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Factors Influencing Maternal Mortality in The Bangka Belitung Archipelago

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Abstract

Maternal mortality remains a key indicator of health system performance. Although Indonesia has seen a general decline in maternal mortality rates, they remain high, with notable fluctuations observed in the Bangka Belitung Islands, particularly an upward trend following the COVID-19 pandemic peak in 2021. This study aimed to identify factors associated with maternal mortality in the province. A case-control design was employed using secondary data from 2023, including Maternal Verbal Autopsy reports, medical records from the Maternal Perinatal Death Notification (MPDN) system, and maternal cohort data from local health centers. A total of 117 subjects were included, comprising 39 cases and 78 controls. Two variables were found to significantly influence maternal mortality in the Bangka Belitung Islands Province in 2023: parity (p = 0.020; OR = 0.306; 95% CI: 0.113–0.831) and antenatal care visits (p < 0.001; OR = 23.233; 95% CI: 7.266–74.226). Of these, antenatal care visits were identified as the most dominant predictor. These findings underscore the urgent need to strengthen maternal healthcare services in line with clinical standards, particularly ensuring comprehensive and timely antenatal care. Improving service governance may enhance early detection of high-risk pregnancies, facilitate safer deliveries, and ultimately reduce maternal mortality in the Bangka Belitung Islands.

Keywords: Maternal Mortality, Antenatal Care, Bangka Belitung, Maternal Health, MPDN

1. Introduction

The Maternal Mortality Ratio (MMR) is a critical indicator of national health outcomes.[1] The global target set by the Sustainable Development Goals (SDGs) aims to reduce the MMR to 70 per 100,000 live births by 2030; however, achieving this benchmark remains a significant challenge. Indonesia's MMR remains relatively high compared to the ASEAN regional average of 40–60 per 100,000 live births.[2] According to the 2020 Population Census (Long Form), Indonesia reported an MMR of 189 per 100,000 live births, reflecting a decline from figures reported in the 2010 Population Census and the 2015 Intercensal Population Survey (SUPAS).[3]

Risk factors contributing to high maternal mortality begin before pregnancy, including anemia, chronic energy deficiency, obesity, and a history of underlying health conditions such as heart disease and tuberculosis. In 2019, the leading causes of maternal death in Indonesia were hemorrhage, hypertensive disorder of pregnancy, infection, metabolic disorders, and other complications.[4]

Data from the Bangka Belitung Islands Provincial Health Office indicate that the Maternal Mortality Ratio (MMR) fluctuated between 2019 and 2023, with a tendency to increase following the peak of the COVID-19 pandemic in 2021. The number of maternal deaths recorded each year during this period was 36, 20, 62, 34, and 38 cases, respectively. In 2023, the leading causes of maternal death in the province were hypertension (12 cases), hemorrhage (6 cases), and infection (4 cases).[5] Although routine data and descriptive analysis on maternal death cases are available, previous studies have not conducted in-depth quantitative analysis to identify the factors significantly influencing maternal mortality in the region. Therefore, this study aims to fill this gap by applying quantitative methods to

provide a more comprehensive and evidence-based understanding of the factors contributing to maternal mortality in the Bangka Belitung Islands Province**.**

2. Method

This study is a quantitative case-control study conducted from June to December 2024 at the Provincial Health Office, District/City Health Office, and Community Health Centers (Puskesmas) in the Bangka Belitung Islands Province, focusing on pregnant women who died in 2023.

The study population comprised all pregnant women who gave birth within the service areas of District/City Health Centers in the Bangka Belitung Islands Province in 2023, as recorded in the Maternal Verbal Autopsy (OVM) reports and/or Maternal Medical Records (RMM) in the Maternal Perinatal Death Notification (MPDN) application of the District/City and Provincial Health Offices, as well as in the manual maternal cohort records at Community Health Centers.

The study sample consisted of a subset of this population, divided into two groups: case samples, which included all pregnant or postpartum women who died in 2023, and control samples, comprising a selection of women who gave birth but did not die, as recorded in the manual maternal cohort registers at Health Centers. Inclusion criteria for cases are all pregnant or postpartum women who died in 2023, has complete medical data on the cause and condition at the time of death from Maternal Verbal Autopsy (MVA) reports and/or Maternal Medical Records (MMR) in the Maternal Perinatal Death Notification (MPDN) application of District/City and Provincial Health Offices, as well as in manual maternal cohort records at Community Health Centers. Meanwhile, the control is a mother who had a live birth and did not die within 42 days after delivery, resides in the same area as the case, and has complete medical data. Participants from both groups will be excluded if their data is incomplete. A total of 39 cases and 78 controls (1:2 ratio) were included, with controls selected using simple random sampling.

