



The Influence of Nutritional Status on the Incidence of Postpartum Hemorrhage in Three Community Health Centers (CHCs) in Dili, Timor-Leste

Alcinda Pinto Fernandes¹, Novida Ariani², Diadjeng Setya Wardani², Hermes Peguinho³, Hadidja Binti Ali Hosman Maia⁴, Filomena Soares⁴, Mirioldis Matos Rodríguez⁵

¹Magister Program, Midwifery Study Program, Faculty of Medicine, Universitas Brawijaya, Malang City, East Java, Indonesia

²Midwifery Department, Faculty of Medicine, Universitas Brawijaya, Malang City, East Java, Indonesia

²Midwifery Department, Faculty of Medicine, Universitas Brawijaya, Malang City, East Java, Indonesia

³Head of Gynecology and Obstetrics Department, University Hospital of Coimbra (H.U.C.), Coimbra, Portugal

⁴Midwifery Department, Faculty of Health Sciences, Instituto Superior Cristal (ISC), Timor-Leste

⁴Midwifery Department, Faculty of Health Sciences, Instituto Superior Cristal (ISC), Timor-Leste

⁵Community Health Centre Viqueque, Viqueque Municipality Health Service, Timor-Leste

Email correspondence: alcindaf65@gmail.com

Track Record Article	Abstract
<p>Revised: 24 June 2025 Accepted: 7 August 2025 Published: 31 August 2025</p> <p>How to cite : Fernandes, A. P., Ariani, N., Wardani, D. S., Peguinho, H., Maia, H. B. A. H., Soares, F., & Rodríguez, M. M. (2025). The Influence of Nutritional Status on the Incidence of Postpartum Hemorrhage in Three Community Health Centers (CHCs) in Dili, Timor-Leste. <i>Contagion : Scientific Periodical of Public Health and Coastal Health</i>, 7(2), 95–105.</p>	<p><i>Postpartum hemorrhage (PPH) remains a leading cause of maternal mortality in low- and middle-income countries, including Timor-Leste. This analytical cross-sectional study, conducted from January to December 2024 in three community health centers (CHCs) in Dili, examined the association between maternal nutritional status and the incidence of PPH. Nutritional indicators included pre-pregnancy body mass index (BMI), gestational weight gain, anemia status, and mid-upper arm circumference (MUAC). Data were collected from medical records of 130 postpartum mothers (65 with PPH, 65 without). The prevalence of PPH was 50%. Among participants, 22.1% had anemia (hemoglobin <11 g/dL), 50.8% had MUAC <23.5 cm, and 41.5% had a pre-pregnancy BMI outside the WHO normal range (18.5–24.9 kg/m²). Only 26.4% achieved gestational weight gain within Institute of Medicine guidelines. Logistic regression analysis revealed that anemia significantly increased the risk of PPH (OR = 3.4; 95% CI: 1.38–8.40; p = 0.011), while other nutritional indicators showed no significant association. These findings highlight the critical role of antenatal anemia screening and targeted nutritional interventions in reducing PPH risk. This study provides locally relevant evidence to inform maternal health strategies in Timor-Leste.</i></p> <p>Keywords: Postpartum hemorrhage, Pre-pregnancy BMI, weight gain, Mid-Upper Arm Circumference, Antenatal Care, Community health center</p>

INTRODUCTION

Postpartum hemorrhage (PPH) is a leading cause of maternal mortality worldwide, responsible for nearly one-third of maternal deaths, particularly in low- and middle-income countries (LMICs) such as Timor-Leste (World Health Organization, 2023; Young et al., 2023). Recent global estimates suggest that PPH contributes to over a quarter of maternal deaths (Young et al., 2023). In Timor-Leste, the maternal mortality ratio remains high at 413 per 100,000 live births (Timor-Leste National Institute of Statistics (INETL), 2024).

Anemia, affecting up to 37% of pregnant women globally and as high as 50% in Southeast Asia, is strongly associated with adverse maternal outcomes, including PPH, preterm birth, low birth weight, and maternal mortality (World Health Organization, 2025a, 2025b). In

Timor-Leste, national data report an anemia prevalence of 38.9% among pregnant women (Timor-Leste MoH, 2022), alongside other nutritional challenges such as undernutrition and inadequate gestational weight gain. Field data from three community health centers (CHCs), Comoro, Becora, and Vera-Cruz, indicate PPH prevalence ranging from 0.04% to 5.58%. However, these figures likely underestimate the true burden due to persistent challenges in case detection and reporting (EIS CHC Becora, 2024; EIS CHC Comoro, 2024; EIS Vera-Cruz, 2024).

