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Spatial pattern of health human resources factors associated with maternal mortality in Indonesia

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ABSTRACT

Background: Indonesia's Maternal Mortality Rate (MMR) in 2022 was still higher than the Sustainable Development Goals (SDGs) target. Previous studies have not paid attention to inadequate Health Human Resources (HHR), its distribution over the country and association with MMR.

Objectives: This study aimed to describe the spatial distribution of HHR and MMR and analyse the association between HHR and MMR in Indonesia.

Methods: This cross-sectional study used the data from Indonesian Health Profile 2022, consist of 34 provinces for spatial pattern and 33 provinces for statistical analysis. The outcome of this study was MMR per 100,000 live births. The independent variables were the ratio of obstetricians per 10,000 population and the ratio of total midwives per 10,000 population.

Results: Of the total 34 provinces in Indonesia, West Papua had the highest MMR, and 9 provinces with MMR<70/100,000 live births. The majority of the provinces (69.7%) had a high MMR (>70 per 100,000 live births). Similarly, most of the provinces (66.7%) had a ratio of obstetricians <0.19 per 10,000 population, and almost all provinces (81.8%) had a ratio of midwives >10 per 10,000 population. The lower ratio of obstetricians was most likely to have a high MMR 5.4 times (95% CI: 1.08 to 26.93, P-value: 0.042) compared to the higher ratio of obstetricians.

Conclusion: Obstetricians were HHR associated with MMR in Indonesia but midwives were not. So, the government should increase the ratio of obstetricians and improve the quality of midwives.

Keywords: Maternal mortality, Midwife, Obstetrician

1. Introduction

Reducing the Maternal Mortality Rate (MMR) to 70 per 100,000 live births or less is a key target of the Sustainable Development Goals (SDGs) [1]. However, MMR in Indonesia remains high at 173 per 100,000 live births [2]. Furthermore, maternal mortality reporting in Indonesia primarily relies on absolute numbers rather than MMR [3]. Notably, the use of MMR per 100,000 live births to map the magnitude of the maternal mortality problem often provides different insights compared to absolute maternal mortality figures [4].

Moreover, the trend of MMR in Central Java Province, Indonesia was negatively affected by the ratio of obstetrics-gynaecology specialist, nutritional personnel, general practitioners [5]. In fact, obstetricians and midwives are key health human resources involved in the prevention of maternal mortality, as outlined in Law No.17 of 2023 concerning to health [6]. Although, research on obstetricians and midwives as HHR in preventing maternal mortality in Indonesia remains limited and their distribution across the country has not been thoroughly evaluated. Therefore, this study aimed to describe the spatial pattern of HHR and MMR and analyse association between HHR and MMR in Indonesia.

2. Methods

2.1 Study Area

This study included all provinces (34 provinces) in Indonesia based on the Indonesia Health Profile 2022. Each province has a provincial health office that supervises health offices at the district or city level. Geographically, Indonesia is located between 6˚ North Latitude to 11˚ South Latitude and 95˚ to 141˚ East Longitude [3].

2.2 Study Design

This was a cross-sectional study. The dependent variable was MMR (per 100,000 live births) while the independent variables were the ratio of obstetricians per 10,000 population and the ratio of midwives per 10,000 population based on the Indonesian Health Profile 2022 [3]. The MMR was obtained by dividing the absolute number of maternal deaths in 2022 by the number of live births in the same year and multiplying the result by 100,000.

2.3 Population and sample size

The population of Indonesia is approximately 284.54 million [7]. The ratio of obstetricians in Kalimantan Utara (North Borneo) was

missing therefore, the unit of analysis in this study was 33 provinces [3].

2.4 Data Collection

The secondary data was obtained from the Indonesian Health Profile 2022 [3].

2.5 Data Analysis

Spatial pattern was conducted using QGIS software (Version 3.38). The North Borneo Province which lacked data on obstetricians was treated as having a value of zero (0). Due to the missing data, the North Borneo Province was excluded from statistical analysis. Then, MMR was categorized based on the SDGs target (70 per 100,000 live births). Initially, the ratio of obstetricians and midwives were expected to be categorized based on the WHO minimum standard of 1:1,000 or 10 per 10,000 population [8]. However, due to the shortage of obstetricians across all provinces, the categorization of the obstetrician ratio was based on the mean per 10,000 population. Furthermore, univariate analysis was conducted for each variable with frequency and percentages used for categorical data, and mean, standard deviation, median, minimum, and maximum values for continuous data. Bivariate analysis was then performed with a significance level of 0.05. All of these analyses were performed using SPSS software.