This study involves seven variables obtained from secondary data sources, including Maternal Verbal Autopsy reports, medical records in the MPDN application, and manual maternal cohort forms. The main variable is maternal death, defined as the death of a mother during pregnancy, childbirth, or postpartum, categorized as "Yes" or "No." The independent variables include age (categorized as at risk if <20 or >35 years, and not at risk if 20–35 years), education level (low if below senior high school, high if senior high school or above), parity (at risk if ≤1 or >3 births, not at risk if 2–3 births), antenatal care visits (adequate if ≥6 visits, inadequate if <6 visits), maternal health status (Has risk factor if the mother had anemia, hypertension, or heart disease; no risk factor if none), and complications leading to death (present if the mother experienced hemorrhage, eclampsia, infection, or hyperemesis gravidarum; absent or unknown if not). All variables are measured on a nominal scale.

Data were analyzed in stages, beginning with univariate analysis to describe the characteristics of variables, followed by bivariate analysis using the chi-square test to assess associations between independent variables and maternal mortality. Variables with $p < 0.25$ were included in a multivariate logistic regression to identify significant predictors while controlling for potential confounders. Results are reported as odds ratios (OR), 95% confidence intervals (CI), and p-values, with statistical significance set at $p < 0.05$. Ethical clearance for this study was obtained from the Health Research Ethics Committee of Universitas Aisyiyah

Yogyakarta, with approval number 3948/KEP-UNISA/VIII/2024, issued on August 29, 2024.

3. Result

In 2023, a total of 39 maternal deaths were recorded across seven regencies/cities in the Bangka Belitung Islands Province. The distribution of these cases by administrative region is presented in Table 1.

Mothers with at-risk age, low educational attainment, inadequate antenatal care, high-risk health status, and complications leading to death were more frequently found in the case group (maternal deaths). In contrast, high-risk parity was more prevalent among the control group. The proportions of these risk factors are summarized in Table 2.

Bivariate analysis showed that parity (p = 0.025), antenatal care (p = 0.000), health status (p = 0.000), and Complications Leading to Death (p = 0.000) had a significant effect on maternal mortality. Meanwhile, age (p = 0.101) and education level (p = 0.073) did not show an important relationship with maternal death.

Table 1. Maternal Death Distribution by Regency/City in Bangka Belitung Islands Province, 2023

Regency/City	Total
Bangka	9
West Bangka	9
Central Bangka	2
South Bangka	8
Belitung	6
East Belitung	3
Pangkalpinang	2
Total	39

Source : MPDN of Bangka Belitung Islands Province 2023

Table 2. Proportion of Maternal Death Risk Factors

Independent Variable	Category	Case		Control	
		n	(%)	n	(%)
Age	At risk	16	41	19	24.4
	Not at risk	23	59	59	75.6
Education	Low	21	53.8	27	34.6
	High	18	46.2	51	65.4
Parity	At risk	19	48.7	56	71.8
	Not at risk	20	51.3	22	28.2
Antenatal Care	Inadequate	23	59	5	6.4
	Adequate	16	41	73	93.6
Health Status	Has Risk Factor	14	35.9	6	7.7
	No Risk Factor	25	64.1	72	92.3
Complication Leading to Death	Present	28	71.8	0	0
	Absent	11	28.2	78	100

Table 3. Bivariate Analysis Results

Variable	P value	OR	CI 95%
Age	0.101	2.16	0.95-4.911
Education	0.073	2.204	1.007-4.824
Parity	0.025	0.373	0.168-0.829
Antenatal Care	0.000	20.988	6.929-63.567
Health Status	0	6.72	2.330-19.379
Complications Leading to Death	0	8.091	4.653-14.069

Table 4. Final Multivariate Analysis Model of Factors Influencing Maternal Mortality, Bangka Belitung Islands Province, 2023

Independent Variable	*P*	OR	95% CI
Parity	0.020	0.306	0.113 – 0.831
Antenatal Care	0.000	23.223	7.266 – 74.226

Note: OR = Odds Ratio; CI = Confidence Interval

Further analysis yielded an OR value of 0.373 (95% CI: 0.168-0.829), indicating that mothers with parity at risk had a lower risk of death compared to mothers with non-risk parity. In terms of risk, mothers with non-risk parity had 2.6 times higher risk of maternal death than those with high-risk parity. Mothers with inadequate antenatal care had an OR of 20.988 (95% CI: 6.929–63.567), meaning they had a 20.9 times higher risk of death compared to those whose antenatal care met the standard. Mothers with health risk factors had an OR of 6.720 (95% CI: 2.330–19.379), meaning their risk of death was 6.7 times higher than that of mothers without such risk factors. Mothers who experienced complications leading to death had an OR of 8.091 (95% CI: 4.653–14.069), indicating an 8 times higher risk of maternal death than those without complications.