Maternal nutritional status, including body mass index (BMI), mid-upper arm circumference (MUAC), gestational weight gain, and hemoglobin level, is a well-established determinant of maternal and perinatal outcomes (Dewidar et al., 2023; González-Fernández et al., 2024; D. Wang et al., 2025). Anemia during pregnancy remains a major global public health concern, with a prevalence of 35.5% among women aged 15-49 years, according to the latest World Health Organization estimates (World Health Organization, 2025b). In Timor-Leste, recent national data report an anemia prevalence of 38.9% among pregnant women (Timor-Leste Ministry of Health, 2022). Community health center (CHC)-based surveys also indicate undernutrition rates of 10.45% and anemia rates of 17.7% (EIS CHC Becora, 2024; EIS CHC Comoro, 2024). Anemia during pregnancy compromises tissue oxygenation and weakens uterine muscle contraction, thereby increasing the risk of PPH and associated maternal mortality (Garcia-Casal et al., 2023; Keya, 2023; Young et al., 2023).

Recent systematic reviews confirm that suboptimal maternal nutritional status, including underweight or overweight (as defined by WHO BMI categories), low gestational weight gain, and MUAC <23.5 cm, significantly increases the risk of postpartum hemorrhage and adverse perinatal outcomes (Dewidar et al., 2023; Diana et al., 2024; González-Fernández et al., 2024; Krsman et al., 2023; D. Wang et al., 2025). Several studies have identified MUAC as a practical screening tool for detecting pregnant women at risk of chronic energy deficiency and poor maternal outcomes, particularly in resource-limited settings (Dewidar et al., 2023; Diana et al., 2024; Shenoy et al., 2023). Both inadequate and excessive maternal BMI have been associated not only with increased risk of PPH but also with higher rates of preeclampsia, gestational diabetes, and low birth weight (Krsman et al., 2023).

Inadequate gestational weight gain is prevalent in low- and middle-income countries (LMICs) and is associated with low birth weight, increased risk of stillbirth, and maternal complications (Dewidar et al., 2023; D. Wang et al., 2025). Although supplemental nutrition and counseling programs have been implemented during pregnancy, several barriers persist. These include limited access to antenatal nutrition counseling, inadequate monitoring of

nutritional status, and low awareness of recommended weight gain and BMI guidelines during pregnancy (Dewidar et al., 2023; González-Fernández et al., 2024; Shenoy et al., 2023).

To date, no local study in Timor-Leste has specifically examined the association between maternal nutritional status, including body mass index (BMI), mid-upper arm circumference (MUAC), hemoglobin levels, and gestational weight gain, and the risk of postpartum hemorrhage (PPH) in primary health care settings. This evident gap in local research limits the development of targeted prevention strategies for PPH within this context. Accordingly, this study aims to assess the association between maternal nutritional indicators (BMI, gestational weight gain, MUAC, and hemoglobin levels) and the incidence of postpartum hemorrhage in primary health care facilities in Dili, Timor-Leste.

METHODS

This retrospective cross-sectional study utilized secondary data from patient records at three community health centers (CHCs) in Dili City: CHC Comoro, CHC Becora, and CHC Vera-Cruz. Data were collected between January and December 2024. The study population included all postpartum mothers recorded at these centers during the study period who experienced postpartum hemorrhage (PPH), totaling 95 cases. Data sources comprised medical records, maternal health books (Buku KIA), and antenatal care (ANC) cohort registers. Key nutritional variables, pre-pregnancy body mass index (BMI), gestational weight gain, mid-upper arm circumference (MUAC), and hemoglobin (Hb) levels, were extracted from these secondary sources. Cases with incomplete data on these variables, multiple pregnancies, or deliveries involving interventions such as vacuum extraction or oxytocin induction were excluded. Based on these criteria, 65 PPH cases with complete data were included. An equal number of postpartum mothers without PPH were selected as controls, matched by time period and data completeness, resulting in a final sample size of 130 subjects.

Body mass index (BMI) was calculated from weight and height measured at the first antenatal care (ANC) visit and categorized according to WHO standards. For analysis, mothers were classified as having either a 'normal BMI' (18.5–24.9 kg/m²) or a 'non-normal BMI' (combining underweight <18.5 kg/m² and overweight/obese ≥25 kg/m²), due to sample size limitations that precluded separate subgroup analyses. Mid-upper arm circumference (MUAC), measured at the first ANC visit, was classified using the WHO cut-off: <23.5 cm indicated risk for chronic energy deficiency (CED), while ≥23.5 cm was considered normal. Hemoglobin (Hb) levels were obtained from the first ANC measurement, with anemia defined as Hb <11 g/dL. Gestational weight gain was assessed from maternal records; however, most

measurements were limited to the initial ANC visit, representing a study limitation. Descriptive statistics were used to summarize sample characteristics, and associations between nutritional variables and PPH incidence were initially explored using simple logistic regression.