2.6 Ethical Clearance

Ethical clearance for this research was obtained from Komisi Bioetika Penelitian Kedokteran/ Kesehatan Fakultas Kedokteran Universitas Sultan Agung Semarang (Medical/Health Research Bioethics Commission, Faculty of Medicine, Sultan Agung University, Semarang), Indonesia with number 314/IX/2021/Komisi Bioetik.

3. Results

In one province (North Kalimantan) the number of obstetricians was not recorded (missing data). For spatial pattern, this was treated as 0 (zero), as excluding missing data would result in the removal of the entire map. The median ratio of obstetricians was 0.14 per 10,000 population while the median ratio of midwife was 16.58 per 10,000 population. The highest provincial MMR in Indonesia reached 222.29 per 100,000 live births while the lowest was 24.31 per 100,000 live births.

Spatial pattern of MMR from 34 provinces in Indonesia showed that only Papua Barat (West Papua) province had an MMR of more than 173 per 100,000 KH. This indicated that West Papua Province had a higher MMR than the national average. West Papua Province recorded the highest MMR among all provinces in Indonesia (Figure 1).

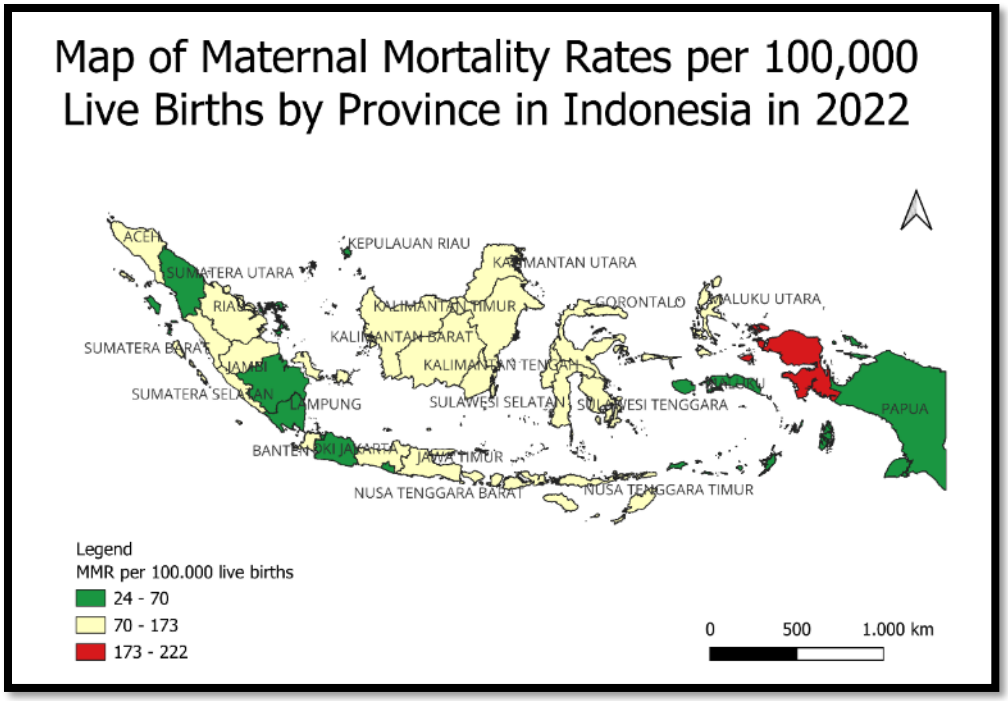

Figure 1: Map of Maternal Mortality Rates per 100,000 Live Births by Province in Indonesia in 2022

The results of the spatial pattern of ratio of obstetricians in Figure 2 showed that 5 out of 9 provinces with an MMR of less than 70 per 100,000 KH had an obstetrician ratio higher than the median. These provinces include: Sumatra Utara (North Sumatra), Sumatra Selatan (South Sumatra), Jakarta, Yogyakarta, and Kepulauan Riau (Riau Islands). Additionally, 13 out of 24 provinces with an MMR ratio between 70 and 173 per 100,000 KH had obstetrician ratio below the median. Notably, the provinces with the highest MMR also had obstetrician ratio higher than the median (Figure 2).

