



Prevalence, Associated Factors and Outcome of Newborns with Anaemia as Seen in Rivers State University Teaching Hospital, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aim: There is paucity of literature on the prevalence of neonatal anaemia globally thus aim of the study was to evaluate the prevalence, determine the associations and the clinical outcome of neonates with anaemia.

Study Design: This was a descriptive prospective cross-sectional study.

Place and Duration of Study: Study was carried out among neonates admitted in the Special Care Baby Unit of Rivers State University Teaching Hospital over one year.

Methodology: A convenient sampling size of 402 neonates who met the inclusion criteria were consecutively recruited. Data was analysed using SPSS version 23.

Results: Of 402 neonates assessed, 106(26.4%) had anaemia with PCV less than 42%. Anaemia was observed more in males 56(52.8%), neonates delivered via Caesarean section 74(69.8%) and at gestational age less than 37 weeks 53(50%). Mild anaemia was observed

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mostly, 66(62.3%). Common pregnancy complications of mothers with anaemic babies were prolonged rupture of membranes 17(35.4%) and hypertension in pregnancy 14(29.2%) while the commonest morbidities in these neonates were probable sepsis 65(63.8%), neonatal jaundice 53(52%) and prematurity 53(52%). There was significant difference in anaemic and non-anaemic neonates with regards to mothers with gestational diabetes (P value < 0.0001). The factors associated with severe anaemia were probable sepsis and the duration of stay. Blood transfusion was carried out in 27(25.5%) neonates. An overall mortality of 7.5% was documented, severe anaemia being highest (21.4%).

Conclusion: The prevalence of anaemia was high being 26.4% and was observed more in males, preterms and babies delivered via Caesarean section. There was significant difference in anaemic and non-anaemic neonates with regards to mothers with gestational diabetes. Probable sepsis and duration of stay were significantly associated with severe anaemia. The mortality rate in neonates with anaemia was 7.5% thus there is need to assess newborns for anaemia with prompt intervention to prevent morbidity, mortality and long term sequelae.

Keywords: Anaemia; associated factors; newborns; Nigeria; outcome; prevalence; caesarean section.

1. INTRODUCTION

Anaemia, defined as haemoglobin or haematocrit level greater than 2 standard deviations below the mean for age is a frequent occurrence in neonatal care units [1,2]. Neonatal anaemia is associated with increased morbidity such as apnoea, cardio-respiratory instability, feeding difficulties and poor weight gain in preterm babies as well as increased mortality even in term babies [3,4].

There is paucity of literature indicating the true prevalence of anaemia in neonates. However, studies from Malawi [5] and Ethiopia [6] reported neonatal anaemia prevalence of 23.4% and 25% respectively while Lee et al. [7] reported a prevalence of 21% among babies born to teenage mothers in the US. For Nigeria, published literature only revealed studies of neonatal anaemia in the context of blood transfusion [8-10]. Anaemia severity can be classified into mild, moderate and severe [3].

Variables such as sampling site (capillary vs vein) [11], gestational age [12], position of neonate relative to the placenta during delivery (lower position drains blood into baby vs higher position drains blood out of the baby) [3,12], and timing of cord clamping (delayed vs immediate) [13] can affect the red cell mass at birth. The major causes of anaemia in neonates include blood loss, decreased production and increased red blood cell destruction [1,3].

Blood loss is regarded as one of the most common causes of neonatal anaemia and is usually from repeated phlebotomy for routine

laboratory tests [3,14]. Other sources of blood loss include internal haemorrhages from difficult and or instrumental deliveries such as sub-galeal haemorrhage, intraventricular haemorrhage, cephal-haematoma and fetomaternal transfusions among others [1,2,14].

Red blood cell destruction usually occurs via immune-mediated mechanisms resulting from red blood cell (RBC) antigen incompatibilities between the infant and the mother and presents with haemolytic anaemia and jaundice. A classic example is Haemolytic disease of the fetus and newborn (HDFN) comprising Rhesus isoimmunization, ABO incompatibility as well as congenital red blood cell enzyme and membrane disorders [1-3,14-16].