To enhance validity and control for potential confounders, a multiple logistic regression model was applied. Nutritional variables (BMI, MUAC, hemoglobin levels, and gestational weight gain) were adjusted for maternal age, parity, and mode of delivery. Results are presented as adjusted odds ratios (AORs) with 95% confidence intervals (CIs) and corresponding p-values. Data analysis was conducted using SPSS version 27. Ethical approval was obtained from the Research Ethics and Technical Committee (INSPTL-RETC; Ref. No. 255/INSP-TL/UEPD-AL/IV/2025), and participant confidentiality was strictly maintained. Due to the retrospective nature of the study and reliance on secondary data, subjects with missing key variables were excluded an acknowledged limitation.

RESULTS

Table 1. Characteristics of Respondents in the CHC Comoro, Vera-Cruz, and Becora Areas

No	Variable	Frequency (n)	Percentage (%)
Maternal Age			
	Low-risk age (19-34 years old)	110	84.6%
	High-risk age (<19/≥ 35 years old)	20	15.4%
Obstetric History (Parity)			
	Low risk (2-4)	50	38.5%
	High risk (1 or ≥ 5)	80	61.5%
Pre-pregnancy BMI			
	Normal (18.5-24.9 kg/m ²)	76	58.5%
	Non-normal (< 18.5 kg/m ²) or overweight/obese (≥ 25 kg/m ²)	54	41.5%
Weight gain during pregnancy			
	Meets IOM recommendation	33	25.4%
	Not according to IOM recommendation	97	74.6%
Mid-upper arm circumference (MUAC)			
	Normal (≥ 23.5 cm)	64	49.2%
	At risk for CED (< 23.5 cm)	66	50.8%
Hemoglobin level (Hb g/dL)			
	Normal (≥ 11 g/dL)	101	77.7%
	Anemia (< 11 g/dL)	29	22.3%

A total of 130 postpartum mothers from CHC Comoro, Vera Cruz, and Becora were included in this study. Table 1 presents the main characteristics of the respondents. The majority (84.6%) of mothers were in the non-risk age group (19-34 years), while 15.4% were in the risk age group (≤ 19 or ≥ 35 years). High-risk parity, defined as parity 1 or ≥ 5, was found in 61.5% of respondents, while 38.5% were in the non-risk parity group (parity 2-4). Based on pre-pregnancy nutritional status, 58.5% of mothers had a normal Body Mass Index

(BMI) according to WHO criteria (18.5-24.9 kg/m²), while 41.5% had a BMI categorized as underweight (<18.5 kg/m²) or overweight/obese (≥ 25 kg/m²). Gestational weight gain that did not meet the Institute of Medicine (IOM) recommendations was found in 74.6% of mothers. MUAC assessment at the first ANC visit showed that 50.8% of mothers had a MUAC < 23.5 cm, indicating the risk of chronic energy deficiency (CED), while 49.2% were classified as normal (≥ 23.5 cm). Anemia (Hb < 11 g/dL) was found in 22.3% of mothers. The incidence of postpartum hemorrhage (PPH) in this sample was 50%.

Table 2. Frequency and Percentage Distribution of Postpartum Hemorrhage by Nutritional Status Variables

Variable	Category	PPH (n)	Non-PPH (n)	Total PPH (%)
Pre-pregnancy BMI	Normal (18.5-24.9 kg/m ²)	35	41	76 (46.1%)
	Non-normal (<18.5 kg/m ²) or overweight/obese (≥ 25 kg/m ²)	30	24	54 (55.6%)
Weight gain during pregnancy	Meets IOM recommendation	17	16	33 (51.5%)
	Not according to IOM recommendation	48	49	97 (49.5%)
Mid-Upper Arm Circumference (MUAC)	Normal (≥ 23.5 cm)	28	36	64 (43.8%)
	At risk for CED (<23.5 cm)	37	29	66 (56.1%)
Hemoglobin (Hb) Level	Normal (≥ 11 g/dL)	44	57	101 (43.6%)
	Anemia (< 11 g/dL)	21	8	29 (72.4%)

Table 2 displays the distribution of PPH incidence by nutritional status. Among mothers with a normal BMI, 46.1% experienced PPH, while the incidence was higher (55.6%) among those with underweight/overweight-obese BMI. Inadequate weight gain during pregnancy was associated with a similar PPH rate (49.5%) compared to those who met the IOM recommendations (51.5%). Among mothers with an at-risk MUAC (< 23.5 cm), 56.1% experienced PPH, compared to 43.8% in the normal MUAC group. For mothers with anemia, the incidence of PPH was markedly higher (72.4%) compared to those with normal hemoglobin levels (43.6%).