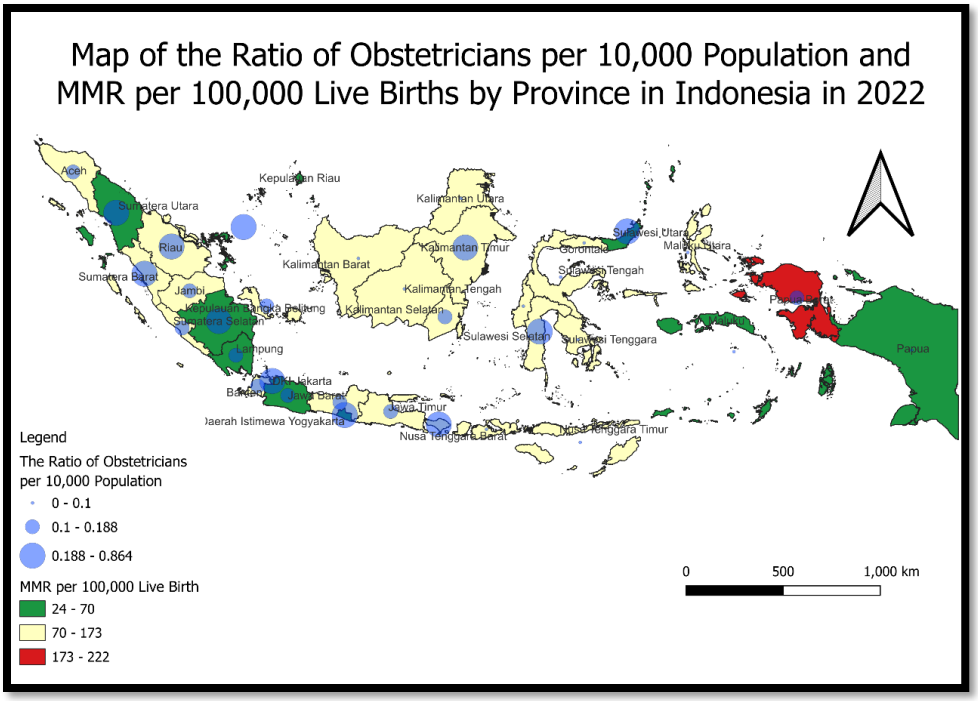

Figure 2: Map of the Ratio of Obstetricians per 10,000 Population and MMR per 100,000 KH by Province in Indonesia in 2022

The spatial pattern in midwife ratio per 100,000 population as shown in Figure 3 revealed that 6 out of the 9 provinces with an MMR of less than 70 per 100,000 KH had a midwife ratio lower than the median. These provinces include: Kepulauan Riau (Riau Islands), Lampung, Jakarta, Yogyakarta, Jawa Barat (West Java), and Papua. Furthermore 14 of the 24 provinces with an MMR between 70and 173 per 100,000 KH had a midwife ratio higher than the median. Interestingly, even the province with the highest MMR had a midwife ratio higher than the median (Figure 3).

