ORIGINAL RESEARCH

The influence of maternal factors and residential building characteristics on infant mortality in Papua Province, Indonesia, based on secondary data analysis of the IDHS 2017

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Article Info	ABSTRACT
	Objective: Infant mortality remains a significant global health issue, with 2.4 million infants died before one month of age in 2020. In Indonesia, the infant mortality rate was 16.85 per 1,000 live births in 2022, with Papua Province reported the highest rate. This study aims to identify factors contributing to infant mortality in Indonesia, focusing on maternal age, antenatal care, immunization, delivery conditions, parity, education, maternal employment, income, and housing characteristics. **Materials and Methods**: This study employed a quantitative cross-sectional design using secondary data from the Indonesian Demographic and Health Survey (IDHS) 2017. The sample included 658 women aged 15-49 who gave birth to infants aged 0-11 months between 2012 and 2017 in Papua Province. The analysis comprised three stages: univariate analysis for frequency distribution, bivariate analysis using logistic regression ($p < 0.05$) to test relationships, and multivariate analysis with multiple logistic regression for simultaneous evaluation. Variables with p values < 0.25 were included, while those > 0.05 were progressively removed, focusing on changes in Odds Ratio (OR). **Results**: The analysis found that maternal education level is a dominant factor influencing infant mortality, with an Adjusted Odds Ratio (AOR) of 43.579 (p-value = 0.000, 95% CI = 5.549-342.235). Mothers with a basic education are 43.57 times more likely to experience infant mortality compared to those with higher education. **Conclusions**: Maternal socioeconomic factors significantly impact infant mortality in Papua Province, and the findings can inform strategies to reduce mortality rates in the region.

Highlights:

1. This study focuses on Papua, which has the highest infant mortality rate, using a multivariate approach to analyze various factors. Data from the IDHS 2017 and robust statistical analysis are expected to aid in formulating effective health policies.
2. The uniqueness of this research lies in its broader scope of variables, including education and employment, while considering the social and cultural context of Papua, providing new insights into infant health issues.

INTRODUCTION

Infant mortality remains a serious public health issue worldwide. According to WHO (2022), in 2020, 2.4 million babies died before reaching one month of age. Every day, approximately 6,700 infants die, contributing to 47% of all deaths among children under five years old. This reflects the welfare and health quality of a country or region. Infant mortality has significant emotional impacts on families and societies and affects economic growth and social development.[1]

The infant mortality rate (IMR) in Papua has decreased from 129 in 1971 to 38 in 2021. However, Papua still has the highest IMR in Indonesia. This requires attention from the government, health institutions, international organizations, and civil society. According to the 2020 Population Census, Papua's IMR is 38.17, meaning there are 38-39 infant deaths per 1,000 live births, more than twice the national average of 16.85.

IMR is a crucial indicator of public health quality. A low rate indicates good health quality.[2] The Sustainable Development Goals (SDGs) target to reduce IMR to 12 per 1,000 live births by 2030. Various efforts have been made, including ensuring deliveries by healthcare professionals in health facilities and providing standard healthcare services for newborns. Over the past 50 years, Indonesia's IMR has decreased by nearly 90%, from 26 per 1,000 live births in the 2010 Census to 16.85 per 1,000 live births in the 2020 Census. Increased complete immunization and duration of breastfeeding have contributed to this decline. According to the Central Statistics Agency (BPS), Indonesia recorded an IMR of 16.85 per 1,000 live births in 2022, with Papua having the highest IMR at 38.17 per 1,000 live births.[3]

Factors influencing infant mortality include maternal age, antenatal care visits, Tetanus Toxoid immunization, place of delivery, birth attendant, birth spacing, number of children, maternal education level, maternal occupation, maternal income, place of residence, and characteristics of residential buildings. Efforts to reduce IMR include ensuring deliveries by healthcare professionals and providing standard healthcare services for newborns. This study aims to identify the causes of infant mortality in Indonesia.

MATERIALS AND METHODS

Observational analysis with a cross-sectional research design was conducted to identify the causes of infant mortality in Papua Province. The study was carried out from January to March 2024, using specified inclusion and exclusion criteria for sample selection. The sample consisted of 658 female respondents aged 15 to 49 years who gave birth between 2012 and 2017. Independent variables included maternal age, antenatal care visits, Tetanus Toxoid immunization, place of delivery, and characteristics of residential buildings from the Indonesian Demographic and Health Survey (IDHS) 2017. Ethical approval was obtained from Universitas Airlangga Surabaya under letter number 60/EC/KEPK/FKUA/2024 dated February 29, 2024.

