



## DETERMINATION OF FACTORS AFFECTING THE INCIDENCE OF ANEMIA IN PREGNANT WOMEN

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### ABSTRACT

Anemia in pregnant women remains a global health problem, including in Timor Leste, where its prevalence is notably high. This study aimed to analyze the factors influencing the incidence of anemia among pregnant women at Centro Saude Komunitaria Becora, Dili. A quantitative study was conducted using an analytical cross-sectional design. The study population comprised all pregnant women diagnosed with iron deficiency anemia in July 2025, totaling 115 individuals, all of whom were included as respondents using a total sampling technique. Data were collected through a structured questionnaire tested for validity ( $p < 0.05$ ) and reliability (Cronbach's Alpha = 0.838). Variables examined included maternal age, parity, education, income, ANC visit frequency, knowledge level, compliance with iron supplementation, and anemia status based on hemoglobin levels ( $<11$  g/dL). Data were analyzed using univariate statistics for frequency distribution, bivariate analysis with Chi-Square tests, and multivariate analysis using binary logistic regression (95% CI;  $p < 0.05$ ). Results revealed six significant factors: age, parity, education, income, ANC visit frequency, and knowledge. High parity (multiparity) emerged as the dominant risk factor (OR = 43.560), while other factors were protective. In conclusion, anemia in pregnant women is more strongly influenced by sociodemographic and behavioral factors than by supplementation compliance alone. Therefore, interventions should emphasize nutrition education, strengthening ANC services, economic empowerment, and optimal birth spacing strategies.

Keywords: anemia; parity; pregnant women; sosiodemografi; timor leste

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## INTRODUCTION

Pregnancy is a crucial period that requires serious attention to the mother's nutritional status, as it significantly determines the health of both mother and fetus. The physiological, hormonal, and metabolic changes that occur during pregnancy require adequate macro and micronutrient intake, particularly iron. Iron deficiency can lead to anemia, characterized by low hemoglobin levels, which reduces the blood's ability to carry oxygen (Leung et al., 2024; Munro et al., 2023; Obeagu, 2025). Anemia in pregnant women remains a global health problem. WHO data indicates that approximately 40% of pregnant women worldwide suffer from anemia, with a higher prevalence in developing countries (Araujo Costa & de Paula Ayres-Silva, 2023). In Southeast Asia, the average prevalence of anemia in pregnant women is 52.5%, while in Indonesia it is recorded at 31% (Ameline et al., 2025). This condition indicates that anemia remains a public health problem that requires more serious attention.

In Timor-Leste, the prevalence of anemia among pregnant women is even higher than in Indonesia, reaching 42.62% (Hadjo, 2024). This condition is exacerbated by the high rate of stunting among children under five, which is around 47% (Mulyani et al., 2025). Local data from the Centro Saude Komunitaria Becora, Dili, shows that from January to August 2024, 866 pregnant women experienced anemia out of a total of 7,989 ANC examinations, or around 10.84%. This fact confirms that anemia remains a serious problem at the community level. Anemia in pregnant

women not only causes clinical symptoms such as fatigue, dizziness, and shortness of breath, but also impacts serious obstetric complications. The risk of premature birth, low birth weight (LBW), and increased maternal and infant mortality are real threats. Furthermore, anemia can affect a child's cognitive development, as explained in the Developmental Origins of Health and Disease (DOHaD) theory, which emphasizes the role of maternal nutrition during pregnancy on a child's long-term health.

Various studies have shown that anemia in pregnant women is influenced by numerous factors, including biological, social, and behavioral factors (Purba & Sitepu, 2023; Sugesti, 2025; Talin et al., 2023). Maternal age, parity, pregnancy spacing, nutritional status, dietary patterns, education level, economic status, frequency of ANC visits, knowledge level, and adherence to iron tablet consumption are all interacting determinants (Engidaw et al., 2025). However, the contribution of each of these factors can vary from region to region due to socio-cultural variations and health care conditions. Although extensive research on anemia in pregnant women has been conducted in various countries, knowledge gaps remain, particularly in Timor-Leste. Local data on anemia risk factors is still very limited, despite its high prevalence. Most previous studies are also descriptive in nature, without in-depth analysis to determine which factors are most dominant in influencing anemia incidence (Balarajan et al., 2011; Gedefaw et al., 2015; Haider et al., 2013; Kassie et al., 2024).