The subsequent stage of analysis involved conducting a multivariate analysis to identify the most influential factors associated with maternal mortality. Candidate variables were selected based on the results of bivariate analyses, with a significance threshold of $p < 0.25$. All independent variables that met this criterion—including maternal age, education, parity, antenatal care (ANC) visits, maternal health status, and complications leading to death—were included in the initial multivariate model.

In the first iteration of the multivariate model, only antenatal care visits remained statistically significant ($p = 0.05$); in contrast, other variables, such as age, education, parity, health status, and complications, had p-values greater than 0.05. Among these, the variable representing complications had the highest *p*-value and was subsequently excluded from the model. The modelling process continued iteratively, removing non-significant variables until the final model was achieved, as presented in Table 4.

Two variables were found to significantly influence maternal mortality in the Bangka Belitung Islands Province in 2023: parity ($p = 0.020$; OR = 0.306; 95% CI: 0.113–0.831) and antenatal care visits ($p < 0.001$; OR = 23.233; 95% CI: 7.266–74.226). Of these, antenatal care visits were identified as the most dominant predictor. The results indicate that mothers who did not receive adequate antenatal care were identified as the most dominant predictor. The results indicate that mothers who did not receive adequate antenatal care were 23.233 times more likely to experience maternal death compared to those who received care that met established standards.

4. Discussion

The optimal reproductive age range for women is generally considered to be between 20 and 35 years. Pregnancies occurring outside this age range—specifically under the age of 20 and over the age of 35—are associated with a higher risk of maternal mortality. In younger women, particularly those under 20, reproductive organs may not be fully mature, increasing the likelihood of complications during pregnancy, childbirth, and the postpartum period. Conversely, women over 35 years are more susceptible to pregnancy-related complications due to physiological aging, as well as a greater prevalence of comorbid conditions such as cardiovascular disease, hypertension,

malignancies, and metabolic disorders.[6] The findings of the bivariate analysis in this study indicate that women under 20 and over 35 years of age are indeed at a higher risk of maternal death compared to those aged between 20 and 35 years. However, age was not found to be a statistically significant factor in the multivariate analysis. This suggests that while maternal age may be associated with mortality risk in a general sense, it does not independently predict maternal death when controlling for other variables.

These results are consistent with previous studies, such as those conducted by Aeni (2011) in Pati Regency and Jayanti in Surabaya, both of which reported no significant association between maternal age and maternal mortality.[7,8] One possible explanation for this finding is the increasing accessibility and quality of maternal health services, which may mitigate age-related risks. Therefore, the lack of a significant relationship between age and maternal death in this study may reflect improvements in healthcare access and the effectiveness of antenatal monitoring across all age groups.

Education plays a crucial role in shaping maternal knowledge, particularly in recognizing pregnancy danger signs. Women with lower educational attainment often lack the necessary awareness to identify early warning signs of complications, which may lead to delays in seeking treatment and, ultimately, increase the risk of maternal death. Moreover, educational level has an indirect influence on a woman's health-related behaviors and decision-making capacity during pregnancy. Lower levels of education are frequently associated with lower socioeconomic status, which can further reduce the likelihood of accessing adequate antenatal care.[9] In contrast, higher educational attainment is often linked with improved social standing, empowering women to make informed decisions and advocate for their health needs, including the utilization of maternal health services.

In this study, bivariate analysis showed that women with educational levels below senior high school—specifically those with no formal education, elementary, or junior high school education—faced a higher risk of maternal death. Conversely, women with a senior high school education or higher had a lower risk. However, the association between education and maternal mortality was not statistically significant. These findings are consistent with previous studies conducted by Respati (2019) in Sukoharjo and Muthoharoh (2016), both of which found no significant effect of maternal education on maternal mortality.[10,11]

One possible explanation for this lack of association is the widespread access to information facilitated by technological advancements. Digital tools have expanded opportunities for informal education, enabling individuals to access health-related knowledge beyond formal schooling. According to 2020 data from Statistics Indonesia (BPS), the Bangka Belitung Islands rank among the top ten provinces in mobile phone ownership, with 93.87% of the population having access to a mobile phone.[5] These devices likely serve as a medium through which pregnant women and their families access health information, including maternal health education, potentially compensating for lower formal education levels. Therefore, it is reasonable to assume that increased access to digital information may mitigate the impact of low educational attainment on maternal mortality.