Impaired RBC production may be the result of physiologic, acquired or congenital disorders. From birth to the first 8 to 12 weeks of life, there is a progressive decline in haemoglobin concentrations which reaches the lowest nadir at 6-10 weeks in term babies (with haemoglobin levels of 9-11g/dL) and 4-8 weeks in preterms (with haemoglobin levels of 7-9g/dL) – Physiologic anaemia [1,14-16]. Due to the fact that this physiologic anaemia is exaggerated and most times symptomatic in premature babies, it is also called Anaemia of prematurity [1,14-16]. Physiologic anaemia results from a temporary cessation of erythropoiesis coupled with shortened RBC life span all leading to a reduction in circulating RBC mass [1,14,15]. Congenital causes of RBC underproduction include bone marrow hypo-regenerative syndromes (Diamond-Blackfan anemia, Fanconi anemia), congenital leukaemia etc, while

acquired causes include acute bacterial and viral infections as well as TORCHES syndrome [1-3,15,16].

Anaemia could lead to life threatening events especially in severe cases [17]. It also leads to impaired brain development, delayed brain maturation, poor school performance and work capacity in later years as well as stunted growth, poor cognitive, motor and socio-emotional development [18,19].

Treatment options for anaemia in the neonate will depend on the severity of symptoms, haemoglobin or haematocrit values (mild, moderate, severe), and the presence of comorbidities that interfere with oxygen delivery [1-3,14-16]. Blood transfusion is the treatment of choice for severe anaemia, given as top-up blood transfusion or exchange blood transfusion [3]. Blood transfusion rates in the neonatal intensive care units (NICU) is very high, particularly in preterms with anaemia being the second most common indication for blood transfusion as documented in several studies [2,3,8-10,16].

There is paucity of data on the prevalence of neonatal anaemia globally, thus the present study was carried out to determine the prevalence, factors associated with anaemia as well as the clinical outcome of newborns with anaemia. Findings from this study would assist in the formulation of policies that would improve the care and outcome of neonates with respect to anaemia.

2. MATERIALS AND METHODS

This descriptive prospective cross-sectional study was carried out over a period of one year from 1st April 2019 to 31st March 2020 in the neonatal unit of the Rivers State University Teaching Hospital(RSUTH), Port Harcourt, Nigeria. Rivers State University Teaching Hospital is a 375 bedded state owned tertiary hospital located in the south-south region of Nigeria. It serves as a referral centre for all the government owned primary health centres (PHC), general hospitals as well as private owned health facilities in Rivers state and its' environs. It consists of several departments including the departments of Paediatrics.

Ethical clearance was obtained from the Rivers State Health Research Ethics Committee before commencement of the study. Informed consents were obtained from parents/caregivers before

recruitment of their babies. A convenient sampling size of 402 inborn neonates, less than 28 days old whose parents/caregivers gave informed consents were consecutively recruited during the study period. Those whose parents did not give consent, outborn neonates and those older than 28 days were excluded from the study.

A research proforma was administered to each recruited neonate. Information obtained from parents/caregivers included demographic characteristics of the mother, pregnancy history, risk factors for anaemia and complications during pregnancy. The neonates age at admission, sex, birth order, gestational age obtained from the first day of the last menstrual cycle or from the ultrasound scan result done in the first trimester of pregnancy were recorded. The baby's weight and clinical features were also recorded. Diagnosis of various comorbidities were made using the units' protocol clinically or using laboratory investigations where necessary.

