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Regional perinatal mortality differences in Indonesia: Evidence from Indonesian demographic health survey

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ABSTRACT

Aim: Perinatal mortality can be used as a reference to assess health status in a country. In Indonesia, none of previous studies specifically discuss the incidence of prenatal mortality by region. The objective of this study was to analyze perinatal mortality difference by region of Indonesia.
Study design: This study used a cross-sectional approach.
Method: The sample in this study was 13,310 women of childbearing age obtained from the Indonesian Demographic Health Survey (IDHS) 2017. The perinatal mortality rate was calculated using data on stillbirths with a gestational duration of seven months or more and early neonatal deaths. Perinatal mortality was analyzed by region using a binary logistic regression statistical test to examine the relationship between perinatal mortality and its factors (socio-demographic factors, individual disease control factors, and maternal factors).
Results: This study shows that the proportion of perinatal mortality in Indonesia is 1.5 % of total births. The highest proportion of perinatal mortality (2.5 %) was in the Papua region, while the lowest proportion (1.3 %) was in the Java region. The results of this study indicated that women in the Maluku Islands had a 1.82 times higher chance of perinatal mortality compared to the Java-Bali region. The causative variable associated with perinatal mortality in the Java-Bali and Papua regions was employment status. The causative variables associated with perinatal mortality in Kalimantan were the quality of antenatal care and delivery assistance. The causative variable associated with perinatal mortality in Nusa Tenggara and Papua was the location of delivery. The causative variable associated with perinatal mortality in Kalimantan, Maluku, and Papua was the mother's age. The causative variable associated with perinatal mortality in the Java-Bali region was parity. The causative variable associated with perinatal mortality in Sumatra was the type of delivery.
Conclusion: This study show that there were disparities in the incidence of perinatal mortality between regions in Indonesia. The government needs to re-adjust the existing strategies to improve health status and focus on community empowerment for women to prevent perinatal mortality.

1. Introduction

Most infant deaths (75 %) occur during the first week after birth [1]. In 2018, it was estimated that globally, 7000 newborn deaths were found every day [2]. The newborn mortality rate accounted for 43 percent of all under-five mortality rates [3]. Perinatal mortality is the death of the fetus that normally occurs when the pregnancy is 28 weeks to seven days after birth [4]. Perinatal mortality is a major public health challenge in low- and middle-income countries [5]. According to the World Health Organization, the perinatal mortality rate in developing countries is 50 deaths per 1000 pregnancies. Meanwhile, the perinatal mortality rate in developed countries is 10 deaths per 1000 pregnancies [6].

Indonesia is included in the top 10 countries with the highest newborn mortality rates, having 56,000 cases in 2020. According to the Indonesian Demographic Health Survey (IDHS) 2012, the highest infant mortality rates occur in the eastern region of Indonesia (with 62 deaths per 1000 live births in North Maluku Province and 74 deaths per 1000 live births in West Papua Province). Meanwhile, according to the IDHS 2017, the perinatal mortality rate is 21 deaths per 1000 pregnancies [7]. The Sustainable Development Goal (SDGs) goals expect that all countries can reduce neonatal mortality to at least 12 per 1000 births by 2030

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[8].

Based on a previous study, it was known that the Sub-Saharan African region has one of the highest perinatal mortality rates globally. There are sub-regional and country-specific differences in the distribution of perinatal mortality [9]. According to Tromp et al. regional differences in the incidence of perinatal death were also found in the Netherlands. Regional differences were analyzed by dividing the 12 provinces into four geographic regions, namely the northern region, eastern region, western region, and southern region. These differences were not caused by demographic or socioeconomic factors, but by healthcare factors [10]. Meanwhile, in Indonesia, none of previous studies are related to perinatal mortality by region.

In Indonesia, several studies have already discussed the causes of perinatal death. However, none of these have specifically explained the causes of perinatal death by region. Prameswari analyzed the causes of perinatal death in Indonesia and found that birth spacing, birth complications, the mother's educational background, Low Birth Weight (LBW), birth attendants, Antenatal Care (ANC) visits, and the mother's living environment had a relationship with perinatal death [11]. In addition, Rinjani and Budiharsana found that educational background, age, parity, pregnancy complications, delivery complications, premature birth, baby weight, Early Initiation of Breastfeeding (EIB), and ANC visits had a relationship with perinatal mortality. Delivery complications were known to be the highest risk factor in causing perinatal death [12].