Maternal mortality risk tends to be higher among primiparous women and those with high parity (>4). For first-time mothers, this increased risk is often linked to limited medical and psychological preparedness. In contrast, high-parity women may experience greater physiological strain and complications

due to the cumulative demands of repeated pregnancies, childbirth, and postpartum recovery.[8]

This study found a statistically significant association between parity and maternal mortality. Women with 0–1(nulliparous and primiparous) or more than three deliveries had a lower risk of maternal death, while those with 2–3 deliveries faced a higher risk. Specifically, mothers with 0–1 or >3 deliveries were 0.373 times as likely to experience maternal death compared to those with 2–3 deliveries, indicating a 2.6-fold increased risk in the latter group.

A prior study found that 62.5% of maternal deaths occurred among women with a parity greater than four.[11] Similarly, previous studies reported that 22% of maternal deaths occurred in those with a parity above three.[12] Moreover, the proportion of maternal deaths was higher among grand multiparous (0.5) and multiparous (0.1471) women compared to primiparous women[13]x. These findings indicate a positive association between higher parity and increased maternal mortality risk.

Contrary to the widely accepted view that high parity (≤1 or >3) increases the risk of maternal mortality, this study observed a higher proportion of deaths among women with low-risk parity (2–3). Specifically, high-risk parity was more prevalent in the control group (71.8%), while low-risk parity was more common in the case group (51.3%). These results suggest that low-risk parity (2–3) may not be protective in this population. The inconsistency with prior studies implies that parity is not always a reliable predictor of maternal mortality, highlighting the possible influence of confounding factors. Further investigation is needed to explore contextual variables and underlying causes. Increasing prenatal care awareness and use among first-time and high-parity mothers may improve monitoring and reduce mortality risk.

Antenatal care (ANC) plays a critical role in identifying risk factors that may complicate pregnancy or childbirth. Adequate ANC is associated with a reduced risk of maternal mortality, as it prepares mothers for delivery and ensures a safe environment for the fetus. Through ANC, healthcare providers can deliver timely screening, diagnosis, management, and referrals, thereby contributing to the reduction of both maternal and neonatal mortality.[14]

The study findings indicate that mothers with fewer than six antenatal checkups face a significantly higher risk of maternal death, whereas those with six or more have a reduced risk. Statistical analysis confirmed a significant association between the frequency of antenatal care and maternal mortality. Mothers whose antenatal visits did not meet the recommended standard had a 20.99 times higher risk of death. Multivariate analysis further supported this, with an odds ratio (OR) of 23.23, indicating that inadequate antenatal care was associated with a 23-fold increase in maternal mortality risk. These findings suggest that the frequency of antenatal care was the most dominant factor influencing maternal mortality in the Bangka Belitung Islands Province in 2023.

Several studies have demonstrated a significant association between inadequate antenatal care (ANC) and maternal mortality. Rohati (2023) reported that mothers with fewer than four ANC visits had a 7.1-fold increased risk of maternal death (OR = 7.108). Similarly, a study in Bulukumba (2007–2009) found that mothers with fewer than four or irregular ANC visits were 4.57 times more likely to die than those receiving regular care. Research in Pati Regency (2013) also showed that poor or incomplete ANC increased the risk of maternal death by 7.86 times (p = 0.008; 95% CI: 1.49–41.3).[8]

Regular antenatal care enables early detection and timely management of

pregnancy and labor complications, while also supporting the physical and mental well-being of expectant mothers in preparation for childbirth and postpartum recovery. According to Minister of Health Regulation No. 21 of 2021, antenatal care (ANC) must be standardized and integrated, with a minimum of six visits distributed across the three trimesters—one in the first trimester, two in the second, and three in the third. These visits should include at least two consultations with a doctor (one each in the first and third trimesters) and an ultrasound examination.[4]

Data from the 2023 maternal health program in Bangka Belitung Islands Province indicate high coverage rates, with 96.3% of pregnant women attending their first ANC visit (K1), 76.3% receiving an ultrasound during this visit, and 85.3% completing the sixth visit (K6). Despite these promising figures, the quality of prenatal care delivery remains critical to maximize benefits and reduce pregnancy-related risks. High-quality care depends on qualified health professionals, adequate technical skills, standardized equipment, and sufficient time for patient consultations.[5]

