (CIs) were presented. Statistical significance was declared if a two-sided p-value was less than 0.05.

Results

Asthma prevalence in adults was 2.7%, with a mean age of 42.9 years. Over half of the adults were women, living in rural areas, married, less active, never smokers, and attained primary education. The adults' mean BMI was 23.9 kg/m^2, and 12.6% of adults were obese. Adults with a records of hypertension and diabetes were 48.8% and 2.3%, respectively (Table 1). Asthma prevalence was higher in women (2.8%) than in men (2.5%). The mean age of men and women was 43.0 and 42.8 years, respectively. More than half of the men and women lived in rural areas, were married, and had primary education. In men, the proportions of current smokers, less active, and records of hypertension were relatively high, but the proportions of obesity and diabetes were relatively low. Most

Table 1. Participants' Characteristics by Sex

Variable	Category	All (n = 633,055)	Male (n = 299,837)	Female (n = 333,218)
		n (%)	n (%)	n (%)
Asthma	No	616,023 (97.3)	292,276 (97.5)	323,747 (97.2)
	Yes	17,032 (2.7)	7,561 (2.5)	9,471 (2.8)
Sex	Male	299,837 (47.4)	-	-
	Female	333,218 (52.6)	-	-
Age, year*		42.9±14.9	43.0±14.9	42.8±14.9
Age group, year	18-44	360,820 (57.0)	168,784 (56.3)	192,036 (57.6)
	45-64	216,183 (34.1)	104,756 (34.9)	111,427 (33.4)
	≥65	56,052 (8.9)	26,297 (8.8)	29,755 (8.9)
Residential area	Rural	359,217 (56.7)	171,051 (57.0)	188,166 (56.5)
	Urban	273,838 (43.3)	128,786 (43.0)	145,052 (43.5)
Marital status	Single	85,501 (13.5)	55,046 (18.4)	30,455 (9.1)
	Married	484,568 (76.5)	230,831 (77.0)	253,737 (76.1)
	Divorced	62,986 (9.9)	13,960 (4.7)	49,026 (14.7)
Education level	Primary	395,244 (62.4)	178,973 (59.7)	216,271 (64.9)
	Secondary	174,492 (27.6)	92,350 (30.8)	82,142 (24.7)
	Higher education	63,319 (10.0)	28,514 (9.5)	34,805 (10.4)
Physical activity	Less active	452,499 (71.5)	168,585 (56.2)	283,914 (85.2)
	Active	180,556 (28.5)	131,252 (43.8)	49,304 (14.8)
Smoking status	Never	397,677 (62.8)	76,680 (25.6)	320,997 (96.3)
	Former	33,057 (5.2)	28,717 (9.6)	4,340 (1.3)
	Current	202,321 (32.0)	194,440 (64.8)	7,881 (2.4)
BMI, kg/m^2*		23.9±4.6	23.0±4.0	24.7±4.9
Obesity status	No	553,057 (87.4)	278,626 (92.9)	274,431 (82.4)
	Yes	79,998 (12.6)	21,211 (7.1)	58,787 (17.6)
Hypertension	No	324,371 (51.2)	132,469 (44.2))	191,902 (57.6)
	Yes	308,684 (48.8)	167,368 (55.8)	141,316 (42.4)
Diabetes	No	618,807 (97.7)	294,287 (98.1)	324,520 (97.4)
	Yes	14,248 (2.3)	5,550 (1.9)	8,698 (2.6)

Notes: BMI = Body Mass Index, *Data are presented as means±standard deviation.

women were never smokers and less active. In women, the proportions of obesity and hypertension were high, but the proportion of diabetes was low (Table 1).

Table 2 shows the characteristics of the participants based on their asthma status. Asthma prevalence was higher in rural, married, lower educated, and less active adults. Adults with asthma were likely to be older, had lower rates of hypertension and diabetes, and 23.1% of adults were current smokers. In men, the highest asthma prevalence was among current smokers. In contrast, the highest asthma prevalence in women was among never smokers.

Figure 1 presents the distribution of obesity according to asthma status. The obesity proportion was higher in adults with asthma than those without asthma. In addition, obesity was specifically higher in women with asthma than in men with asthma. Obesity was significantly associated with asthma regardless of sex.

Table 3 presents the OR associated with asthma according to obesity status. Obese adults had 1.23 times higher odds of having asthma than non-obese adults. The odds of having asthma associated with obesity differed between sexes. The odds of having asthma were 1.15 for obese men and 1.26 for obese women. Adjustment for the covariates did not noticeably change the results. The multivariate-adjusted odds of having asthma were higher in obese women than in obese men (aOR (95% CI) = 1.25 (1.21–1.34) vs. 1.14 (1.05–1.25), p-value<0.05).

Discussion

This study showed that asthma prevalence was relatively low in Indonesian adults and slightly higher in women than men. The prevalence of doctor-diagnosed asthma in this study was 2.5% in men and 2.8% in women. These findings were lower than the respective prevalence of 6.7% and 7.0% among men and women workers in Indonesia, which defined asthma based on symptoms.[24] In addition, several studies have reported that the prevalence of adult asthma differs between men and women.[4,17,22,23,28,29] Results from a national survey of Iranian adults in 2018 reported a variation in asthma prevalence between sexes and asthma definitions. In that study, asthma prevalence was higher in men using the European Community Respiratory Health Survey questionnaire but higher in women when using self-report of doctor-diagnosis.[29] Consistent with the current findings, many studies have shown a higher prevalence among women than men.[4,17,22,23,28] It has been suggested that