Capillary blood was collected aseptically from the heel prick of recruited patients after cleaning with cotton wool swab and 70% alcohol. The blood collected into micro-capillary tubes, was spun using a Hawksey micro-haematocrit centrifuge (serial no. 271156) at 5000 revolutions per minute for 5 minutes. The packed red cell volume (PCV) of the spun blood was thereafter read using the haematocrit reader and noted. A PCV reading of 42% and above was classified as normal [20,21]. The patient was classified as having mild anaemia if the PCV was between 36-42%, moderate anaemia if between 30-36% and severe anaemia if < 30%. All neonates with severe anaemia were transfused either by top-up transfusions or an exchange blood transfusion as indicated by the unit protocol. Other comorbidities were also managed accordingly and babies followed up appropriately until either discharged home, discharged against medical advice or death.

Data was entered into Microsoft Excel spread sheet and thereafter analysed using SPSS version 23. Descriptive statistics were presented as frequency tables, percentages, Pie and Bar charts for categorical variables and as means and standard deviations for continuous variables. For Inferential statistics, Fishers' Exact test was conducted to find the statistical significance in the associations with anaemia among neonates. The level of statistical significance was set at < 0.05 at 95% confidence interval.

3. RESULTS

3.1 Sociodemographic Characteristics of the Study Population

Of 402 neonates admitted during the study period, 106 had anaemia with PCV less than 42% giving a prevalence of 26.4%. Males predominated with a M:F ratio of 1.1:1. Majority of these neonates were admitted within 24 hours of birth, 99 (93.4%) with mean age at presentation being 6.18 ± 13.01 hours and were

of 1st birth order, 42 (39.6%). Most neonates were delivered at gestational age of < 37 weeks, 53 (50.0%) with mean gestational age of 36.27 ± 3.88 weeks. Most had birth weight of 2.5-3.9kg, 54 (50.9%) with mean birth weight of 2.64 ± 0.95 kg. Caesarean section delivery predominated, 74 (69.8%). Majority of the mothers whose neonates were anaemic were of age group 27-36 years, 74 (69.8%) with a mean age of 32.31 ± 5.52 years and had mainly tertiary education 56 (52.8%), Table 1.

Table 1. Sociodemographic characteristics of the study population

Variables	Frequency, n=106 (%)
Sex	
Male	56 (52.8)
Female	50 (47.2)
Age at presentation (hours)	
≤ 24	99 (93.4)
> 24	7 (6.6)
Birth order	
1 st	42 (39.6)
2 nd	32 (30.2)
3 rd and above	32 (30.2)
Gestational age (weeks)	
< 37	53 (50.0)
37-42	51 (48.1)
> 42	1 (1.9)
Birth weight (kg)	
< 2.5	43 (40.6)
2.5-3.9	54 (50.9)
≥ 4.0	9 (8.5)
Mode of delivery	
SVD	32 (30.2)
CS	74 (69.8)
Maternal age (years)	
17-26	11 (10.4)
27-36	74 (69.8)
> 36	21 (19.8)
Maternal level of education	
No formal education	1 (0.9)
Primary education	8 (7.6)
Secondary education	41 (38.7)
Tertiary education	56 (52.8)
Mother's occupation	
Civil/public servants	28 (26.4)
House wife/unemployed	28 (26.4)
Business/Artisan	43 (40.6)
Professionals	7 (6.6)

SVD-Spontaneous vaginal delivery, CS- Caesarean section

3.2 Severity of Anaemia

The mean PCV for neonates with anaemia was $36.20 \pm 4.96\%$ while for non-anaemic neonates, $50.10 \pm 5.13\%$ (P value < 0.001). Mild anaemia (PCV=36-<42%) was mostly observed, 66 (62.3%) while the least was severe anaemia (PCV \leq 30%), 14 (13.2%). The mean PCV for mild anaemia was $39.24 \pm 1.53\%$, moderate was $33.55 \pm 1.51\%$ while for severe anaemia, $26.79 \pm 5.16\%$ (P value < 0.001), Fig. 1.