Univariate analysis was performed to determine the frequency distribution of the dependent variable (infant mortality) and independent variables, such as maternal age, antenatal care, Tetanus Toxoid immunization, place of delivery, birth attendant, birth spacing, parity, maternal education, maternal employment, family income, residence, and residential building characteristics. Bivariate analysis tested the relationships between independent and dependent variables using a 95% confidence level and a significance level of 5% (p <0.05), employing simple logistic regression. Multivariate analysis examined the relationships between multiple independent variables and one dependent variable using multiple logistic regression. Variables with p-values <0.25 were considered, while those >0.05 were removed sequentially. Important variables with p-values <0.05 were retained, and changes in Odds Ratio (OR) were monitored to ensure significant variables remained in the model, continuing until all variables had p-values ≤ 0.05.

RESULTS AND DISCUSSION

Based on the findings of this study, here are the characteristics of the respondents as presented in Table 1. Candidates for multiple logistic regressions were chosen from Table 2 when the p < 0.25.[4] They were maternal age, ANC, Tetanus Toxoid immunization, place of delivery and building residence variables.

Table 1. Characteristics of respondents

Characteristics	Frequency (n)	Percent (%)
Maternal age		
< 20 years	142	21.6
20-35 years	321	48.8
> 35 years	195	29.6
Pregnancy check-ups		
First ANC	492	74.8
Complete ANC	166	25.2
Tetanus toxoid immunization		
No	522	79.3
Yes	136	20.7
Maternity center		
No health facilities	157	23.9
Health facilities	501	76.1
Residential Building		
Not liveable	117	17.8
Liveable	541	82.2
Total	658	100.0

Table 2. Relationship of mother's age, pregnancy check-up, tetanus toxoid immunization, place of delivery, and building residence to infant mortality

Characteristics	Infant mortality				Total		ρ value n
	Die		Live				
	n	%	n	%	n	%	
Maternal Age							
< 20 years	36	5.5	106	16.1	142	21.6	0.295
20-35 years	72	10.9	249	37.8	321	48.8	0.609
> 35 years	40	6.1	155	23.6	195	29.6	
Total	148	22.5	510	77.5	658	100.0	
Pregnancy Check-ups							
First ANC	103	15.7	381	59.1	492	74.8	0.100
Complete ANC	45	6.8	121	18.4	166	25.2	
Total	148	22.5	510	77.5	658	100.0	
TT Immunization							
No	123	18.7	399	60.6	522	79.3	0.199
Yes	25	3.8	111	16.9	136	20.7	
Total	148	22.5	510	77.5	658	100.0	
Maternity Center							
No health Facilities	49	7.4	108	16.4	157	23.9	0.003
Health Facilities	99	15.0	402	61.1	501	76.1	
Total	148	22.5	510	77.5	658	100.0	
Residential Building							
Not liveable	6	0.9	111	16.9	117	17.8	< 0.001
Liveable	142	21.9	399	60.6	541	82.2	
Total	148	22.5	510	77.5	658	100.0	

Table 3. Results of multiple logistic regression analysis variables

Variables	B	p-value	Adjusted Odds Ratio (AOR)	95% CI
Pregnancy Check-up	0.135	0.548	1.144	0.738-1.775
Tetanus Toxoid Immunization	0.273	0.337	1.314	0.752-2.294
Maternity Center	-0.660	0.003	0.517	0.333-0.803
Residential Building	1.861	0.000	6.427	2.732-15.120
Constant	0.836	0.001	2.306	

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Four hypotheses were tested regarding factors influencing infant mortality. The analysis results show variation in the significance of these factors in relation to infant mortality rates. Firstly, no significant relationship was found between pregnancy check-ups and infant mortality (p = 0.548). Similarly, Tetanus Toxoid immunization did not show a significant relationship with infant mortality (p = 0.337). However, significance was found in the relationship between place of delivery and infant mortality (p = 0.003), with mothers delivering at health facilities having 0.517 times higher odds of preserving their baby's life compared to those delivering at non-health facilities. Lastly, the condition of the building residence significantly affects infant mortality (p = 0.000), where babies living in uninhabitable conditions have a 6.427 times higher risk of death compared to those living in habitable residences (Table 3). These results underscore the importance of access to and quality of health services during delivery and the living environment in reducing infant mortality rates.

