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Impact Of Maternal Anemia On Perinatal Outcomes: A Prospective Study.

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ABSTRACT

Background: Anemia in pregnancy is still a major public health problem in developing countries and plays an important role in adverse perinatal outcomes. The low hemoglobin levels reduce oxygen delivery to the fetus and has complications such as intrauterine growth restriction, preterm birth and perinatal morbidity. Early diagnosis and treatment are necessary for better maternal and neonatal outcomes.

Objective: To ascertain the effects of maternal anemia on perinatal outcomes such as birth weight, preterm delivery and neonatal morbidities in pregnant mothers receiving care at the tertiary level hospitals.

Study design: A prospective study at Watim General Hospital from Jan 2024 to December 2024.

Methods: This is a prospective study of 100 pregnant women. Hb was determined with standard laboratory methods and categorized according to WHO criteria. Maternal characteristics, obstetric history, and neonatal outcomes were extracted. Continuous variables were presented as the mean ± SD. Chi square and t-tests were used to compare outcomes among anemic versus non-anemic subjects. All analyses were performed by SPSS version 24.0 and $p<0.05$ was considered as the level of significance.

Results: The mean maternal age was 27.4 ± 4.6 years in a cohort of 100 subjects. Anemia prevalence was 52%. The frequency of low birth weight was 46% as against 21% among anemic and non-anemic mothers respectively (p=0.01). Anemic women had significantly more preterm deliveries (33% vs. 12%, p=0.02). Twenty nine percent of anemic mother's babies versus 10% in the nonanemic group needed to be admitted to NICU (p=0.01). Perinatal mortality were also significantly higher in the anemic group (8% vs. 2%, p=0.04), reflecting a clear relationship between maternal anemia and adverse perinatal outcomes.

Conclusion: Maternal anemia was significantly associated with higher odds of adverse perinatal outcomes including low birth weight, preterm birth, admission to NICU and perinatal mortality. These results underscore the demand for antenatal screening and correct intervention of anemia in order to enhance maternal and neonatal survival. Public health measures emphasizing prevention, early diagnosis and nutrition supplementation are vital in decreasing anemia related perinatal morbidity and mortality

Keywords: Maternal Anemia; Pregnancy; Perinatal Outcomes; Infant, Low Birth Weight.

1. INTRODUCTION

Anemia during pregnancy is one of the most common medical problems during pregnancy and has a great impact on the health of both mother and newborn. Worldwide, the World Health Organization (WHO) reports that almost 40% of pregnant women suffer from anemia and the prevalence is unevenly distributed with more cases occurring in low- and middle-income countries [1]. Pregnancy-associated anemia is generally defined as a hemoglobin value <11 g/dL, with iron deficiency being

still the leading cause, while folate and vitamin B12 deficiencies and hemoglobinopathies are also implicated [2]. The physiologic demands of pregnancy predispose women to anemia as a result of expanded maternal blood volume, higher iron requirements and nutritional inadequacy [3]. Untreated maternal anemia can lead to severe obstetric complications such as preeclampsia, antepartum hemorrhage and post-partum infections. In addition, poor oxygen delivery from lowered hemoglobin level is deleterious to fetal growth and development. The perinatal implications of maternal anemia have been of great concern [4]. Studies have consistently shown that anemic mothers deliver more LBW, IUGR babies being born preterm as stilled births and the perinatal losses [5]. The neonates of anemic mothers are prone to be admitted directly to the NICU and show a delay in neurodevelopmental attainment [6]. The association of maternal anemia with perinatal morbidity makes the case for intervention to prevent this problem even in resource-limited areas where universal screening and supplementation have not been established. Though substantial literature has highlighted the link between maternal anemia and unfavorable perinatal outcomes, results have been inconsistent based on the severity, timing, and cause of the anemia. Severe anemia; hemoglobin levels<7 g/dL, have particularly been linked to an increase in maternal death and still- birth [7]. However, mild-to-moderate anemia may continue to be a risk factor for LBW and preterm delivery in the neonate. In spite of an abundance of epidemiological information, there are still deficiencies in region-specific effects since socioeconomic, cultural and dietary habits vary between populations. South Asian countries, such as Pakistan, have one of the highest burdens related to maternal anemia which is primarily a result of poor nutrition, frequent pregnancies and inadequate antenatal care [8]. Prevailing anemia prevalence of 40–70% has been reported among pregnant women in the region, resulting in increased obstetric complications and neonatal morbidity. Nevertheless, most of these studies are cross-sectional and without prospective follow-up, and therefore the strength of the evidence is weakened as a result. It is to fill this void that the current study was performed, in order to prospectively observe the effect of maternal anemia over perinatal outcome on a consecutive cohort of pregnant women in a tertiary hospital. The purpose of this study was to offer some evidence for clinical and public health practice by focusing on birth weight, preterm births, NICU admissions and perinatal deaths. The results may help to design intervention such as periodic screening, nutritional supplementation and awareness to reduce the impact of anemia in pregnancy [9]