It is important to study whether there are differences in the incidence of perinatal death by region considering that Indonesia has wide geographical and economic diversity. It is well known that the Java-Bali region has urban growth and morphology that is different from other regions in Indonesia [13]. Infrastructure development in the Java-Bali region is far more advanced compared to other regions. In addition, the Java region is inhabited by more than 90.83 million urban residents or approximately 66.97 % of the total urban population in Indonesia [14].

Countries or regions are often compared according to perinatal mortality. The perinatal mortality rate can be used as a very useful indicator for assessing delivery services in a country, both based on the ability to ensure the birth of healthy babies and the use of services [15]. The perinatal mortality rate in Indonesia is currently still far from the target set by the SDGs. Indonesia, none of previous studies specifically discuss the incidence of prenatal mortality by region. The results of this study can be used as a reference for the Indonesian government to optimize several public health interventions and improve health status through reduction of perinatal mortality. We used data from the IDHS 2017 to analyze infant mortality (gestational age$\geq$28 weeks to 7 days after birth) experienced by women within five years. This study was conducted to determine differences of perinatal mortality by region in Indonesia.

2. Method

Perinatal mortality was calculated based on the number of stillbirths and neonatal deaths during the five years prior to the IDHS 2017. Stillbirth is the loss of a fetus at 7 months or older while early neonatal death is the death of a baby within the first seven days (days 0–6) after live birth. This study used a cross-sectional approach.

2.1. Data source

This study used secondary data obtained from the IDHS 2017. The sample from the IDHS 2017 includes 1970 census blocks covering urban and rural areas. The researchers conducted interviews with 49,627 household women. The unit of analysis was women aged 15–49 who had given birth in the last 5 years. The total sample for this study was 13,310 household women.

2.2. Research factors

The causal factors in this study were based on previous studies [9] (10). They include socio-demographic, individual disease control, and maternal factors. Socio-demographic factors include educational background, employment status, economic status, maternal age, parity, delivery complications, and birth attendants.

Maternal age was divided into three age groups, namely 15–19 years, 20–34 years, and 35–49 years. Educational background was calculated based on the last formal education level taken by the mother. We devide into primary education, secondary education, and high education. Employment status was calculated based on the criteria of working mothers within the last 12 months. We devide employment status into working and not working. Meanwhile, economic status was calculated based on ownership of household assets such as transportation equipment, durable goods, and household facilities. We divide economic status into poor, middle and rich. Individual disease control factors include the quality of antenatal care, birth attendants, and location of delivery. The quality of antenatal care is the number of ANC visits made by a mother during pregnancy. The World Health Organization (WHO) recommended that the minimum ANC visit requirement is 4 times [16]. If the mother visited$\geq$4 times during pregnancy, then the mother had good ANC quality. Maternal factors include Parity in this study was categorized into two, namely parity 1 and parity >1. Meanwhile, delivery complications were considered to occur if the mother experienced bleeding, premature rupture of membranes, and others during delivery. We divide delivery complications into yes and no. Type of delivery divide into Caesar and vaginal. Place of delivery divide into health facilities and non health facilities. Childbirth helper divide into health worker and non health worker.

2.3. Procedure

Before conducting the study, the researchers first submitted a consent letter to use data from the IDHS 2017. After obtaining the approval, the researchers had a permission to use the data for this study on the following website: https://dhsprogram.com/data/new-userregistration.cfm.

2.4. Data analysis

Data analysis by region was grouped based on the largest islands, namely Sumatra, Java-Bali, Nusa Tenggara, Kalimantan, Sulawesi, the Maluku Islands, and Papua [17]. After weighing, the analysis was performed using the complex sample method through frequency and percentage distributions to obtain more accurate results. Data regarding the incidence of perinatal mortality were processed according to the instructions stated in the Demographic Health Survey (DHS) Guide Book, namely using the contraceptive calendar variable so that no missing data was found during perinatal mortality rate calculations [18].