Table 2. Participants' Characteristics by Asthma Status

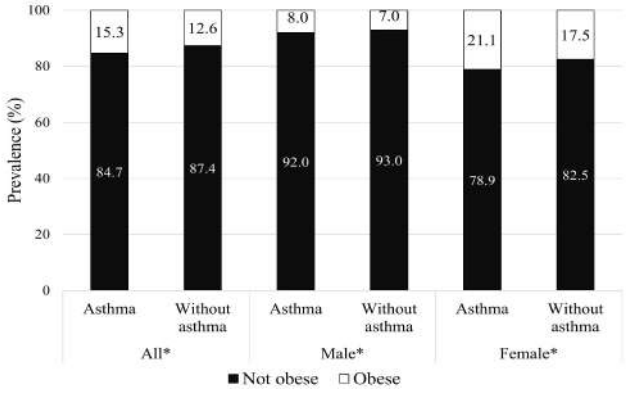
Variable	Category	All (n = 633,055)			Male (n = 299,837)			Female (n = 333,218)		
		Asthma	Without Asthma	p-value*	Asthma	Without Asthma	p-value*	Asthma	Without Asthma	p-value*
		n (%)	n (%)		n (%)	n (%)		n (%)	n (%)	
Sex	Male	7,561 (44.4)	292,276 (47.4)	<0.001	-	-	-	-	-	-
	Female	9,471 (55.6)	323,747 (52.6)							
Age, year**		47.0±16.2	42.8±14.8	<0.001	49.8±16.7	42.8±14.8	<0.001	44.7±15.4	42.8±14.9	<0.001
Age group, year	18-44	7,914 (46.5)	352,906 (57.3)		2,911 (38.5)	165,873 (56.8)		5,003 (52.9)	187,033 (57.8)	
	45-64	6,433 (37.8)	209,750 (34.0)	<0.001	3,077 (40.7)	101,679 (34.8)	<0.001	3,356 (35.4)	108,071 (33.4)	<0.001
	65	2,685 (15.8)	53,367 (8.7)		1,573 (20.8)	24,724 (8.5)		1,112 (11.7)	28,643 (8.8)	
Residential area	Rural	9,287 (54.5)	349,930 (56.8)	<0.001	4,305 (56.9)	166,746 (57.1)	0.843	4,982 (52.6)	183,184 (56.6)	<0.001
	Urban	7,745 (45.5)	266,093 (43.2)		3,256 (43.1)	125,530 (42.9)		4,489 (47.4)	140,563 (43.4)	
Marital status	Single	1,738 (10.2)	83,765 (13.6)		976 (12.9)	54,070 (18.5)		760 (8.0)	29,695 (9.2)	
	Married	13,088 (76.8)	471,480 (76.5)	<0.001	5,982 (79.1)	224,849 (76.9)	<0.001	7,106 (75.0)	246,531 (76.2)	<0.001
	Divorced	2,208 (13.0)	60,778 (9.9)		603 (8.0)	13,357 (4.6)		1,605 (16.9)	47,421 (14.6)	
Education level	Primary	11,284 (66.3)	383,960 (62.3)		5,106 (67.5)	173,867 (59.5)		6,178 (65.2)	210,093 (64.9)	
	Secondary	4,010 (23.5)	170,482 (27.7)	<0.001	1,783 (23.6)	90,567 (31.0)	<0.001	2,227 (23.5)	79,915 (24.7)	0.003
	Higher education	1,738 (10.2)	61,581 (10.0)		672 (8.9)	27,842 (9.5)		1,066 (11.3)	33,739 (10.4)	
Physical activity	Less active	13,254 (77.8)	439,245 (71.3)	<0.001	4,965 (65.7)	163,620 (56.0)	<0.001	8,289 (87.5)	275,625 (85.1)	<0.001
	Active	3,778 (22.2)	176,778 (28.7)		2,596 (34.3)	128,656 (44.0)		1,182 (12.5)	48,122 (14.9)	
Smoking status	Never	11,242 (66.0)	386,435 (62.7)		2,278 (30.1)	74,402 (25.5)		8,964 (94.6)	312,033 (96.4)	
	Former	1,848 (10.9)	31,209 (5.1)	<0.001	1,606 (21.2)	27,111 (9.3)	<0.001	242 (2.6)	4,098 (1.3)	<0.001
	Current	3,942 (23.1)	198,397 (32.2)		3,677 (48.6)	190,763 (65.3)		265 (2.8)	7,616 (2.4)	
BMI, kg/m²**		23.8±5.2	23.9±4.6	0.019	22.5±4.4	23.0±4.0	<0.001	24.9±5.5	24.7±4.9	0.004
Hypertension	No	9,683 (56.9)	314,688 (51.1)	<0.001	4,002 (52.9)	128,467 (44.0)	<0.001	5,681 (60.0)	186,221 (57.5)	<0.001
	Yes	7,349 (43.1)	301,335 (48.9)		3,559 (47.1)	163,809 (56.0)		3,790 (40.0)	137,526 (42.5)	
Diabetes mellitus	No	16,347 (96.0)	602,460 (97.8)	<0.001	7,289 (96.4)	286,998 (98.2)	<0.001	9,058 (95.6)	315,462 (97.4)	<0.001
	Yes	685 (4.0)	13,563 (2.2)		272 (3.6)	5,278 (1.8)		413 (4.4)	8,285 (2.6)	

Notes: BMI = Body Mass Index, *p-values were calculated by t-test for continuous variables and the Chi-square test for categorical variables, **Data are presented as means±standard deviation.

the mixed results in asthma prevalence may be partially due to differences in diagnostic criteria.[30] A review article on the prevalence of adult asthma with a wide variation of asthma definitions in Asian countries, including Indonesia, showed that the asthma prevalence in adults varied from 0.7% to 11.9%.[31]

This study showed a slight increase in the odds of having asthma in obese adults regardless of sex, and the associations were statistically significant. The increase in the odds of having asthma was higher in obese women compared to obese men. However, the association for men should cautiously be interpreted because the 95% CI of the OR for asthma in obese men reached a null association. Obesity is a significant risk factor for developing asthma, worsening asthma symptoms, and controlling poor asthma.[5,6] Although this study found a slight increase in the odds of having asthma in obese adults, the prevalence of both asthma and obesity is rising.[9,10] Thus, asthma-related obesity may cause an immense burden of chronic disease prevention in the future public healthcare systems.

Obesity has many negative impacts on health,[12] and the risk of asthma associated with obesity may differ by sex.[32] The association of obesity with asthma in men remains unclear.[23,32] In addition, previous studies found



Notes: The association between obesity and asthma was evaluated using Chi-square tests, *p-value<0.05.

Figure 1. Distribution of Obesity according to Asthma Status

an increase in the odds of having asthma associated with obesity in adults after adjusting for potential confounders; however, results for separate analyses were not shown for men and women.[15,17] Several other studies reported an increased risk of adult asthma associated with obesity only in women and not men.[19,20] Similar to the current findings, a few national-level cross-sectional stud-

Table 3. Odds Ratio (95% Confidence Interval) Associated with Asthma According to Obesity Status

Variable	Category	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
All	Non-obese	1.00 (reference)	-	1.00 (reference)	-
	Obese	1.23 (1.21–1.31)	<0.001	1.22 (1.17–1.28)*	<0.001
Male	Non-obese	1.00 (reference)	-	1.00 (reference)	-
	Obese	1.15 (1.06–1.25)	0.001	1.14 (1.05–1.25)**	0.002
Female	Non-obese	1.00 (reference)	-	1.00 (reference)	-
	Obese	1.26 (1.20–1.33)	<0.001	1.25 (1.21–1.34)**	<0.001

Notes: OR = Odds Ratio, CI = Confidence Interval
*Adjusted with sex, age, residence area, marital status, educational attainment, physical activity, smoking status, and history of hypertension and diabetes mellitus.
**Adjusted with age, residence area, marital status, educational attainment, physical activity, smoking status, and history of hypertension and diabetes mellitus.

ies reported a higher increase in the odds of having asthma associated with obesity in women than men.[16,22,23] A meta-analysis of 174,556 adults from 51 nationally representative surveys in which asthma prevalence remains common showed that obese men and women had a similarly high risk for doctor-diagnosed asthma.[33] Results from a prospective study including 523,245 adults found a higher risk of asthma in obese women compared to obese men after an 11-year follow-up.[21] In addition, a retrospective cohort study on more than 5 million adults with a BMI≥23.0 kg/m^2 showed that the risk of adult asthma gradually increased with increasing BMI, and the increased risk of adult asthma associated with obesity was higher in women than men.[34]

The mechanisms for sex differences in asthma prevalence in adults remain unclear. It has been suggested that sex hormones may cause women a higher asthma risk after puberty.[32] In addition, weight gain may reduce the airway, resulting in airway obstruction in women with smaller airways than men.[35] Another mechanism is probably due to sex differences in the inflammatory response. A higher level of inflammation associated with obesity in obese women than in obese men may explain a higher risk of having asthma for women.[36]

This study had some limitations. First, the causality between obesity and adult asthma could not be determined due to the cross-sectional design. Second, recall bias might occur because the definition of asthma relies on self-reporting a doctor's diagnosis. However, many epidemiologic studies have used this self-report of doctor-diagnosed asthma; thus, it is a standard definition used in asthma studies. Third, the large sample size of this study tended to detect significant associations, and a low asthma prevalence in both sexes precluded further stratification analysis from assessing the association. Nonetheless, a slight increase in the odds of having asthma in obese adults might be considered to prevent comorbidity of the two conditions and alleviate the burden of chronic disease in future public healthcare systems.