3.3 Pregnancy Complications Seen in Mothers of Neonates with Anaemia

The commonest pregnancy complication seen in mothers of neonates with anaemia was prolonged rupture of membranes, 17 (35.4%) followed by hypertension in pregnancy, 14 (29.2%), antepartum haemorrhage, 9 (18.7%) and peripartum pyrexia, 6 (12.5%) Fig. 2.

3.4 Morbidity Pattern among Neonates with Anaemia

The commonest morbidities in neonates with anaemia were probable sepsis, 65 (63.8%), neonatal jaundice, 53 (52.0%) and prematurity 53 (52.0%) while the least was congenital abnormalities, 2 (2.0%) Table 2.

3.5 Factors Associated with Anaemia

The socio-demographic characteristics of neonates (sex, gestational age, birth weight, mode of delivery and mother's level of education) and morbidity pattern were not significantly associated with anaemia (P value > 0.05), however there was significant difference in anaemic and non-anaemic neonates with regards to mothers with gestational diabetes (P value < 0.0001), Table 3.

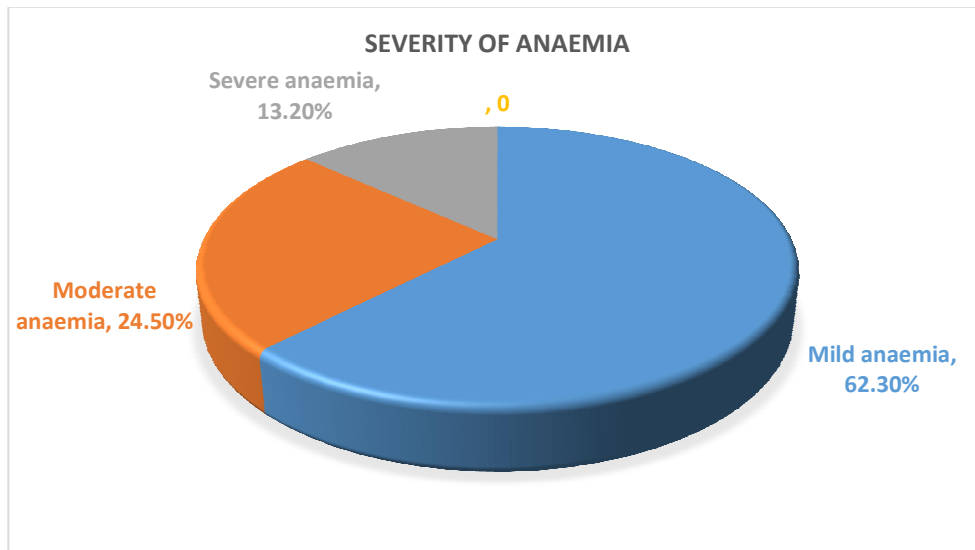


Fig. 1. Severity of anaemia

Table 2. Morbidity pattern among neonates with anaemia

Morbidity pattern	Frequency (%)
Probable sepsis	65 (63.8)
Neonatal jaundice	53 (52.0)
Prematurity	53 (52.0)
Hypoglycaemia	22 (21.6)
Birth asphyxia	12 (11.8)
Malaria	9 (8.8)
Infants of diabetic mothers	3 (2.9)
Birth trauma	3 (2.9)
Congenital abnormalities	2 (2.0)

