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Analysis of hematological parameters in newborns and estimation of anemia prevalence in the neonatal period

Análises dos parâmetros hematológicos em recém-nascidos e estimativa da prevalência de anemias no período neonatal

Análisis de los parámetros hematológicos en recién nacidos y estimación de la prevalencia de anemias en el período neonatal

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Abstract:
Introduction: Neonatal anemia is a hematological disorder that requires the interpretation of red blood cell parameters while accounting for the physiological particularities of newborns, especially their gestational and postnatal age. Objective: To analyze the hematological parameters of newborns admitted to the Neonatal Intensive Care Unit at the University Hospital of Western Paraná (HUOP) and to estimate the prevalence of anemia during the neonatal period. Method: This is an observational, descriptive, cross-sectional, and retrospective study with a quantitative approach, conducted through the analysis of electronic medical records and laboratory data of newborns under 28 days of age, covering the period from March 2024 to March 2025. A total of 161 medical records were evaluated, taking into account red blood cell (erythrocyte) parameters and specific reference criteria for the neonatal population. The data were subjected to descriptive statistical analysis, and hematological parameters were compared across gestational groups. Results: There was a predominance of males (59.62%) and preterm newborns (70.18%), with a mean gestational age of 35.37 ± 0.25 weeks. The prevalence of anemia was 6.21% (n = 10), while 93.79% (n = 151) did not present with anemia according to the criteria used. When comparing gestational groups, a statistically significant difference was identified in erythrocyte counts, whereas no significant differences were observed in hemoglobin or hematocrit values. Conclusion: The results made it possible to characterize the hematological profile of the newborns evaluated and to estimate the prevalence of anemia in the studied population. The findings reinforce the importance of using reference values specific to gestational and postnatal age, contributing to the proper interpretation of hematological parameters and the identification of potential abnormalities during the neonatal period.

Keywords: Neonatal anemia; newborns; complete blood count; gestational age; hematological parameters.

Resumo:
Introdução: A anemia neonatal é uma alteração hematológica cuja identificação requer a interpretação dos parâmetros eritrocitários considerando as particularidades fisiológicas dos recém-nascidos, especialmente a idade gestacional e pós-natal. Objetivo: Analisar os parâmetros hematológicos de recém-nascidos internados na Unidade de Terapia Intensiva Neonatal do Hospital Universitário do Oeste do Paraná (HUOP) e estimar a prevalência de anemia no período neonatal. Método: Trata-se de um estudo observacional, descritivo,

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transversal e retrospectivo, com abordagem quantitativa, realizado por meio da análise de prontuários eletrônicos e registros laboratoriais de recém-nascidos com idade inferior a 28 dias, referentes ao período de março de 2024 a março de 2025. Foram avaliados 161 prontuários, considerando os parâmetros do eritrograma e os critérios de referência específicos para a população neonatal. Os dados foram submetidos à análise estatística descritiva e à comparação dos parâmetros hematológicos entre grupos gestacionais. Resultados: Observou-se predominância do sexo masculino (59,62%) e de recém-nascidos pré-termo (70,18%), com idade gestacional média de 35,37 ± 0,25 semanas. A prevalência de anemia foi de 6,21% (n = 10), enquanto 93,79% (n = 151) não apresentaram anemia segundo os critérios adotados. Na comparação entre os grupos gestacionais, foi identificada diferença estatisticamente significativa na contagem de eritrócitos, enquanto não foram observadas diferenças significativas nos valores de hemoglobina e hematócrito. Conclusão: Os resultados permitiram caracterizar o perfil hematológico dos recém-nascidos avaliados e estimar a prevalência de anemia na população estudada. Os achados reforçam a importância da utilização de valores de referência específicos para a idade gestacional e pós-natal, contribuindo para a interpretação adequada dos parâmetros hematológicos e a identificação de possíveis alterações no período neonatal.