Table 3. Results of Simple Logistic Regression Analysis of Nutritional Status on the Incidence of Postpartum Hemorrhage

Variable	Category	Odds Ratio (OR)	95% CI OR	p-value Chi-square
Pre-pregnancy BMI	Normal (18.5-24.9 kg/m ²)	Ref	-	0.374
	Non-normal (<18.5 kg/m ²) or overweight/obese (≥25 kg/m ²)	1.46	0.7-2.95	
Weight gain during pregnancy	Meets IOM recommendation	Ref	-	1.000
	Not according to IOM recommendation	0.92	0.42-2.03	
Mid-Upper Arm Circumference (MUAC)	Normal (≥ 23.5 cm)	Ref	-	0.219
	At risk for CED (<23.5 cm)	1.64	0.82-3.28	
Hemoglobin (Hb) Level	Normal (≥ 11 g/dL)	Ref	-	0.011
	Anemia (< 11 g/dL)	3.40	1.38-8.40	

Simple logistic regression analysis (Table 3) showed no statistically significant association between pre-pregnancy BMI and PPH (OR: 1.46; 95% CI: 0.73-2.92; $p > 0.05$). Similarly, gestational weight gain (OR: 0.92; 95% CI: 0.39-2.17) and MUAC (OR: 1.64; 95% CI: 0.84-3.21) were not significantly associated with PPH ($p > 0.05$ for both variables). In contrast, mothers with hemoglobin levels <11 g/dL had a significantly higher risk of PPH (OR: 3.4; 95% CI: 1.38-8.40; $p = 0.011$). This finding emphasizes anemia as the main nutritional risk factor for PPH among the studied population. Following the results of the simple logistic regression analyses, a multiple logistic regression was conducted to control for potential confounding variables and to assess the independent effects of each factor on the incidence of PPH.

Table 4. Results of Multiple Logistic Regression Analysis of Nutritional Status on the Incidence of Postpartum Hemorrhage

Variable	Category	Adjusted Odds Ratio (AOR)	95% CI OR	p-value Chi-square
Maternal age	Low risk age (19-34 years)	Ref	-	0.764
	High risk age (<19 or ≥ 35 years)	1.17	0.41-3.33	
Obstetric history	Low risk (2-4)	Ref	-	0.097
	High risk (1 or ≥5)	0.52	0.24-1.12	
Pre-pregnancy BMI	Normal (18.5-24.9 kg/m ²)	Ref	-	0.348
	Non-normal (<18.5 kg/m ²) or overweight/obese (≥ 25 kg/m ²)	1.43	0.68-3.04	
	Meets IOM recommendation	Ref	-	0.708

Variable	Category	Adjusted Odds Ratio (AOR)	95% CI OR	p-value Chi-square
Weight gain during pregnancy	Not according to IOM recommendation	0.85	0.36-2.00	0.62
Mid-Upper Arm Circumference (MUAC)	Normal (≥ 23.5 cm)	Ref	-	
	At risk for CED (<23.5 cm)	1.22	0.56-2.69	
Hemoglobin (Hb) Level	Normal (≥ 11 g/dL)	Ref	-	0.011
	Anemia (< 11 g/dL)	3.57	1.34-9.53	

Multivariate logistic regression analysis demonstrated that only maternal anemia (hemoglobin <11 g/dL) was independently and significantly associated with an increased risk of postpartum hemorrhage (AOR: 3.57; 95% CI: 1.34-9.53; $p = 0.011$). This indicates that mothers who were anemic during pregnancy had a 3.6-fold higher risk of experiencing postpartum hemorrhage compared to non-anemic mothers, even after adjusting for maternal age, obstetric history, and other nutritional variables. In contrast, other nutritional indicators, including abnormal pre-pregnancy BMI, inadequate gestational weight gain, and low MUAC, did not show statistically significant associations with the risk of PPH after adjustment ($p > 0.05$ for all). The logistic regression model showed good fit to the data (Hosmer-Lemeshow test $p = 0.644$) and accounted for approximately 11.9% of the variation in PPH outcomes (Nagelkerke $R^2 = 0.119$).

