Journal of Public Health Indonesian
Volume.2 Issue.6, (March, 2026) Pages 45-53
E-ISSN: 3048-1139
DOI : https://doi.org/10.62872/ttxa4d85
https://nawalaeducation.com/index.php/JHH

Risk Factors Associated with Maternal Mortality in Donggala Regency, Indonesia: Evidence from a Case–Control Study (2020–2024)

Tri Rizkiyanti Alwi[1], Sudirman[2], Zhanaz Tasya[3]
[1,2,3]Universitas Muhammadiyah Palu, Indonesia

Received: January 07, 2026
Revised: February 20, 2026
Accepted: March 10, 2026
Published: March 26, 2026

Corresponding Author:
Author Name*: Tri Rizkiyanti Alwi
Email*: tririzkiyantinote12@gmail.com

***Abstract*:** *Maternal mortality remains a significant public health problem and reflects the quality of maternal health services. Donggala Regency is one of the regions with a relatively high and fluctuating maternal mortality rate during the period 2020–2024. This study aimed to analyze risk factors and determine the most influential factors associated with maternal mortality in Donggala Regency from 2020 to 2024. This study employed an observational analytic design with a case–control approach, involving a total sample of 108 subjects, consisting of 54 cases and 54 controls, selected using purposive sampling. Secondary data were obtained from Maternal Verbal Autopsy (MVA) records and the maternal cohort registry. Data analysis was conducted using IBM SPSS Statistics, applying Odds Ratio (OR) and p-values for bivariate analysis, and multiple logistic regression for multivariate analysis. The results of the study showed that the risk factors for maternal mortality in Donggala Regency during 2020–2024 were a history of hemorrhage (AOR = 9.01; 95% CI = 1.61–50.64; p = 0.013), history of disease (AOR = 8.21; 95% CI = 1.56–43.32; p = 0.013), and incomplete antenatal care (ANC) visits (AOR = 6.14; 95% CI = 1.52–24.85; p = 0.011). Delay in referral was identified as the main and independent risk factor associated with maternal mortality (AOR = 10.05; 95% CI = 2.04–49.61; p = 0.005). Parity, interpregnancy interval, history of hypertensive disorders of pregnancy, and maternal education did not show statistically significant associations; however, they acted as confounding variables in the final multivariate model.Maternal mortality in Donggala District during 2020–2024 was significantly influenced by a history of hemorrhage, comorbid diseases, inadequate ANC, and referral delay. Referral delay was the strongest determinant of maternal mortality. These findings highlight the importance of early detection of pregnancy complications, adherence to standard ANC services, and an effective and timely maternal referral system to reduce maternal mortality*

Keywords : Case-Control Approach, Maternal mortality , Risk factors

INTRODUCTION

Maternal mortality remains one of the most critical global public health challenges and serves as a key indicator of the quality of maternal health services within a health system. The World Health Organization reports that maternal mortality reflects the effectiveness of health service accessibility, quality of obstetric care, and broader socio-economic determinants affecting women's health. Despite significant global efforts to reduce maternal deaths, maternal mortality continues to occur at alarming rates, particularly in low- and middle-income countries where health systems face structural limitations (WHO, 2024).

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Globally, approximately 287,000 maternal deaths were recorded in 2020, equivalent to nearly 800 women dying every day from pregnancy-related complications. The number increased to approximately 322,000 deaths in 2021 due to disruptions in health services during the COVID-19 pandemic, although subsequent years showed a gradual decline to around 260,000 cases in 2023. Nevertheless, these figures indicate that maternal mortality remains a persistent global health issue, with approximately 90% of deaths occurring in developing countries where access to comprehensive maternal health care remains limited (WHO, 2024).

Maternal mortality not only represents a medical problem but also reflects broader social and developmental challenges. The death of a mother has significant implications for the survival and well-being of children and families. Studies show that children who lose their mothers during childbirth have a mortality risk three to ten times higher during the first two years of life compared with children whose mothers survive. Furthermore, maternal mortality often results in long-term socio-economic consequences for households, including decreased educational opportunities for children and reduced household productivity. Therefore, reducing maternal mortality is not only a health priority but also an essential component of sustainable social development (Kementerian Kesehatan Republik Indonesia, 2024).

