



Risk factors associated with anemia and its complications in pregnant women, in the perioperative period of the Third Level Hospital Montero, management 2024 – 2025

Factores de riesgo asociados con anemia y sus complicaciones en embarazadas, en el perioperatorio del Hospital de Tercer Nivel Montero, gestión 2024 – 2025

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ABSTRACT

Introduction. Anemia during pregnancy accounts for a significant portion of the avoidable nutritional burden in low- and middle-income countries, and its persistence until delivery increases surgical risk. **Objective.** To determine the risk factors associated with anemia and its relationship with perioperative complications in pregnant women treated at the Montero Tertiary Hospital during 2024-2025. **Methods.** Observational, analytical, cross-sectional, and prospective study of 317 pregnant women in their third trimester and immediate postpartum women. Data were obtained from structured interviews and medical records. Analysis was performed using EPI INFO 7.2 with bivariate tests and logistic regression, with odds ratios (OR), 95% confidence intervals, and significance at $p < 0.05$. **Results.** The prevalence of anemia was 24.3% (77/317; 95% CI 19.9-29.3), with mild forms predominating. Inadequate adherence to ferrous sulfate supplementation (OR 1.9; $p = 0.02$) and discontinuation due to nausea (OR 1.8; $p = 0.04$) were associated with anemia. Anemia was also associated with perioperative complications (OR 2.5; $p < 0.001$) and blood component transfusion (OR 9.2; $p < 0.001$). In the multivariate model, postpartum hemorrhage (OR 5.95; 95% CI 2.86-12.39), premature rupture of membranes (OR 3.24; 95% CI 1.33-7.89), and surgical site infection (OR 3.47; 95% CI 1.03-11.67) remained significant. **Conclusions.** Anemia was present in 24.3% of the pregnant women studied, predominantly mild and moderate forms, indicating a significant clinical burden in the third trimester of pregnancy. Inadequate adherence to ferrous sulfate and its discontinuation due to nausea were significantly associated with the presence of anemia, highlighting specific opportunities to improve adherence and prenatal follow-up. The complete absence of preconception care in the sample, rather than being a quantifiable risk factor, reflects a gap in the care continuum that simply does not exist in this setting.

Keywords: Anemia; pregnancy; risk factors; perioperative period; postpartum hemorrhage; ferrous sulfate.

RESUMEN

Introducción. La anemia en el embarazo concentra buena parte de la carga nutricional evitable en países de ingresos bajos y medios y su persistencia hasta el momento del parto condiciona el riesgo quirúrgico. **Objetivo.** Determinar los factores de riesgo asociados con anemia y su relación con complicaciones perioperatorias en gestantes atendidas en el Hospital de Tercer Nivel Montero durante 2024-2025. **Métodos.** Estudio observacional, analítico, transversal y prospectivo en 317 gestantes del tercer trimestre y púerperas inmediatas. Los datos procedieron de entrevista estructurada y expediente clínico. El análisis se realizó en EPI INFO 7.2 mediante pruebas bivariadas y regresión logística, con odds ratio (OR), intervalo de confianza del 95 % y significación en $p < 0,05$. **Resultados.** La prevalencia de anemia fue de 24,3 % (77/317; IC95 % 19,9-29,3), con predominio de las formas leves. Se asociaron con anemia la adherencia inadecuada a la suplementación con sulfato ferroso (OR 1,9; $p = 0,02$) y su abandono por náuseas (OR 1,8; $p = 0,04$). La anemia se asoció con complicaciones perioperatorias (OR 2,5; $p < 0,001$) y con transfusión de hemocomponentes (OR 9,2; $p < 0,001$). En el modelo multivariado persistieron la hemorragia posparto (OR 5,95; IC95 % 2,86-12,39), la rotura prematura de membranas (OR 3,24; IC95 % 1,33-7,89) y la infección del sitio quirúrgico (OR 3,47; IC95 % 1,03-11,67). **Conclusiones.** La anemia estuvo presente en el 24,3 % de las gestantes estudiadas, con predominio de las formas leves y moderadas, lo que evidencia una carga clínica relevante en el tercer trimestre de la gestación. La adherencia inadecuada al sulfato ferroso y su abandono asociado a náuseas se relacionaron significativamente con la presencia de anemia, identificándose oportunidades concretas para fortalecer la adherencia y el seguimiento prenatal. La ausencia total de atención preconcepcional en la muestra, más que un factor de riesgo cuantificable, describe un tramo del continuo de atención que sencillamente no existe en este entorno.