To strengthen ANC services, the Bangka Belitung Islands Provincial Health Office has implemented initiatives including obstetrician-gynecologist support, capacity building for ultrasound use among doctors, and ultrasound availability at community health centers (Puskesmas).[5] Ensuring pregnant women have access to regulated antenatal care significantly reduces maternal mortality risk by facilitating early complication detection and appropriate management, thereby preventing severe or fatal outcomes during pregnancy, childbirth, and postpartum. Maternal illnesses occurring before or during pregnancy significantly increase the risk of maternal mortality. Many of these conditions—including anemia, cardiovascular disease, hypertension, diabetes mellitus, and infections such as malaria, hepatitis, HIV/AIDS, and bronchopneumonia—can be detected during antenatal checkups, enabling timely intervention and prevention of adverse outcomes.[9]

Bivariate analysis in this study demonstrated that mothers with health risk factors faced a significantly higher risk of maternal death compared to those without such factors. Specifically, mothers with health risks had a 6.72-fold increased risk of death. These findings align with previous research, including Aeni (2013), which reported that a history of illness increased maternal mortality risk by approximately 27.74 times ($p = 0.011$, 95% CI: 1.118–363.147), as well as studies from Cilacap Regency and Muhammad Husin Hospital Palembang, which found odds ratios of 210.2 ($p = 0.002$) and 4.4 ($p = 0.001$), respectively. This study identified anemia, heart disease, and hypertension as key maternal health conditions. Anemia can reduce oxygen supply to the uterus, impairing uterine contractions and causing uterine atony, a leading cause of hemorrhage.[7]

The pathogenesis of heart disease during pregnancy remains poorly understood and warrants further investigation. Some cases involve pre-existing conditions, including hypertension, diabetes mellitus, and congestive heart failure, while others develop due to physiological and hormonal changes associated with pregnancy.[15]

Pregnancy, childbirth, and the postpartum period carry risks of complications that can increase maternal mortality. Pregnancy complications—conditions arising during gestation or delivery—often develop early in pregnancy. For example, hyperemesis gravidarum, characterized by persistent and severe vomiting, affects nearly 80% of pregnant women, with 0.3–2% requiring treatment. When excessive vomiting occurs more than 10 times daily, it can disrupt nutritional and

electrolyte balance, leading to dehydration, impaired health, and, in severe cases, coma or death. Other common complications include bleeding, preeclampsia/eclampsia, and infections.[12]

This study found that mothers with pregnancy complications faced a significantly higher risk of maternal death compared to those without complications. Statistical testing confirmed this association, with mothers experiencing complications exhibiting an 8.09-fold increased risk of death.

This study aligns with Hari Respati's (2019) findings in Sukoharjo, which reported that mothers with labor complications had a 9.55-fold higher risk of maternal death compared to those without complications (OR = 9.553, p = 0.001; 95% CI: 2.397–37.909).[12] Similarly, Muthoharoh (2016) found a 4.23-fold increased risk of maternal death among mothers expriencing labor complications.[10]

In this study, complications leading to death included bleeding, eclampsia /preeclampsia, infection, and hyperemesis gravidarum, as documented in Maternal Verbal Autopsy reports and Maternal Medical Records in the MPDN application or in the manual cohort. Postpartum hemorrhage may result from uterine atony, retained placenta, birth canal trauma, or coagulopathy, with massive bleeding potentially causing hypovolemic shock and multi-organ failure due to oxygen deprivation.[9] Eclampsia compromises organ perfusion by increasing circulatory pressure, potentially impairing liver and kidney function; untreated cases may lead to seizures, brain damage, coma, and maternal-fetal mortality. Postpartum infections can progress to septicemia through systemic bacterial spread, posing a significant risk of death.[12]

5. Conclusion

Maternal mortality is influenced by several factors, including parity, antenatal care (ANC) history, maternal health status, and pregnancy complications. Among these, inadequate ANC emerged as the most dominant risk factor. Strengthening education on the importance of standardized maternal health services—both in quantity and quality—is essential to improving outcomes. ANC should be conducted at least six times during pregnancy, with a minimum of two visits by medical professionals in the first and third trimesters, including ultrasound examinations. Healthcare providers must reinforce their commitment to delivering standardized, high-quality care. Additionally, these findings underscore the need to raise public awareness about the importance of accessing quality ANC services to reduce the risk of maternal mortality.

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