In Indonesia, maternal mortality remains a significant concern despite various national programs designed to improve maternal health services. Data from the 2020 Population Census reported a maternal mortality ratio of 189 per 100,000 live births. Although the government has set a target of reducing the maternal mortality ratio to 183 per 100,000 live births by 2024 as part of the National Medium-Term Development Plan, recent statistics indicate that the figure remains above this target. In 2022, Indonesia recorded 4,005 maternal deaths, increasing slightly to 4,129 cases in 2023. The leading causes of maternal mortality include hypertensive disorders during pregnancy, particularly preeclampsia and eclampsia, as well as obstetric hemorrhage, which together account for the majority of maternal deaths in the country (Kementerian Kesehatan Republik Indonesia, 2024).

Regional disparities further complicate the issue of maternal mortality in Indonesia. Several provinces still experience relatively high maternal mortality rates due to limited access to health services, geographic challenges, and unequal distribution of health resources. Central Sulawesi Province is one of the regions with a relatively high maternal mortality rate compared with other provinces. Provincial health records indicate that maternal mortality in Central Sulawesi fluctuated significantly during the last five years. In 2020, the maternal mortality ratio was recorded at 149 per 100,000 live births, increasing to 206 per 100,000 live births in 2021. Although the number declined to 128 per 100,000 live births in 2022 and 108 per 100,000 live births in 2023, the figure rose again in 2024 to approximately 119 per 100,000 live births. These fluctuations suggest that maternal mortality in the province remains unstable and requires further investigation to identify the underlying determinants (Central Sulawesi Provincial Health Office, 2024).

At the district level, Donggala Regency presents a particularly concerning situation. Although located near the provincial capital, Donggala has experienced significant fluctuations in maternal mortality over recent years. Data from the District Health Office indicate that the maternal mortality ratio in Donggala was 184 per 100,000 live births in 2020, increasing to 204 per 100,000 live births in 2021. The figure declined slightly to 170 per 100,000 live births in 2022 but sharply increased again to 260 per 100,000 live births in 2023 before decreasing to 139 per 100,000 live births in 2024. These fluctuations highlight persistent challenges in maternal health services and indicate that existing interventions have not yet effectively addressed the root causes of maternal mortality in the region.

Understanding maternal mortality requires a comprehensive conceptual framework that captures both medical and socio-structural determinants. One widely recognized framework was developed by

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McCarthy and Maine (1992), which categorizes the determinants of maternal mortality into three levels: proximate determinants, intermediate determinants, and contextual determinants. Proximate determinants refer to direct medical causes such as hemorrhage, hypertensive disorders during pregnancy, and infection. Intermediate determinants include maternal health status, reproductive characteristics, access to health services, and utilization of maternal care. Contextual determinants involve broader socio-economic and cultural factors such as education, employment, and household economic status. This multidimensional framework emphasizes that maternal mortality is not caused by a single factor but results from complex interactions between biological, behavioral, and social determinants.

Globally, approximately 75% of maternal deaths are caused by five major complications: severe bleeding, infections after childbirth, hypertensive disorders of pregnancy, complications during delivery, and unsafe abortion. These complications are largely preventable through timely detection, adequate antenatal care, and effective emergency obstetric services (WHO, 2024). In Indonesia, hemorrhage accounts for approximately 28% of maternal deaths, followed by hypertensive disorders during pregnancy at around 24%, while infections contribute to approximately 11% of cases (Kementerian Kesehatan Republik Indonesia, 2024). These statistics indicate that most maternal deaths occur due to complications that could potentially be prevented with early detection and appropriate medical intervention.

In addition to direct medical causes, maternal mortality is strongly influenced by health service utilization and accessibility. Antenatal care (ANC) plays a crucial role in identifying risk factors during pregnancy and ensuring early management of complications. Regular ANC visits allow health professionals to detect conditions such as anemia, hypertension, and chronic diseases that may increase the risk of maternal death. Previous studies have demonstrated that inadequate ANC significantly increases the risk of maternal mortality because complications are often detected too late. For example, research has shown that incomplete ANC visits may increase maternal mortality risk several times compared with mothers who receive adequate antenatal care (Mandang et al., 2014; Moyo et al., 2018).

Another important determinant of maternal mortality is the delay in obtaining appropriate medical care, commonly conceptualized as the “three delays model.” The first delay occurs when families fail to recognize danger signs or delay the decision to seek care. The second delay refers to difficulties in reaching health facilities due to distance, transportation limitations, or geographic barriers. The third delay occurs within health facilities when patients do not receive timely and adequate treatment due to shortages of medical staff, equipment, or essential medicines. Previous studies have demonstrated that delays in referral systems can increase the risk of maternal death significantly, sometimes up to eleven times compared with cases where timely referral is provided (Prihesti et al., 2019; Mohammed et al., 2020).

