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ORIGINAL RESEARCH **OPEN ACCESS**

Gestational anemia and clinical characteristics in a Peruvian obstetric sample

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ABSTRACT

Background: Gestational anemia should be considered alongside maternal and obstetric characteristics when describing antenatal populations. **Objective:** To describe gestational anemia and maternal and obstetric characteristics in a selected hospital sample from Trujillo, Peru, during 2021–2024. **Methods:** A retrospective descriptive analysis included 319 medical records originally selected according to prelabor rupture of membranes (PROM) status: 156 women with PROM and 163 without PROM. Eligible women were aged 18–35 years and had third-trimester hemoglobin measurements and complete clinical information. Anemia severity, maternal age, body mass index, gestational age, gravidity, preeclampsia, and oligohydramnios were summarized using frequencies and percentages. **Results:** Anemia was documented in 160 women (50.2%): 116 (36.4% of the sample) had mild anemia, 43 (13.5%) moderate anemia, and one (0.3%) severe anemia. The largest maternal age group was 18–22 years (36.1%), and 78.7% were classified as overweight according to recorded measurements. Most women were at 38 weeks of gestation (66.8%); 60.5% were in their first pregnancy. Preeclampsia and oligohydramnios were recorded in 41.4% and 47.3%, respectively. **Conclusions:** Mild anemia predominated among anemia diagnoses in this selected sample. These findings characterize the hematological and obstetric profile of the selected hospital sample and support attention to anemia assessment within comprehensive antenatal care.

Keywords: Anemia; Pregnancy; Premature Rupture of Fetal Membranes; Retrospective Studies; Hemoglobins.

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Introduction

Anemia remains a substantial maternal health concern. A pooled analysis of population-representative surveys estimated that 36% of pregnant women worldwide had anemia in 2019, with insufficient progress toward international reduction targets [1]. Increased iron requirements and physiological plasma-volume expansion complicate the interpretation of hemoglobin during pregnancy. Iron deficiency is an important pathological cause, although a low hemoglobin concentration alone does not establish the etiology of anemia [2,3]. In a large retrospective cohort, associations between anemia and adverse maternal and fetal outcomes differed according to anemia severity, underscoring the clinical importance of distinguishing mild, moderate, and severe anemia [4].

Prelabor rupture of membranes (PROM) is rupture of the fetal membranes before the onset of labor. Preterm PROM occurs before 37 completed weeks, whereas term PROM occurs at or after 37 weeks. These conditions differ in prognosis and management, particularly in the balance between infection and prematurity-related morbidity [5,6]. Fetal membrane integrity depends on interacting structural, inflammatory, oxidative, and mechanical processes. PROM therefore occurs within a complex clinical context that includes maternal health and obstetric characteristics [7].

The literature linking maternal hematological status with pregnancy outcomes provides a rationale for describing anemia in obstetric populations. An updated global meta-analysis found associations between low maternal hemoglobin and several adverse maternal and infant outcomes, with differences according to measurement timing and hemoglobin threshold [8]. A meta-analysis of cohort studies identified an association between anemia and PROM, and a synthesis of Ethiopian studies identified anemia among the factors associated with preterm PROM [9,10]. A hospital-based study in Callao, Peru, also reported an association between anemia and preterm membrane rupture [11]. These analytical studies address relationships between exposures and outcomes; descriptive characterization serves a complementary purpose by identifying the distribution and severity of clinical conditions within a defined sample.

Obstetric history, infection, and nutritional characteristics are relevant to the clinical context of PROM [12]. Describing these dimensions alongside anemia helps establish which patient profiles are represented in hospital research and provides context for interpreting findings across settings. The objective of this study was to describe gestational anemia and its severity, maternal age and body mass index (BMI), gestational age, gravidity, preeclampsia, and oligohydramnios in a sample of women with and without PROM treated at a public referral hospital in Trujillo, Peru, during 2021–2024. This local description focuses on the composition of the selected clinical sample.

Materials and methods

Study design and setting

A retrospective descriptive analysis was conducted using medical records from the obstetrics and gynecology service of a public referral hospital in Trujillo, Peru, covering 2021–2024. The sample had been assembled using case-control eligibility criteria: women with a documented diagnosis of PROM formed the case group, and women without PROM formed the control group. The present analysis describes the pooled sample. Reporting was structured according to the applicable Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations, including specification of the design, eligibility criteria, variables, and descriptive results [13].

