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Original Research Article

Exploring the Association Between Maternal Severe Anemia and Early Neonatal Morbidity and Mortality

Article History:

Name of Author:
Dr Fariha Anjum[1], Dr. Sofia Shabbir[2] Dr. Mir Abdul Qadir [3], Tayyaba Siddique[4], Dr Amna Aslam[5], Dr Hina Rashed[6]

Affiliation: *[1]Consultant Gynecologist DHQ Hospital, Khanewal*
[2] Consultant OBG Family Hospital Havelian, Abbottabad
[3] Associate Prof Post Graduate Medical Institute, Quetta
[4] Consultant Gynecologist THQ Hospital, Wazirabad
[5]Demonstrator Anatomy Department CMH Kharian Medical College National University of Medical Sciences
[6]Demonstrator Anatomy Department CMH Kharian Medical College National University of Medical Sciences

Corresponding Author:
Dr Fariha Anjum

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Abstract: ***Background:*** Maternal anemia remains a major public health concern in developing countries and is strongly associated with adverse perinatal outcomes. Objective: To explore the association between maternal severe anemia and early neonatal morbidity and mortality. ***Methodology:*** This was a descriptive, cross-sectional study conducted at Multiple Tertiary Centers of Pakistan from March 2024 till December 2025 including 275 neonates born to mothers diagnosed with severe anemia during pregnancy. ***Results:*** The mean maternal hemoglobin was 6.1 ± 0.5 g/dL. Preterm delivery occurred in 34.9% of cases, while 44.0% of neonates had low birth weight (mean 2.1 ± 0.2 kg). The mean APGAR scores were 6.2 ± 1.3 at one minute and 8.1 ± 1.0 at five minutes. Resuscitation was required in 35.6% of neonates, and 45.8% required NICU admission. Overall, early neonatal morbidity was observed in 58.9%, with common complications including respiratory distress (30.5%), jaundice (33.8%), sepsis (24.4%), and prematurity-related problems (34.9%). Early neonatal mortality was 8.4%. Neonates born to mothers with hemoglobin levels of 5.0–5.9 g/dL showed significantly higher morbidity (77.8%) compared to those with levels of 6.0–6.9 g/dL (51.0%) ($p < 0.05$). ***Conclusion:*** Maternal severe anemia is significantly associated with increased early neonatal morbidity and mortality. Early identification and timely correction of anemia during pregnancy may substantially reduce preventable neonatal complications and improve survival outcomes.

Keywords: Maternal anemia, severe anemia, neonatal morbidity, neonatal mortality, low birth weight, prematurity

INTRODUCTION

Maternal anemia has been one of the most common and avoidable pregnancy complications across the globe but has been a major contributor to poor maternal and neonatal outcomes, especially in the low- and middle-income countries. The World Health Organization estimates that approximately forty percent of the pregnant women in the world are anaemic, and South Asians have a disproportionate number of these women because of nutritional deficiencies, infections, insufficient birth spacing, and inadequate antenatal care [1]. Hemoglobin below 11 g/dL is considered anemia in pregnancy, whereas hemoglobin below 7 g/dl is severe anemia, which is

a critical clinical condition significantly impairing the oxygen-carrying capacity of maternal hemoglobin. Declines in oxygen delivery result in a decrease in uteroplacental perfusion and chronic fetal hypoxia, which hurts fetal growth and survival. These modifications augment the hazard of intrauterine development constraint, prematurity, and low neonatal birth weight, all significant factors of early neonatal morbidity and mortality [2][3]. The physiological effects of severe anemia include impaired placental functioning and nutrient transfers, leading to low fetal reserves at birth. Newborns of women who are severely anemic often have a low Apgar score, respiratory distress, hypothermia, sepsis, and an increased neonatal intensive care unit admission [4][5]. Also, maternal complications like prolonged labor, postpartum haemorrhage, and delivery by operation have been added to the likelihood of birth asphyxia and perinatal compromise [6][7].