Several empirical studies have attempted to identify risk factors associated with maternal mortality. Research conducted by Julfiana and Nismawati (2022) found that obstetric hemorrhage remains one of the strongest predictors of maternal mortality. Similarly, Bauserman et al. (2020) reported that antepartum hemorrhage increases the risk of maternal death by approximately 2.59 times, while hypertensive disorders may increase the risk by up to 6.87 times. Other studies highlight the role of chronic diseases, such as cardiovascular disorders and metabolic conditions, in increasing maternal mortality risk during pregnancy (Suriani, 2017; Diana et al., 2020). However, some studies have produced inconsistent findings regarding the influence of reproductive factors such as parity and birth spacing, suggesting that the determinants of maternal mortality may vary across regions and health system contexts.

Despite the growing body of research on maternal mortality, several gaps remain in the literature. Many studies focus on national or provincial trends but provide limited evidence regarding district-level determinants, particularly in geographically diverse regions such as Central Sulawesi. Additionally,

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previous research often examines individual risk factors separately rather than analyzing the combined influence of clinical, behavioral, and health service variables within a comprehensive analytical framework. As a result, the specific determinants contributing to maternal mortality in certain districts remain insufficiently understood.

The present study addresses this research gap by examining the risk factors associated with maternal mortality in Donggala Regency during the period 2020–2024 using a case–control approach. By integrating clinical factors such as hemorrhage history and comorbid diseases with health service variables including antenatal care utilization and referral delays, this study provides a more comprehensive understanding of maternal mortality determinants at the district level. The novelty of this research lies in its use of maternal verbal autopsy data combined with cohort registry records to analyze maternal deaths within a specific local health system context. This approach allows for a more detailed identification of both medical and systemic factors contributing to maternal mortality.

Based on the background described above, the objective of this study is to analyze the risk factors associated with maternal mortality and identify the most dominant determinant influencing maternal deaths in Donggala Regency during the period 2020–2024.

METODOLOGI

This study employed an observational analytic research design using a case–control approach to identify the risk factors associated with maternal mortality in Donggala Regency during the period 2020–2024. The case–control design was selected because it allows the comparison between mothers who experienced maternal death (cases) and mothers who survived pregnancy or childbirth (controls) in order to determine factors associated with the occurrence of maternal mortality. The study was conducted in Donggala Regency, Central Sulawesi Province, Indonesia. The population in this study consisted of all maternal cases recorded in the maternal health surveillance system during the study period. The sample comprised 108 respondents, consisting of 54 maternal death cases and 54 controls, selected using purposive sampling techniques based on predetermined inclusion criteria. Cases were defined as mothers who died during pregnancy, childbirth, or within 42 days postpartum due to pregnancy-related causes, while controls were mothers who experienced pregnancy and childbirth during the same period but survived. The study utilized secondary data sources obtained from Maternal Verbal Autopsy (MVA) records and the maternal cohort registry maintained by the local health authorities. Data collection involved reviewing these official health records to obtain information regarding maternal characteristics and potential risk factors, including history of hemorrhage, hypertensive disorders in pregnancy, maternal disease history, parity, interpregnancy interval, antenatal care utilization, referral delays, and maternal education level.

Data analysis was conducted using IBM SPSS Statistics software. The analytical process began with descriptive analysis to summarize the characteristics of the study variables. Subsequently, bivariate analysis was performed using the Odds Ratio (OR) with a 95% confidence interval and p-value to examine the association between each independent variable and maternal mortality. Variables that demonstrated statistical significance or met the selection criteria in the bivariate stage were then included in the multivariate analysis using multiple logistic regression to determine the most dominant risk factors associated with maternal mortality while controlling for potential confounding variables. The results of the analysis were presented in tabular and narrative forms to facilitate interpretation of the relationships between risk factors and maternal mortality in Donggala Regency.