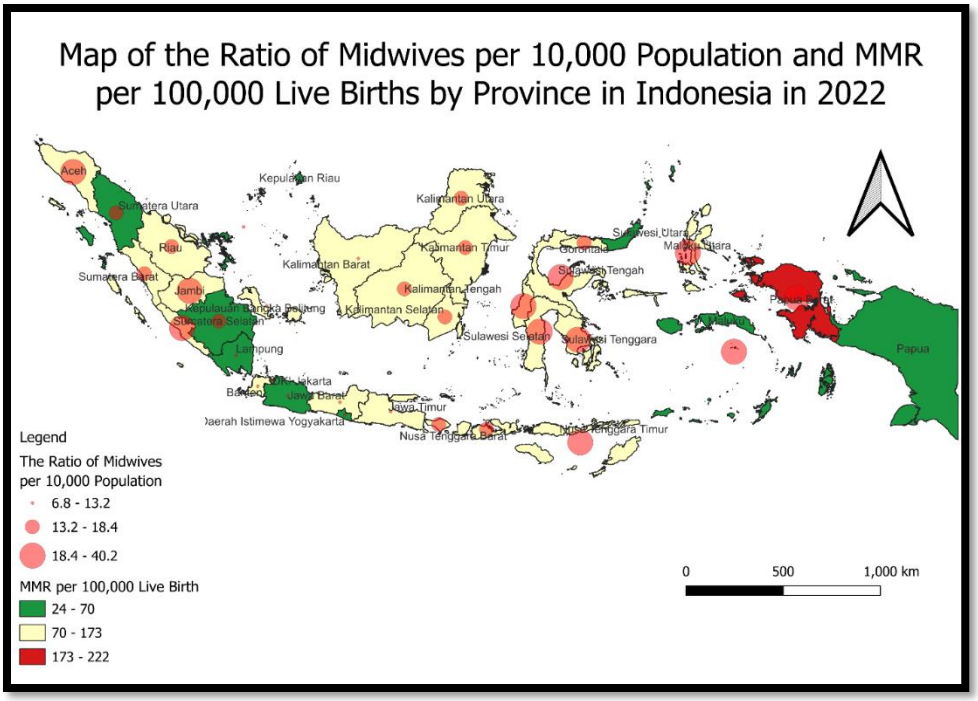

Figure 3: Map of Total Midwife Ratio per 10,000 Population and MMR per 100,000 Live Births by Province in Indonesia in 2022

Of 33 provinces in Indonesia the majority (81.8%) had MMR more than the SDGs target (70 per 100,000 live births), had ratio of obstetricians (66.7%) less than mean (0.19 per 10,000 population), and had a ratio of midwives (81.8%) more than minimum standard of WHO (10 per 10,000 population) (Table 2).

Table 1: MMR and Health Human Resource Factors (n=33)

Variables	Number (n)	Percentage
MMR (per 100,000 live births)		
High (>70)	23	69.7
Low (<70)	10	30.3
Mean (±SD)	92.66 (±40.63)	
Median (Min: Max)	90.58 (24.31: 222.29)	
The ratio of obstetricians (per 10,000 population)		
Lower than mean (<0.19)	22	66.7
Higher than mean (>0.19)	11	33.3
Mean (±SD)	0.19 (±0.16)	
Median (Min: Max)	0.15 (0.05: 0.86)	
The ratio of midwives (per 10,000 population)		
<10	6	18.2
>10	27	81.8
Mean (±SD)	16.90 (±7.56)	
Median (Min: Max)	15.99 (6.77: 40.16)	

From the result, the provinces with lower ratio of obstetricians per 10,000 population was associated with a 5.4 times higher likelihood of having a high MMR (95% CI: 1.08-26.93) compared to provinces with a higher ratio of obstetricians per 10,000 population. (Table 2).

Table 2: Health HR Factors Associated with MMR per 100000 Live Births (n=34)

Health Human Resources	Number of samples	Number of High MMR (%)	OR	95%CI	p-value
Overall	33	23 (69.7)	N/A	N/A	N/A
The ratio of obstetricians (per 10,000 population)					0.042
Less than mean (<0.19)	22	18 (81.8)	5.40	1.08-26.93	
More than mean (>0.19)	11	5 (45.5)	1	1	
The ratio of midwives (per 10,000 population)					0.245
Less than 10	6	3 (50)	0.35	0.06-2.15	
More than 10	27	20 (74.1)	1	1	

4. Discussion

The mapping of MMR in Indonesia in 2022 showed that the West Papua Province had the highest MMR. This condition appeared to be influenced by the province's geographic location, as it is second farthest from Jakarta, the capital city of Indonesia [9]. Moreover, a study on maternal and child health problems in West Papua Province showed that maternal and child health services faced structural challenges including issues with health facilities and infrastructure as well as institutional and regulatory problems. Socio-cultural obstacles such as local customs and habits also impacted maternal and child health behaviour [10]. However, a 2020 study done in West Papua Province showed that the province's education index and health development index were relatively strong, ranking better than the other regions on the same island and even outperforming other regions in the Eastern Indonesia [11].

In addition, the ratio of obstetricians in all provinces in Indonesia was lower than WHO minimum standard (<10 per 10,000 population). Unfortunately, no studies addressing this issue were found.

In contrast, most provinces in Indonesia had a ratio of midwives above than the WHO standard (>10 per 10,000 population). Although the average ratio of midwives per 10,000 population in Indonesia was much higher than the average ratio of obstetricians per 10,000 population, both ratios were still below 23 per 10,000 population. The 2006 World Health Report showed that countries

with a medical personnel ratio of less than 23 per 10,000 population generally failed to achieve health priority targets [8].