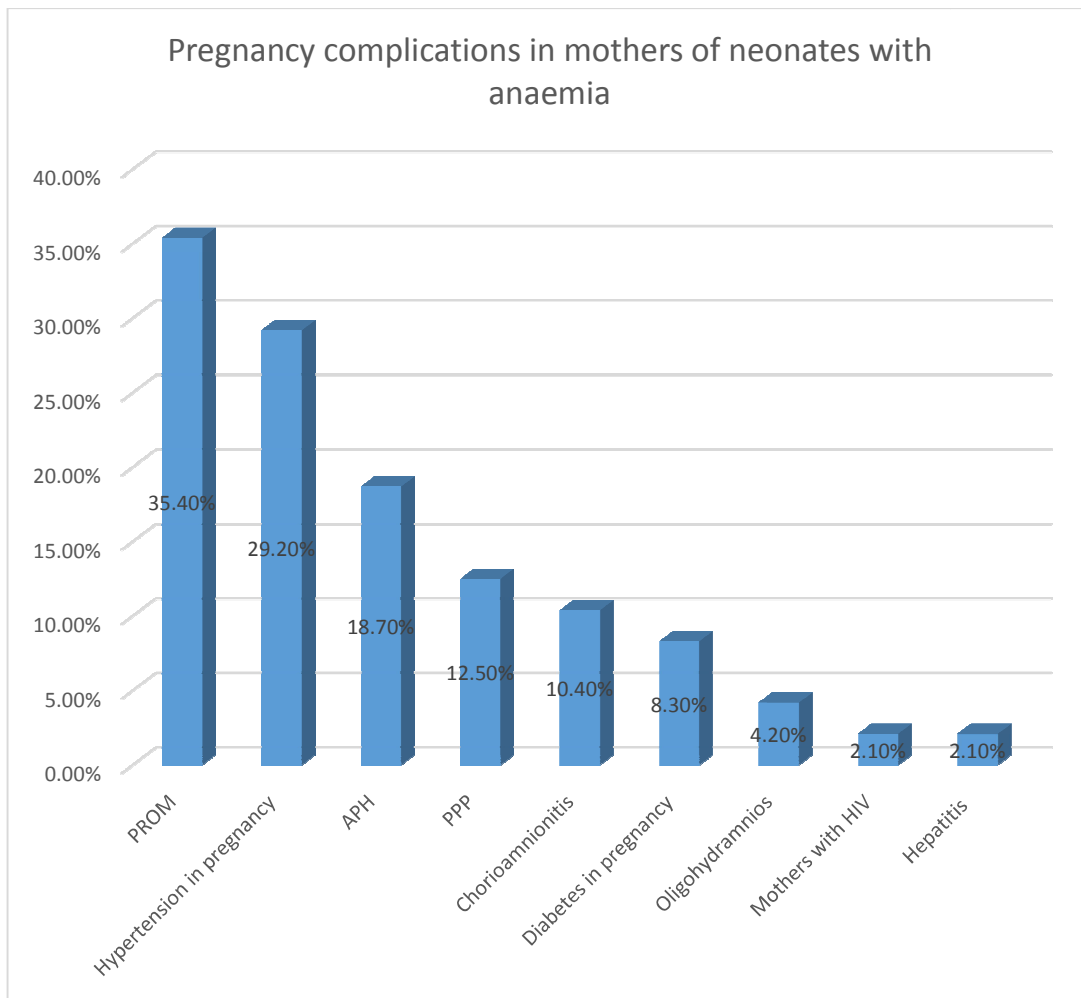


Fig. 2. Pregnancy complications in mothers of neonates with anaemia
 PROM-Prolonged rupture of membranes, APH-Antepartum haemorrhage, PPP-Peripartum pyrexia

3.6 Factors Associated with Severity of Anaemia

Probable sepsis was significantly associated with the severity of anaemia while neonatal jaundice, prematurity and hypoglycaemia were not. Sex, gestational age and birth weight were not significantly associated with the severity of anaemia (P value > 0.05) whereas the duration of stay was significantly associated with the severity of anaemia (P value=0.014), Table 4.

3.7 Treatment Modalities of Neonates with Anaemia

Of 106 neonates with anaemia, 27 (25.5%) neonates had blood transfusion. Majority 22 (81.5%) had top up transfusion while 5 (18.5%)

had exchange blood transfusion. Indications for blood transfusion were mainly severe anaemia only 23 (85.2%) followed by severe anaemia with severe neonatal jaundice, 2 (7.4%) and sepsis 2 (7.4%), Fig. 3.