Conclusion

This study of Indonesian adults shows that asthma prevalence is relatively low and slightly higher in women. Obesity is associated with asthma in both sexes, and the increase in the odds of having asthma is higher in women than men. Longitudinal studies are needed to understand better the causality association of obesity with asthma in adults.

Abbreviations

BMI: Body Mass Index; WHO: World Health Organization; OR: Odds Ratio; CI: Confidence Interval.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of the National Institute of Health Research and Development, the Ministry of Health of the Republic of Indonesia.

Competing Interest

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

Availability of Data and Materials

The data used in this study are not publicly available. A reasonable request for the dataset can be sent to the corresponding author.

Authors' Contribution

HN was responsible for the entire process, including conceptualization, data analysis, writing, and revising the manuscript.

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Maternal and Child Health Handbook Utilization, Quantity and Quality of Antenatal Services, and Maternal Emergency Rates in Padang City in 2022

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Abstract

This study analyzed the relationship between the utilization of the Indonesian Ministry of Health's Maternal and Child Health Handbook and the quantity and quality of antenatal care to maternal emergency levels. This study applied mixed methods with a consecutive sampling technique and included 108 mothers undergoing maternal emergencies at a central general hospital (quantitative) and eight mothers, seven midwives, and five cadres at primary health cares (qualitative) as informants. The result showed a relationship between the utilization of the Maternal and Child Health Care Handbook (p-value = 0.043), the quantity of antenatal care (p-value<0.001), the quality of antenatal care (p-value = 0.044) and the maternal emergency level. Not all mothers understood the benefits of the Maternal and Child Health Handbook. Most did not read it, and some mothers perceived that it could prevent emergency cases for them. The mothers were satisfied with the quality of the antenatal care services received. Maternal emergency cases are still quite high; hence, it is necessary to increase the use of Maternal and Child Health Handbook and the quantity and quality of antenatal care.

Keywords: antenatal care, Maternal and Child Health Handbook, maternal emergency

Introduction

Maternal mortality rate (MMR) is an indicator to assess a country's level of welfare, health status and quality of life. Based on the World Health Organization (WHO) data, in 2017, the global MMR was approximately 295,000.[1] Indonesia, having 177 maternal deaths per 100,000 live births, ranked fourth among Asia Pacific countries with the highest estimated MMR.[2] The 2020 Indonesia Health Profile shows an increase in maternal deaths compared to that in 2019. The MMR was 4.6% in 2020 and 4.2% in 2019.[3]

An increase in maternal deaths also occurred in West Sumatra Province, Indonesia. There were 116 and 125 cases of maternal mortality in 2019 and 2020, respectively.[3] Maternal emergencies can cause maternal deaths. A maternal or obstetric emergency is a life-threatening condition that, if not treated immediately, will result in the death of the mother and fetus.[4] Obstetric emergencies occur due to unmanaged pregnancy, childbirth, and puerperium complications.[5] Based on data from the 2020 Padang City Health Profile, approximately 20% of pregnant women suffer from complications, but only 61.3% of them are treated according to standards.[6]

One of the efforts to prevent obstetric emergency cases and accelerate the decline in MMR was to conduct antenatal care (ANC) examinations on time and according to standards.[7] The ANC is recorded in the Maternal and Child Health (MCH) Handbook, an integrated home-based record that supports sustainable care.[8] The MCH Handbook contains examination standards, health information and danger signs for pregnancy, childbirth, postpartum period, infants and children.[9] Based on the Regulation of Minister of Health Number 4 of 2019, by quantity standards, antenatal services should include at least four visits during pregnancy (K4); furthermore, the quality of ANC should meet the 10 T criteria (weigh and measure body height, measure blood pressure, determine nutritional status value, measure the height of the uterine fundus, determine the presentation of the fetus and the calculation of the fetal heart rate, screen for tetanus toxoid status, provide blood supplement tablets, perform laboratory tests, manage cases, conduct dialogue/counseling).[10]

The standard 10 T criteria involve the patients' records; examination; management; information, education, and communication (IEC); and documentation of

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ANC services. The 2020 Padang City Health Profile showed an increase in first visits for prenatal care in the first trimester (K1) and fourth visits for prenatal care in the third trimester (K4) compared to those in 2019. The K1 coverage was 94.1% in 2019 and 107.4% in 2020. K4 achievement was 90.5% in 2019 and 94.4% in 2020.[6] The number of K1 and K4 visits increased, but a decrease in MMR did not follow.

The central general hospital was a Grade A national referral hospital. Based on an initial survey at the Comprehensive Emergency Obstetric and Neonatal Care (CEmONC) of the central general hospital in Padang City in 2021, which obtained secondary data, there were 1,360 cases of pregnancy and childbirth complications, including COVID-19 (12.3%), preeclampsia (9.04%), premature rupture of membranes (7.57%), placenta previa (6.69%) and anemia (6.54%).[11] The assessment of pregnancy complications and emergency obstetric cases is an evaluation of the quality of ANC at primary health cares (PHCs).[11]

Approximately 92.6% of labor complication cases in mothers with a record of ANC examinations were not carried out according to standards.[12] ANC examinations performed less than four times during pregnancy are associated with a risk of maternal death due to obstetric bleeding (p-value = 0.003).[13] Measuring the quality of ANC is an essential step towards improving the welfare of mothers, children, and the country.[14]

The ANC examinations are recorded in the MCH Handbook to ensure the continuity of care and empower mothers and families to maintain their health.[9] In a previous study, the use of the MCH Handbook influenced pregnant women's attitudes about complications of pregnancy and childbirth (p-value = 0.027).[15] Another study also stated that using the MCH Handbook increased pregnant women's healthy behaviors (p-value = 0.01).[16]

The ANC quality assessment is essential for improving maternal and child health. ANC focuses on promotive and preventive efforts, early detection, and management of complications, as stated in the MCH Handbook. The number of visits and inspection service coverage per year, according to the 10 T criteria in Padang City has increased.[6] However, maternal morbidity and mortality also increased. Therefore, this study aimed to analyze the relationship of MCH Handbook utilization and the quantity and quality of ANC to maternal emergency level.

Method

This study involved a mixed method with a sequential explanatory design, which combined quantitative and qualitative methods. In the first phase, quantitative study was carried out using a cross-sectional design at the Central General Hospital in Padang City. The population in the study comprised maternal emergency cases that entered Comprehensive Emergency Obstetric and Neonatal Care (CEmONC) of the Central General Hospital in Padang City between May and July 2022. The sample in this study was part of the population that met predetermined inclusion and exclusion criteria. The inclusion criteria were that the mother was willing to be a respondent, could communicate verbally and had an MCH Handbook. The exclusion criteria were having a gestational age that was less than the third trimester and having never had their pregnancy checked at a health facility.

The sample size was determined using the Lemeshow formula for one population.[17] Based on the sample formula, the number of samples in this study was 97 respondents, and 10% of the total sample calculation was added to avoid possible dropouts. The sample size of this study was 108 respondents included using a consecutive sampling technique.