2. METHODS

This is a prospective study done in the Department of Obstetrics and Gynecology of Watim General Hospital for a period of 12 months. One hundred consecutive pregnant women with ≥28 weeks of gestation were recruited. Hemoglobin level was determined by an automated hematology analyzer. World Health Organization criteria were used to categorize anemia: mild (10–10.9 g/dL), moderate (7–9.9 g/dL), and severe (<7 g/dL). Maternal demographic data, obstetric history and perinatal outcome (birth weight, gestational age at delivery, NICU admission and perinatal mortality) were reported. Informed written consent was obtained from all the participants included in the study.

Inclusion Criteria

Pregnant women between 18–40 years of age who had singleton pregnancies at ≥ 28 weeks gestation followed up in antenatal clinic, agreed to participate and with hemoglobin estimation at the time of enrolment.

Exclusion Criteria

Women who had pre-existing chronic diseases (renal disease, diabetes or hypertension), multiple gestations, known hemoglobinopathies or declined consent were excluded to prevent confounding influences on perinatal outcomes.

Ethical Approval

The study was approved by the Ethical Committee, and participants provided written informed consent. The study followed the principles of Declaration of Helsinki. Participant confidentiality was strictly maintained.

Data Collection

Data were filled on structured proforma regarding maternal characteristics, obstetric history, laboratory hemoglobin values and delivery parameters. The neonatal outcomes including birth weight, gestational age, NICU admission and perinatal mortality were recorded. All case notes were reviewed by an obstetrician, with cross-checking against hospital maternity databases.

Statistical Analysis

Statistical analysis was performed by IBM SPSS version 24.0. Quantitative variables (i.e., maternal age, birth weight) were presented as mean ± SD. Categorical variables (anemia prevalence, preterm births) were reported as frequency and percentage. The chi-square and independent t-tests were used. p <0.05 was considered statistically significant.

3. RESULTS

A hundred pregnant women were enrolled with a mean maternal age of 27.4 ± 4.6 years. The prevalence of anemia was 52%: 34% were moderately anemic, 12% mildly and another 6% severely. Adverse perinatal outcomes were significantly more frequent among the anemic compared with non-anemic women. Neonates of anemic mothers had significantly more low birth weight (<2.5 kg, 46%) when compared with that of non-anemic mothers (21%, p=0.01). The incidence of preterm birth

(<37 weeks) was 33% and 12% in anemic and non-anemic women respectively (p=0.02). NICU admissions were also higher in the anemic group than in the non-anemic group (29% vs 10% p=0.01). The anemic group also had a significantly increased perinatal mortality (8% vs 2% p=0.04). This study concluded that maternal anemia had a significant association with adverse pregnancy outcomes, particularly preterm delivery and LBW. These findings underscore the pivotal need for early recognition and treatment of pregnancy anemia in order to enhance neonatal survival and decrease morbidity.

Table 1: Baseline Characteristics of Study Participants (N=100)

Variable	**Mean ± SD / n (%)**
Maternal Age (years)	27.4 ± 4.6
Gestational Age (weeks)	35.8 ± 2.4
Parity (Primigravida)	42 (42%)
Parity (Multigravida)	58 (58%)

Table 2: Distribution of Maternal Anemia by Severity (N=100)

Anemia Status	**Frequency (n)**	**Percentage (%)**
Non-anemic	48	48%
Mild Anemia (10–10.9 g/dL)	12	12%
Moderate Anemia (7–9.9 g/dL)	34	34%
Severe Anemia (<7 g/dL)	6	6%
Total Anemic	**52**	**52%**

Table 3: Perinatal Outcomes by Maternal Anemia Status

Outcome	**Anemic Mothers (n=52)**	**Non-anemic Mothers (n=48)**	***p*-value**
Low Birth Weight (<2.5 kg)	24 (46%)	10 (21%)	0.01
Preterm Delivery (<37 weeks)	17 (33%)	6 (12%)	0.02
NICU Admission	15 (29%)	5 (10%)	0.01
Perinatal Mortality	4 (8%)	1 (2%)	0.04