Palavras-chave: Anemia neonatal, Recém-nascidos, Hemograma, Idade gestacional, Parâmetros hematológicos.

Resumen:
Introducción: La anemia neonatal es una alteración hematológica cuya identificación requiere la interpretación de los parámetros eritrocitarios, considerando las particularidades fisiológicas de los recién nacidos, especialmente la edad gestacional y posnatal. Objetivo: Analizar los parámetros hematológicos de recién nacidos ingresados en la Unidad de Cuidados Intensivos Neonatales del Hospital Universitario del Oeste de Paraná (HUOP) y estimar la prevalencia de anemia en el período neonatal. Método: Se trata de un estudio observacional, descriptivo, transversal y retrospectivo, con enfoque cuantitativo, realizado mediante el análisis de historias clínicas electrónicas y registros de laboratorio de recién nacidos menores de 28 días, correspondientes al período comprendido entre marzo de 2024 y marzo de 2025. Se evaluaron 161 historias clínicas, considerando los parámetros del eritrograma y los criterios de referencia específicos para la población neonatal. Los datos fueron sometidos a un análisis estadístico descriptivo y a la comparación de los parámetros hematológicos entre grupos gestacionales. Resultados: Se observó un predominio del sexo masculino (59,62 %) y de recién nacidos prematuros (70,18 %), con una edad gestacional media de 35,37 ± 0,25 semanas. La prevalencia de anemia fue del 6,21 % (n = 10), mientras que el 93,79 % (n = 151) no presentó anemia según los criterios adoptados. En la comparación entre los grupos gestacionales, se identificó una diferencia estadísticamente significativa en el recuento de eritrocitos, mientras que no se observaron diferencias significativas en los valores de hemoglobina y hematocrito. Conclusión: Los resultados permitieron caracterizar el perfil hematológico de los recién nacidos evaluados y estimar la prevalencia de anemia en la población estudiada. Los hallazgos refuerzan la importancia de utilizar valores de referencia específicos para la edad gestacional y posnatal, lo que contribuye a la interpretación adecuada de los parámetros hematológicos y a la identificación de posibles alteraciones en el período neonatal.

Palabras clave: Anemia neonatal; recién nacidos; hemograma; edad gestacional; parámetros hematológicos.

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1. Introduction

Neonatal anemia is a condition characterised by a reduction in hemoglobin and/or hematocrit levels below the reference values expected for newborns, taking their physiological particularities and developmental stage into account. The neonatal period comprises the first 28 days of life, a phase marked by intense hematological adaptations resulting from the transition from intrauterine to extrauterine life. During this period, changes occur in erythrocyte production, erythropoietin concentration and hemoglobin dynamics, directly influencing hematological parameters (Freire et al., 2010). Identifying abnormalities in red blood cell parameters therefore requires careful interpretation of results, considering factors such as gestational age, postnatal age and the newborn's clinical condition (German; Juul, 2023; Christensen et al., 2023).

Anemia during the neonatal period has a multifactorial origin and may be related to blood loss, increased erythrocyte destruction or reduced production. Among the associated conditions, anemia of prematurity stands out, particularly in preterm newborns, in whom immature erythrocyte production mechanisms, a reduced erythropoietin response and rapid growth contribute to decreasing hemoglobin levels. Furthermore, frequent blood sampling for laboratory tests, particularly in newborns hospitalised in intensive care units, may represent an additional factor in blood loss and anemia development. However, not every reduction in hematological parameters indicates a pathological condition, since physiological changes also occur during neonatal adaptation (German; Juul, 2023).

In this context, laboratory assessment is a fundamental tool for identifying and characterising hematological abnormalities in newborns. The complete blood count, particularly its red blood cell component, enables analysis of parameters such as hemoglobin concentration, hematocrit, erythrocyte count, mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH) (Christensen et al., 2023).