Statistical analysis included univariate and bivariate analysis. Univariate analysis was used to see the characteristics of respondents based on socio-demographics, health services, and maternal factors. Bivariate analysis using binary logistic regression was carried out to calculate the odds ratio and see significant values statistically to determine the relationship between perinatal mortality and its factors. Binary logistic regression analysis was also used to determine disparities in perinatal mortality in Indonesia. Spatial analysis was carried out to determine the distribution of perinatal mortality by region in Indonesia. Analysis was performed using Statistical Product and Service Solutions (SPSS) and Quantum GIS (QGIS) software.

3. Results

3.1. Perinatal mortality

After analyzing data from the IDHS 2017, this study found that the percentage of perinatal mortality in Indonesia is 1.5 % of total births. The QGIS visualization in Fig. 1 shows that Papua and the Maluku Islands are the regions with the highest perinatal mortality rates in Indonesia. Meanwhile, Java-Bali is the region with the lowest perinatal mortality rate in Indonesia.

3.2. Respondent characteristics

Table 1 shows that all respondents are women aged 20–34 years and have completed secondary education. In the Nusa Tenggara and Papua regions, the majority of women are working women. The majority of women living in the Java-Bali region come from upper economic status, while the majority of women in other regions come from lower economic status.

Table 1 also shows that the majority of women in all regions have a good quality of ANC and chose health workers as birth attendants. In the Maluku Islands, the majority of respondents choose non-health facilities as delivery locations. Meanwhile, the majority of women in all regions choose normal delivery.

Table 2 shows that age, occupation, quality of ANC, birth attendant, location of delivery, parity, and type of delivery have relationships with the incidence of perinatal mortality. Women aged under 20 years in Kalimantan had a significant relationship with perinatal mortality (OR 6.182; 95 % CI 7.202–6.500), Maluku Islands (OR 2.164; 95 % CI 1.754–2.178), and Papua (OR 2.278; 95 % CI 3.151–1.648). Working women have a relationship with perinatal mortality in the Java-Bali region (OR 2.018; 95 % CI 1.230–3.313) and Papua (OR 14.502; 95 % CI 1.557–135.051). The quality of ANC and birth attendants have a relationship with perinatal mortality in Kalimantan. Poor quality of ANC and the absence of health workers during childbirth provide 2.45 times and 3.52 times higher chance of causing perinatal mortality, respectively.

Deliveries performed at non-health facilities have a relationship with perinatal mortality in the Nusa Tenggara (OR 5.098; 95 % CI 1.903–13.652) and Papua (OR 3.536; 95 % CI 3.659–3.418). Parity >1 have a 2404 times higher chance of causing perinatal mortality in the Java-Bali Region (OR 2.404; 1.274–4.537). Cesarean delivery have a 2.64 times higher chance of causing perinatal mortality (OR 2.641; 95 % CI 1.242–5.612).

Table 3 indicates the results of the binary logistic regression test. The test showed disparities in perinatal mortality among regions in Indonesia. In this analysis, the Java-Bali region was used as a reference due to having the lowest percentage of perinatal mortality. Table 2 shows that the Maluku Islands have a 1828 times higher chance of perinatal mortality compared to the Java-Bali region (OR 1.828; 95 % CI 1.065–3.138).

The results of bivariate analysis on independent variables with the incidence of perinatal mortality showed that in the Sumatra region, type of delivery was significantly associated with perinatal mortality. In the Java-Bali region, occupation and parity were significantly associated with perinatal mortality. In the Nusa Tenggara region, location of delivery was significantly associated with perinatal mortality. In the Kalimantan region, age, quality of ANC, and birth attendant were significantly associated with perinatal mortality. In the Sulawesi region, no variables were associated with perinatal mortality. In the Maluku Islands region, age was significantly associated with perinatal mortality. In the Papua region, age, occupation, and location of delivery were significantly associated with perinatal mortality.