Participants and record selection

Eligible records were those of pregnant women aged 18–35 years who had undergone hemoglobin testing during the third trimester and had complete information for the study variables. Records with incomplete information were excluded. Selection was based on PROM status and these eligibility criteria. The final sample comprised 319 women, including 156 with PROM and 163 without PROM, drawn from the same hospital service and clinical period. The descriptive analysis included all 319 selected records.

Variables and definitions

Gestational anemia was defined by a third-trimester hemoglobin concentration below 11.0 g/dL. Anemia was classified as mild (10.0–10.9 g/dL), moderate (7.0–9.9 g/dL), or severe (<7.0 g/dL); hemoglobin concentrations of 11.0 g/dL or higher were classified as no anemia. These severity thresholds are consistent with those used in contemporary obstetric research [4]. The classification describes hemoglobin status and does not assign a specific cause of anemia.

PROM status was obtained from the documented clinical diagnosis of membrane rupture before labor, irrespective of whether the pregnancy was preterm or term. Maternal age was recorded in years and gestational age in weeks. The observed maternal-age categories were 18–22, 23–27, 28–32, and 33–34 years; gestational-age categories were 35, 36, 37, and 38 weeks. Primigravidity denoted a first pregnancy. Preeclampsia and oligohydramnios were recorded as present or absent according to the clinical diagnoses.

BMI was calculated as weight in kilograms divided by height in meters squared. The data-collection form classified BMI as underweight (<18.5 kg/m²), normal weight (18.5–24.9 kg/m²), overweight (25.0–29.9 kg/m²), or obesity (30.0–45.0 kg/m²). BMI refers to the maternal measurements recorded in the clinical documentation.

Data collection

Information was abstracted from hospital medical records using a structured form covering maternal age, gestational age, gravidity, weight, height, anemia diagnosis and severity, PROM, preeclampsia, and oligohydramnios. The form underwent content review by three medical specialists, including clinicians in internal medicine and obstetrics and gynecology. Access to the records was coordinated with the hospital administration and medical-records service. Data collection involved review of existing documentation without additional clinical procedures.

Statistical Analysis

Categorical variables were summarized as frequencies and percentages. Percentages were calculated as the category count divided by 319 and multiplied by 100, then rounded to one decimal place. The same denominator was used for each variable. The number with any anemia was the sum of the mild, moderate, and severe categories. This subtotal was presented alongside the mutually exclusive severity categories for clarity. The analysis described the pooled sample; sample proportions were not used to estimate population prevalence. No between-group comparisons or association estimates were calculated for this descriptive analysis.

Ethical considerations

The study was authorized by the Research Ethics Committee of the participating hospital under authorization No. 213, dated 18 September 2024, and was conducted in accordance with the principles of the Declaration of Helsinki applicable during the study period [14]. Informed consent was obtained from the participants for the use of their clinical information in the research. The investigation involved review of existing clinical records without a study intervention or changes to patient care. Confidentiality was protected, and only aggregate results without patient identifiers are presented. Access to record-level information is subject to institutional authorization and confidentiality safeguards.

Results

The analysis included 319 women. Anemia and membrane status are described in Table 1, maternal age and BMI in Table 2, and obstetric characteristics in Table 3. All percentages refer to the complete study sample.

Anemia was documented in 160 women (50.2%), while 159 (49.8%) had no anemia. Mild anemia was the most frequent severity category, affecting 116 women (36.4% of the full sample); moderate anemia affected 43 (13.5%) and severe anemia one (0.3%). The sample comprised 156 women with PROM (48.9%) and 163 without PROM (51.1%) (Table 1).

Table 1. Gestational anemia and prelabor rupture of membranes in the study sample

Characteristic	n	%
Gestational anemia		
No anemia	159	49.8
Any anemia	160	50.2
Mild anemia	116	36.4
Moderate anemia	43	13.5
Severe anemia	1	0.3
Prelabor rupture of membranes		
Present	156	48.9
Absent	163	51.1
Total women	**319**	**100.0**

Values are n and percentage of the full sample (N = 319). "Any anemia" is the subtotal of mild, moderate, and severe anemia. The no-anemia and three severity categories together account for all 319 women. PROM: prelabor rupture of membranes.