3.8 Outcome of Neonates with Anaemia

Out of 106 neonates with anaemia, 98 (92.5%) were discharged home while 8 (7.5%) died. According to severity, neonates with mild anaemia had the highest survival rate of 95.5% while those with severe anaemia had the least survival rate of 78.6%. Neonates with severe anaemia had the highest mortality rate of 21.4% while neonates with mild anaemia had the least mortality of 4.5%. This was however not statistically significant, P value > 0.05 (Table 5).

Table 3. Factors associated with anaemia

Variables	Anaemia status		P value
	Anaemic, n=106(%)	Non-anaemic, n=296(%)	
Socio-demographic features			
Sex			
Male	56 (52.8)	159 (53.7)	0.875
Female	50 (47.2)	137 (46.3)	
Gestational age (weeks)			
< 37	53 (50.0)	133 (44.9)	0.130
37-42	51 (48.1)	162 (54.7)	
> 42	2 (1.9)	1 (0.3)	
Birth weight (kg)			
< 2.5	43 (40.6)	112 (37.8)	0.168
2.5-3.9	54 (50.9)	137 (46.3)	
≥ 4.0	9 (8.5)	47 (15.9)	
Mode of delivery			
SVD	32 (30.2)	63 (21.3)	0.064
CS	74 (69.8)	233 (78.7)	
Mother's level of education			
No formal education	1 (0.9)	5 (1.7)	0.659
Primary education	8 (7.5)	13 (4.4)	
Secondary education	41 (38.8)	121 (40.9)	
Tertiary education	56 (52.8)	157 (53.0)	
Morbidity pattern			
Neonatal jaundice	53 (50.0)	163 (55.1)	0.427
Neonatal sepsis	61 (57.5)	196 (66.2)	0.126
Prematurity	53 (50.0)	133 (44.9)	0.427
Hypoglycaemia	22 (20.8)	64 (21.6)	0.891
Pregnancy complications			
PROM	17 (16.0)	53 (17.9)	0.766
Diabetes mellitus	4 (3.8)	246 (83.1)	<0.0001*