This research gap demonstrates that results from other countries cannot necessarily be generalized to Timor-Leste. The country's social, economic, educational, and access to healthcare conditions differ from those of neighboring countries such as Indonesia or Vietnam. Therefore, research exploring the determinants of anemia in pregnant women in Timor-Leste is crucial to provide a clear picture of local risk factors. The novelty of this study lies in its multivariate analysis approach, which allows researchers to assess the contribution of each factor simultaneously. In addition to highlighting biological factors, the study also considers socioeconomic and health behavioral aspects, such as maternal knowledge, adherence to iron tablet consumption, and regularity of antenatal care visits. This comprehensive approach has rarely been used in previous research in Southeast Asia, particularly in Timor-Leste.

Furthermore, another novelty of this study is the provision of community-based empirical evidence in the Centro Saude Komunitaria Becora, Dili. This area was chosen due to its relatively high prevalence of anemia, despite being located in the nation's capital. The results are expected to provide more representative information on the dominant factors causing anemia in urban areas with limited access to health services. Based on this background, this study aims to analyze the determinants of anemia in pregnant women in the Centro Saude Komunitaria Becora, Dili. The results are expected to enrich the scientific literature on the determinants of anemia in pregnant women, provide a basis for more effective health interventions, and serve as a reference for policymakers in designing anemia management programs and improving maternal and child health in Timor-Leste.

## **METHOD**

This study used a quantitative approach with a cross-sectional analytical design. This design was chosen because it allows researchers to measure the prevalence of anemia in pregnant women while identifying the relationship between independent variables (age, parity, education, income, frequency of ANC visits, knowledge level, and adherence to iron tablet consumption) with the dependent variable (the incidence of anemia) over a certain period of time. With this approach, researchers can obtain a comprehensive picture of the determinants of anemia without requiring long-term follow-up. This study was conducted at the Becora Community Health Center, located in the Cristu Rei Administrative Post. The population in this study were all pregnant women with anemia and registered as patients at the Becora Community Health Center, Cristu Rei

Administrative Post, Dili Municipality, Timor Leste in July 2025. This population was chosen because the health center is one of the main referral facilities in the Dili area with a fairly high number of pregnant women patients, so it is considered representative to describe the condition of anemia incidence in urban areas of Timor Leste.

Based on available medical records, the number of pregnant women with anemia during that period was recorded at 115. This figure was obtained after screening based on previously established inclusion and exclusion criteria. Inclusion criteria included pregnant women diagnosed with iron deficiency anemia, being mentally healthy, and being able to read, write, and communicate in the national language of Timor-Leste. Exclusion criteria included pregnant women who did not have iron deficiency anemia, had mental or psychological disorders that hindered data collection, and were unable to communicate effectively in the national language.

For sampling, this study used a total sampling technique (Subhaktiyasa, 2024), namely the entire population that met the criteria were directly made respondents to the study. In other words, the number of samples was the same as the population, namely 115 people. This technique was chosen because the population size was relatively small and still allowed for research as a whole without having to use other probability sampling methods. The use of total sampling has several advantages, namely (1) This technique allows researchers to obtain a comprehensive picture of the characteristics of all pregnant women with anemia in the study area; (2) Using the entire population as a sample can reduce the potential for selection bias, because there is no reduction or selection of some respondents that can affect the results of the study; and (3) The results of the study become stronger in terms of external validity, because the entire relevant population has been included in the study.

Furthermore, by involving all respondents, the data analysis can realistically depict the phenomenon of anemia among pregnant women at the Centro Saude Komunitaria Becora. This is important because each respondent has different social, economic, and biological characteristics, so the more data obtained, the higher the accuracy of the multivariate analysis results in identifying the dominant factors causing anemia. Therefore, selecting the population of pregnant women with anemia at the CSC Becora and using the total sampling technique is not only a practical consideration, but also a methodological strategy to ensure accurate, representative research results that can be used as a basis for formulating maternal health policies in Timor Leste.