In addition to the short-term complications, low maternal iron stores have a direct impact on the iron status of infants, which predisposes the infants to early anemia, immunological and neurodevelopmental retardation. Researchers have seen that the risks of infection, feeding difficulties, and metabolic instability of newborn babies dropped to significantly lower rates in cases of mothers with severe anemia during the first week of life [8][9]. Evidence based on population also shows that severe maternal anemia is linked to two to four-fold higher rates of premature delivery, low birth weights, and sepsis among the neonates [10] [11]. Although this is a condition that can be greatly avoided by early identification and the use of supplements, severe maternal anemia has not been taken seriously in most institutions because of late antenatal checkups and lack of treatment adherence, despite the condition being mostly preventable. The effect of maternal anemia and poor care together increases the risk to the neonate significantly in a resource-limited healthcare system with minimal or no advanced neonatal support [12]. Besides, a large number of researches assesses anemia in the broad sense without singling out severe cases, restricting the ability to understand the real effect of anemia [13].

Objective

To explore the association between maternal severe anemia and early neonatal morbidity and mortality.

Methodology

This was a descriptive, cross-sectional study conducted at Multiple Tertiary Centers of Pakistan from March 2024 till December 2025, including 275 neonates born to mothers diagnosed with severe anemia during pregnancy.

Inclusion Criteria

- Mothers diagnosed with severe anemia (hemoglobin < 7 g/dL) during the third trimester or at delivery
- Singleton pregnancies
- Live-born neonates delivered at the study center
- Neonates assessed within the first 7 days of life
- Mothers willing to provide informed consent

Exclusion Criteria

- Mothers with mild or moderate anemia (Hb ≥ 7 g/dL)
- Multiple gestations (twins or higher order pregnancies)
- Major congenital anomalies
- Known chromosomal or genetic disorders
- Neonates with birth trauma unrelated to maternal anemia
- Incomplete maternal or neonatal records
- Mothers unwilling to participate

Data Collection

Data were collected prospectively using a structured, predesigned proforma to ensure standardized documentation of all variables. Maternal characteristics recorded included age, parity, socioeconomic status, booking status, gestational age at delivery, hemoglobin level, nutritional status, antenatal complications (such as preeclampsia, infections, or hemorrhage), and mode of delivery. Severe anemia was confirmed through laboratory hemoglobin estimation performed using automated hematology analyzers during admission or before delivery. Neonatal variables assessed included gender, birth weight, gestational maturity, APGAR scores at 1 and 5 minutes, need for immediate resuscitation, requirement for neonatal intensive care unit (NICU) admission, respiratory distress, neonatal sepsis, hypoglycemia, jaundice, prematurity-related complications, feeding difficulties, and duration of hospital stay. Early neonatal morbidity was defined as the presence of any clinical complication requiring medical treatment or NICU care within the first seven days of life. Early neonatal mortality was defined as death occurring within seven days after birth.

Statistical Analysis

Data were entered and analyzed using SPSS version 24.0. Quantitative variables such as maternal age, hemoglobin levels, birth weight, gestational age, and APGAR scores were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Associations between maternal severe anemia and neonatal morbidity or mortality were evaluated using the chi-square test for categorical variables and the independent t-test for continuous variables. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

The majority were aged 21–30 years (53.8%, n=148; mean age 25.8 ± 2.6 years), followed by 31–40 years (28.4%, n=78; 34.1 ± 2.5 years), while adolescents ≤20 years comprised 11.6% (19.2 ± 1.1 years) and only 6.2% were older than 40 years (41.8 ± 1.3 years). Nearly half were multigravida (49.5%, parity 2.8 ± 0.9), whereas 36.7% were primigravida and 13.8% were grand multiparous (5.6 ± 0.7). Most patients were unbooked (62.2%), reflecting limited antenatal follow-up. The mean gestational age at delivery was 35.9 ± 2.8 weeks, indicating a tendency toward earlier deliveries.