Palabras clave: Anemia; embarazo; factores de riesgo; periodo perioperatorio; hemorragia posparto; sulfato ferroso.

INTRODUCTION

Anemia affects about 36% of pregnant women worldwide, and its reduction is progressing at a rate below that required by the World Health Assembly targets for 2030 (1). The burden is concentrated in low- and middle-income countries, where low intake of bioavailable iron, chronic infections, and poor continuity of prenatal care coincide.

Part of the decline in hemoglobin during pregnancy is due to plasma volume expansion and does not indicate disease. Distinguishing between this physiological hemodilution and iron deficiency anemia requires trimester-specific thresholds, which the World Health Organization updated in 2024 (2). Iron deficiency is the most common cause, because the demand for iron triples toward the third trimester while maternal reserves rarely suffice to cover it (3). The consequences are not limited to delivery. Iron deficiency during pregnancy is associated with placental abruption, preeclampsia, preterm birth, low birth weight, and postpartum hemorrhage (4,5), and severe anemia increases the risk of maternal death (6). Iron also participates in myelination and neurotransmitter synthesis, so its intrauterine deficit has been linked to neurodevelopmental disorders in offspring (7,8). Even in high-income countries, up to half of pregnant women without anemia have iron deficiency in the first trimester (9), which reveals that hemoglobin alone identifies the problem late.

In Bolivia, the 2016 Demographic and Health Survey reported the prevalence of anemia in women aged 15 to 49 years at 29.9%, with a predominance of mild forms (24.3%); in Santa Cruz, mild anemia also prevails (10). These figures describe women of childbearing age, but they do not provide information on what happens when anemia reaches the operating room. The literature on the link between gestational anemia and perioperative morbidity comes mostly from other contexts (11,12), and in eastern Bolivia, no local estimates are available.

The present work aims to identify the intrinsic and extrinsic risk factors associated with iron deficiency anemia in pregnant women and the complications in the perioperative period at Hospital de Tercer Nivel Montero, so that this information is valid and reliable for designing strategies aimed at counteracting the risk factors that alter the normal hemoglobin value and predispose the pregnant woman to iron deficiency anemia, thus also avoiding complications in the perioperative period secondary to anemia in pregnancy.

METHODS

One observational, analytical, cross-sectional, quantitative, and prospective study was conducted at the Hospital de Tercer Nivel Montero, department of Santa Cruz, Bolivia, between 2024 and 2025.

The study population included third-trimester pregnant women and immediate postpartum women attended for prenatal care, delivery and postpartum care, with and without anemia, who agreed to participate through written informed consent. For underage participants, authorization from the legal guardian was obtained. Records with incomplete hematological data were excluded.

Sample size. The calculation was performed in EPI INFO 7.2 (StatCalc module) on an estimated universe of 5000 patients, with an expected prevalence of 25%, error of 5% and confidence of 95%, which yielded a minimum of 270 participants. A total of 317 were incorporated, thereby exceeding the required size.

Variables and sources. The dependent variable was anemia, defined by the third-trimester hemoglobin concentration according to current thresholds and classified as mild, moderate, and severe. The independent variables included the number of prenatal visits, socioeconomic status, multiparity, short interpregnancy interval, adherence to ferrous sulfate supplementation, discontinuation of the supplement due to nausea, and attendance at preconception consultation. Perioperative outcomes included postpartum hemorrhage, premature rupture of membranes, preeclampsia, placenta previa, surgical site infection, and transfusion of blood components. History was collected through a structured interview administered via an electronic form; hemoglobin, hematocrit, mean corpuscular volume, and mean corpuscular hemoglobin concentration, as well as complications, were extracted from the clinical record after birth. All determinations were processed in the hospital laboratory.