Data collection was conducted using a structured questionnaire that included independent and dependent variables. Operational definitions were formulated in detail so that each variable could be measured clearly, such as (1) Maternal age was categorized as at risk if  $\leq 20$  years or  $\geq 35$  years; parity was divided into nulliparous/primiparous and multiparous; (2) Income was categorized as low if  $< 115$  USD (below the minimum wage); (3) Frequency of ANC visits was considered complete if  $\geq 4$  times; knowledge was assessed using a standardized questionnaire; (4) Compliance with Fe tablet consumption was measured based on consumption of at least 1 tablet/day; and (4) Anemia status was determined based on Hb examination according to WHO standards ( $< 11$  g/dL). Prior to implementation, researchers obtained permission from the Dili Municipal Health Office and ethical approval from the Health Research Ethics Commission.

To ensure validity, the instrument was tested through expert judgment and empirical validity testing with Pearson correlation on 30 trial respondents. The results showed that most items were significant ( $p < 0.05$ ), making it suitable for use. Reliability was tested using Cronbach's Alpha and obtained a value of 0.838, which is considered high. Ethically, this study upholds the principles of respect for persons, beneficence, and justice. Respondents were given the freedom to refuse or accept, data were kept confidential, and identities were disguised with an anonymous code. Data were analyzed using the SPSS program. Univariate analysis was used to describe the distribution of

respondent characteristics. Bivariate analysis used the Chi-Square test to determine the relationship between independent variables and anemia. Next, multivariate analysis was performed with binary logistic regression to assess the simultaneous influence of all independent variables and determine the dominant factors associated with the incidence of anemia. The analysis results were considered significant if the p-value < 0.05 with a 95% confidence interval (Rachman et al., 2024).

**RESULT**

Table 1.  
Distribution of Characteristics of Pregnant Women Respondents

Variables	Category	f	%
Mother's Age	Risky	60	52.2
	No Risk	55	47.8
Parity	Nullipara/Primipara	38	33.0
	Multipara	77	67.0
Education	Low	90	78.3
	Tall	25	21.7
Income	Low	91	79.1
	Tall	24	20.9
Frequency of ANC Visits	Incomplete	89	77.4
	Complete	26	22.6
Level of Knowledge	Not enough	92	80.0
	Pretty good	23	20.0
Fe Consumption Compliance	Not obey	98	85.2
	Obedient	17	14.8
Anemia Incident	Light	23	20.0
	Medium/Heavy	92	80.0

The table above shows that the majority of pregnant women are in the at-risk age category (<20 years or >35 years), multiparous, have little education, and have low income, making them more susceptible to anemia. This condition is exacerbated by high rates of incomplete ANC visits, low levels of knowledge about nutrition and anemia, and low compliance with iron tablet consumption. The accumulation of these factors contributes to the high prevalence of moderate to severe anemia in pregnant women (80%), confirming that anemia remains a serious problem in this region and requires comprehensive intervention through increased education, improved access to health services, and adequate nutritional support.

Table 2.  
Crosstab Distribution of Maternal Age with Anemia Incidence

Category	Moderate/Severe Anemia	Mild Anemia	Total	$\chi^2$	p-value
At risk	55 (91.7%)	5 (8.3%)	60	10.6	0.001
No risk	37 (67.3%)	18 (32.7%)	55		

Based on the table above, it is known that the proportion of anemia cases in pregnant women with an age at risk ( $\leq 20$  years or  $\geq 35$  years) is higher, namely 55 respondents (91.7%). The results of the Chi-Square test showed a significant relationship between maternal age and the incidence of anemia ( $\chi^2 = 10.6$ ;  $p = 0.001$ ).