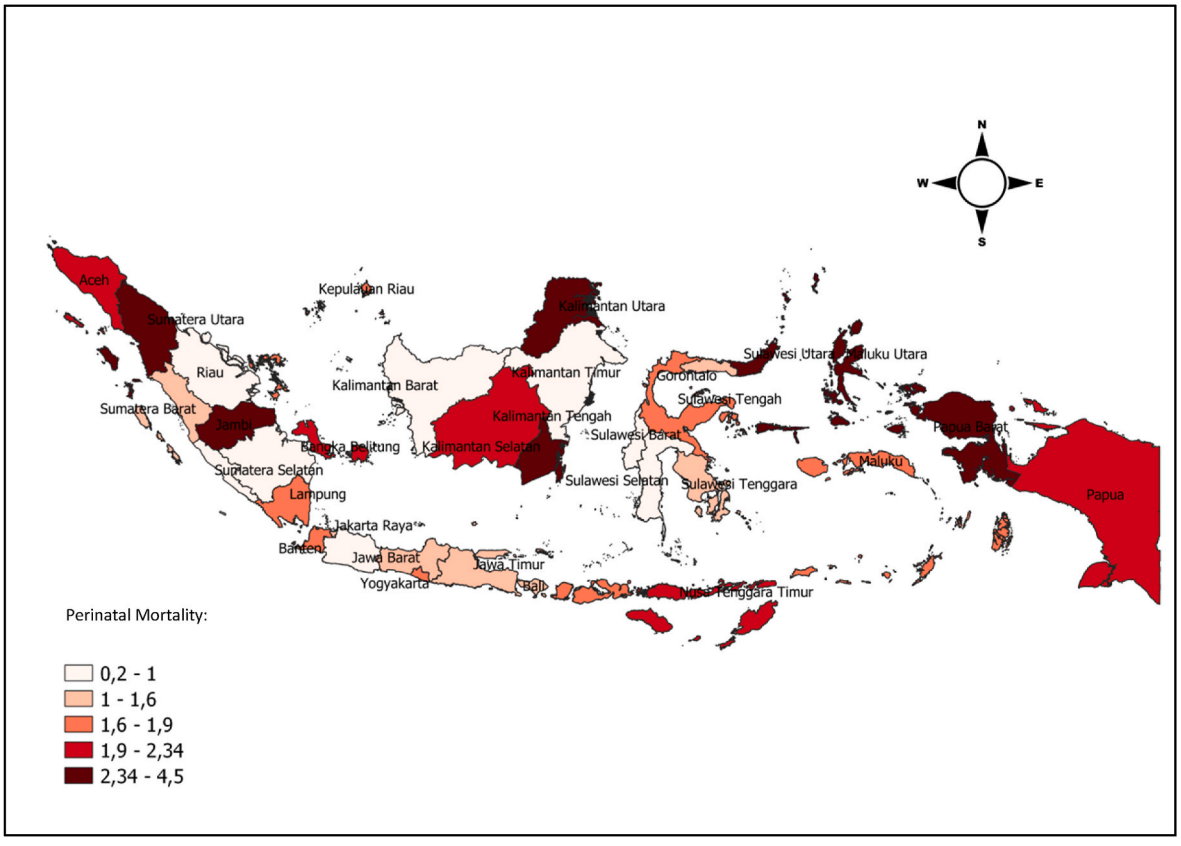

Fig. 1. Distribution of perinatal mortality by province in Indonesia.

Table 1
Respondent characteristic.