PROM=Prolonged rupture of membranes

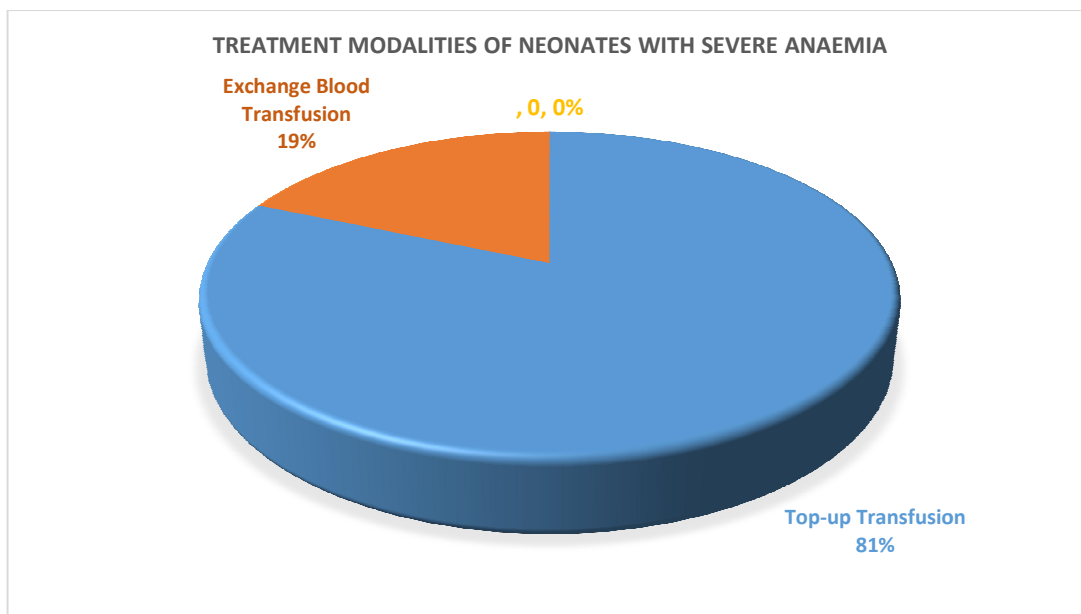


Fig. 3. Treatment modalities of neonates with anaemia

Table 4. Factors associated with severity of anaemia

Variables	Severity of anaemia		P value
	Severe, n=14(%)	Mild/Moderate	
Morbidity pattern			
Neonatal jaundice	7 (50.0)	46 (50.0)	1.000
Probable sepsis	4 (28.6)	57 (62.0)	0.023*
Prematurity	10 (71.4)	43 (46.7)	0.150
Hypoglycaemia	5 (35.7)	17 (18.5)	0.161
Socio-demographic characteristics			
Sex			
Male	5 (35.7)	51 (55.4)	0.251
Female	9 (64.3)	41 (44.6)	
Gestational age (weeks)			
< 37	10 (71.4)	43 (46.7)	0.258
37-42	4 (28.6)	47 (51.1)	
Birth weight (kg)			
< 2.5	9 (64.3)	34 (37.0)	0.109
2.5-3.9	4 (28.6)	50 (54.3)	
≥ 4.0	1 (7.1)	8 (8.7)	
Age at presentation (hours)			
≤ 24	5 (85.7)	87 (94.6)	0.231
> 24	2 (14.3)	5 (5.4)	
Mode of delivery			
SVD	6 (42.9)	26 (28.3)	0.349
CS	8 (57.1)	66 (71.7)	
Duration of stay			
< 24 hours	1 (14.3)	0 (0.0)	0.014*
1-7 days	4 (28.6)	21 (22.8)	
> 7 days	8 (57.1)	71 (77.2)	

Table 5. Outcome of neonates with anaemia

Severity of anaemia	Total n=106	Outcome		P value
		Discharged, n (%)	Died, n (%)	
Mild anaemia	66	63 (95.5)	3 (4.5)	0.077
Moderate anaemia	26	24 (92.3)	2 (7.7)	
Severe anaemia	14	11 (78.6)	3 (21.4)	

4. DISCUSSION

Anaemia which is a frequent occurrence in neonatal units is a significant public health problem leading to neonatal morbidity and mortality [18,22,23]. The prevalence of anaemia in neonates in the present study of 26.4% was comparable to the 25% in Ethiopia [6] but higher than the 21% documented in New York [7] and the Netherlands [24], 19.44%, 5.7% in India [25] and Nepal [26] respectively. It was however lower than the 28.9% and 32.6% reported in a study in Nigeria [27] and Brazil [28] respectively. These differences could be attributed to varying sample size variation, inclusion criteria and methods. Socioeconomic status of the participants and the varying geographic locations

could also account for the varying prevalence rates.

There was male predominance in the present study as observed by Tiruneh et al. [6], in Ethiopia. This may not be unconnected with the fact that gender has been observed to be a significant predictor of health with males observed to be more vulnerable as compared with their female counterparts [29].

About half of neonates with gestational age < 37 weeks had anaemia in the present study. Similar observation was also observed by Banerjee et al [4]. This was not surprising as premature babies are predisposed to anaemia because of their untimely delivery which results in incomplete

placental iron transport and fetal erythropoiesis [30]. In addition, frequent phlebotomy, low plasma levels of erythropoietin due to both diminished production and accelerated catabolism, rapid body growth and need for commensurate increase in red cell volume/mass result in anaemia [30].

Interestingly, neonates delivered via Caesarean section in the present study were observed to be more anaemic. This was in consonance with the study in Iran [31]. Anaemia could be observed more in operative deliveries because of the possibility of accidental incision of the placenta resulting in bleeding with subsequent anaemia in the newborn.