Table 1. Maternal Demographic and Obstetric Characteristics (N = 275)

Variable	Category	n (%)	Mean ± SD
Age (years)	≤20	32 (11.6)	19.2 ± 1.1
	21–30	148 (53.8)	25.8 ± 2.6
	31–40	78 (28.4)	34.1 ± 2.5
	>40	17 (6.2)	41.8 ± 1.3
Parity	Primigravida	101 (36.7)	1.0 ± 0.0
	Multigravida (2–4)	136 (49.5)	2.8 ± 0.9
	Grand multipara (≥5)	38 (13.8)	5.6 ± 0.7
Booking Status	Booked	104 (37.8)	1.0 ± 0.0
	Unbooked	171 (62.2)	2.0 ± 0.0
Gestational Age at Delivery (weeks)	Overall	275 (100)	35.9 ± 2.8
Mode of Delivery	Vaginal	165 (60.0)	1.0 ± 0.0
	Cesarean	110 (40.0)	2.0 ± 0.0

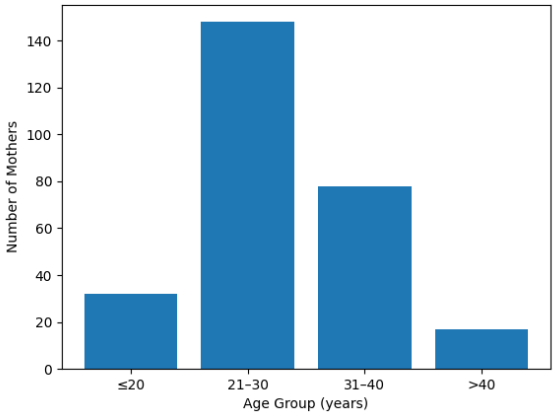

Figure 1: Maternal age distribution

Regarding hematological status, 70.5% of mothers had hemoglobin levels between 6.0–6.9 g/dL (mean 6.4 ± 0.2 g/dL), while 29.5% exhibited more critical levels of 5.0–5.9 g/dL (5.4 ± 0.3 g/dL), with an overall mean hemoglobin of 6.1 ± 0.5 g/dL. Antenatal complications were frequent, including maternal infections in 25.8%, preeclampsia in 22.5%, antepartum hemorrhage in 13.8%, and preterm labor in 34.9% of pregnancies. Additionally, clinical signs of nutritional deficiency were observed in over half of the mothers (51.6%).

Table 2. Maternal Hematological Profile and Antenatal Complications

Variable	Category	n (%)
Hemoglobin 5.0–5.9 g/dL	Severe	81 (29.5)
Hemoglobin 6.0–6.9 g/dL	Severe	194 (70.5)
Overall Hemoglobin	All mothers	275 (100)
Preeclampsia	Present	62 (22.5)
Antepartum hemorrhage	Present	38 (13.8)
Maternal infections	Present	71 (25.8)
Preterm labor	Present	96 (34.9)
Nutritional deficiency signs	Present	142 (51.6)

Among the 275 neonates, males constituted 53.5% and females 46.5%. The mean birth weight was 2.6 ± 0.5 kg, with 44.0% classified as low birth weight (2.1 ± 0.2 kg) and only 56.0% achieving normal weight (2.9 ± 0.3 kg). Preterm births accounted for 34.9% of deliveries with a mean gestational age of 34.1 ± 1.8 weeks, whereas term neonates averaged 38.4 ± 1.2 weeks. Immediate neonatal condition was suboptimal, with mean APGAR scores of 6.2 ± 1.3 at one minute and 8.1 ± 1.0 at five minutes.