Statistical analysis. Data were consolidated in a spreadsheet and analyzed using EPI INFO 7.2. Qualitative variables were described using absolute and relative frequencies with 95% confidence intervals by the Wilson method. The association between each factor and anemia was evaluated with the chi-square test, or with Fisher's exact test when expected frequencies were less than five, and was quantified using odds ratios.

Perioperative complications were modeled by logistic regression, from which coefficients, standard errors, Z statistic, and odds ratios with their confidence intervals were obtained. A p value less than 0.05 was considered significant.

Ethical considerations. The protocol was reviewed and approved by the ethics committee of Hospital de Tercer Nivel Montero. The study conformed to the Declaration of Helsinki, the Nuremberg Code, the Belmont Report, and the CIOMS-WHO guidelines. The female participants received information about the objectives and procedures before signing the consent, and the data were anonymized.

RESULTS

Of the 317 pregnant women evaluated in the third trimester, 77 presented anemia, corresponding to a prevalence of 24,3 % (IC95 % 19,9-29,3) (Table 1). Mild forms predominated: 39 cases (12,3 % of the total) versus 38 moderate cases (12,0 %). No severe anemias were recorded.

Table 1. Distribution of pregnant patients, with and without anemia, in the H.T. N.M., during the period 2024-2025.

Hemoglobin Third Quarter	n	Percentage	Percentage Cum.	Wilson 95% LCL	Wilson 95 % UCL
Pregnant women With anemia	77	24.29 %	100.00 %	19.90 %	29.30 %
Pregnant women Without anemia	240	75.71 %	75.71 %	70.70 %	80.10 %

IC: confidence interval.

The sociodemographic profile was homogeneous. The age group from 25 to 29 years included 30.3% of the participants; 40.7% had completed secondary education; 71.6% (227 women) reported engaging in unpaid domestic work, and 73.5% were in a stable union.

None of the classic sociodemographic and obstetric variables reached statistical significance (Table 2). The number of prenatal visits, socioeconomic status, multiparity, and short interpregnancy interval yielded estimates with wide intervals and p values between 0.48 and 0.57.

Risk factors associated with anemia in pregnant women behaved differently (Table 3). Inadequate adherence to ferrous sulfate almost doubled the probability of anemia (OR 1.9; p = 0.02), and discontinuation of the supplement attributed to nausea showed a similar magnitude (OR 1.8; p = 0.04). The absence of preconception care was universal in the sample, making it impossible to estimate an odds ratio or compare exposed and unexposed groups.

Table 2. Risk factors associated with anemia in pregnant women, at Hospital Tercer Nivel Montero during the period 2024-2025.

Evaluated factor	With anemia n (%)	Without anemia n (%)	OR	χ^2	p
Insufficient prenatal check-ups	29 (27,1)	78 (72,9)	1,25	0,48	0,48
Low socioeconomic level	73 (23,9)	233 (76,1)	0,50	0,35	0,55
Multiparity	46 (26,0)	131 (74,0)	1,23	0,43	0,50
Short interpregnancy interval	11 (20,4)	43 (79,6)	0,76	0,31	0,57

OR: odds ratio. No contrast reached statistical significance (p ≥ 0.05).

Table 3. Risk factors associated with anemia in pregnant women, at Hospital Tercer Nivel Montero during the period 2024 – 2025.

Factor evaluated	With anemia n (%)	No anemia n (%)	OR	χ^2	p
Inadequate adherence to ferrous sulfate	40 (31,5)	87 (68,5)	1,9	5,30	0,02
Lack of consumption of ferrous sulfate due to adverse effect of nausea	25 (33,8)	49 (66,2)	1,8	4,08	0,04
Absence of preconception care	77 (24,3)	240 (75,7)	NE	NE	NE

All participants lacked preconception care, so the absence of 1 comparison group prevents calculating the measure of association and interpreting Fisher's exact test.

Anemia was associated with the occurrence of complications during the perioperative period (OR 2.5; $p < 0.001$) and, to a considerably greater magnitude, with the need to transfuse blood components (OR 9.2; $p < 0.001$) (Table 4). Among the 77 anemic pregnant women, 46 (59.7%) had some perioperative complication and 28 (36.4%) required transfusion.