Table 3.  
Crosstab Distribution of Parity with Anemia Incidence

Category	Moderate/Severe Anemia	Mild Anemia	Total	$\chi^2$	p-value
Nullipara/Primipara	26 (68.4%)	12 (31.6%)	38	4.75	0.029
Multipara	66 (85.7%)	11 (14.3%)	77		

The table above shows that the incidence of anemia in multiparous pregnant women is higher, at 85.7%. Chi-square test results indicate a significant relationship between parity and the incidence of anemia ( $\chi^2 = 4.75$ ;  $p = 0.029$ ).

Table 4.  
Crosstab Distribution of Education Level with Anemia Incidence

Category	Moderate/Severe Anemia	Mild Anemia	Total	$\chi^2$	p-value
Low	76 (84.4%)	14 (15.6%)	90	5.1	0.024
Tall	16 (64.0%)	9 (36.0%)	25		

The table 4 shows that the prevalence of anemia among pregnant women with low education was higher, at 38 respondents (84.4%). Chi-square test results showed a significant relationship between education and anemia ( $\chi^2 = 5.1$ ;  $p = 0.024$ ).

Table 5.  
Crosstab Distribution of Income with Anemia Incidence

Category	Moderate/Severe Anemia	Mild Anemia	Total	$\chi^2$	p-value
Low	78 (85.7%)	13 (14.3%)	91	8.9	0.003
Tall	14 (58.3%)	10 (41.7%)	24		

The table 5 shows that the prevalence of anemia among pregnant women with low incomes is higher, with 48 respondents (85.7%). Chi-square test results indicate a significant relationship between income and the incidence of anemia ( $\chi^2 = 8.9$ ;  $p = 0.003$ ).

Table 6.  
Crosstab Distribution of ANC Visit Frequency with Anemia Incidence

Category	Moderate/Severe Anemia	Mild Anemia	Total	$\chi^2$	p-value
Not Routine	76 (85.4%)	13 (14.6%)	89	7.2	0.007
Routine	16 (61.5%)	10 (38.5%)	26		

The table above shows that the proportion of anemia cases among pregnant women who do not make regular ANC visits is higher, at 35 respondents (85.4%). Chi-square test results indicate a significant relationship between the frequency of ANC visits and the incidence of anemia ( $\chi^2 = 7.2$ ;  $p = 0.007$ ).

Table 7.  
Crosstab Distribution of Knowledge Level with Anemia Incidence

Category	Moderate/Severe Anemia	Mild Anemia	Total	$\chi^2$	p-value
Not enough	84 (91.3%)	8 (8.7%)	92	36.7	0.001
Pretty good	8 (34.8%)	15 (65.2%)	23		

The table 7 shows that the proportion of anemia cases in pregnant women with less knowledge is relatively high, namely 42 respondents (91.3%). The results of the Chi-Square test showed a very significant relationship between the level of knowledge and the incidence of anemia ( $\chi^2 = 36.7$ ;  $p = 0.001$ ).

Table 8.  
Crosstab Distribution of Fe Consumption Compliance with Anemia Incidence

Category	Moderate/Severe Anemia	Mild Anemia	Total	$\chi^2$	p-value
Not obey	82 (83.7%)	16 (16.3%)	98	5.6	0.018
Obedient	10 (58.8%)	7 (41.2%)	17		

The table 8 shows that the proportion of anemia cases in pregnant women who did not comply with iron consumption was higher, namely 36 respondents (83.7%). The chi-square test results showed a significant relationship between compliance with iron consumption and the incidence of anemia ( $\chi^2 = 5.6$ ;  $p = 0.018$ ).