Table 3. Neonatal Baseline Characteristics at Birth

Variable	Category	n (%)
Gender	Male	147 (53.5)
	Female	128 (46.5)
Birth Weight <2.5 kg	Low birth weight	121 (44.0)
Birth Weight ≥2.5 kg	Normal weight	154 (56.0)
Overall Birth Weight	All neonates	275 (100)
Gestational Age	Preterm	96 (34.9)
	Term	179 (65.1)
APGAR Score (1 minute)	All neonates	275 (100)
APGAR Score (5 minutes)	All neonates	275 (100)

Resuscitation was required in 35.6% of neonates, 40.7% required oxygen therapy, and nearly half (45.8%) necessitated NICU admission. Respiratory distress was observed in 30.5%, neonatal jaundice in 33.8%, prematurity-related complications in 34.9%, feeding difficulties in 26.9%, and sepsis in 24.4%, while hypoglycemia occurred in 18.9%. Hospital stay was prolonged in most cases, with 63.3% remaining hospitalized for more than three days (mean 6.3 ± 1.7 days), resulting in an overall average stay of 4.7 ± 2.1 days.

Table 4. Early Neonatal Morbidity and Clinical Course (First 7 Days)

Variable	Category	n (%)
Resuscitation required	Yes	98 (35.6)
Oxygen therapy	Required	112 (40.7)
NICU admission	Required	126 (45.8)
Respiratory distress	Present	84 (30.5)
Neonatal sepsis	Present	67 (24.4)
Hypoglycemia	Present	52 (18.9)
Neonatal jaundice	Present	93 (33.8)
Feeding difficulty	Present	74 (26.9)
Prematurity-related complications	Present	96 (34.9)
Hospital stay ≤3 days	Short stay	101 (36.7)
Hospital stay >3 days	Prolonged stay	174 (63.3)
Overall stay (days)	All neonates	275 (100)

Overall neonatal morbidity was present in 58.9% of cases, while 45.8% required NICU admission. Preterm delivery (34.9%) and low birth weight (44.0%; mean 2.1 ± 0.2 kg) were significantly associated with adverse outcomes. Early neonatal mortality occurred in 8.4% of neonates. Infants born to mothers with more severe hemoglobin levels (5.0–5.9 g/dL; mean 5.4 ± 0.3) demonstrated markedly higher morbidity (77.8%) compared to those with hemoglobin 6.0–6.9 g/dL (51.0%; mean 6.4 ± 0.2). All associations were statistically significant ($p \leq 0.004$).

Table 5. Association of Maternal Severe Anemia with Neonatal Morbidity and Mortality

Outcome Variable	Outcome Present n (%)	Outcome Absent n (%)	p-value
Any neonatal morbidity	162 (58.9)	113 (41.1)	0.001
NICU admission	126 (45.8)	149 (54.2)	0.001
Preterm birth	96 (34.9)	179 (65.1)	0.002
Low birth weight	121 (44.0)	154 (56.0)	0.001
Early neonatal survival	252 (91.6)	23 (8.4)	0.004
Hb 5.0–5.9 group morbidity	63 (77.8)	18 (22.2)	0.001
Hb 6.0–6.9 group morbidity	99 (51.0)	95 (49.0)	0.001