The dependent variable in this study was maternal emergency level. Maternal emergencies were obstetric cases that, if not treated immediately, would result in the death of the mother and fetus.[4] Cases of maternal emergency were assessed through triage and the patients' medical records at the central general hospital. The central general hospital in Padang implemented the Australian Triage System (ATS) with modifications. Every patient in the emergency room was treated using ATS with this modification. The ATS was modified into three groups: patients with ATS categories 1 and 2 were combined into first-priority patients with a red color code, and patients with ATS categories 3 and 4 were combined into second-priority patients with a yellow color code.

The independent variables in this study were MCH Handbook utilization, the quantity of ANC (at least six visits for prenatal care up to the third trimester (K6)), and the quality of the ANC. MCH Handbook utilization was assessed from three aspects: as a medium for recording ANC (documentation), behavioral change and self-monitoring.[17] It was assessed using a questionnaire and was considered effective if the score was ≥80% and ineffective if the score was <80%.

The standard quantity of ANC visits was at least six: two in the first trimester, one in the second trimester, and three in the third trimester or more than three if with competent midwives to render ANC services according to the standard.[10,19] The quantities of ANC visits were determined from the records in the MCH Handbook. The measurement results were considered insufficient if the number of ANC visits was less than six times and sufficient if it was more than six times. The quality of ANC was the services the mother received by the 10 T criteria.[7,20,21] The quality of ANC was assessed using a questionnaire. ANC quality was interpreted to be good and not good if the score was ≥80% and <80%, respective-

ly.[21]

The questionnaire used a Guttman scale, "yes" or "no," to assess the utilization of the MCH Handbook and the quality of the ANC. The Guttman scale measures behavior with firm and consistent answers and an even number of questions.[22] The questionnaire used to assess the MCH Handbook utilization contained three aspects: as a medium for recording ANC (documentation), behavioral change, and self-monitoring.[17] The questionnaire used to assess the quality of ANC contained standard 10 T criteria in record, examination, management, IEC and documentation of ANC services.[7,20,21]

The validity and reliability test of the questionnaire was conducted in December 2021 with 35 respondents who were not the sample in this study. First, a preliminary survey permit was applied, and the validity and reliability of the questionnaire were tested. Second, the purpose of the survey was explained, and each respondent's consent to test the validity and reliability of the questionnaire was obtained. The respondents filled out the questionnaire, and the data were processed and tested for the validity and reliability of the questionnaire using IBM SPSS version 21 (free version). The number of questions were 26 for the assessment of MCH Handbook utilization and 34 for ANC quality assessment. The questionnaire for the utilization of the MCH Handbook was reliable (Spearman–Brown, 0.851>0.344), and the quality of ANC was reliable (Spearman–Brown, 0.884>0.344).

Quantitative data were analyzed using free version of IBM SPSS 21. A descriptive analysis was performed to determine the distribution of the frequency of MCH Handbook utilization, the quantity of ANC, the quality of ANC and the level of maternal emergencies. Chi-square was used to determine the relationship between the independent variables (MCH Handbook utilization, quantity of ANC and the quality of ANC) with the dependent variable (maternal emergency level), with the significance level set at p-value<0.05.

In the second stage (qualitative study), the case study method was used to clarify the quantitative study results. The data were proven again, strengthened, deepened, and expanded with qualitative methods. Qualitative study data were collected from July to August 2022 in seven PHCs of Padang City: Ulak Karang, Padang Pasir, Air Dingin, Andalas, Rawang, Kuranji and Lapai PHCs.

The informants in the qualitative study included eight mothers, seven midwives and five cadres. The determination of informants was done purposively and selected based on specific considerations.[23] Qualitative data were collected through in-depth interviews, and the questions involved MCH Handbook utilization and the quality of ANC. This qualitative study used thematic analysis, an analytical method for grouping and interconnecting certain theme codes or characteristics. The grouping of each theme characterizes, and the main step of thematic analysis determines the viewpoint of the phenomenon being analysed.[24] In this study, data sources were triangulated.[23] All recruited respondents agreed to sign a written informed consent form before data collection.

Results

The respondents were all maternal emergency cases that entered CEmONC in the central general hospital in Padang City. Table 1 shows that almost half of the research respondents did not use the MCH Handbook effectively. Table 2 presents the frequency distribution of maternal emergency levels according to each independent variable and its relationship. The results showed that a

Table 1. Frequency Distribution of Maternal and Child Health Handbook Utilization, Quantity and Quality of Antenatal Care and Maternal Emergency at the Central General Hospital in 2022

Variable	Category	n	%
MCH Handbook utilization	Ineffective	47	43.5
	Effective	61	56.5
Quantity of the ANC	Not enough	29	26.9
	Enough	79	73.1
Quality of the ANC	Not good	20	18.5
	Good	88	81.5
Maternal emergency level	Red	12	11.1
	Yellow	96	88.9

Notes: MCH = Maternal and Child Health, ANC = Antenatal Care

Table 2. Relationship of the Distribution of Maternal and Child Health Handbook Utilisation and the Quantity and Quality of Antenatal Care with Maternal Emergency Level at the Central General Hospital in 2022

Variable	Category	Maternal Emergency Level (%)		p-value	POR	95% CI
		Red	Yellow			
MCH Handbook utilization	Ineffective	19.1	80.9	0.043	4.579	1.165–18.005
	Effective	4.9	95.2			
Quantity of ANC	Not enough	31	69	0.000	11.400	2.821–46.063
	Enough	3.8	96.2			
Quality of ANC	Not good	25	75	0.044	3.857	1.080–13.776
	Good	8	92			

Notes: MCH = Maternal and Child Health, ANC = Antenatal Care, POR = Prevalence Odds Ratio, CI = Confidence Interval

significant relationship existed between MCH Handbook utilization and the maternal emergency level (p-value <0.05). Furthermore, mothers who did not use the MCH Handbook effectively had 4.579 times the chance of being in the red triage emergency level compared to mothers who used the MCH Handbook effectively (prevalence odds (POR) = 4.579).

There was a significant relationship between the quantity of ANC and maternal emergency level (p-value <0.05). Mothers who made ANC visits <6 times had 11.4 times chance of being in the red triage emergency level compared to mothers who made ANC visits six times (POR = 11.4). A significant relationship between the quality of ANC and the maternal emergency level (p-value <0.05). Furthermore, mothers who received poor ANC quality had 3.857 times the likelihood of being in the red triage emergency level compared to mothers who received good ANC quality (POR = 3.857).

The quantitative study results (stage 1) provided information on the relationship between MCH Handbook utilization, the quantity and quality of ANC, and the maternal emergency level at the central general hospital. There was a significant relationship between the quantity of ANC and maternal emergency levels. Hence, the qualitative study (stage 2) aimed to deepen, strengthen, and clarify information from quantitative research results regarding the relationship of MCH Handbook utilization and the quality of the ANC to the maternal emergency level at the central general hospital.

In-depth interviews were conducted with mothers in maternal emergency cases, and triangulation was carried out with midwives and cadres. Qualitative study on MCH Handbook utilization produced the following themes: explanations from midwives, mothers' awareness of reading the MCH Handbook and mothers' perception of the MCH Handbook. The quality of ANC produced a theme of mothers' perceptions of the quality of ANC.

Maternal and Child Health Handbook Utilization

a. Explanation from Midwives

Some mothers said that they did not get an explanation from midwives regarding MCH Handbook utilization. One of the mothers said that the midwives informed her to read the MCH Handbook at home and brought it to every pregnancy checkup.