Hemoglobin is related to the blood's oxygen-carrying capacity, while hematocrit expresses the proportion of blood volume occupied by erythrocytes. Erythrocyte count indicates the number of circulating red blood cells, while MCV and MCH help characterise their average size and average hemoglobin content. Joint analysis of these parameters helps identify erythrocyte abnormalities and provides relevant information for assessing the neonatal hematological profile (Guerra et al., 1992).

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However, interpreting these results involves important particularities, since newborn hematological values differ from those observed in older children and adults and vary according to gestational age and time since birth. For this reason, identifying anemia should not rely exclusively on reference intervals intended for adults. According to Christensen et al. (2023), hemoglobin concentration and hematocrit should be assessed using reference intervals specific to the neonatal population, allowing more appropriate classification of the abnormalities found. Furthermore, morphological classification of anemias using red blood cell indices helps investigate their etiology and should be interpreted alongside the clinical picture and other available laboratory parameters (De Santis, 2019).

Investigating hematological abnormalities in newborns admitted to neonatal intensive care units is relevant to clinical assessment and the identification of erythrocyte abnormalities, contributing to understanding the hematological profile and occurrence of anemia in this population (German; Juul, 2023).

In this context, analysing complete blood counts from newborns admitted to the Neonatal ICU of the University Hospital of Western Paraná (HUOP) allows characterisation of red blood cell parameters and estimation of anemia prevalence, considering the physiological particularities of the neonatal period and reference values appropriate to gestational and postnatal age.

Thus, this study aimed to analyse hematological parameters in newborns admitted to the HUOP Neonatal ICU and estimate anemia prevalence. Specifically, it sought to describe hemoglobin, hematocrit, erythrocyte count, mean corpuscular volume and mean corpuscular hemoglobin values, identify results consistent with anemia according to available reference criteria, and calculate its prevalence in the study population.

2. Theoretical framework

2.1 Concept of anemia in the neonatal period

Neonatal anemia is defined as a reduction in hemoglobin concentration or red blood cell mass relative to reference values established for the newborn's gestational and postnatal age. Reduced hemoglobin levels may compromise tissue oxygenation and cellular metabolism, especially in newborns with adverse clinical conditions. From a pathophysiological standpoint,

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neonatal anemia may result from three main mechanisms: blood loss, decreased erythrocyte production or increased red blood cell destruction (hemolysis) (Jopling et al., 2009).

Physiological neonatal anemia results from the natural decline in hemoglobin concentration after birth, caused by reduced erythropoietin production in response to increased blood oxygenation. In term newborns, it occurs gradually during the first months of life and generally requires no specific treatment. Pathological anemia, in contrast, is associated with conditions such as hemorrhage, hemolysis, maternal-fetal blood incompatibility and infections, and may require investigation and treatment according to its cause and severity (Walter, 2024).

Hemoglobin and hematocrit values vary according to gestational age and clinical conditions. In term newborns, hemoglobin at birth ranges approximately from 16.5 to 21.5 g/dL, with hematocrit around 51%. In preterm infants, these parameters may be lower because of hematopoietic system immaturity (Christensen et al., 2023; Jopling et al., 2009).

The physiological decline in hemoglobin is more pronounced in preterm infants owing to lower erythropoietin production and other factors specific to this population. Interpretation of hematological parameters should therefore consider gestational age and day of life, helping distinguish physiological changes from pathological conditions and contributing to the newborn's clinical assessment (German, Juul et al., 2023).

2.2 Main types and mechanisms involved

Neonatal anemia may result from three main mechanisms: blood loss, hemolysis and erythrocyte hypoproliferation. These mechanisms may occur alone or in combination, compromising hemoglobin concentration and oxygen-carrying capacity (FAY, 1983).

Blood loss may occur during pregnancy, delivery or after birth. Among prenatal causes, fetomaternal hemorrhage stands out, characterised by the passage of fetal blood into the maternal circulation. When significant, it may cause fetal anemia, hypovolemia and tissue hypoxemia, with a risk of severe injury. After birth, external or internal hemorrhage may also reduce red blood cell mass (NEW et al., 2016).