Those midwives were the product of from several kinds of education such as diploma, advanced diploma, bachelor's degree, and master's degree in midwifery [12]. They were then were categorized into ahli madya (diploma midwives) and bidan (professional midwives) based on the Minister of Health Decree No. 320 of 2020 concerning professional standards for midwives in Indonesia [13]. Meanwhile, midwifery education in New Zealand and Australia has been at the bachelor's degree level since 2000, with no diploma or advanced diploma options [14]. Midwifery education in developed countries (Australia, Canada, Europe, New Zealand, Ireland, and Norway) differs significantly from that of developing countries (Indonesia, East Africa, and Democratic Republic of Congo), as developed countries recognize a bachelor's degree as the minimum standard for midwifery education [15].

Furthermore, the ratio of obstetricians associated with the high MMR but the ratio of midwives did not significantly associated with MMR because the main causes of maternal mortality in Indonesia were hypertensive disorder and noncommunicable diseases [16] that were obstetrician authority in Indonesia and not midwives' authority. Also, a research in 2019 revealed that the number of doctors working at the community health centre (8.6%), the number of doctors in the village (6.9%) and distance to the nearest hospital (5.9%) were the most important contributors of maternal mortality in Indonesia beside health service access and characteristics that account for 23% of the difference in maternal mortality ratios between high and low-performing provinces [17]. Also, according to research in Indonesia in 2020, the number of residents, the ratio of obstetricians, and the ratio of hospitals had a positive association with childbirth in healthcare [18].

This finding was consistent with research in China, which highlighted that improving midwives' competencies is crucial in regions with high maternal mortality, where factors such as education, experience, teaching participation and access to in-service training influence their self-perceived ability to detect and treat pregnancy and childbirth-related complications [19].

In addition, another research in Australia revealed that most midwives (77.1%) gave limited attention to formally assessing

women's health literacy. Thirty to sixty percent of midwives either never or only sometimes used specific techniques to promote maternal health literacy, and the majority (75%) had not received training on health literacy [20]. Additionally, requiring midwives to be licensed was associated with a reduction in maternal mortality by 7%–8% and may have contributed to modest reductions in infant mortality [21].

Additionally, the midwives' personality were not only the factors influencing MMR, inadequate infrastructure such as lack of bed and physical space, logistical challenges, lack of motivation, and limited in-service training opportunities especially in rural areas, also played a role [22]. Moreover, 65% of research journals stated that the performance of midwives was classified as good with factors that influence performance in ANC services being knowledge, facilities and infrastructure, and length of service, so midwives were advised to continue learning, training, and following developments in science and technology [23]. On the other hand, a 2019 research on the association between the ratio of midwives and the performance of maternal and child health programs in Indonesia showed that coverage for K1, K4, neonatal visits, postpartum visits, and deliveries assisted by health workers in several provinces was successful even though the ratio of midwives was low [24]. However, another research in primary health care in Indonesia in highlighted that, apart from the availability and distribution of health human resources, task shifting and multitasking posed significant challenges and strategic issues in community health centres [25].

This study could not account for several confounders due to data unavailability or methodological constraints. Socioeconomic factors (e.g., education, income), geographic disparities (rural vs. urban settings), and cultural or behavioural influences (e.g., health-seeking behaviours, pre-existing conditions like hypertension or anaemia) were excluded due to incomplete or inconsistent data. Additionally, healthcare system variables, such as the quality of prenatal care and availability of skilled birth attendants, were not assessed due to a lack of standardized metrics. Lastly, underreporting or misclassification of maternal deaths may have introduced bias, affecting the findings' accuracy. Future research should address these gaps for a more comprehensive analysis.

5. Conclusion

The spatial pattern showed that West Papua had the highest MMR while most provinces with lower MMRs had a higher ratio of obstetricians but fewer midwives. Most provinces in Indonesia still had an MMR more than 70 per 100,000 live births, meaning they had not yet achieved the SDG's target. Majority of provinces in Indonesia also had obstetrician ratio lower than 0.19 per 10,000 population, which is below WHO's minimum standard. However, nearly all provinces in Indonesia had a ratio of midwives higher than 10 per 10,000 population, meeting WHO's minimum standard. Also, the statistical analysis showed a significant association between the ratio of obstetricians with MMR, but not significant association between the ratio of midwives with MMR. This could be attributed to the high cost and lengthy education required for obstetricians and many kinds of midwifery education in Indonesia.

As a matter of that, this study supports policies aimed at accelerating the number of obstetricians and improving the quality of midwives in Indonesia. Firstly, the government of Indonesia could provide scholarships for physicians to specialize as obstetricians and establish a bachelor's degree as the standard for midwifery education, replacing diploma or advanced diploma programs. Secondly, the government could spread the distribution of HHR evenly in every province based on the ratio to population number.

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