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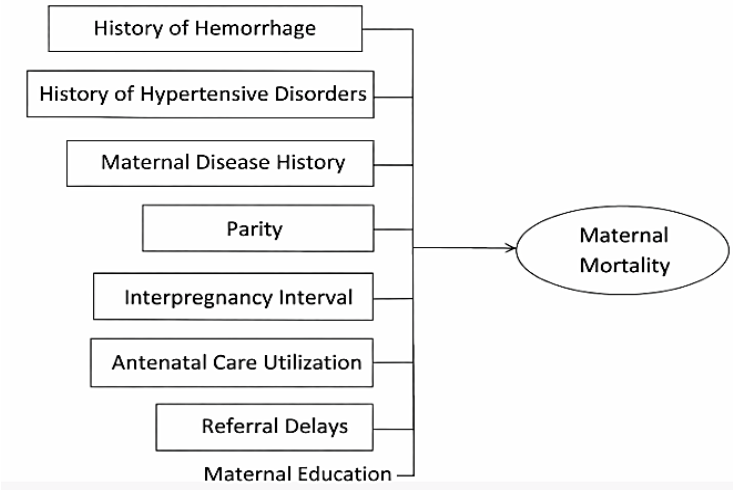

Figure 1. Diagram Conceptual Research

RESULTS AND DISCUSSION

This study involved a total of 108 respondents consisting of 54 maternal death cases and 54 controls who survived pregnancy and childbirth. The respondents were selected using purposive sampling based on maternal health records in Donggala Regency from 2020 to 2024. Bivariate analysis was conducted to examine the relationship between each independent variable and maternal mortality. The analysis used Odds Ratio (OR) with a 95% confidence interval and p-value to determine statistical significance.

Table 1. Bivariate Analysis of Risk Factors for Maternal Mortality in Donggala Regency (2020–2024)

Variables	Odds Ratio (OR)	p-value	Interpretation
History of hemorrhage	Significant	<0.05	Associated
History of hypertensive disorders (HDK)	Not significant	>0.05	Not associated
History of maternal disease	Significant	<0.05	Associated
Parity	Not significant	>0.05	Not associated
Interpregnancy interval	Not significant	>0.05	Not associated
ANC visits	Significant	<0.05	Associated
Referral delay	Significant	<0.05	Associated
Maternal education	Not significant	>0.05	Not associated

The results of the bivariate analysis show that several variables were significantly associated with maternal mortality in Donggala Regency. A history of hemorrhage, history of maternal disease, incomplete

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antenatal care visits, and referral delays demonstrated statistically significant relationships with maternal death. Conversely, other variables such as parity, interpregnancy interval, history of hypertensive disorders of pregnancy (HDK), and maternal education did not show statistically significant associations with maternal mortality. Although these variables were not statistically significant, they were still considered relevant and included in the multivariate analysis as potential confounding variables.

Multivariate logistic regression analysis was performed to determine the most influential independent risk factors associated with maternal mortality.

Table 2. Multivariate Logistic Regression Analysis of Maternal Mortality Risk Factors

Variables	Adjusted Odds Ratio (AOR)	95% Confidence Interval	p-value
History of hemorrhage	9.01	1.61 – 50.64	0.013
History of maternal disease	8.21	1.56 – 43.32	0.013
Incomplete ANC visits	6.14	1.52 – 24.85	0.011
Referral delay	10.05	2.04 – 49.61	0.005

The multivariate logistic regression analysis revealed that several variables remained statistically significant predictors of maternal mortality after controlling for other factors. Referral delay was identified as the strongest determinant of maternal mortality, with mothers experiencing referral delays having more than ten times higher risk of death compared with those who received timely referral services. This finding highlights the critical importance of an efficient maternal referral system in preventing maternal deaths.

A history of hemorrhage also significantly increased the risk of maternal mortality. Hemorrhage remains one of the leading direct causes of maternal death and requires immediate clinical intervention. In addition, mothers with a history of underlying disease were found to have a substantially higher risk of maternal death, indicating that pre-existing medical conditions can worsen during pregnancy and childbirth. Incomplete antenatal care (ANC) visits were also identified as an important risk factor. Adequate ANC services are essential for early detection of pregnancy complications, monitoring maternal health status, and ensuring appropriate referral when complications arise. Overall, the findings indicate that maternal mortality in Donggala Regency is strongly influenced by both clinical factors and health system factors, particularly referral delays and inadequate antenatal care services

Discussion

Maternal mortality remains one of the most critical indicators reflecting the quality of maternal health services and the overall health system performance in a region. This study aimed to analyze the risk factors associated with maternal mortality and to determine the most influential determinants of maternal death in Donggala Regency during the period 2020–2024. The findings of this study demonstrate that several variables significantly contribute to maternal mortality, including a history of hemorrhage, a history of maternal disease, incomplete antenatal care (ANC) visits, and delays in referral services. Among these variables, referral delay emerged as the most influential determinant associated with maternal mortality.