This study evaluated the relationship between maternal age and infant mortality. The majority of respondents were aged 20-35 years, and no significant relationship was found between maternal age and infant mortality.[5] However, early marriage (under 19 years) increases serious health risks,[6] including infant mortality due to immature reproductive systems. Maternal health also influences infant mortality risk, but regular pregnancy care and competent health assistance can mitigate this risk.[7]

This study indicates that the majority of pregnant women in Papua do not receive optimal antenatal care (ANC). While some research shows a relationship between ANC visits and infant mortality(5), the low number of ANC visits meeting standard guidelines can increase the risk of neonatal death.[8] Factors such as low maternal nutritional status, including Chronic Energy Deficiency (CED), and inadequate iron intake pose significant challenges to maternal health in Papua.[9] Research suggests that strenuous work habits during pregnancy can affect timely ANC visits, often influenced by socio-economic and cultural factors in Papua.[9] Overall, while ANC is crucial for maternal and infant health, challenges in its implementation and suboptimal quality, along with socio-economic issues like CED and low iron intake among pregnant women, are major barriers in reducing infant mortality rates in Papua and Indonesia as a whole. More effective interventions are needed to enhance awareness, access, and quality of healthcare services for pregnant women.

This study also shows that the majority of respondents have received Tetanus Toxoid immunization, and research findings indicate that TT immunization significantly prevents infant deaths caused by neonatal tetanus infections.[10] Tetanus infection in infants can result from non-sterile deliveries or maternal wounds before childbirth. Tetanus Toxoid immunization is a key strategy in the Maternal and Neonatal Tetanus Elimination (MNTE) program, aimed at ensuring safe and sterile deliveries.[11] Data from the 2023 Provincial Health Profile of Papua indicate that complete basic immunization programs play a crucial role in preventing various infectious diseases, including those that can cause infant deaths.[3] Despite improvements in immunization coverage in Papua, challenges remain in achieving complete immunization for all children, which is a focus for enhancing awareness and access to healthcare services. Overall, Tetanus Toxoid immunization is not only important for protecting individuals from tetanus but also as part of a broader strategy to improve maternal and infant health. By increasing awareness of the importance of immunization and expanding access to healthcare services, it is expected to reduce infant deaths caused by preventable diseases like tetanus.[12]

The majority of mothers give birth in healthcare facilities, and research shows a significant relationship between the place of delivery and neonatal mortality rates.[13] This research confirms that childbirth assistance in healthcare facilities equipped with trained healthcare personnel and adequate facilities can reduce the risk of infant mortality compared to deliveries elsewhere that are not sterile or lack proper care. Another study by Mogi & Anggraeni (2021) presents contrasting findings, suggesting that the place of delivery does not significantly correlate with infant mortality. However, the study emphasizes that deliveries in healthcare facilities meeting appropriate standards can minimize complications leading to infant death.[14] Data from the Health Profile of Papua Province 2023 indicates an increase in the percentage of women giving birth in healthcare facilities in recent years, yet challenges remain in improving access and quality of healthcare services in urban and rural areas.[15] Factors such as education, economic status, and age also influence mothers' decisions in choosing the place of delivery (decision-making).[16]

Overall, despite healthcare facilities offering a safer environment for childbirth, challenges remain in improving service quality and accessibility to reduce infant mortality rates in Papua Province. Continuous interventions to enhance public awareness of the importance of delivering in healthcare facilities and to improve health infrastructure are crucial to achieving better maternal and child health outcomes.