> *"They only gave (the MCH Handbook) and told me to read it but did not explain the function." [Mother 4]*

In the in-depth interviews with the midwives, they said that some forgot to explain the MCH Handbook's function because there was no time.

> *"... Our weakness was that some of us often forgot to explain its (MCH Handbook) function." [Midwife 4]*

The cadres also said the same concern. The conclusion of the in-depth interviews with the respondents (mothers, midwives, and cadres) was that some mothers did not get an explanation about the benefits of the MCH Handbook.

b. Mothers' Awareness of Reading the Maternal and Child Health Handbook

There were three aspects in MCH Handbook utilization: a medium for recording ANC (documentation), behavioral change and self-monitoring. An in-depth examination regarding mothers' awareness of reading the MCH Handbook was conducted to assess MCH Handbook utilization.

> *"I do not read (MCH Handbook) books because my pregnancy felt safe." [Mother 3]*

The midwives and cadres also provided the same information.

> *"Many pregnant women do not read the MCH Handbook because they view pregnancy checks as routine. Pregnant women consider the MCH Handbook only as a complement. When they got home, sometimes they had not given birth yet, but the handbooks had been damaged. If pregnant women feel they need the MCH Handbook, they will maintain it" [Midwife 3]*
>
> *"Pregnant women were busy, so they rarely read the MCH Handbook…." [Cadre 3]*

After in-depth interviews with mothers, midwives, and cadres, it could be concluded that mothers' awareness of reading the MCH Handbook was still lacking. Mothers thought their pregnancy was going well, did not have time to read the MCH Handbook and were busy doing housework.

c. Mothers' Perception of the Maternal and Child Health Handbook

The informants perceived that the MCH Handbook, if explained by health providers and read by mothers, could prevent maternal emergency cases. The following were an excerpt from the results of the in-depth interviews with mothers:

> *"Yes, there was, maybe there was an explanation in the MCH Handbook, but that's because it was not read and not explained by the midwives….." [Mother 3]*
>
> *"Yes, if from the beginning, the midwives had explained the benefits of the MCH Handbook……." [Mother 5]*

Similarly, the midwives and cadres stated the following:

> *"Yes, it is possible. If we do it according to the procedure (MCH Handbook utilization), we can detect early symptoms and signs of pregnancy complications" [Midwife 1]*
>
> *"Yes, there are instructions in the MCH Handbook, like having a seizure during pregnancy. What is it again…, they are all in the MCH Handbook. Pregnant women have to read that. There's enough information in that MCH Handbook." [Cadre 3]*

The interview with the informant concluded that using the MCH Handbook was related to emergency cases; reading it and following the procedures would allow the early detection of mothers' emergencies.

Quality of Antenatal Care

The in-depth interviews with mothers with maternal emergency cases showed that they were satisfied with the ANC services. The midwives and cadres also stated the same, indicating that the overall quality of ANC was good and satisfying.

"Satisfied, seizures came suddenly……." [Women 1]

"The quality of ANC 10T can detect complications if the solution was found immediately." [Midwife 2]

The results of the interviews with cadres as informants showed that the quality of the ANC examination was good, with the support of sophisticated tools. In conclusion, the in-depth interviews showed that the mothers were generally satisfied with the ANC examination services they received.

Discussion

Relationship between Maternal and Child Health Handbook Utilization and Maternal Emergency Levels

Maternal emergencies can develop due to complications that are not correctly identified, monitored, or managed and are largely preventable.[25] The MCH Handbook can increase knowledge of complications in pregnancy to prevent maternal emergencies. A study conducted at the largest hospital in Bhutan showed a significant association between mothers reading maternal and child health handbooks and knowledge of obstetric danger signs (p-value = 0. 043).[26] Yanagisawa, *et al.*, stated that pregnant women in Cambodia who used the MCH Handbook experienced increased knowledge of danger signs during pregnancy, such as swelling, persistent vomiting and convulsions.[27]

This study also showed that mothers did not read the MCH Handbook because they were busy taking care of the household. Tamang, *et al.*, stated that 66% of pregnant women did not read the MCH Handbook as a source of information on obstetric danger signs.[26] The current study revealed that MCH Handbook utilization was related to mothers' behaviors. Ainiyah, *et al.*, stated that there was a relationship between the use of the MCH Handbook and the healthy behaviors of pregnant women.[15]

The results of the qualitative study in this study suggested that explanations of the MCH Handbook and its function were lacking. Green analyzed how a person's health behavior is influenced by two main factors: behavioral and non-behavioural causes. Behavior is formed from three aspects: the presupposing factor (maternal knowledge), the enabling factor (availability of time) and the reinforcing factor (provider behavior).[28] The use of the MCH Handbook can be supported by the driving factors that manifest in midwives' attitudes and behaviors in providing ANC services to shape community behavior.[15]

There is a need for cooperation between mothers and midwives in using the MCH Handbook to detect complications that end in maternal emergency cases early. Midwives who provide MCH services must facilitate the understanding and application of the MCH Handbook by mothers.[29] Clear communication is a crucial component of any interaction between midwives and patients and needs to be consciously considered effective.[30]

Relationship between Quantity of Antenatal Care and Maternal Emergency Level

Mothers who had ANC visits had a reduced incidence of maternal emergencies compared to those without a history of ANC visits.[31] Similarly, the optimal number of ANC visits would prevent the occurrence of maternal emergencies.[32] The number of ANC visits recommended by the WHO was eight: one contact in the first trimester, two in the second trimester, and five in the third trimester.[7] The latest policies in Indonesia regarding the minimum number of ANC visits are contained in the 2020 MCH Handbook and the Indonesian Ministry of Health Regulation No. 21 of 2021, stating that ANC visits should be made at least six times (K6): two in the first trimester, one in the second trimester, and three in the third trimester.[19]

As recommended, the standard number of ANC visits would detect complications early and obtain appropriate and timely services.[31,32] There was a difference in the incidence of complications between mothers who had complete and incomplete ANC visits.[33] The number of ANC visits was significantly related to the mother's knowledge of danger signs during pregnancy. Mothers who visited the ANC clinic four times were 11 times more likely to know about the danger signs during pregnancy than mothers who only made one visit.[34] There was a relationship between pregnant compliance in carrying out ANC examinations and the ability to detect complications early.[35]

One of the barriers to accessing and utilizing ANC was the economic factor. Mothers with better economic status make more ANC visits than mothers with lower economic status.[36] Routine examinations during ANC aim to detect and intervene if complications are found in pregnancy to prevent maternal emergencies.[37] The first ANC visit provides an important opportunity for the midwife to teach mothers to recognise the danger signs of complications during pregnancy, labor and delivery and encourage them to plan a clean and safe delivery.[33] In the range of midwifery services, ANC is an essential part

of health services, including health promotion, screening, diagnosis and disease prevention.[7]

Relationship between the Quality of Antenatal Care and Maternal Emergency Level

Maternal emergency cases can occur due to undetected complications. Antenatal check-ups can help pregnant women prepare for childbirth and obtain information on childbirth complications and the benefits of giving birth with trained midwives. Antenatal check-ups carried out by trained personnel enable the detection of problems faced by pregnant women who require special services.[38] The incidence of complications differs between midwives who provide ANC services according to standards and midwives who offer ANC services that do not meet standards.[39]

The WHO recommends five principles (nutrition in pregnancy, maternal and fetal assessment, preventive measures, interventions for managing physiological symptoms in pregnancy and health system-level interventions) in ANC to improve the utilization and quality of ANC.[7] This enables health providers to identify risk factors and provide appropriate care.[21] This is in line with the recommendation from the Indonesian Ministry of Health that quality antenatal services include record taking, examination, follow-up, recording of examination results and IEC.[19]

The results of the qualitative study in this study showed that the participants reported being satisfied with their received ANC examinations. These results are similar to those of Hussein and Worku, stating that more than half of the respondents were satisfied with the ANC services.[40] Ensuring the quality of ANC services requires infrastructure, trained medical personnel, infection control facilities, diagnostic equipment, consumables, essential medicines, and proper policy enforcement.[40]

Strengths and Limitations

The results of this study complemented previous studies on MCH Handbook utilization and the quantity and quality of ANC at the maternal emergency level. This was the first study to analyze the relationship between MCH Handbook utilization and the quantity and quality of ANC and the level of maternal emergencies. The results showed that the relationship was statistically significant.

