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Prevalence and Determinants of Neonatal Anemia in a Tertiary Hospital in Nouakchott, Mauritania

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Abstract: Introduction: Neonatal anemia remains a significant yet under-recognized public health concern, particularly in low-resource settings. Neonatal anemia is characterized by a decreased hemoglobin level in the blood of newborns. Its complications include tissue hypoxia and delayed neurodevelopment. This study aimed to determine the prevalence, severity, associated factors, and outcomes of anemia among hospitalized neonates in Nouakchott, Mauritania. Methods: A cross-sectional study was conducted between April and September 2021 among 242 neonates admitted to a tertiary hospital. Sociodemographic, clinical, and laboratory data were collected. Anemia was defined based on WHO criteria. Statistical associations between anemia and potential risk factors were analyzed using Chi-squared tests. Results: The prevalence of neonatal anemia was 16.5%. Among anemic neonates, 52.2% had mild anemia, 37.5% moderate, and 10% severe. Low birth weight was present in 62.5% of anemic cases. Neonatal infections were diagnosed in 40% and Rhesus incompatibility in 22.5% of anemic newborns. Significant associations were found between anemia and neonatal infection (p = 0.03), as well as lack of maternal iron supplementation during pregnancy (p = 0.02). Management included antibiotics (40%), phototherapy (30%), and blood transfusion (15%). While 80% of anemic neonates recovered, 20% died during hospitalization. Conclusion: Neonatal anemia affects one in six hospitalized newborns in the Hôpital de lAmitié of Nouakchott. It is associated with preventable risk factors such as infection and inadequate maternal iron supplementation. The wider aim of this research is to improve the rates of neonatal anemia in this setting.

Keywords: neonatal anemia; determinants factors; hemoglobin; infection; iron deficiency; Mauritania; Sub-Saharan Africa

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1. Introduction

Anemia is a widespread public health problem affecting approximately 42% of children under five worldwide, with a higher burden in low-and middle-income countries, particularly in Sub-Saharan Africa [1]. Neonatal anemia, defined by reduced hemoglobin concentration during the first 28 days of life, can severely affect a childs development and survival if not properly managed [2]. In neonates, anemia is generally considered when hemoglobin is below 13 g/dL in venous blood and 14 g/dL in capillary blood [3]. However, defining anemia in newborns is complex, requiring consideration of gestational age, perinatal factors, and sample collection techniques. In Sub-Saharan Africa, studies have reported varied prevalence rates of neonatal anemia. Dairo et al. (2004) [4] found a prevalence of 21% in Nigeria, while Brabin et al. (2004) reported higher rates in Malawi [5]. The causes of neonatal anemia are multifunctional and may include premature, prenatal infection, haemolytic diseases, nutritional deficiency, and maternal conditions such as anemia preeclampsia, or chronic illnesses [6]. In Mauritania, data on neonatal anemia remain scarce. This study aims to assess the prevalence of neonatal anemia at the Hôpital de lAmitié (HA) in Nouakchott, identify associate factors, and describe clinical outcomes and management strategies.

2. Methods

2.1. Study Design, Period, and Setting

This study is a descriptive, cross-sectional, single-center study, conducted between April and September 2021 at the neonatology unit of the HA in Nouakchott, Mauritania. Nouakchott is the capital and the largest city of Mauritania, located on the Atlantic coast, with 1,491,958 inhabitants in 2023 (Figure 1). The HA is one of the main referral hospitals in the city, with a pediatric department comprising a neonatology unit equipped with eight incubators, four radiant warmers, and two bassinets.

2.2. Inclusion Criteria

We included all newborns aged 1 to 28 days who were hospitalized in the neonatology department with hemoglobin levels of 14.5 g/dL for preterm infants or 3.5 g/dL for full-term infants.

2.3. Exclusion Criteria

We excluded all newborns with congenital anomalies, those with inaccessible blood samples, and those born to mothers with chronic illnesses such as HIV/AIDS, diabetes, HTA, kidney/liver disease, malaria, and malignancies.

2.4. Sample Size

The minimum sample size was calculated on an estimate based on the number of newborns admitted to the neonatology department of HA in the same period (6 months) of the last year, 2020. For

600 newborns and a confidence level = 95% (Z=1.96, Z = 1.96, Z=1.96; margin of error = 5%), the recommended population of the study was 235 newborns.