The largest maternal age group was 18–22 years, comprising 115 women (36.1%), followed by 23–27 years with 96 (30.1%). Overweight was the predominant BMI category, recorded in 251 women (78.7%). Normal weight was recorded in 67 women (21.0%), obesity in one (0.3%), and underweight in none (Table 2).

Table 2. Maternal age and body mass index in the study sample

Characteristic	n	%
Maternal age		
18–22 years	115	36.1
23–27 years	96	30.1
28–32 years	66	20.7
33–34 years	42	13.2
Body mass index		
Underweight (<18.5 kg/m^2)	0	0.0
Normal weight (18.5–24.9 kg/m^2)	67	21.0
Overweight (25.0–29.9 kg/m^2)	251	78.7
Obesity (30.0–45.0 kg/m^2)	1	0.3
Total women	**319**	**100.0**

Values are n and percentage of the full sample (N = 319). Categories within each variable sum to 319. Percentages may sum to 100.1% because of rounding. BMI categories follow the data-collection form and refer to recorded maternal measurements.

Most women were at 38 weeks of gestation (213; 66.8%), followed by 37 weeks (93; 29.2%). Ten women were at 36 weeks (3.1%) and three at 35 weeks (0.9%). First pregnancy was documented in 193 women (60.5%). Preeclampsia was recorded in 132 (41.4%) and oligohydramnios in 151 (47.3%) (Table 3).

Table 3. Gestational age, gravidity, and recorded obstetric conditions in the study sample

Characteristic	n	%
Gestational age		
35 weeks	3	0.9
36 weeks	10	3.1
37 weeks	93	29.2
38 weeks	213	66.8
Gravidity		
First pregnancy	193	60.5
Previous pregnancy	126	39.5
Preeclampsia		
Present	132	41.4
Absent	187	58.6
Oligohydramnios		
Present	151	47.3
Absent	168	52.7
Total women	**319**	**100.0**

Values are n and percentage of the full sample (N = 319). Categories within each variable sum to 319. First pregnancy denotes primigravidity. Preeclampsia and oligohydramnios are separate clinical variables and may occur in the same woman.

Discussion

This descriptive analysis characterized a sample of 319 women whose records were selected according to PROM status at a referral hospital. Approximately half had anemia, with mild anemia accounting for most anemia diagnoses. The sample was concentrated at 37–38 weeks of gestation, the largest maternal age group was 18–22 years, and most women were classified as overweight according to recorded measurements. First pregnancy, preeclampsia, and oligohydramnios were also prominent components of the clinical profile. These results describe the women included in the review and provide a context for understanding the clinical spectrum represented by the sample.

The anemia proportion of 50.2% warrants attention within this clinical group, but it is not directly comparable with a population prevalence estimate. Stevens et al. estimated a global anemia prevalence of 36% among pregnant women in 2019 using population-representative surveys [1]. Differences in recruitment, clinical setting, gestational timing, and case composition influence such comparisons. In the present study, the proportions of women with and without PROM arose from selection according to outcome status. The observed anemia proportion therefore cannot establish whether the hospital population or the surrounding community had a higher anemia prevalence than a national or global reference population.

Severity adds clinical meaning to the overall anemia count. Mild anemia affected 116 women, compared with 43 with moderate anemia and one with severe anemia. This distribution identifies mild anemia as the principal hematological category in the sample while retaining the clinical relevance of moderate and severe disease. Large observational studies indicate that maternal and fetal outcomes vary by anemia severity, and global evidence also points to the importance of the timing of hemoglobin measurement [4,8]. The third-trimester measurements used here describe hematological status late in pregnancy; they should be interpreted in that temporal context.

The distinction between anemia and iron-deficiency anemia is essential. Hemoglobin concentration establishes an anemic state, whereas determining its cause requires a clinical assessment that may include iron studies and evaluation for other hematological or inflammatory conditions [2,15]. Accordingly, the anemia categories in this study describe severity without assigning etiology. This approach avoids treating every

low hemoglobin result as evidence of the same underlying process. Clinical management should address the cause, severity, symptoms, and response to treatment, consistent with contemporary reviews of anemia in pregnancy [3,15].