Table 9.  
Multivariate initial modeling

Variables	OR (Exp(B))	Lower–Upper	p-value
Age of Pregnant Mother	0.049	0.005 – 0.519	0.012
Parity	43,560	4,467 – 424,787	0.001
Level of education	0.154	0.028 – 0.856	0.033
Income	0.126	0.023 – 0.701	0.018
Frequency of ANC Visits	0.077	0.011 – 0.536	0.010
Level of Knowledge	0.020	0.003 – 0.156	0.000
Fe Consumption Compliance	1,019	0.146 – 7.119	0.985

Based on the table 9, it is known that protective factors against anemia in pregnant women are certain age, high education, high income, frequency of regular ANC visits, and a good level of knowledge, because all showed OR values <1 with a significant reduction in the risk of anemia. Conversely, high parity (multiparity) was proven to be a dominant risk factor with a very large OR, namely 43.560, thus increasing the likelihood of anemia by 42-fold. Meanwhile, compliance with the consumption of Fe tablets did not show a significant effect on the incidence of anemia, because the OR value is close to 1 and the p-value is not significant. These findings confirm that sociodemographic factors and health behaviors play an important role in determining the risk of anemia in pregnant women.

Table 10.  
Multivariate Final Modeling

Variables	OR (Exp(B))	Lower-Upper	p-value
Age of Pregnant Mother	0.049	0.005 – 0.519	0.012
Parity	43,560	4,467 – 424,787	0.001
Level of education	0.154	0.028 – 0.856	0.033
Income	0.126	0.023 – 0.701	0.018
Frequency of ANC Visits	0.077	0.011 – 0.536	0.010
Level of Knowledge	0.020	0.003 – 0.156	0,000

Based on the table 10, it is known that six variables are significantly associated with the incidence of anemia in pregnant women: age, parity, education, income, frequency of ANC visits, and level of knowledge. Certain age, higher education, high income, regular ANC visits, and good knowledge have been shown to be protective because they significantly reduce the risk of anemia, while high parity (multiparity) is the dominant risk factor that drastically increases the chance of anemia. Meanwhile, adherence to iron tablet consumption did not show a significant relationship in the multivariate model, so sociodemographic factors and maternal health behaviors are more determinants of the incidence of anemia than adherence to supplement consumption alone.

## DISCUSSION

The results of this study, which indicate that maternal age at risk ( $\leq 20$  years or  $\geq 35$  years) increases the incidence of anemia, align with the findings of Getaneh & Atnafu (2020) in Ethiopia, who reported that pregnant women who are too young or too old have lower iron reserves and are susceptible to obstetric complications. This finding is also supported by Kapoor et al. (2021), who found the highest prevalence of anemia in adolescent pregnant women. Thus, age is consistent across various developing country contexts as an important determinant of anemia. The finding that multiparity is a dominant risk factor for anemia is consistent with the study of Azmi & Puspitasari (2022), which showed that multiparous mothers are at higher risk of anemia due to reduced iron reserves due to repeated pregnancies. However, these results differ slightly from the study of Gedefaw et al. (2015), which stated that parity is not always significant when accompanied by a relatively long birth interval. This suggests that not only the number of births, but also the spacing between pregnancies is important for further study.

The results of this study indicate that low education is correlated with an increased incidence of anemia, in line with the findings of Balarajan et al. (2011) who stated that maternal education is a protective factor because it increases health literacy. Research by Thifal et al. (2023) in Indonesia also reported that mothers with higher education were more compliant in taking iron tablets and better understood the importance of a balanced diet. Thus, education impacts not only knowledge but also maternal health attitudes and behaviors. Economic factors also showed a significant influence, in line with research by Kassie et al. (2024), which found that mothers with low economic status had limited access to iron-rich foods. However, research by Animut & Berhanu (2022) showed different results, where anemia remained high despite increasing income levels. This indicates that cultural aspects and dietary patterns also play a role, so economic factors are not always the sole factor in determining anemia status.

This study found that regular ANC visits play a protective role against anemia, in line with the research of Gebremedhin et al. (2014) in Ethiopia, which showed that mothers who attended  $\geq 4$  ANC visits had a lower prevalence of anemia. ANC allows for early detection, iron supplementation, and health education. However, Kassa et al. (2019) reported that despite high ANC frequency, maternal compliance with supplement consumption remained low. This emphasizes that ANC quality is as important as the number of visits. The level of maternal knowledge about anemia in this study proved highly significant, supporting the findings of Berhe et al. (2019) in Eritrea, which showed that mothers with good knowledge were three times less likely to experience anemia. A study by Noptriani & Simbolon (2022) in Indonesia also confirmed that nutrition education improves maternal adherence to iron consumption. The fact that knowledge emerged as the strongest protective factor in the multivariate model emphasizes the importance of education-based interventions as a primary strategy for anemia prevention.