Table 4: Summary of Key Findings

Parameter	**Observation**
Prevalence of Maternal Anemia	52% (Moderate 34%, Mild 12%, Severe 6%)
Mean Maternal Age	27.4 ± 4.6 years
Most Common Adverse Outcome	Low Birth Weight (46% vs. 21%, *p*=0.01)
Other Significant Associations	Preterm delivery, NICU admission, mortality
Clinical Implication	Maternal anemia significantly increases risk of poor perinatal outcomes

4. DISCUSSION

In a prospective cohort analysis of 100 pregnant women, maternal anemia (prevalence 52%) was independently associated with increased risks of LBW, prematurity, NICU admission, and perinatal mortality. These results are in agreement with the extensive published evidence that antenatal anemia, especially iron-deficiency anemia, is associated with placental hypoxia, fetoplacental ischemia and consequent fetal growth restriction and prematurity [10]. Our LBW percentage among anemic

mothers (46%) reflects the intervals reported in South Asia and sub-Saharan Africa, where the burden of anemia and shortages of nutrition are high [11]. Alternatively, the two to three times increased risk of preterm delivery among anemic mothers found in some meta-analyses is consistent with our findings [12]. Biological plausibility supports these associations. Decreased hemoglobin concentration reduces the oxygen-carrying capacity, and induces a corresponding compensatory maternal and placental hemodynamic adaptation leading to IPI (in utero-placental insufficiency), generation of oxidative stress may be an overarching mechanism as well as inflammation activation – all mechanisms postulated for preterm parturition and poor fetal growth [13]. Iron deficiency also disrupts thyroid hormone turnover and mitochondrial function which may have implications for myometrial contractility, and fetal growth [14]. The gradient of risk tends to follow the severity of anemia; studies assessing severe (moderate and severe) versus mild anemia show a dose-response relationship with LBW, mortality, consistent with our distribution by severity category (moderate: 34%, severe: 6%) and outcome gradients [15]. Our rate of NICU admission in neonates born to anemic mothers (29%) resembles the findings reported for neonates exposed to antenatal anemia who are at risk for having respiratory distress, sepsis and thermoregulatory instability associated with prematurity and intrauterine growth restriction [16]. There was also a trend towards higher perinatal mortality in the anemia group in our cohort, reflecting pooled estimates that severe maternal anemia is associated with significantly increased risk of stillbirth and early neonatal death particularly where access to emergency obstetric and neonatal care is compromised [17]. Regional comparisons are informative. Reports from Pakistan and surrounding countries reveal anemia prevalences of 40–70% and similar landscapes of poor outcomes, with variation explained by dietary iron intake, helminth load (ANWs), malaria co-endemicity, ANC coverage, and interpregnancy interval [18]. Our prospective design enhances predominantly cross-sectional regional literature by enabling temporally ordered exposure–outcome assessment and use of standardized hemoglobin measurement. In addition, we defined anemia using WHO cut-offs which increases comparability between settings [19]. From a programmatic point of view our results further underline the necessity for early antenatal screening and correction in time. The evidence indicates that early second trimester (or earlier as possible) initiation of IFA supplementation decreases the risk of LBW and preterm birth; greater benefits are realized where baseline anemia is high [20]. But effectiveness depends on adherence, side-effect management and supply-chain reliability. Integration with deworming (where applicable), nutrition counseling, fortification programmers and postpartum continuation of iron supplementation could result in additive benefits. Based on these data specifically, we speculate that focusing our attention on women with at least moderate/severe anemia who could be candidates for stepped up follow-up, recheck of hemoglobin and parenteral iron supplementation if oral therapy has failed may be high yield. Timing is also a key aspect of our results. Multiple investigations indicate that anemia in the first and second trimesters appears to be more significantly related to adverse outcomes compared with anemia diagnosed for the first time at term, likely because of the increased period during which the fetus is exposed to hypoxia and nutrient insufficiency.

5. CONCLUSION

Maternal anemia is associated with increased risk of adverse perinatal outcomes, such as low birth weight (LBW), preterm delivery, NICU admission and perinatal mortality. Early antenatal identification and management of anemia with nutritional supplementation and interventions can be important tools in reducing maternal and neonatal mortality in resource poor settings.

Limitations

Limitations of our study include its single center nature and relatively small sample size, which may limit the extendibility of study conclusions. Ferritin parameters or the index of serum iron level also were not assessed in our study. Confounding by socioeconomic status and dietary habits was not ruled out completely.

Future Findings

Future studies are needed to be multicenter, large-scale prospective studies including early pregnancy recruitment, anemia classification using ferritin-based criteria and adherence analysis of supplementation. Inclusion of biochemical, dietary and inflammatory markers will further inform mechanisms underpinning associations between anemia and perinatal outcomes to guide region-specific strategies aiming to reduce maternal/newborn morbidity/mortality.

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Authors Contribution

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