Variable	Region							All
	Sumatera	Jawa-Bali	Nusa Tenggara	Kalimantan	Sulawesi	Maluku	Papua	
Maternal Age								
>20	68 (2.0 %)	100 (2.2 %)	22 (1.9 %)	41 (3.3 %)	70 (3.5 %)	36 (4.7 %)	8 (2.5 %)	314 0.4 %)
20–34	2340 (69.3 %)	2979 (66.9 %)	757 (66.0 %)	896 (71.8 %)	1299 (65.3 %)	502 (64.7 %)	234 (73.6 %)	9001 (67.6 %)
> = 35	969 (28.6 %)	1375 (30.9 %)	369 (32.1 %)	311 (25.0 %)	620 (31.2 %)	237 (30.6 %)	75 (23.6 %)	3995 (30.0 %)
Education								
Primary	742 (22.0 %)	1114 (25.0 %)	407 (35.5 %)	401 (32.1 %)	519 (26.1 %)	169 (21.8 %)	63 (19.9 %)	3362 (25.3 %)
Secondary	1990 (59.2 %)	2742 (61.5 %)	560 (48.8 %)	676 (54.2 %)	1061 (53.4 %)	435 (56.2 %)	187 (59.1 %)	7893 (59.3 %)
High	645 (19.1 %)	668 (13.4 %)	181 (15.7 %)	171 (13.7 %)	409 (20.5 %)	171 (22.1 %)	66 (21.0 %)	2055 (15.4 %)
Occupation								
Working	1681 (49.8 %)	1937 (43.5 %)	578 (50.4 %)	582 (46.7 %)	940 (47.2 %)	385 (49.7 %)	188 (59.4 %)	6107 (45.9 %)
Not working	1696 (50.2 %)	2517 (56.5 %)	570 (49.6 %)	666 (53.3 %)	1049 (52.8 %)	390 (50.3 %)	129 (40.6 %)	7203 (54.1 %)
Economic status								
Poor	1480 (43.8 %)	1246 (28.0 %)	859 (74.8 %)	578 (46.3 %)	1154 (58.0 %)	566 (73.0 %)	214 (67.3 %)	5016 (37.7 %)
Middle	723 (21.4 %)	974 (21.9 %)	130 (11.3 %)	292 (23.4 %)	340 (17.1 %)	94 (12.2 %)	41 (13.0 %)	2775 (20.8 %)
Rich	1174 (34.8 %)	2234 (50.1 %)	159 (13.9 %)	378 (30.3 %)	495 (24.9 %)	115 (14.9 %)	62 (19.7 %)	5519 (41.5 %)
Quality of antenatal care								
Bad	565 (16.7 %)	505 (11.3 %)	220 (19.2 %)	246 (19.7 %)	587 (29.5 %)	229 (29.5 %)	115 (36.3 %)	2016 (15.1 %)
Good	2812 (83.3 %)	3949 (88.7 %)	928 (80.8 %)	1002 (80.3 %)	1401 (70.5 %)	546 (70.5 %)	202 (63.7 %)	11,294 (84.9 %)
Childbirth helper								
Non health worker	153 (4.5 %)	220 (5.0 %)	150 (13.1 %)	94 (7.6 %)	200 (10.0 %)	156 (20.1 %)	52 (16.4 %)	808 0.1 %)
health worker	3224 (95.5 %)	4234 (95.0 %)	998 (86.9 %)	1154 (92.4 %)	1789 (90.0 %)	619 (79.9 %)	265 (83.6 %)	12,502 (93.9 %)
Place of delivery								
Non health facilities	836 (24.7 %)	408 (9.2 %)	220 (19.2 %)	427 (34.2 %)	538 (27.1 %)	472 (60.9 %)	120 (37.9 %)	2218 (16.7 %)
Health facilities	2541 (75.3 %)	4046 (90.8 %)	928 (80.8 %)	821 (65.8 %)	1451 (72.9 %)	303 (39.1 %)	197 (62.1 %)	11,092 (83.3 %)
Parity								
>1	2359 (69.9 %)	2813 (63.1 %)	819 (71.4 %)	872 (69.9 %)	1367 (68.7 %)	578 (74.6 %)	248 (78.0 %)	8795 (66.1 %)
1	1018 (30.1 %)	1641 (36.9 %)	329 (28.6 %)	376 (30.1 %)	622 (31.3 %)	197 (25.4 %)	69 (22.0 %)	4515 (33.9 %)
Childbirth complication								
Yes	2374 (70.3 %)	3173 (71.2 %)	860 (74.9 %)	896 (71.8 %)	1329 (66.8 %)	636 (82.0 %)	161 (50.9 %)	9418 (70.8 %)
No	1003 (29.7 %)	1281 (28.8 %)	288 (25.1 %)	352 (28.2 %)	660 (33.2 %)	139 (18.0 %)	156 (49.1 %)	3982 (29.2 %)
Type of delivery								
Caesar	717 (21.2 %)	859 (19.3 %)	113 (9.8 %)	178 (14.3 %)	295 (14.8 %)	83 (10.4 %)	39 (12.5 %)	2457 (18.5 %)
Vaginal	2660 (78.8 %)	3595 (80.7 %)	1035 (90.2 %)	1070 (85.7 %)	1694 (85.2 %)	712 (89.6 %)	278 (87.5 %)	1,0853 (81.5 %)