Hemolysis consists of premature erythrocyte destruction, reducing hemoglobin and potentially increasing unconjugated bilirubin concentrations. Causes include ABO and Rh incompatibilities, enzyme deficiencies, hemoglobinopathies and infections (Christensen et al., 2023).

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In Rh incompatibility, hemolytic disease may occur when a sensitised Rh-negative pregnant woman produces IgG antibodies against the D antigen present on the fetal erythrocytes of an Rh-positive fetus. These antibodies cross the placenta and promote erythrocyte destruction; sensitisation may occur during pregnancy itself. In ABO incompatibility, maternal IgG anti-A or anti-B antibodies may cause hemolysis, particularly when the mother has blood group O (Murray; Roberts, 2007).

Glucose-6-phosphate dehydrogenase (G6PD) deficiency is an X-linked inherited disorder. This enzyme helps protect erythrocytes against oxidative damage; deficiency increases their vulnerability to destruction and may cause hemolytic anemia and neonatal hyperbilirubinemia (Anderle et al., 2018).

Hemoglobinopathies are inherited quantitative or structural abnormalities of globin chains. At birth, fetal hemoglobin (HbF), composed of two alpha and two gamma chains, predominates. After birth, its production decreases while adult hemoglobin (HbA), consisting of two alpha and two beta chains, increases. This transition influences the clinical expression of hemoglobinopathies: alpha-thalassemia may cause anemia during fetal or neonatal life, while sickle cell disease and many forms of beta-thalassemia tend to become more clinically apparent during the first months of life as HbF declines (Ghosh et al., 2014).

Erythrocyte hypoproliferation occurs when bone marrow red blood cell production is insufficient to maintain red blood cell mass. One of the main conditions associated with this mechanism is anemia of prematurity, resulting from hematopoietic system immaturity and relatively reduced production of erythropoietin, the hormone responsible for stimulating erythropoiesis (Blankenhorn et al., 2024).

2.3 Associated risk factors

Prematurity and low birth weight are associated with greater hematological vulnerability because birth before term interrupts part of the placental iron transfer concentrated in the third trimester of pregnancy (Moreno-Fernandez et al., 2019). Maternal conditions may also influence neonatal hematological status. Iron deficiency during pregnancy may compromise fetal iron stores, while deficiencies of other micronutrients, such as folic acid and vitamin B12, may interfere with blood cell formation (Zhao et al., 2024).

In a randomised clinical trial, Anderson et al. (2011) observed that delayed cord clamping was associated with higher ferritin concentrations at four months and lower neonatal

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anemia prevalence in the first days of life compared with early clamping. Twin pregnancy may also increase maternal iron requirements and is associated with a greater risk of prematurity and low birth weight. Intrapartum hemorrhage, particularly when involving placental abnormalities or fetal blood loss, may directly contribute to neonatal anemia (Anderson et al., 2011).

2.4 Physiological particularities of the newborn

Hemoglobin concentration undergoes physiological changes during the neonatal period, related to adaptation to extrauterine life, regulation of erythropoiesis and the characteristics of neonatal erythrocytes. At birth, fetal hemoglobin (HbF), consisting of two alpha and two gamma chains ($\alpha_2\gamma_2$), has a higher oxygen affinity than adult hemoglobin (HbA). After birth, the establishment of pulmonary respiration increases tissue oxygen availability, reducing the stimulus for erythropoietin production and consequently erythropoietic activity. This process contributes to the progressive decline in hemoglobin concentration observed during the first weeks of life (New et al., 2016).