Logistic regression analysis discriminated which complications sustain that global association (Table 5). Postpartum hemorrhage presented the highest magnitude (OR 5.95; IC95 % 2.86-12.39), followed by surgical site infection (OR 3.47; IC95 % 1.03-11.67) and premature rupture of membranes (OR 3.24; IC95 % 1.33-7.89). Preeclampsia and placenta previa showed no association, and their intervals included unity with considerable width.

Table 4. Complications presented by pregnant women with anemia, at Hospital Tercer Nivel Montero - during the period 2024-2025.

Complications	With anemia	Without anemia	OR	X2	P value
Complications presented by pregnant women with anemia	46(59,74 %) (CI95%; 34.7%-59.7%)	31(40,26%) (CI95%; 17.03%-40.2%)	2,5	11,3	0,00
Maternal anemia associated with transfusion in the perioperative period	28(36,36 %) (CI95%;66.67%-36.3%)	49 (63,64 %) (CI95%; 17.82%-63.6%)	9,2	44,6	0,00

Table 5. Perioperative complications presented by pregnant women with anemia, at Hospital Tercer Nivel Montero, during the period 2024-2025.

Complications	OR	IC 95 %	Coefficient	EE	Z Statistic	P Value
Postpartum hemorrhage	5,95	2,86 - 12,39	1,78	0,37	4,76	< 0,001
Surgical site infection	3,47	1,03 - 11,67	1,24	0,61	2,01	0,04
Premature rupture of membranes	3,24	1,33 - 7,89	1,17	0,45	2,59	< 0,01
Placenta previa	1,21	0,13 - 11,26	0,19	1,13	0,17	0,86
Preeclampsia	0,75	0,31 - 1,83	-0,27	0,45	-0,61	0,53

OR: odds ratio. IC: confidence interval. EE: standard error.

DISCUSSION

The present study was conducted in the city of Santa Cruz de la Sierra, at the Hospital de Tercer Nivel Montero, involving 317 patients in the third trimester of pregnancy and immediate puerperium. Patients were randomly selected to participate in the study, of whom 77 pregnant women had some type of anemia, ranging from mild to moderate. The prevalence of anemia, 24,3 %, is close to that reported for women of childbearing age in Bolivia and is below the global average for pregnant women (1,10). The types of anemia presented were: mild anemia in 39 patients (12,3 %) and moderate anemia in 38 patients (11,9 %) of the population studied with some type of anemia; data consistent with those from the 2016 Demographic and Health Survey (EDSA), which reports that mild anemia predominates in Santa Cruz. The selected patients were women of reproductive age. The majority of the study population was in the age group of 25–29 years, representing 30,28 % of the total study population. In total, 73,50 % of the study population had a stable union marital status. Regarding occupation, 227 patients (71, 61 %) were housewives. Regarding education, 40,69 % of the study population had completed secondary education. The risk factors associated with anemia during pregnancy were: inadequate adherence to ferrous sulfate intake during pregnancy (OR: 1,9) and a value of (P: 0,02), indicating that it is a risk factor for developing anemia during pregnancy and is statistically significant. Similarly, in 1 study, Seidu H. found lack of adherence to ferrous sulfate due to side effects, with OR: 3,70, CI: (1,756; 7,793). (14)

The adverse effect of nausea for not consuming ferrous sulfate during pregnancy with (OR: 1.8) and value of (P: 0.04) means that the adverse effect of nausea is a risk factor for developing anemia during pregnancy. As mentioned in the literature by Merino Almaraz VN, where he found lack of adherence to ferrous sulfate consumption during pregnancy due to the adverse effect of nausea (OR: 3.05; P=0.02).(15)

The absence of preconception care merits differentiated treatment. No participant had received that consultation, a condition that precludes the possibility of estimating an odds ratio: without a comparison group there is no contrast, and the exact test that yielded a value below 0.05 lacks causal interpretation in these circumstances. This finding does not lose descriptive value, because it documents a complete gap in the continuum of care, but it cannot be presented as a risk factor identified in this study. Reviews of periconceptional interventions in low- and middle-income countries show favorable effects on maternal nutritional status (16), which lends plausibility to the hypothesis without substituting for the evidence that this design cannot provide.