A qualitative study clarified and deepened the results of a quantitative analysis. This study showed that MCH Handbook utilization was still ineffective. The quantity and quality of ANC were quite good, but they could not detect early cases of maternal emergencies. The results of the qualitative study showed that not all the mothers received an explanation regarding the benefits of the MCH Handbook from midwives, mothers' awareness of reading the MCH Handbook and mothers' perception of the MCH Handbook. The mothers stated that they were satisfied with the quality of the ANC received, even though they could not detect early cases of maternal emergencies. This was a source of evaluation for the improvement of ANC services.

However, this study has several limitations: no data were available regarding the midwives' understanding of the quality of the ANC; the variable quality ANC was assessed based on the 10 T criteria, so it could not reveal the process of implementing ANC; and qualitative data were collected via in-depth interviews only.

Conclusion

MCH Handbook utilization remains underutilized, and although the quantity and quality of ANCs are reasonably good, they cannot detect obstetric complications early. Not all the midwives explained how the MCH Handbook should be utilized, and most mothers do not read their MCH Handbooks. The mothers are satisfied with ANC services despite the inability to identify early obstetric complications that ultimately lead to maternal emergencies. Midwives should consistently explain the benefits of the MCH Handbook and improve their competence in quality ANC services to detect complications and prevent maternal emergencies with the support of professional organizations and the health office. For further study, the understanding of midwives about the quality of ANC can be assessed, and the process of implementing ANC can be evaluated.

Abbreviations

MMR: Maternal Mortality Rate; WHO: World Health Organization; ANC: Antenatal Care; MCH: Maternal and Child Health; IEC: Information, Education, and Communication; CEmONC: Comprehensive Emergency Obstetric and Neonatal Care; ATS: Australian Triage System; PHC: Primary Health Care; POR: Prevalence Odds Ratio; CI: Confidence Interval.

Ethics Approval and Consent to Participate

This study passed the research ethics review by the Research Ethics Committee of the Faculty of Medicine, Andalas University, with license number No.707/UN/16.2/KEP-FK/2022. This study also passed an ethical review by the Ethics Committee of the Central General Hospital in Padang City, with license number LB/02/02/5.7.163/2022. Informed consent was obtained from the participants.

Competing Interest

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

Availability of Data and Materials

The data and materials in this study are available to the corresponding author upon request.

Authors' Contribution

Conceptualization: RAN, YW; study design: RAN, JS; writing–original draft: RAN; framework: RAN, YW; data interpretation: JS, RAN; editing: RAN.

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Understanding the Health-related Quality of Life of People Living with HIV Based on Sexual Orientation

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Abstract

Human immunodeficiency virus (HIV) infection has detrimental impacts on the lives of different population groups living with HIV, including men who have sex with men (MSM). Using the World Health Organization Quality of Life questionnaire, this study aimed to assess the health-related quality of life of men living with HIV with different sexual orientations and to determine the dominant influential factors. This cross-sectional study involved 206 men living with HIV. They were recruited from the Sriwijaya Plus Foundation and a medical facility that provided antiretroviral therapy. The data were analyzed using Chi-square and binomial logistic regression. The analysis showed that the percentage of MSM patients was greater than that of non-MSM patients, accounting for 68.9% of the total population. The multivariate logistic regression revealed that the most dominant influential factor was depression status (PR = 6.268; 95% CI = 2.811–13.975), with the majority of the depressed patients being 6.268 times more at risk of a lower quality of life compared to others. These findings suggest that depression can lead to a low quality of life among HIV patients.

Keywords: depression, HIV, men who have sex with men, sexual orientation

Introduction

Human immunodeficiency virus (HIV) infection is a global public health issue with high morbidity and mortality rates.[1,2] The UNAIDS data reported an estimated 37.7 million people living with HIV (PLHIV) globally in 2020, with Eastern and Southern Africa, Asia, and the Pacific at the top position, accounting for 20.6 million and 5.8 million PLHIV, respectively.[3] In Indonesia, the AIDS national report shows an estimation of more than five thousand PLHIV in 2021, with less than 50% (144,632) actively on antiretroviral therapy (ART).[4]

HIV infection has been reported to cause PLHIV with various detrimental impacts, including psychological, social (stigma and discrimination), and economic impacts.[5,6] These impacts, compounded with many other factors, can also lead to further negative impacts and result in reduced or poor quality of life (QoL) of PLHIV. Studies investigating the QoL of PLHIV have reported that PLHIV experienced poor QoL in several domains, such as physical health, psychological health, level of independence, social relationships, and environmental and spirituality domains.[7,8]

Studies have also suggested several factors associated with poor QoL of PLHIV in general, including a low level of educational attainment, unemployment status, perception of being ill, and dissatisfaction with sexual activity.[7,9–11] The experiences of family food insecurity, polypharmacy use, the advanced state of HIV infection, and psychiatric comorbidities are also factors associated with poor QoL among PLHIV.[10–12] The use of illicit drugs, which negatively influence the physical and mental well-being of PLHIV, was also found to cause poor QoL among them.[13] Stigma, perceived discrimination, adverse effects of ART, non-adherence to ART, and low family income are factors associated with poor QoL among men who have sex with men (MSM) living with HIV.[14,15]

Previous studies have also reported factors associated with good QoL of PLHIV to include being employed, having no financial concerns, not having mental health issues (e.g., stress, depression, anxiety) and other medical comorbidities, higher education level, and undergoing ART.[8,9,13,16,17] Other supporting factors for good QoL of PLHIV include the availability of social support, such

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as emotional, tangible, and informational support, and having good coping strategies toward HIV-related difficult life situations. Similarly, studies on MSM living with HIV have reported that their better acceptance of the illness, family acceptance, and peer support are positively associated with their better QoL.[18-21]

Despite a range of factors associated with poor or good QoL of PLHIV, as reported in the previous studies, none of these studies reported a global comparison of QoL of MSM living with HIV and non-MSM living with HIV or heterosexual men. In Indonesia, there is limited evidence and studies exploring the QoL of different population groups living with HIV.[18,20,21] Therefore, this study aimed to compare the QoL of men living with HIV with different sexual orientations and determine the dominant factors affecting their QoL.

Method

This study used a quantitative approach with a cross-sectional design, and the sample population consisted of 1,180 HIV patients. The sample was calculated using a two-proportion hypothesis test formula from Lemeshow, *et al*.[22] Subsequently, a total of 206 respondents (MSM = 142; non-MSM = 64) were recruited using purposive sampling. They were registered with the Care Support and Treatment (CST) service and the Sriwijaya Plus Community in Palembang City.