About 2/3rd of neonates had mild anaemia while severe anaemia constituted the least. This pattern was also documented by Tiruneh et al. [6] in Ethiopia.

Socio-demographic characteristics and the various morbidity patterns were not significantly associated with anaemia. However, among pregnancy complications, mothers with diabetes mellitus were significantly more likely to have babies who were non-anaemic. This is not surprising as anaemia although seen in infants of diabetic mothers, is not one of the common complications observed. The present study showed that neonates with probable sepsis were significantly more likely to have mild/moderate anaemia than severe anaemia. Anaemia could arise in neonates with sepsis as a result of increased red blood cell destruction (haemolysis). It is worthy of note however that the severity of the anaemia is thus dependent on the severity of the infection. Interestingly, neonates with severe anaemia had a shorter duration of stay whereas those with mild/moderate anaemia had a longer duration of stay in the neonatal unit. This finding was statistically significant. This could be attributable to the fact that severe anaemia which usually leads to increased mortality and therefore the possibility of a shorter duration of hospital stay as compared to the mild/moderate group. Also those with severe anaemia had their anaemia promptly corrected by blood transfusion whereas those with mild/moderate anaemia more likely had their blood levels built up with iron supplementation over a period of time and as such are more likely to have a longer duration of hospital stay.

A quarter of anaemic neonates were transfused in the present study. Similarly, a previous study

in Port Harcourt carried out over a decade ago documented blood transfusion rate of 20% [8] and in Sagamu [9] south-west Nigeria, 27.9% had blood transfusion. In contrast, 58.2% neonates in the United Kingdom [4] received blood transfusion. These discrepancies in the blood transfusion rates in the various centres could be attributable to the varying treatment protocol with regards to the cut-off values of severe anaemia warranting blood transfusion. Religious and cultural beliefs could also account for acceptance of blood transfusion and thus the blood transfusion rate.

Majority of neonates in the present study had top-up transfusion while the least was exchange blood transfusion (EBT). This was similarly observed in Zaria [10], northern Nigeria and Sagamu [9], south-west Nigeria. In contrast, a previous study in Port Harcourt [8] documented EBT as the commonest type of transfusion carried out in the neonatal unit, the reason being that neonatal jaundice was documented as the commonest indication of blood transfusion with EBT being the treatment of choice. In the present study however, the commonest indication of blood transfusion was severe anaemia.

Majority of anaemic neonates were discharged home with a mortality rate of 7.5%. More than 95% of anaemic neonates in the mild category were discharged home while the least discharged was in the severe group. It is worthy of note however that severe anaemia accounted for close to a quarter mortality while the least was observed in the mild group. This corroborates the analysis by Brabin et al. [32] who documented an increased mortality in children with severe anaemia. This is not surprising as Scott et al. [33] in their meta-analysis of 12,000 children from six African countries revealed that for every 1g/dL increase in haemoglobin, the risk of death falls by 24%. Banerjee et al. [4] also reported that neonates with lower haemoglobin at birth were significantly associated with the primary outcome of death.

5. CONCLUSION

The prevalence of anaemia amongst inborn neonates in the Rivers State University Teaching Hospital, Nigeria is high being 26.4%. Anaemia is commoner in males, babies delivered via Caesarean section and in the preterms. Probable sepsis, neonatal jaundice and prematurity were the commonest morbidities observed in anaemic neonates. Sociodemographic characteristics and

morbidity patterns of the neonates were not significantly associated with anaemia however there was significant difference in anaemic and non-anaemic neonates with regards to mothers with gestational diabetes. Probable sepsis and the duration of stay were significantly associated with the severity of anaemia. Mortality of anaemia amongst neonates was 7.5% with severe anaemia constituting the highest rate. There is therefore need to assess neonates for anaemia and treatment instituted promptly to prevent morbidity and mortality observed in this age group.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the authors.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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