The complications presented by pregnant women with anemia during the perioperative period had (OR: 2,5) and (P: 0,00); therefore, we can interpret that pregnant women with anemia during pregnancy have 2,5 times higher risk of presenting complications during the perioperative period, and this is statistically significant. Likewise, in one study, Montano Vega, G. found a statistically significant association between anemia and maternal-fetal complications, with an OR value of 3,94 and (p=0,000). This is also similar to the data of J. Mercado, who found the coincidence between anemia in pregnant women in the third trimester and maternal-perinatal complications (OR:3,44).(18)

The perioperative complications that pregnant women with anemia presented were: postpartum hemorrhage with (OR: 5,95) and value of (P: 0,00); it can be interpreted that pregnant women with anemia presented the complication of postpartum hemorrhage, 5 times more than the pregnant population without anemia, and it is statistically significant. Similarly, in one study, M. Vega found statistical significance between anemia and postpartum hemorrhage with (OR:7,14) and (p: 0,00). (17) Also similar to the data from Wang R, who found statistical significance between anemia and postpartum hemorrhage where (RR: 2,76). (19)

The complication of surgical wound infection with (OR: 3.47) and value of (P: 0.04); means that pregnant women with anemia have a risk of presenting surgical wound infection, 3 times more than the pregnant population without anemia. Similar to the results of M. Otiniano who found statistical significance between maternal anemia and post-cesarean surgical wound infection (OR: 3.80).(19)

The complication of premature rupture of membranes with (OR: 3,24) and value of (P: 0,00) means that the pregnant population with anemia has a risk of presenting the complication of premature rupture of membranes, 3 times more than the pregnant population without anemia. Similar to the data of M. Vega who found statistical significance between anemia and premature rupture of membranes with (OR: 4,94) and (p:0,00).(17). Thus, in 1 study, Wang R. found statistical significance between anemia and anemia and premature rupture of membranes (OR: 1, 94).(18) In addition; anemia during pregnancy is associated with transfusion of blood components (blood) in the perioperative period with (OR: 9,2) and value of (P: 0,00) which means that it is statistically significant. In this study it was demonstrated that pregnant women with anemia have 9 times more risk of being transfused in the perioperative period than the pregnant population without anemia. Similar to those of Montano Vega, G. where a statistically significant association was found between anemia and postpartum hemorrhage (p=0,001) with OR: 7,14 (IC 1,89 – 27,0).(17)

Study Limitations

Some limitations constrain the scope of these findings. The cross-sectional design precludes establishing a temporal sequence between exposure and outcome, a restriction that particularly affects the causal interpretation of complications. Anemia was defined by hemoglobin without determination of ferritin or transferrin saturation, so the iron-deficiency origin was not confirmed, nor were pregnant women with iron deficiency without anemia identified. Adherence was measured by self-report, a procedure subject to social desirability bias. The study was conducted at a single center, which limits extrapolation.

CONCLUSIONS

Anemia was present in 24,3 % of the pregnant women studied, with a predominance of mild and moderate forms, evidencing a relevant clinical burden in the third trimester of gestation. Inadequate adherence to ferrous sulfate and its discontinuation associated with nausea were significantly associated with the presence of anemia, identifying concrete opportunities to strengthen adherence and prenatal follow-up. Anemia that persists until delivery does not constitute a laboratory finding but rather a modifier of surgical risk. It multiplied by six the probability of postpartum hemorrhage, by three that of surgical site infection and premature rupture of membranes, and by nine that of requiring transfusion.

Distributing ferrous sulfate solves the problem of access, not that of tolerance, and the difference between them determines whether the pregnant woman reaches the operating room with or without reserves. Anticipating the adverse effect, adjusting the dose or formulation, and verifying consumption at each check-up costs considerably less than a unit of blood and probably yields more than increasing the number of prenatal check-ups without modifying their content. The total absence of preconception care in the sample, rather than a quantifiable risk factor, describes a segment of the continuum of care that simply does not exist in this setting. Prospective and multicenter studies should determine whether interventions aimed at adherence and timely treatment of anemia can reduce these adverse outcomes.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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