The respondents' QoL was measured using the World Health Organization Quality of Life-HIV BREF (WHO-QOL-HIV BREF) instrument, consisting of six domains: physical, psychological, level of independence, social relationships, environment, and spirituality. Each domain was rated on a 5-point Likert scale, where 1 indicates low and negative perceptions, and 5 shows high positive perceptions. The validity and reliability tests of the instrument were carried out in Indonesia. The validity test revealed a strong correlation coefficient (r = 0.60–0.79); while the Cronbach's alpha value obtained from the reliability test was in the medium and good categories (0.513–0.798).[23]

Depressive symptoms: The symptoms evaluated included the psychological state of the respondents within the last two weeks before the survey. Furthermore, their depression status was measured using the Patient Health Questionnaire-9 (PHQ-9), and the answers were assigned different scores: never (0), several days (1), more than a week (2), and almost every day (3). The PHQ was a self-administered version of the Primary Care Evaluation of Mental Disorder diagnostic instrument for common mental disorders. Depression status was grouped into two categories, where scores of 5–27 indicated a depressed state, while 0–4 were categorized as not depressed.[24]

Social stigma: This is a negative mark or view received by people living with HIV/AIDS, and it was assessed using the Berger HIV Stigma Scale instrument, in which the total score ranged from 25 to 125. The categorization was carried out using a cut-off point formula of 75% of the total score (125), in which values ≥93.75 indicated high stigma, while values <93.75 were in a low category. The validity and reliability test of the Indonesian version of the Berger HIV Stigma Scale questionnaire (40 items) conducted by Nurdin obtained a Cronbach's alpha value of 0.94. In contrast, a value of 0.93 was recorded on the short version, consisting of 25 items.[25]

Family support: This includes the support received by PLHIV from family members, such as husband, wife, and children, as well as biological relatives (father, mother, brother, and sister) caring for them during illness. This support could take various forms, including informational, emotional, instrumental, and appreciative support. It was measured using an instrument developed by Arikunto, in which the total score ranged from 18 to 90. The categorization was carried out using a cut-off point formula of 75% of the total score, in which values <67.5 indicated low support, while others ≥67.5 were in the high category. A Cronbach's alpha value of 0.6 was obtained from the reliability results.[26]

Occupation: Information on the respondent's occupation was obtained through interviews with the available questions in a structured questionnaire. Their occupations were then categorized into "unemployed" or "employed" for further analysis.

Duration of ART: Information on the respondent's duration of ART was obtained through interviews using the available questions in a structured questionnaire. The durations were categorized into "<1 year" or "≥1 year" for further analysis.

Duration of living with HIV: Information on the respondent's duration of HIV infection was collected through interviews with the available questions in a structured questionnaire. The durations were then categorized into "<5 years" or "≥5 years" for further analysis.

The data were analyzed statistically in three stages. The analysis began with data completion by editing, coding, and entering. The refined data were further analyzed using univariate, bivariate, and multivariate methods. Furthermore, univariate analysis was conducted to describe the characteristics and distribution of each variable: sex, occupation, marital status, income, age, degree, QoL, social stigma, duration of ART (years), duration of living with HIV (years), family support, and depression symptoms. Bivariate statistical analysis was applied to the Chi-square test to explore the relationship between the independent variables and QoL. To determine the dominant factors, a multivariate analysis was performed using a multiple logistic regression test. The significance of the

multivariate analysis was 5% alpha. If the p-value <0.05, it means that the independent variables significantly could predict QoL.

Results

Based on descriptive analysis, the demographic characteristics of the respondents showed that there were more MSM patients than non-MSM/heterosexual men, accounting for 68.9% of the study sample. Table 1 reveals that within the MSM group, 68.1% have a job, 71.2% have incomes below the minimum wage, 71.2% are not married, and 76.9% are below the age of 30 years. Furthermore, 64.8% have an undergraduate degree, 68.8% are undergoing ART, and 70.2% are not depressed. The analysis also showed that 63.9% of the MSM participants experienced stigma, 72% had been diagnosed with HIV for less than five years, 80.6% received low family support, and 71% had a low QoL.

Table 1. Demographic Characteristics of People Living with Human Immunodeficiency Virus Based on Sexual Orientation

Variable	Category	Sexual Orientation			
		MSM (n = 142)		Non-MSM (n = 64)	
		n	%	n	%
Sex	Male	142	68.9	64	31.1
Occupation	Unemployed	18	75.0	6	25.0
	Employed	124	68.1	58	31.9
Marital status	Single	126	82.9	26	17.1
	Married	12	27.3	32	72.7
	Widower	4	40.0	6	60.0
Income	<regional minimum wage	94	71.2	38	28.8
	≥regional minimum wage	48	64.9	26	35.1
Age (years)	<30	80	76.9	24	23.1
	≥30	62	60.8	40	39.2
Education	Elementary school	2	28.6	5	71.4
	Junior high school	7	70.0	3	30.0
	Senior high school	81	72.3	31	27.7
	Diploma	15	75.0	5	25.0
	Undergraduate	35	64.8	19	35.2
	Graduate	2	66.7	1	33.3
Quality of Life	Low	76	71.0	31	29.0
	High	66	66.7	33	33.3
Social stigma	High	43	84.3	8	15.7
	Low	99	63.9	56	36.1
Duration of ART (years)	<1	23	69.7	10	30.3
	≥1	119	68.8	54	31.2
Duration of living with HIV (years)	<5	118	72.0	46	28.0
	≥5	24	57.1	18	42.9
Family support	Low	108	80.6	26	19.4
	High	34	47.2	38	52.8
Depression symptoms	Depressed	36	65.5	19	34.5
	Not depressed	106	70.2	45	29.8

Notes: MSM = Men who have Sex with Men, HIV = Human Immunodeficiency Virus, ART = Antiretroviral Therapy.

Table 2. Descriptive Analysis of the Health-related Quality of Life of People Living with Human Immunodeficiency Virus Based on Sexual Orientation

Quality of Life Domain	MSM (n = 142)		Non MSM (n = 64)	
	Mean±SD	Min–Max	Mean±SD	Min–Max
Physical	13.75±2.98	6–19	14.58±2.88	5–20
Psychological	14.33±2.63	5.6–20	14.01±2.10	8–18.4
Level of independencies	14.52±2.39	7–19	13.77±2.01	7–18
Social relationship	13.65±2.61	8–20	13.48±2.89	8–20
Environment	13.81±2.15	8.5–20	13.58±2.29	9–20
Spiritual	13.08±3.76	4–20	14.23±3.54	6–19
Individual perception of QoL	3.84±0.89	1– 5	3.63±0.81	1–5
Individual perception of health	3.76±0.86	2–5	3.58±0.89	2–5

Notes: MSM = Men who have Sex with Men, SD = Standard Deviation, Min = Minimum, Max = Maximum, QoL = Quality of Life.