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The findings of this research can be explained using the conceptual framework of maternal mortality developed by McCarthy and Maine, which categorizes determinants into proximate determinants, intermediate determinants, and contextual determinants. According to this framework, proximate determinants include obstetric complications such as hemorrhage, hypertensive disorders of pregnancy, and infection. Intermediate determinants include maternal health status, reproductive status, and access to health services, while contextual determinants include socioeconomic factors such as maternal education and employment status (McCarthy & Maine, 1992). The results of this study indicate that both proximate and intermediate determinants significantly contribute to maternal mortality in Donggala Regency.

One of the most important findings of this study is the significant relationship between a history of hemorrhage and maternal mortality. The multivariate analysis revealed that mothers with a history of hemorrhage had a significantly higher risk of experiencing maternal death compared to those without such a history. Hemorrhage is widely recognized as one of the leading causes of maternal mortality globally. Severe bleeding, particularly postpartum hemorrhage, can lead to rapid hemodynamic deterioration and death if not managed promptly and effectively. This finding is consistent with global reports indicating that approximately 75% of maternal deaths are caused by major obstetric complications, with hemorrhage being the most prominent cause (WHO, 2024).

The results of this study are also consistent with previous research that identified hemorrhage as a major determinant of maternal mortality. Julfiana and Nismawati (2022) reported that pregnancy complications, particularly hemorrhage, significantly increase the risk of maternal death. Similarly, Bauserman et al. (2020) found that severe antepartum hemorrhage increased the risk of maternal mortality by more than two times. The presence of hemorrhage during pregnancy or childbirth requires immediate medical intervention, including blood transfusion and emergency obstetric care. In regions where health facilities have limited resources or delayed emergency response, hemorrhage can rapidly lead to fatal outcomes.

In the context of Donggala Regency, the high contribution of hemorrhage to maternal mortality may also be associated with limited access to emergency obstetric care and delayed referral processes. When complications such as severe bleeding occur in remote areas, the availability of skilled health personnel and adequate health facilities becomes crucial. Without timely intervention, maternal conditions can deteriorate rapidly, resulting in death. Therefore, strengthening emergency obstetric care systems is essential to reduce hemorrhage-related maternal mortality.

Another significant determinant identified in this study is the history of maternal disease. The results indicate that mothers who had pre-existing medical conditions were significantly more likely to experience maternal death compared to mothers without such conditions. Chronic diseases such as heart disease, diabetes mellitus, tuberculosis, malaria, and hypertension can worsen during pregnancy due to physiological changes in the maternal body. These conditions can increase the risk of complications during pregnancy and childbirth.

Previous studies have also highlighted the significant role of maternal health conditions in determining maternal outcomes. Suriani (2017) emphasized that chronic diseases can significantly increase maternal morbidity and mortality because they reduce the body's ability to adapt to the physiological demands of pregnancy. Similarly, Diana et al. (2020) found that maternal disease history significantly contributes to maternal mortality. Prihesti et al. (2019) also reported that heart disease increased the risk of maternal death up to four times.

Pregnancy places considerable physiological stress on the cardiovascular, respiratory, and metabolic systems of the mother. Women with underlying health conditions may experience worsening symptoms

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during pregnancy, which can lead to life-threatening complications if not properly managed. In addition, pre-existing diseases may also affect fetal development and increase the risk of adverse pregnancy outcomes. Therefore, early detection and proper management of maternal diseases during antenatal care are essential strategies to reduce maternal mortality.

Another important factor identified in this study is incomplete antenatal care (ANC) visits. The results indicate that mothers who did not receive adequate ANC services had a significantly higher risk of maternal death. Antenatal care plays a critical role in monitoring maternal health, detecting pregnancy complications early, and providing timely interventions. Regular ANC visits allow healthcare providers to identify risk factors such as anemia, hypertension, infections, and fetal growth abnormalities.

The importance of ANC services in preventing maternal mortality has been widely documented. Mandang et al. (2014) emphasized that ANC services are essential for ensuring maternal and neonatal health because they enable early detection of complications and appropriate management. Moyo et al. (2018) also reported a strong association between inadequate ANC visits and maternal mortality. According to WHO recommendations, antenatal care should include multiple contacts with healthcare providers to ensure comprehensive maternal health monitoring.