4. Discussion

This study shows that disparities in the incidence of perinatal mortality were found between regions in Indonesia. There was a clear difference between the eastern and western regions. This finding is in line with several studies in Indonesia which showed that the eastern region is classified as underdeveloped when compared to the western region, especially Java-Bali, which is known as the center of government [19]. The Java-Bali region has different urban growth and morphology when compared to other regions. Infrastructure development in the Java-Bali region is way more advanced. This is similar to a study conducted by Tromp et al. which found differences in the incidence of perinatal mortality in the northern part of the Netherlands caused by factors of socioeconomic status and urbanization [10].

The results of bivariate analysis between regions showed that there were significant differences in the incidence of perinatal mortality in Indonesia. The results of the spatial analysis showed that the incidence of perinatal mortality in the Java-Bali region visualized has a low case distribution. Meanwhile, the incidence of perinatal mortality in Papua and Maluku visualized has a very high case distribution.

Underdevelopment in the eastern region can be caused by many factors such as geographical location, regional topography, policies, access to health services, and others. Conditions in the eastern region were categorized as isolated since they showed more excessive diversity. In addition, in terms of topography, the eastern region has extreme conditions, resulting in limited road access and supporting public transportation.

In terms of health policy and service issues, health infrastructure and the adequacy of health workers tasked in the promotive, preventive, curative, and rehabilitative fields are only concentrated in big cities [20]. At the same time, primary health services in the eastern region have a fairly broad scope of responsibilities, while some health services are difficult to reach and had different service quality [21]. In addition, other elements such as culture, religion, and insurance ownership also contribute to perinatal mortality in Indonesia. In line with a previous study, the absence of health insurance or medical treatment vouchers reduce the likelihood of contact with the health care system [22]. Given the high cost of delivery at health facilities, women who had insurance were more likely to deliver at health facilities compared to women who did not have [23].

The analysis of inter-regional disparities aims to provide clear directions that can be utilized by each regional policy maker to improve the quality of delivery services in their area. Therefore, efforts to deal with these problems must consider socio-demographic factors and the local cultural environment [24]. Perinatal mortality can be caused by several factors. In terms of sociodemographic factors, maternal age <20 years had a relationship with the incidence of perinatal mortality. These findings are in accordance with a previous study that suggested that the risk of neonatal death was significantly higher in young infants. Female adolescents who gave birth tended to come from low economic status and educational backgrounds [25]. Competition for nutrients between young mother and fetus may occur when teenage women still need additional energy for growth [26]. Working mothers tended to be more at risk of perinatal mortality. Several studies have shown that working women tend not to have enough time to care for their children, thus increasing the risk of death for their children [27]. In addition, working women tend to lose more energy, affecting the fetus.

In terms of individual disease control, poor quality of ANC had a relationship with perinatal mortality. A study conducted in Ethiopia indicates that women who had at least one ANC visit experienced a 58 %–66 % lower perinatal mortality [28]. Mothers who make more ANC visits not only receive maternal health education but are also more aware of the danger signs. ANC visits are conducted to find out early danger signs. In certain areas, low awareness to visit antenatal care may

Table 2
Relationship of independent variables with perinatal mortality by region in Indonesia.