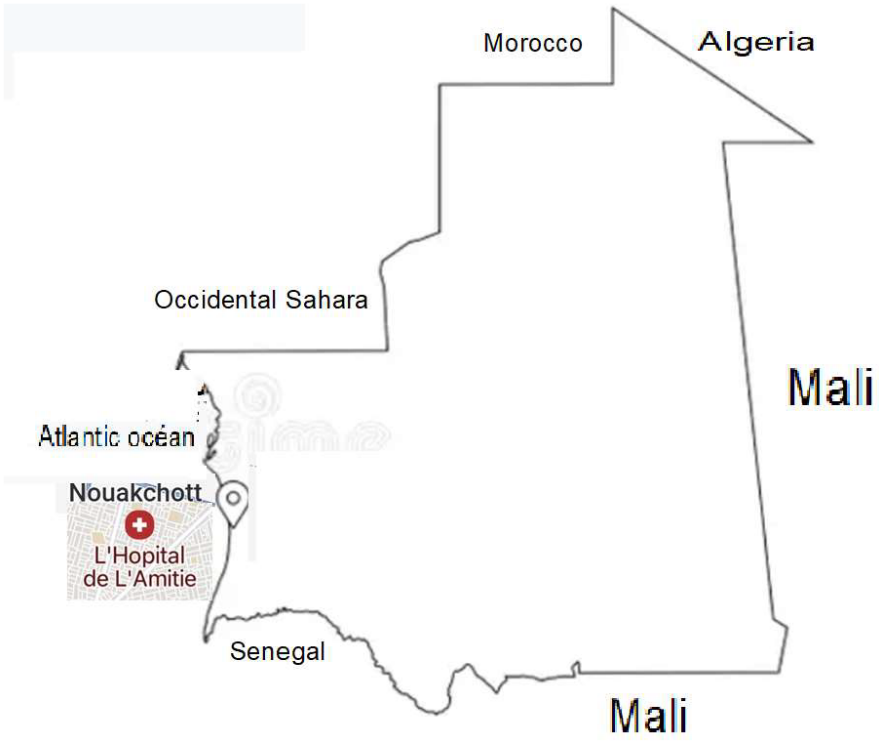

Figure 1: Map of Mauritania showing the location of the capital, Nouakchott.

2.5. Data Collection

Severe anemia was defined as a hemoglobin level below 7 g/dL in full-term newborns and below 10 g/dL in premature infants. Moderate anemia was defined as hemoglobin levels between 7 and 11 g/dL in full-term newborns and between 10 and 13 g/dL in premature infants. Sociodemographic and clinical data were collected using a pre-tested structured questionnaire translated into Arabic and other national languages during face-to-face interviews with mothers or guardians. The information collected included maternal age, education, occupation, place of residence, antenatal care follow-up, iron and folic acid supplementation, number of pregnancies, and history of bleaching or complications during pregnancy. Neonatal clinical data (fever, irritability, poor feeding), including neonatal birth weight, gestational age, Apgar score, and symptoms of infection, were extracted from hospital records using a standardized data extraction sheet.

2.6. Laboratory Analysis

Blood samples of 1.5 to 2 mL were collected via venous puncture under sterile conditions. Samples were placed in EDTA tubes. The hemoglobin concentration was immediately analyzed using a HemoCue® Hb 301 System. The rest of the samples were kept at 4 °C and analyzed within 2 h using a Sysmex XP-300. Additional tests included CBC, C-reactive protein (CRP), bilirubin level,

blood grouping, Rhesus factor, and blood culture, when available. CBC and CRP values > 6 mg/L and blood culture were used to diagnose neonatal infections.

2.7. Data Quality Control

All data collectors received training, and data collection tools were pre-tested. Laboratory samples were handled by qualified personnel, and standard operating procedures were followed to minimize errors. Data entry was double-checked for consistency.

2.8. Data Entry and Statistical Tests

Analysis data were entered into Microsoft Excel and exported to SPSS version 21 for analysis. Descriptive statistics were used to summarize variables (frequencies, percentages, means, medians, and interquartile ranges). Chi-squared tests were used to analyze associations between anemia and categorical variables such as infection, maternal anemia, and Rhesus incompatibility, with significance threshold of $p < 0.05$. Hemoglobin distributions were analyzed by age group and anemia severity (mild—11–13.4g/dL; moderate—7–10.9 g/dL; and severe—<7 g/dL).

2.9. Ethical Considerations

The study was approved by the institutional committee of the faculty of Medicine, University of Nouakchott. Written informed consent was obtained from the parents or legal guardians of all newborns included in the study.

3. Results

3.1. Sociodemographic Characteristics

Among the 242 newborns hospitalized between April and September 2021 in the neonatology department of HA in Nouakchott, 57% were male and 43% female (sex ratio = 1.35). Most mothers (72%) lived in urban areas. The mean maternal age was 27.4 years (range: 16–44). About 45% had completed secondary education, and 35% received regular antenatal care. Iron and folic acid supplementation during pregnancy was reported by 58% of mothers.

3.2. Prevalence and Severity of Anemia

The global prevalence of neonatal anemia was 16.5% (40 out of 242). Among anemic newborns, 55% were full-term and 45% preterm. Mild anemia accounted for 60.0%(24 out of 40), moderate for 30.0%(12 out of 40), and severe anemia for 10%(4 out of 40) of cases (Table 1). The median hemoglobin concentration was 11.2 g%dL (IQR: 9.8–12.4).