These findings reaffirm maternal anemia as the main nutritional risk factor for postpartum hemorrhage in this population and highlight the importance of prioritizing anemia screening and management in antenatal care. It is important to note that the proportion of PPH cases reported in this study (50%) reflects the case-control sampling design and does not represent population prevalence.

DISCUSSION

The findings of this study confirm that anemia, defined as hemoglobin (Hb) <11 g/dL, is the sole nutritional indicator significantly associated with an increased risk of postpartum hemorrhage (PPH). Pregnant women with anemia were found to have more than a threefold higher likelihood of experiencing PPH compared to their non-anemic counterparts. This result aligns with recent meta-analyses and global investigations, particularly those conducted in low- and middle-income countries, where anemia is consistently identified as a major determinant of severe maternal complications, including PPH, preterm birth, and maternal mortality.

(González-Fernández et al., 2024; Wang et al., 2025; Williams et al., 2024; WOMAN-2 trial collaborators, 2023; World Health Organization, 2025).

From a pathophysiological perspective, anemia increases the risk of postpartum hemorrhage (PPH) by reducing the oxygen-carrying capacity of blood supplied to uterine tissue. This impairment diminishes uterine muscle contractility, disrupts hemostatic balance, and heightens susceptibility to uterine atony and subsequent postpartum bleeding (Faysal et al., 2023; Lakew et al., 2024; WOMAN-2 trial collaborators, 2023).

Beyond nutritional status, socioeconomic conditions play a pivotal role in shaping maternal health outcomes. Evidence from both local and international studies highlights that women from households with low socioeconomic status often face limited access to health services, iron supplementation, and adequate nutrition-factors that significantly elevate the risk of PPH (Fernandes et al., 2025; Habonimana & Batura, 2021; M. Wang & Ren, 2025). Therefore, nutritional interventions alone are insufficient. There is a critical need to integrate strategies that enhance economic support and social protection, particularly for high-risk pregnant women and their families.

These findings underscore the importance of integrating routine anemia screening and iron supplementation into the primary antenatal care (ANC) service package in Timor-Leste. Additionally, strengthening counseling and nutrition education is essential to raise pregnant women's awareness of the importance of balanced nutrition during pregnancy. However, efforts to prevent maternal complications will be more effective when combined with robust socioeconomic interventions, such as cash transfer programs, social protection schemes, and family economic empowerment initiatives, as recommended by the World Health Organization and supported by both national and local research (Fernandes et al., 2025; M. Wang & Ren, 2025).

Other nutritional factors, including pre-pregnancy body mass index (BMI), gestational weight gain, and mid-upper arm circumference (MUAC), were not found to be associated with PPH in this cohort. This may be attributed to the relative homogeneity in nutritional status and the high prevalence of malnutrition within the study population (González-Fernández et al., 2024).

It is important to emphasize that the observed proportion of PPH cases (50%) in this study is solely a result of the case-control design and does not represent the true prevalence in the general population. Therefore, all findings should be interpreted strictly as associations between risk factors and PPH, rather than as estimates of population-level prevalence (Williams et al., 2024).

In conclusion, effective strategies to reduce maternal complications, particularly postpartum hemorrhage in Timor-Leste, should integrate nutritional interventions with robust social and economic support, grounded in the framework of national maternal health policy. A multidimensional approach is essential to achieving more equitable, comprehensive, and sustainable maternal health outcomes.

This study presents several limitations. First, while the case-control design was appropriate for identifying associations between exposure factors and postpartum hemorrhage (PPH), it does not allow for estimation of the actual prevalence of PPH in the broader population. The reported 50% proportion of PPH cases reflects the matched sampling methodology and should not be interpreted as representative of population-level prevalence. Accordingly, all findings must be understood as associations rather than estimates of incidence or prevalence.

Additionally, the potential for residual confounding remains, due to limitations in variable measurement and sample homogeneity. To establish accurate prevalence estimates and further validate the risk factors identified in this study, future research should employ population-based, prospective cohort designs.

CONCLUSIONS

This study is the first to provide local evidence from community health centers (CHCs) in Dili, Timor-Leste, demonstrating a significant association between maternal anemia and postpartum hemorrhage, while other nutritional indicators showed no significant effect. These findings highlight the urgent need for robust public health policies that mandate routine hemoglobin screening, iron supplementation, and integrated nutrition education within primary health services. Strategically embedding these interventions into the national maternal health system is essential for reducing PPH and improving maternal outcomes in low-resource settings.

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