Interestingly, this study found that adherence to iron tablet consumption was not significantly associated with anemia. This finding contradicts many studies, such as Haider et al. (2013), which confirmed that iron supplementation is effective in reducing the prevalence of anemia. This discrepancy could be explained by possible issues with distribution, quality, or reporting of compliance by respondents. These results suggest the need for further evaluation of the effectiveness of supplementation programs in Timor-Leste. Overall, this study suggests that sociodemographic and behavioral factors are more important than pharmacological interventions alone. This aligns with the Social Determinants of Health framework (WHO, 2021), which emphasizes that health is influenced by social, educational, economic, and behavioral conditions. Therefore, intervention programs must be multidimensional, encompassing not only the provision of iron tablets but also increasing access to education, strengthening family finances, and community-based health promotion.

From a policy perspective, this study complements the findings of the World Food Programme which highlighted the link between maternal anemia and high stunting rates in Timor-Leste. With a stunting prevalence of 47%, the findings of this study demonstrate that anemia is not only a maternal problem but also a long-term risk factor for children's health. This supports the DOHaD (Developmental Origins of Health and Disease) theory, which states that maternal nutrition during pregnancy influences child development into adulthood. Future research should explore other factors not examined here, such as pregnancy spacing, specific dietary patterns, chronic infection status (e.g., malaria or worms), and the quality of iron tablet distribution. Longitudinal research is also crucial to assess the long-term effects of maternal anemia on child health. Therefore, this study provides a strong foundation for more comprehensive follow-up research to reduce anemia rates and improve maternal-child health in Timor-Leste and other developing countries.

## **CONCLUSION**

The results of this study confirm that anemia in pregnant women in Timor-Leste is a very serious public health problem, with the prevalence of moderate to severe anemia reaching 80%. This figure not only reflects the high burden of disease but also indicates structural weaknesses in the health system, education, and socioeconomic conditions of the community. Six significant factors identified—age, parity, education, income, frequency of ANC visits, and level of knowledge—suggest that anemia does not stand alone as a medical condition but is rooted in social and behavioral determinants. The finding that multiparity is a dominant risk factor suggests that fertility control, family planning education, and birth spacing must be prioritized. For future research, a more in-depth study of the interactions between parity, pregnancy spacing, and nutritional status is crucial for more targeted prevention strategies.

The finding that social determinants and maternal health behaviors exert a stronger influence than

pharmacological interventions broadens the understanding that anemia cannot be addressed solely through the distribution of iron tablets. The insignificant compliance factor for iron consumption in this study may reflect issues with distribution quality, variations in availability, or inaccurate reporting. This aligns with the Social Determinants of Health framework, which emphasizes that health is the result of a complex interaction between individual and social environmental factors. Therefore, anemia management strategies must involve a cross-sectoral approach: education, economics, health, and community empowerment. For future research, a comprehensive evaluation of the effectiveness of iron supplementation programs is recommended, including testing tablet quality, consumption patterns, and cultural factors or food preferences that may influence the program's success.

The conclusions of this study point to the need for a comprehensive anemia management strategy, focusing on nutrition education, improving the quality of antenatal care (ANC), empowering families economically, and spacing pregnancies through family planning programs. However, there is still room for further research. Factors such as local dietary patterns (foods rich in iron and vitamin C that increase absorption), other health conditions such as chronic infections (malaria, worm infestation), and access to clean water and sanitation also have significant potential to influence the anemia status of pregnant women. Longitudinal studies are also recommended to assess the impact of maternal anemia on child growth and development, including the risk of stunting and cognitive impairment. With an evidence-based, multidimensional approach, designed interventions will not only reduce the prevalence of anemia but also improve the quality of life of mothers and children in a sustainable manner.

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