The maternal profile also requires attention to measurement context. Overweight accounted for 78.7% of the sample, but BMI calculated from measurements recorded during pregnancy incorporates gestational changes in body mass. It cannot automatically be interpreted as prepregnancy nutritional status. A Mexican birth-cohort study examined prepregnancy BMI and gestational weight gain in relation to third-trimester hemoglobin, illustrating why these dimensions should be distinguished [16]. Similarly, the predominance of younger women and first pregnancies describes the sampled group; it does not demonstrate that age or gravidity increased or reduced the likelihood of anemia or PROM.

The gestational-age distribution was concentrated at 37–38 weeks, while preeclampsia and oligohydramnios were recorded in 41.4% and 47.3% of women, respectively. These figures characterize the case mix of the selected records. Clinical interpretation of concurrent obstetric conditions depends on the sequence of events; for example, fluid loss after membrane rupture can contribute to oligohydramnios [5,6]. Differentiating term and preterm PROM remains clinically relevant because the balance of maternal and neonatal risks changes with gestational age.

Evidence from analytical studies places the descriptive findings in a broader research context. Wang et al. reported an association between maternal anemia and PROM in a meta-analysis of cohort studies [9]. Geremew et al. identified anemia among the factors associated with preterm PROM in Ethiopian studies, and Meléndez-Saravia and Barja-Ore reported a corresponding association in a Peruvian hospital sample [10,11]. Other evidence identifies several obstetric-history and infection-related factors associated with PROM [12]. These studies evaluate relationships that the present pooled descriptive analysis does not estimate. Their effect sizes should therefore remain distinct from the sample proportions presented here.

The biological complexity of membrane rupture further supports a measured interpretation. Reviews describe inflammation, tissue remodeling, cellular stress, and membrane aging as interconnected processes [7,17]. Experimental studies have examined impaired antioxidant responses under stretch, neutrophil-mediated membrane inflammation and weakening, and inflammatory responses to extracellular vesicles released under oxidative stress [18-20]. These mechanisms help explain why a clinical diagnosis such as PROM can arise through multiple pathways. They do not establish a mechanistic link between the anemia diagnoses and membrane status in this sample.

The practical relevance of the findings lies in the clinical characterization of women undergoing obstetric care. The predominance of mild anemia supports continued attention to antenatal hematological assessment, appropriate etiological evaluation, and treatment follow-up. The latest Cochrane review found that daily oral iron may reduce maternal anemia and iron deficiency at term, while evidence for several other maternal and infant outcomes remained uncertain or showed little difference [21]. Decisions about supplementation and treatment should follow the applicable clinical guidance and individual assessment; the descriptive results do not establish an effect of anemia treatment on PROM.

Strengths include use of a structured extraction form reviewed by medical specialists and presentation of the full distribution of each clinical variable with a consistent denominator. The retrospective design is subject to the characteristics of routine clinical documentation, and the single-hospital setting limits generalizability. Selection according to PROM status and restriction to eligible records define the sample to which the findings apply. The descriptive scope supports characterization of that sample, but not population prevalence estimation, assessment of associations, or causal inference. Prospective studies across multiple settings, with standardized measurement timing and explicit differentiation of term and preterm PROM, would allow broader evaluation of these clinical patterns.

Conclusions

Gestational anemia was documented in 50.2% of the 319 selected women, with mild anemia predominating. The sample was characterized by frequent overweight, a predominance of first pregnancies, and a concentration at 37–38 weeks of gestation. Preeclampsia and oligohydramnios were recorded in 41.4% and 47.3%, respectively. These findings describe the clinical composition of the reviewed hospital records and support attention to hematological assessment within comprehensive obstetric care.

Author Contributions Statement (CrediT)

RJV: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Validation, Visualization, Supervision, Project administration, Writing – original draft, and Writing – review & editing.

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Conflict of Interest

The author declares no financial, institutional, professional, or personal competing interests related to this work.

Data Availability

The aggregate data supporting the findings are presented in the article. Further information about the data-collection form and tabulated results may be requested from the corresponding author upon reasonable request. Individual clinical records are not publicly available and remain subject to institutional authorization and confidentiality requirements.

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