Table 3. Predictors of Health-related Quality of Life

Variable	Category	Quality of Life				p-value	PR (95% CI)
		Low		High			
		n	%	n	%		
Depression status	Depressed	45	81.8	10	18.2	<0.001	1.993 (1.586–2.503)
	Not depressed	62	41.1	89	58.9		
Social stigma	High	36	70.6	15	29.4	0.004	1.541 (1.204–1.972)
	Low	71	45.8	84	54.2		
Family support	Low	80	59.7	54	40.3	0.004	1.592 (1.146–2.212)
	High	27	37.5	45	62.5		
Occupation	Unemployed	16	66.7	8	33.3	0.187	1.333 (0.970–1.833)
	Employed	91	50.0	91	50.0		
Duration of ART	<1 year	23	69.7	10	30.3	0.042	1.435 (1.093–1.885)
	1 year	84	48.6	89	51.4		
Duration of living with HIV	<5 years	91	55.5	73	44.5	0.066	1.457 (0.967–2.193)
	5 years	16	38.1	26	61.9		

Notes: PR = Prevalence Ratio, CI = Confidence Interval, HIV = Human Immunodeficiency Virus, ART = Antiretroviral Therapy.

Table 4. Multivariate Analysis of Health-related Quality of Life

Risk Factor	Category	β	p-value	Adjusted PR (95% CI)
Depression status	Depressed	1.690	<0.001	6.268 (2.811–13.975)
	Not depressed	Reff		
Duration of ART	<1 year	0.493	0,002	2.723 (1.426–5.198)
	≥1 year	Reff		
Social stigma	High	0.919	0.013	2.506 (1.213–5.176
	Low			

Notes: PR = Prevalence Ratio, CI = Confidence Interval, ART = Antiretroviral Therapy.

The evaluation of the participants' QoL showed that non-MSM/heterosexual men had a better QoL in the physical domain. However, the MSM group was better in terms of psychological aspects, independencies, social interaction, environmental domain, and perception of health, as shown in Table 2. The bivariate analysis showed that depression status, social stigma, family support, and the duration of ART and HIV infection were significantly correlated with the QoL of MSM and non-MSM with a p-value = <0.001, as shown in Table 3.

The multivariate analysis using logistic regression revealed that the most influential factor was depression status (p-value = <0.001, prevalence ratio (PR)Adj = 6.268; 95% confidence interval (CI) = 2.811–13.975) in both the MSM and non-MSM groups. The findings indicated that depressed HIV patients were 6.268 times more at risk than others, as shown in Table 4.

Discussion

The study suggested that the MSM group had lower QoL compared to the non-MSM/ heterosexual men. The higher prevalence of depression among the MSM group compared to the non-MSM group was a possible explanation for their experience of low QoL. The findings of this study confirmed previous findings indicating that depression was common among PLHIV due to their experience of health status deterioration, negative side effects of ARV therapy, and apathy following their HIV diagnosis.[27,28]

A previous study suggested that depression, consisting of a series of disorders, could negatively affect sleep, weight loss, appetite, health-seeking behaviors, and motivation of the PLHIV, which in turn could further deteriorate their health and psychological well-being.[29] Depression is one of the most common psychiatric disorders, negatively impacting the adherence and outcomes of ARV therapy among PLHIV.[30,31] The QoL of the MSM population found in this study was negatively influenced by several factors, including social inequalities, lack of health programs prioritizing their needs, and social rejection by family members, communities, and various institutions in Indonesia. Such rejection toward the MSM populations was mainly due to the unacceptance of same-sex relationships, which are considered taboo and sinful.

The findings of this study showed that such perceived

and internalized stigma led to an increase in the intensity of depression among MSM and non-MSM. They also influenced both groups of patients' health behaviors and led to non-disclosure of HIV status to partners, poor adherence to ARV therapy, increased risk of developing drug resistance, restricted access to health services, and reduced health-related QoL. These findings were in line with the results of previous studies suggesting the association of stigma with poor physical life quality among PLHIV.[32,33]

Despite numerous efforts to reduce the negative impact of HIV-related stigma, patients or PLHIV are still stigmatized in various contexts, including within families, communities, workplaces, and health care settings.[32,34-36] This study also suggested that there was a significant relationship between QoL and family support among both MSM and non-MSM with HIV. This finding was consistent with previous reports that family support was associated with encouragement and the absence of stigma and discrimination against PLHIV.[37] This study found that negative treatment and stigma toward PLHIV also negatively impact their daily activities and influence their access to health care services or willingness to undergo health care and treatment. This, in turn, will exacerbate their health condition and result in negative health outcomes.

Strategies to improve the QoL of PLHIV included strengthening support and family care for them and promoting HIV screening among high-risk populations. Family supports include encouraging medication adherence, overcoming discrimination, encouraging early ARV therapy initiation, and supporting regular attendance of therapy, which can reduce loss to follow-up.[38] Adherence to therapy strongly supports the QoL of PLHIV. This study indicated that the length of treatment is significantly related to improving the QoL of PLHIV. This finding was consistent with previous studies that associated being on ARV therapy with good QoL of PLHIV.[8,9]

The intake of ARV therapy helps lower viral load, improve physical immune function, and reduce opportunistic infections and comorbidities. It also increases the patient's productivity, social inclination, and QoL. ARV therapy is a key component of increasing longevity and controlling other infectious diseases, and it has a significant long-term contribution to improving health-related QoL.[39] Ideally, PLHIV are suggested to adhere to ARV therapy to suppress viral load or to achieve viral load suppression in their body. Viral suppression will not only contribute to better health outcomes, but also enable their body to function properly in any activities they engage in, and it will positively contribute to improving their QoL.

The findings of this study provided valid and complete information on the QoL of PLHIV. Such information is the main contribution to the body of knowledge, as it fills in the gap in the paucity of information and understanding about the association between sexual orientation and the QoL of PLHIV who do not disclose their sexual orientations and are under-researched.

There is a possibility of information bias in this study, as the participants were not open or reluctant to talk about their sexual orientation at the beginning of the interviews. This problem was solved through discussion and coordination with Sriwijaya Plus Community, which supported the respondents in their daily activities. This solution resulted in the participants being open and encouraged to actively participate in the study and respond to the study questions without any hesitation. However, for generalizability purposes, further studies with a larger sample size and intervention studies involving both MSM and non-MSM populations are recommended.

Conclusion

The results of this study show that the average physical and spiritual life quality of HIV patients with MSM sexual orientation was higher than that of others in the non-MSM category. They also have better psychological well-being, independence level, social relationships, environment, and perceptions of health. The QoL of this population can be improved by providing vital support, reducing stigma, and paying attention to stress levels and therapy adherence.

Abbreviations

HIV: Human Immunodeficiency Virus; PLHIV: People Living with HIV; ART: Antiretroviral Therapy; QOL: Quality of Life; MSM: Men Having Sex with Men; CST: Care Support and Treatment; WHOQOL-HIV BREF: World Health Organization Quality of Life-HIV BREF; PHQ-9: Patient Health Questionnaire-9; PR: Prevalence Ratio; CI: Confidence Interval; SD: Standard Deviation.

Ethics Approval and Consent to Participate

This study was approved by the Ethical Review Committee of the Faculty of Public Health Sriwijaya University, with reference number 149/UN9.FKM/TU.KKE/2021.

Competing Interest

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

Availability of Data and Materials

All data and related materials from this study are available and can be provided by the first author

Authors' Contribution

RJS designed the study, developed a data instrument for data collection analysis and drafted the manuscript. NKF contributed to drafting and

proofreading the e-manuscript. NYA contributed to the interpretation of the results, as well as the reviewing and editing of the article. Furthermore, RVS contributed to the proofreading and editing of the article, while MNP assisted in the literature review and editing. All coauthors reviewed and approved the final manuscript before submission.

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