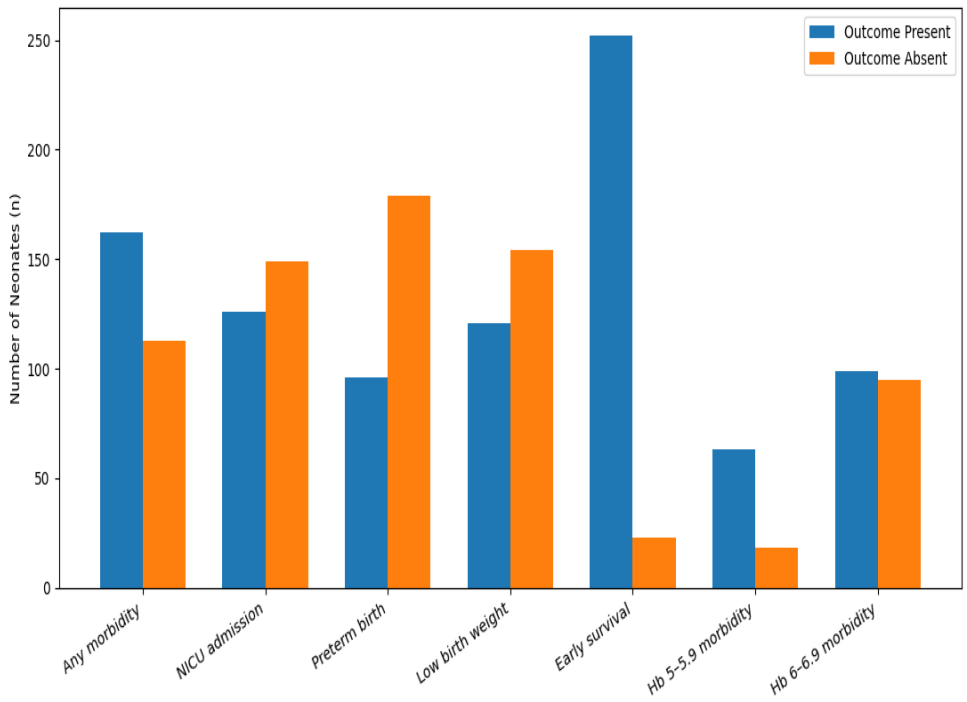

Figure 2. Distribution of Neonatal Morbidity and Mortality Outcomes According to Severity of Maternal Anemia

DISCUSSION

This paper has assessed 275 mother-neonate pairs and identified a high correlation of maternal severe anemia with unfavorable early neonatal outcomes. The majority of mothers were young (53.8% of whom aged 2130 years; mean 25.82.6 years), and 62.2% were un-booked, which means that they did not receive much prenatal care. The average hemoglobin level was severely low at 6.1 ± 0.5 g/dL, and 29.5 percent were found to be between 5.0g/dL and 5.9g/dL. Perinatal risk was further enhanced by the presence of antenatal problems like preterm labor (34.9%), infections (25.8%), and preeclampsia (22.5%) as well. Bad antenatal supervision and severe anemia have been associated with unfavourable outcomes in neonatal survival, as has been reported in earlier studies with similar demographic and clinical trends [15] [16]. Neonatal parameters were indicative of poor intrauterine growth, and the mean birth mass was 2.6 ± 0.5 kg; 44.0% of the infants were low birth weight (2.1 ± 0.2 kg), and 34.9% of the infants were preterm. Early adaptation was not optimal with reduced APGAR scores (6.2 ± 1.3 at one minute) and more than a third (35.6%) of them needed resuscitation. Past studies have also revealed prematurity, low birth weight, and birth asphyxia among the babies of anemic mothers, which are probably related to chronic fetal hypoxia [17] [18]. The morbidity of early neonatal workers was high, as NICU admission was 45.8, respiratory distress was 30.5, jaundice was 33.8, sepsis was 24.4, and the average length of stay was 4.7 + 2.1 days. General morbidity was at 58.9 percent of the neonates, and mortality was at 8.4 percent. Notably, morbidity was more severe (77.8) in infants of mothers with more severe hemoglobin (5.059 g/dl) than in those with hemoglobin levels of 6.06.9 g/dl (51.0), which was dependent on severity. Similar complications and mortality increases have been reported in other studies in the past [19][20]. All in all, these results affirm that maternal severe anemia subjects the unborn children to the high risks of preterm births, low birth weights, high-intensive care units, and early neonatal mortality. Because anemia is treatable and avoidable, screening early, iron supplementation, and proper antenatal care are developed as the critical measures to enhance survival of the neonates and prevent the complications that can be avoided.

Conclusion

It is concluded that maternal severe anemia is strongly associated with increased early neonatal morbidity and mortality, as demonstrated in this study of 275 mother–neonate pairs, where critically low maternal hemoglobin levels (mean 6.1 ± 0.5 g/dL) were linked with high rates of preterm birth (34.9%), low birth weight (44.0%; mean 2.1 ± 0.2 kg), NICU admission (45.8%), and overall neonatal complications (58.9%), while early neonatal mortality reached 8.4%. Notably, neonates born to mothers with more severe anemia (Hb 5.0–5.9 g/dL) experienced substantially higher morbidity (77.8%) compared to those with relatively higher levels (51.0%), indicating a clear severity-dependent relationship.

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