Variabel	Sumatera			Jawa-Bali			Nusa Tenggara			Kalimantan			Sulawesi			Maluku			Papua		
	OR	95 % CI	P Value	OR	95 % CI	P Value	OR	95 % CI	P Value	OR	95 % CI	P Value	OR	95 % CI	P Value	OR	95 % CI	P Value	OR	95 % CI	P Value
Maternal age																					
<20	1.273	0.266–6.099	0.762	1.584	0.544–14.709	0.569	1.356	0.181–10.143	0.765	6.182	1.754–2.178	< 0.001	1.974	0.435–8.961	0.377	2.164	7.202–6.500	< 0.001	2.278	3.151–1.648	**< 0.001**
≥35	1.444	0.707–2.949	0.312	1.122	0.502–1.578	0.693	0.435	0.112–1.688	0.227	0.496	0.127–1.932	0.310	0.509	0.186–1.372	0.181	0.424	0.103–1.735	0.230	0.221	0.023–2.088	0.182
20–34	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Education																					
Primary	1.260	0.436–3.640	0.669	1.229	0.445–3.395	0.691	2.054	0.415–11.182	0.394	0.676	0.141–3.234	0.662	0.673	0.140–3.246	0.621	0.563	0.111–2.869	0.486	3.324	0.510–21.6764	0.203
Secondary	1.078	0.65–2.500	0.861	1.266	0.573–2.799	0.559	1.581	0.350–8.241	0.573	0.402	0.135–1.196	0.101	0.786	0.208–2.971	0.722	0.759	0.215–2.684	0.666	1.206	0.249–5.836	0.811
High	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Occupation																					
Working	1.598	0.853–2.994	0.143	2.018	1.230–3.313	0.006	1.538	0.552–4.286	0.407	0.541	0.208–1.409	0.207	0.909	0.422–2.091	0.878	1.225	0.468–3.204	0.676	14.502	1.557–135.051	**0.020**
Not working	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Economic status																					
Poor	1.489	0.689–3.222	0.311	1.042	0.498–2.177	0.913	1.083	0.120–9.743	0.943	0.660	0.213–2.047	0.469	1.749	0.420–7.289	0.441	1.473	0.244–8.893	0.670	0.792	0.100–6.250	0.821
Middle	0.880	0.347–2.232	0.787	0.494	0.193–1.266	0.142	1.371	0.106–17.679	0.807	0.551	0.070–4.328	0.569	1.062	0.250–4.805	0.915	1.556	0.164–14.810	0.698	0.315	0.012–8.177	0.477
Rich	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Quality of antenatal care																					
Bad	1.093	0.472–2.531	0.835	0.560	0.232–1.349	0.196	1.397	0.443–4.402	0.566	2.542	1.402–4.289	<0.001	0.696	0.317–1.529	0.366	1.299	0.440–3.830	0.633	0.957	0.147–6.224	0.963
Good	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Childbirth helper																					
Non health worker	2.708	0.587–12.492	0.201	0.136	0.16–1.189	0.071	0.320	0.063–1.627	0.168	3.529	1.016–1.225	<0.001	0.677	0.168–2.732	0.562	1.022	0.259–4.040	0.975	2.387	0.345–16.525	0.369
Health worker	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Place of delivery																					
Non health facilities	0.661	0.247–1.766	0.408	2.028	0.764–5.381	0.155	5.098	1.903–13.652	0.001	0.820	0.220–3.059	0.767	1.316	0.438–3.951	0.623	1.236	0.299–4.923	0.764	3.536	3.659–3.418	**< 0.001**
Health Facilities	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Parity																					
>1	1.090	0.558–2.129	0.800	2.404	1.274–4.537	0.007	0.920	0.336–2.552	0.870	1.572	0.481–5.140	0.452	0.725	0.293–1.792	0.485	1.375	0.358–5.277	0.639	4.290	0.483–38.089	0.185
1	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Childbirth complication																					
Yes	1.484	0.708–3.110	0.296	1.540	0.816–2.907	0.182	1.202	0.441–3.278	0.717	1.599	0.586–4.368	0.357	1.437	0.556–3.711	0.453	2.824	0.393–20.276	0.299	1.489	0.191–11.592	0.697
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Type of delivery																					
Caesar	2.641	1.242–5.612	0.012	0.994	0.520–1.900	0.986	1.219	0.269–5.532	0.796	1.951	0.627–6.070	0.247	2.635	0.994–6.967	0.052	1.021	0.186–5.611	0.980	2.491	0.280–22.135	0.403
Vaginal	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref

Table 3
Binary logistic regression model of perinatal mortality by region.