Despite the recognized importance of ANC services, some pregnant women still do not receive adequate antenatal care due to various barriers such as limited access to health facilities, lack of awareness, financial constraints, and cultural beliefs. In rural areas such as Donggala Regency, geographical barriers and transportation difficulties may further limit access to health services. As a result, many pregnancy complications remain undetected until they become severe.

In addition to medical factors, health system factors also play a crucial role in maternal mortality. One of the most significant findings of this study is the strong association between referral delays and maternal mortality. The results show that referral delay is the most dominant risk factor associated with maternal death. Mothers who experienced referral delays were significantly more likely to die compared to those who received timely referrals.

The concept of referral delay is closely related to the "Three Delays Model," which explains maternal mortality through three types of delays: delay in deciding to seek care, delay in reaching healthcare facilities, and delay in receiving appropriate care at healthcare facilities. These delays often occur in low-resource settings where access to health services is limited. According to Diana et al. (2020) and Sitaula et al. (2021), these delays significantly contribute to maternal mortality in many developing countries.

In many rural regions, including Donggala Regency, geographical barriers and limited transportation infrastructure can significantly delay access to emergency obstetric care. Mothers experiencing complications may have to travel long distances to reach referral hospitals, and transportation options may be limited or unavailable. Additionally, financial constraints may prevent families from seeking immediate medical care.

Research by Mohammed et al. (2020) and Sageer et al. (2019) also highlights that weak referral systems, lack of skilled healthcare providers, limited blood transfusion services, and inadequate medical supplies contribute to delays in emergency obstetric care. Prihesti et al. (2019) reported that referral delays increased the risk of maternal death up to eleven times. These findings emphasize the critical importance of strengthening maternal referral systems to reduce maternal mortality.

Although several variables showed significant associations with maternal mortality, other variables such as parity, interpregnancy interval, hypertensive disorders of pregnancy (HDK), and maternal education were not statistically significant in this study. However, these variables still played a role as confounding factors in the multivariate model.

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Parity and interpregnancy interval are commonly recognized as important reproductive factors influencing maternal health outcomes. High parity and short birth intervals can increase the risk of obstetric complications such as postpartum hemorrhage and maternal anemia. Bauserman et al. (2020) found that high parity and short birth intervals increased maternal mortality risk in several low- and middle-income countries. However, some studies have reported inconsistent findings. For example, Fitriani (2019) found no significant relationship between parity, birth spacing, and maternal mortality.

Maternal education is another factor often associated with maternal health outcomes. Women with higher education levels tend to have better knowledge of maternal health, recognize pregnancy danger signs, and utilize healthcare services more frequently. Bauserman et al. (2020) reported that women with low educational levels had a significantly higher risk of maternal mortality. However, in this study, maternal education did not show a statistically significant association with maternal mortality. This may be due to the influence of other factors such as healthcare access and referral systems that play a more dominant role in determining maternal outcomes in this region.

Overall, the findings of this study highlight the complex interaction between medical, behavioral, and health system factors in determining maternal mortality. Obstetric complications such as hemorrhage and maternal diseases represent direct causes of maternal death, while health service utilization factors such as ANC visits and referral systems represent important intermediate determinants influencing maternal survival.

The results of this study emphasize the need for comprehensive strategies to reduce maternal mortality in Donggala Regency. These strategies should include strengthening antenatal care services, improving early detection of pregnancy complications, enhancing maternal referral systems, and ensuring the availability of emergency obstetric care services. In addition, community education programs should be implemented to increase awareness of pregnancy danger signs and encourage timely healthcare utilization.

CONCLUSIONS

This study concludes that maternal mortality in Donggala Regency during the period 2020–2024 is significantly influenced by several medical and health service–related factors, particularly a history of hemorrhage, a history of maternal disease, incomplete antenatal care (ANC) visits, and delays in referral services. Among these determinants, referral delay was identified as the most dominant factor contributing to maternal death. These findings indicate that maternal mortality is not only associated with obstetric complications but also with the effectiveness of maternal health services and the timeliness of referral systems. Therefore, efforts to reduce maternal mortality in Donggala Regency should prioritize early detection of pregnancy complications, improvement in the quality and completeness of ANC services according to established standards, and strengthening an effective, responsive, and timely maternal referral system to ensure that mothers experiencing obstetric complications receive appropriate medical care as quickly as possible.

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Journal of Public Health Indonesian
Volume.2 Issue.6, (March, 2026) Pages 45-53
E-ISSN: 3048-1139
DOI : https://doi.org/10.62872/ttxa4d85
https://nawalaeducation.com/index.php/JHH

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