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The majority of survey respondents live in habitable buildings, and there is a correlation with significant influence on infant mortality rates related to the attributes of residential buildings. The health status of infants is influenced by the physical condition and cleanliness of their living environment. Diseases such as flu, diarrhea, and typhoid can arise from unclean environments, hindering infant growth and increasing the likelihood of newborn mortality.[17,18] Gozali et al. (2023) found a strong correlation between the prevalence of diarrhea in children and the presence of healthy toilets and closed waste disposal systems.[19] UNICEF Indonesia also found that 88% of child deaths due to diarrhea worldwide are caused by inadequate sanitation and contaminated drinking water, limiting children's potential and reducing human resource quality. Infant health is influenced by the quality of residential structures, including construction, building materials, and community conditions. These factors also reflect household financial health. Protecting infants from the outdoors and diseases partly depends on the condition of walls, floors, and roofs of homes. Eighty-three percent of homes in Papua experiencing infant deaths are in high-quality buildings, while only 17% have low-quality homes. Low-quality homes are generally identified by features like inadequate heating, ventilation, structural issues, overcrowding, and the presence of health hazards such as mold, all of which significantly increase the risk of health problems for residents.[20,21]

According to the study's findings, there are noteworthy correlations between infant mortality and prenatal checkups, Tetanus Toxoid vaccinations, birth sites, and the standard of residential buildings. Based on the research findings, the type of housing structure is the most significant factor contributing to infant mortality among all other factors. The study indicates a significant correlation between infant mortality and several aspects, including prenatal care, Tetanus Toxoid vaccination, place of birth, and housing standards. For instance, Okech et al. (2021) emphasize that poor housing conditions, such as inadequate construction and lack of basic facilities, can elevate the risk of infant mortality.[22] Additionally, Rahman et al. (2022) highlight that access to quality prenatal health services and a safe living environment can significantly reduce infant mortality rates.[23] However, maternal age does not significantly correlate with infant mortality in Papua Province according to 2017 SDKI data. Regular prenatal check-ups and Tetanus Toxoid immunizations can reduce the risk of infant mortality. Delivering in non-healthcare facilities increases the risk of infant mortality, consistent with previous research findings.[24] The increasing rate of deliveries in healthcare facilities, particularly in urban areas among economically better-

off mothers, underscores the importance of healthcare access and quality services. Cleanliness and the physical condition of living spaces also affect infant health. Unhealthy environments and poor sanitation can cause diseases that hinder infant growth and increase mortality risk. This study emphasizes the importance of good sanitation practices and cleanliness to enhance community quality of life and reduce infant mortality rates. Sustained efforts are needed to improve healthcare accessibility, service quality, and living conditions to mitigate infant mortality risk, especially in Papua Province.[5]

The research on infant mortality in Papua Province presents several advantages and disadvantages. One key advantage is its high relevance, focusing on an area with the highest infant mortality rates in Indonesia, which is crucial for improving public health. The use of secondary data from the Indonesia Demographic and Health Survey (IDHS) ensures that the data is reliable and standardized. Additionally, the study's comprehensive analysis involves various independent factors affecting infant mortality, providing a thorough understanding of the issue. The findings can inform better health policies in regions with high infant mortality rates and raise community awareness about risk factors. However, there are limitations to consider. The reliance on secondary data may lead to gaps in coverage or biases in data collection. Establishing direct causal relationships between variables can be challenging. The research is geographically focused on Papua, limiting the generalizability of the results to other areas in Indonesia. Moreover, there may be unmeasured factors influencing infant mortality that the dataset does not capture. Finally, the data represents a snapshot from 2017, which might not reflect current trends or changes. Despite these drawbacks, the study aims to make a significant contribution to efforts to reduce infant mortality in Papua.

CONCLUSION

This study underscores the significant impact of residential building quality on infant mortality rates in Papua Province. It identifies that while factors such as maternal age, antenatal care, and Tetanus Toxoid immunization are relevant, they do not show a direct correlation with infant mortality. Deliveries in health-care facilities are linked to lower mortality rates, highlighting the necessity of access to quality maternal healthcare services. Furthermore, the physical condition of living environments plays a crucial role, with inadequate housing contributing to increased risks for infants. Overall, improving healthcare access, enhancing living conditions, and promoting maternal health

education are essential steps needed to reduce infant mortality in Papua and similar regions.

DISCLOSURES

Conflict of interests

The authors declare that there are no conflicts of interest regarding this research. All authors have contributed to, reviewed, and approved the final manuscript for publication.

Author contributions

All authors have actively contributed to this study, each playing a distinct role in its conception, design, data collection, analysis, and manuscript preparation. Their collective efforts have been essential to the completion of this study.

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