3.3. Associated Factors

Neonatal infections were diagnosed in 40% of anemic newborns based on CRP levels and clinical signs. Rhesus incompatibility was noted in 22.5% of anemic cases. Low birth weight (<2500 g) was observed in 62.5% of anemic neonates. A significant association was found between anemia and infection ($p = 0.03$), as well as between anemia and lack of maternal iron supplementation ($p = 0.02$).

Table 1: Prevalence and severity of anemia in newborns, by age group, in Hôpital Amitié, Nouakchott, Mauritania, 2021.

Degree of Severity	Examined	Age of Newborns			Total
	N = 40	0-7 days N = 31	8-15 days N = 7	16-28 days N = 02	
Mild Anemia	24(60.0%)	24(77.4%) *	00 (00 %)	00 (00%)	24(60.0%) *
Moderate Anemia	12(30.0%)	6 (19.4%)	6(85.7%)	00(00%)	12 (30.0%)
Severe Anemia	04(10.0%)	1(03.2%)	1 (14.3%)	2(100.0%)	04 (10.0%)
Total	40 (100.0%)	31 (100.0%)	7(100.0%)	2(100.0%)	40 (100%)

N = number of children examined; % = percentage. * = significant differences.

3.4. Management and Outcomes

Treatment included antibiotics (40%), phototherapy (30%), and blood transfusion (15%), (Table 2). The mean hospital stay was 5 days (range :1–9). At discharge, 80% of newborns had fully recovered without sequelae, while 20% died during hospitalization.

Table 2: Management of neonatal anemia cases, according to the type of treatment, at Hôpital Amitié, Nouakchott, Mauritania, 2021.

Treatment	Effective	Frequency%
Transfusion	6	15.0%
Phototherapy	12	30.0%
Antibiotherapy	16	40.0% *
Vit K	21	52.5%
Vit D	18	45%
Antiepileptic	3	7.5%
Diuretic	2	5%
Corticosteroid	2	5%

*= significant differences

4. Discussion

This study highlights a neonatal anemia prevalence of 16.5%, a rate that is consistent with findings from other low-and middle-income countries, where neonatal anemia ranges from 10% to 25%, depending on population and diagnostic criteria used [7]. The relatively moderate prevalence observed here suggests a significant, yet potentially preventable, burden on neonatal health services [8]. The sociodemographic profile of the mothers, predominantly urban, with a mean age of 27.4 years and moderate levels of education, indicates that despite relatively favorable maternal characteristics, neonatal anemia remains a concern. Notably, only 35% received regular antenatal care, and 58% reported iron and folic acid supplementation, pointing toward gaps in maternal health service utilization and adherence. This finding is critical, as antenatal iron supplementation is well-documented to reduce the risk of anemia in both mothers and neonates [9,10]. Among anemic neonates, the distribution by gestational age (55% term, 45% preterm) and birth weight (62.5% with LBW) underscores the multifactorial nature of neonatal anemia. While prematurity is a recognized risk factor for anemia due to reduced iron stores and erythropoiesis, the relatively high proportion of term neonates with anemia in this study suggests that other factors, such as maternal nutrition and perinatal infections, may play important roles [11]. The severity profile, with

more than 31 of anemic newborns presenting with moderate to severe anemia, indicates that this condition is not only common but may have serious clinical implications. The median hemoglobin level of 11.2 g/dL aligns with WHO thresholds but also reflects a significant proportion of neonates at risk of poor oxygenation and developmental delays if left untreated. A key finding in this study is the significant association between neonatal anemia and infection (p = 0.03), corroborating prior research that identifies infections as both a cause and consequence hemolysis, leading to a drop in hemoglobin levels. Similarly, Rhesus incompatibility (22.5%) and low birth weight were prominent among anemic cases, reinforcing the role of haemolytic and nutritional mechanisms [12]. Of equal importance is the association between lack of maternal iron supplementation and neonatal anemia (p = 0.02). This finding supports WHO recommendations for routine iron and folic acid supplementation during pregnancy and highlights a missed opportunity in antennal care that should be addressed through policy and education. Management approaches in this cohort, antibiotics (40%), phototherapy (30%), and blood transfusions in 15% of cases, demonstrate the resource-intensive nature of neonatal anemia care [13]. The mortality rate of 20% among anemic neonates is alarming and emphasizes the urgent need for prevention, early diagnosis, and comprehensive management strategies [14].

5. Strengths and Limitations

This study provides valuable insights into neonatal anemia in a hospital setting and identifies key risk factors. However, limitations include its single-center design and potential underestimation of some factors such as maternal nutritional status or socioeconomic determinants that were not fully captured.

6. Conclusions and Implications

Neonatal anemia is a significant public health issue in Mauritania, with preventable causes such as maternal iron deficiency, infections, and haemolytic conditions playing a major role. Strengthening antenatal care, ensuring adequate iron supplementation, and improving early neonatal infection control could substantially reduce this burden. Further research is needed to explore long-term outcomes and community-level risk factors.

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