Another relevant aspect is the shorter survival of neonatal erythrocytes compared with adult erythrocytes. While adult red blood cells have an average lifespan of approximately 120 days, neonatal cells survive around 60 to 90 days. In term newborns, the minimum value usually occurs between the sixth and twelfth weeks of life. In preterm newborns, this decline is more intense and earlier, characterising anemia of prematurity; the magnitude of the hemoglobin decline varies according to gestational age, birth weight and clinical conditions (Moreno-Fernandez et al., 2019).

2.5 Laboratory diagnosis

The complete blood count is one of the main tests for assessing neonatal anemia, allowing analysis of hemoglobin concentration (Hb), hematocrit (Hct), erythrocyte count and red blood cell indices such as mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH) (Christensen et al., 2023).

Reticulocyte count and the immature reticulocyte fraction (IRF) help assess bone marrow erythropoietic activity. These indicators help investigate the body's response to reduced hemoglobin, distinguishing abnormalities related to insufficient erythrocyte production from those associated with blood loss or erythrocyte destruction (German; Juul, 2023).

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Serum ferritin may be used to assess iron stores and is particularly relevant when investigating preterm newborns, whose iron stores may be lower owing to early interruption of placental transfer (Vittorazzi et al., 2022).

2.6 Prevalence and clinical impacts

Worldwide studies show variations in neonatal anemia prevalence across populations. A systematic review and meta-analysis published by Messelu et al. (2025), investigating anemia prevalence and associated factors in newborns in African countries, identified frequencies ranging approximately from 23% to 66%. This variation highlights the influence of population characteristics, socioeconomic conditions and factors related to maternal and infant health (Musselu et al., 2025).

Accordingly, investigating neonatal anemia prevalence and clinical impact expands knowledge of this condition, particularly in hospitalised populations. Comparing term and preterm newborns allows recognition of differences related to hematological abnormalities and each group's physiological particularities. Collecting laboratory data from newborns admitted to neonatal intensive care is therefore epidemiologically and clinically relevant, as it characterises this population's hematological profile and provides a basis for future neonatal anemia research (Zare-Badie et al., 2024).

3. Methodology

3.1 Study design and ethical aspects

This was an observational, descriptive, cross-sectional and retrospective study with a quantitative approach, based on electronic medical records and laboratory records of newborns treated in the Neonatal Intensive Care Unit (NICU) of the University Hospital of Western Paraná (HUOP) in Cascavel, Paraná.

The study was approved by the HUOP Research Ethics Committee on 12 August 2026 and by the Human Research Ethics Committee (CEPEH) of Universidade Paranaense (UNIPAR), under CAAE No. 01173726.1.0000.0109 and Opinion No. 8.716.788. A waiver of informed consent was granted because secondary data were used. Confidentiality was maintained through the use of data without personal names.

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3.2 Population and data collection

Medical records were analysed for newborns younger than 28 days postnatally, covering the period from 1 March 2024 to 1 March 2025. Records with available complete blood counts were included, while those failing to meet the established criteria or containing insufficient information were excluded.

Data were collected using the Philips Tasy system, considering sex, age, gestational age, birth weight, inpatient unit, record dates and laboratory results. Each newborn contributed only one complete blood count. Erythrocyte count, hemoglobin, hematocrit, mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH) were assessed.

3.3 Gestational classification and anemia

Participants were divided into two groups according to gestational age at birth: Group A, 29 to 34 weeks, and Group B, 35 to 42 weeks.

Anemia classification considered the reference intervals described by Jopling et al. (2009), who demonstrated hemoglobin and hematocrit variations according to gestational and postnatal age. For newborns at 35 to 42 weeks, the authors described mean hemoglobin of approximately 18 g/dL at birth, with a fifth percentile of 14 g/dL, and a mean of 13 g/dL at 28 days, with a fifth percentile of 9.5 g/dL. For those at 29 to 34 weeks, the fifth percentile of hemoglobin at 28 days was 7.8 g/dL.

Individual classification considered the study's adopted reference criteria, applying thresholds corresponding to each participant's gestational and postnatal age. The other erythrocyte parameters were used to characterise the hematological profile.