variable	Perinatal Mortality			
	p value	OR	Lower Bound	Upper Bound
Region				
Sumatera	0.159	1.326	0.895	1.965
Nusa Tenggara	0.202	1.432	0.825	2.486
Kalimantan	0.319	1.320	0.765	2.278
Sulawesi	0.250	1.323	0.821	2.133
Maluku	0.029	1.828	1.065	3.138
Papua	0.080	2.011	0.921	4.391
Jawa-Bali	*Ref*			

be caused by low literacy [29]. In addition, delivery attendants and the location of delivery also had a relationship with the incidence of perinatal mortality. Health facilities in countries with high maternal and infant mortality rates often have less optimal quality of maternal and newborn care. Health workers must also be more accessible to everyone in the farthest and poorest regions. In fact, some specialist services are only provided in large cities and suburbs [30]. The theory adopted in a previous study estimated that 52 million births occurred without the help of birth attendants, considering that mothers often gave birth outside health facilities with the help of traditional birth attendants [26]. The eastern regions of Indonesia tend to make less use of health facilities compared to the western region [31,32]. The majority of rural residents had a poor economic status which resulted in them being unable to give birth at secondary and tertiary health services [33].

Women with high parity were more at risk of perinatal mortality than women with low parity. A previous study states that women with no birth history are more likely to seek information related to appropriate health services and delivery processes, while women with high parity are more likely to receive poor obstetric care [34]. Parity in Indonesia is still relatively high. This is evidenced by the Total Fertility Rate (TFR) of 2.4 per woman. A study conducted in the Democratic Republic of the Congo shows that parity >4 was proven to increase the risk of perinatal mortality [35,36]. In addition, mothers who are continuously pregnant have the potential to experience a loss of tissue elasticity due to stretch marks during pregnancy and childbirth.

Cesarean delivery had a relationship with the incidence of perinatal mortality. These findings are consistent with Sobhy et al. who stated that the proportion of stillbirths and perinatal mortality in cesarean delivery is high or 1 in 10 babies born by cesarean delivery is stillborn [37]. The WHO sets a recommended rate of 10 %–15 % to improve maternal and perinatal outcomes and prevent maternal and infant mortality [38]. Meanwhile, in Sumatra, the cesarean delivery rate (23.1 %) exceeded the maximum limit of the standard set by the WHO. Perinatal deaths in cesarean delivery can be caused by several factors such as delays in delivery referrals due to the inability of healthcare providers to recognize abnormalities in the fetus, inadequate hospital conditions, undetected stillbirths, or cesarean operations performed even though a stillbirth are diagnosed [37].

Although this study can analyze perinatal mortality by region in Indonesia and visualize the incidence of perinatal mortality in Indonesia using GIS analysis, it still has some limitations. It should be noted that bias may occur due to respondent. The quality of ANC visits and delivery complications had missing value due to respondents who did not remember the exact number of their ANC visits per trimester and complications they experienced during delivery. The other limitations are that several factors cannot be analyzed. Some of these factors include a history of diseases owned by the mother (hypertension, diabetes, etc.) and abnormalities in the baby such as asphyxia, infection, and pneumonia. In addition, the variables examined in this study were limited because the data from the IDHS 2017 not cover the variables.

This study implies that it is important to government to identify the primary need for future intervention by doing prioritize intervention that address the most criticsl needs in each region and ensure that interventions are culturally appropriate, sustainable, and feasible within the local context. Another intervention should consider improving access to perinatal care, enhancing healthcare infrastructure, providing training for healthcare providers, implementing community-based eduction programs, and addressing socio-economic determinant health of each region.

5. Conclusions

This study concludes that there were disparities in the incidence of perinatal mortality between regions in Indonesia. The Maluku Islands had a higher risk of perinatal mortality compared to the Java-Bali region. The causative variable associated with perinatal mortality in the Java-Bali and Papua regions was employment status. The causative variables associated with perinatal mortality in Kalimantan were the quality of antenatal care and delivery assistance. The causative variable associated with perinatal mortality in Nusa Tenggara and Papua was the location of delivery. The causative variable associated with perinatal mortality in Kalimantan, Maluku, and Papua was the mother's age. The causative variable associated with perinatal mortality in the Java-Bali region was parity. The causative variable associated with perinatal mortality in Sumatra was the type of delivery. The government needs to re-adjust the existing strategies to improve health status and focus on community empowerment for women to prevent perinatal mortality.

Ethical approval

This study was conducted with the approval of the Ethics Committee of the Faculty of Public Health, Sriwijaya University.

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Declaration of competing interest

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

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