3.4 Statistical analysis

Data were organised in electronic spreadsheets and analysed using GraphPad Prism®. Categorical variables were presented as absolute and relative frequencies, and numerical variables as mean and standard deviation (SD).

Normality was assessed separately in Groups A and B. Independent groups were compared using the unpaired Student's t-test with equal variances for hemoglobin and hematocrit, and the Mann–Whitney test for erythrocyte count.

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Anemia prevalence was calculated as the proportion of cases relative to the total number of participants, expressed as a percentage. No inferential analysis of the association between gestational group and anemia occurrence was performed. A significance level of 5% ($p < 0.05$) was adopted.

4. Results and discussion

A total of 161 medical records were assessed for newborns admitted to the HUOP Neonatal Intensive Care Unit. The mean interval between birth and the complete blood count was 1.21 ± 0.35 days. Males predominated, accounting for 59.62% (n = 96) of the sample, while females represented 40.37% (n = 65). Regarding birth classification, 70.18% (n = 113) were classified as preterm and 29.81% (n = 48) as term, as shown in Table 1.

Table 1 – Distribution of newborns by sex and birth classification

Sex	**(n)**	**(%)**
Female	65	40.37
Male	96	59.62
Total	161	100
Birth	**(n)**	**(%)**
Term	48	29.81
Preterm	113	70.18
Total	161	100

Source: Research data, 2026.

Newborns with a gestational age below 37 completed weeks are considered preterm, while term newborns have a gestational age between 37 completed weeks and 41 weeks and 6 days. This distinction is relevant to hematological assessment because gestational maturity influences blood parameter values and should be considered when interpreting laboratory results. Jopling et al. (2009) demonstrated that hemoglobin and hematocrit values vary with

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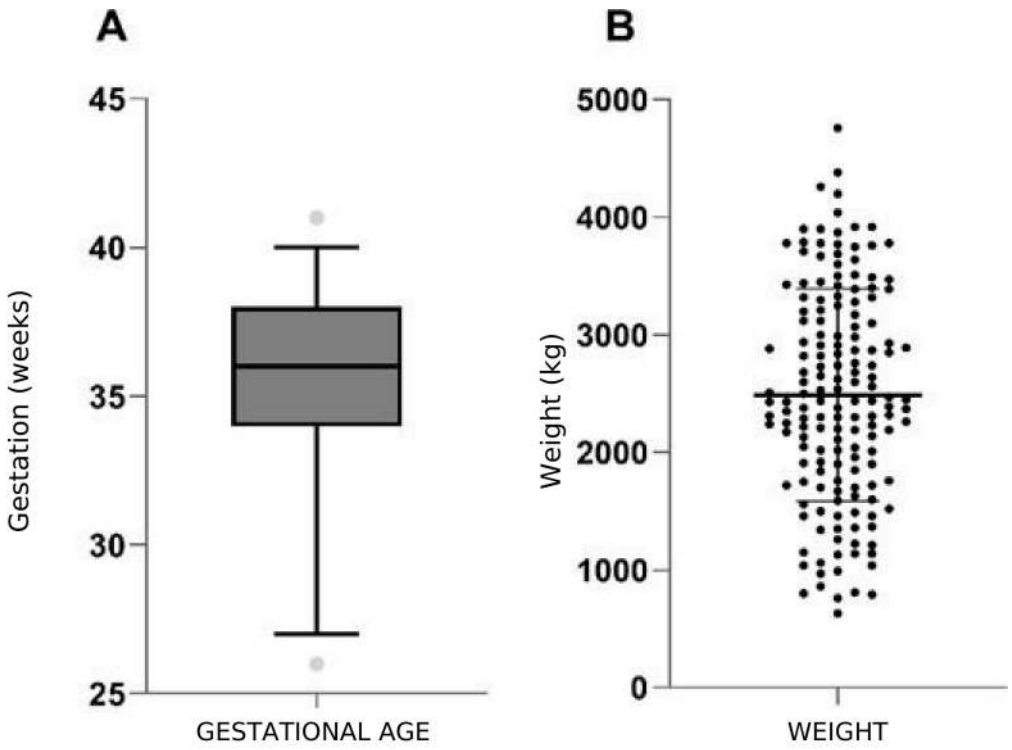
gestational and postnatal age, reinforcing the importance of considering these variables in newborn assessment.

Mean gestational age among the individuals assessed was 35.37 ± 0.25 weeks, while mean birth weight was 2,489 ± 71.11, as shown in Figure 1. These data help characterise the study population and demonstrate the importance of considering gestational and anthropometric conditions when analysing neonatal hematological parameters. However, because the sample comprised newborns admitted to intensive care, these values should be interpreted within the participants' specific clinical context and cannot be generalised to all newborns.

Figure 1 – Distribution of gestational age and birth weight among the newborns assessed



Data represented as mean ± SD for (A) gestational age; (B) birth weight.
Source: Research data, 2026.

For hematological assessment, individuals were divided into two groups according to gestational week at birth: 29-34 weeks (Group A) and 35-42 weeks (Group B).

The erythrocyte profile was assessed to evaluate and investigate anemia (Figure 2). Regarding erythrocyte count, Group A had a mean of 4.301 ± 0.09439 × 10^6/µL, while Group B had a mean of 4.628 ± 0.06069 × 10^6/µL. Mean hemoglobin concentrations were 16.05 ±

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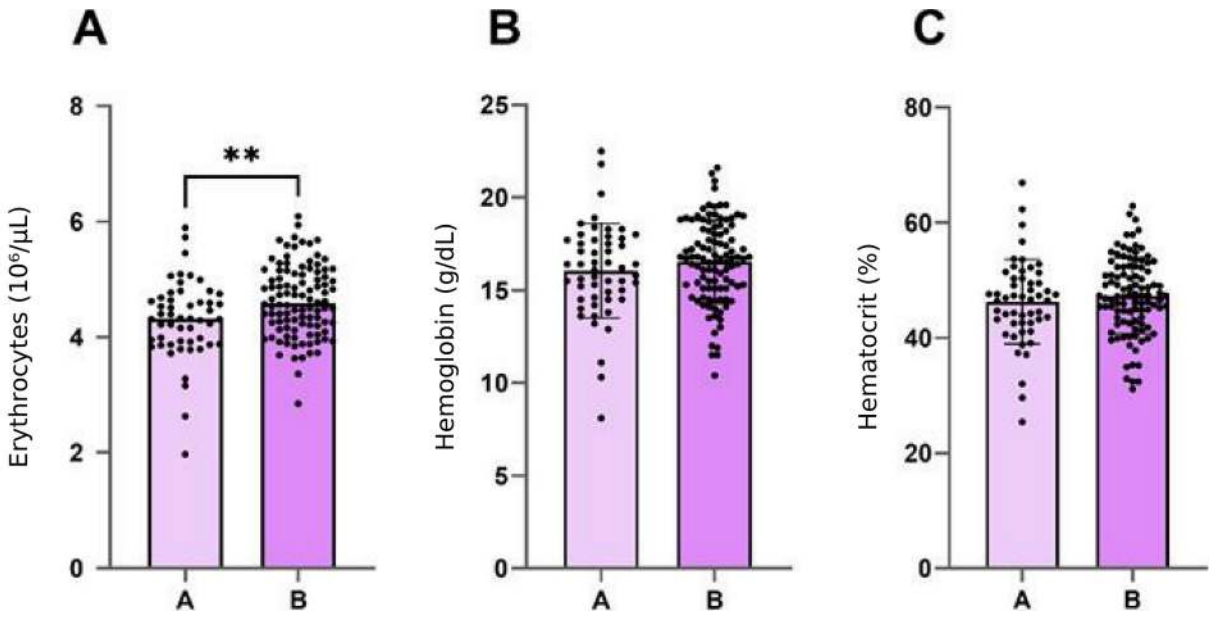
0.3527 g/dL in Group A and 16.53 ± 0.2201 g/dL in Group B. Mean hematocrit values were 46.27 ± 1.019% in Group A and 47.29 ± 0.6516% in Group B.

Figure 2 – Comparison of hematological parameters between gestational groups



Data are presented as mean ± standard deviation. (A) Erythrocyte count; (B) hemoglobin concentration; (C) hematocrit. ** Statistically significant difference between groups for erythrocyte count ($p < 0.01$).
Source: The authors, 2026.

Anemia prevalence in this study was 6.21% (n = 10), while 93.79% (n = 151) of newborns did not have anemia according to the adopted criteria.

Overall, mean hemoglobin and hematocrit values in both groups are consistent with the absence of marked abnormalities in these parameters in the study population. However, individual interpretation should consider reference intervals specific to gestational and postnatal age, as described by Jopling et al. (2009). Thus, although the results suggest a generally preserved erythrocyte profile, the hematological normality of each newborn cannot be established solely from group means and must be considered alongside individual anemia classification.

Jopling et al. (2009) demonstrated variations in hemoglobin and hematocrit values according to these characteristics, highlighting the importance of appropriate reference values for newborn assessment. Christensen et al. (2023) likewise emphasise the importance of considering gestational and postnatal age when interpreting neonatal hematological parameters.

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In a Brazilian study, Valete et al. (2026) identified anemia in 3.9% (n = 6) of 151 newborns assessed during the first week of life. The authors also found no statistically significant difference in gestational age between newborns with and without anemia (p = 0.78). This finding resembles the present study, in which no clear relationship could be established between gestational age and anemia occurrence. However, the prevalences differed, which may be related to characteristics of the study populations and the diagnostic criteria used.

Another aspect to consider when discussing the low neonatal anemia prevalence (6.21%) is prenatal care. During pregnancy, monitoring maternal health allows identification of abnormalities such as anemia, enabling follow-up and treatment when necessary. A review by Zhao et al. (2024) identified an association between maternal anemia during pregnancy and lower newborn hemoglobin levels, reinforcing the importance of pregnancy monitoring to identify and treat maternal abnormalities. Prenatal care and timely identification of maternal anemia may therefore be relevant to neonatal hematological health. However, because data on prenatal care attendance, maternal anemia or treatments received during pregnancy were not assessed, it cannot be claimed that these factors directly contributed to the low prevalence observed in this study (Da Silva et al., 2024).

Furthermore, identifying only ten anemia cases in this study and their distribution across gestational groups limits assessment of possible associations. The absence of a clear relationship therefore does not establish that gestational age is unassociated with anemia occurrence. Studies with larger samples and more balanced distributions across gestational age ranges may help clarify this possible association.

5. Final considerations

This study analysed hematological parameters in 161 newborns admitted to the Neonatal Intensive Care Unit of the University Hospital of Western Paraná (HUOP), aiming to estimate neonatal anemia prevalence. Males (59.62%) and preterm newborns (70.18%) predominated. Anemia prevalence was 6.21% (n = 10), while 93.79% of newborns showed no abnormalities meeting the adopted criteria.

Although no clear relationship was identified between gestational age and anemia occurrence, the results characterised the study population's hematological profile. The importance of neonatal-specific reference values is highlighted, considering the physiological

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particularities and rapid hematological changes characteristic of this period, which are essential to avoiding inappropriate interpretations of laboratory tests.

In conclusion, the study contributed to understanding anemia occurrence in newborns admitted to the HUOP Neonatal ICU, reinforcing the importance of laboratory monitoring and age-appropriate interpretation of hematological parameters to help identify abnormalities and support clinical decision-making.

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