ASSOCIATION OF LOW ANTENATAL HEMATOCRIT LEVEL WITH LOW BIRTH WEIGHT

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ABSTRACT

Background: The typical determinants of "low birth weight" are linked with critical biological, environmental & social circumstances that can occur before or during pregnancy. Nutritional elements, including a woman's weight prior to pregnancy and the amount of weight gained during pregnancy, are crucial in influencing the fetus birth weight.

Objectives: To determine the relationship between low antenatal hematocrit level with "low birth weight"**.**

Methods: A "retrospective Cohort Study" **at** Department of Pediatrics, PAF Hospital Mushaf, Sargodha**.** This study was managed from 10th June 2024 to 10th December 2024. A total of 200 newborns (100 exposed/ 100 non-exposed) were covered in the study. 100 sample size for Group A or low antenatal hematocrit group while 100 sample size for Group B or normal antenatal hematocrit level group. Low birth weight was noted from the two groups.

Results: Age range in this research was gestational age >36 weeks with mean age at of 38.300±1.24 weeks, mean mother age 28.950±2.73 years and mean birth weight was 2.775±0.31 kg in exposed group and mean age of 38.800±1.26 weeks, mean mother age 28.000±2.98 years and mean birth weight was 2.936±0.21 kg in non-exposed group. Low birth weight was 2.936±0.21 kg in non-exposed group. Low birth weight was observed in 23 (23%) patients in exposed group as compare to 5 (5%) patients in non-exposed group (P= 0.000, RR=4.6)

Conclusion: Our study showed that low antenatal hematocrit is related with low birth weight

Keywords: Newborns, Low antenatal hematocrit, low birth weight, Association

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INTRODUCTION

Anemia affects approximately 43% of pediatric population, 38% of expecting women and 29% women of child bearing age worldwide.[1] In under developed countries, the prevalence of anemia among expecting mothers range in 40-60%.[2,3] The "World Health Organization" (WHO) defines anemia as hemoglobin concentration of <11g/dl.[1] Maternal anemia is categorized as severe when Hemoglobin levels <7g/dl, moderate when in range of 7-9 g/dl and mild as 10-10.9 g/dl.[4] The causes of anemia during pregnancy are multi-variable. They may include nutritional insufficiency of iron, folic acid and mecobalamin.[1] Socioeconomic & lifestyle factors also play a key role like cultural and religious taboos.[3,5] Additional causes of anemia include parasitic infections and conditions related to inadequate dietary iron intake or malabsorption.[4] Iron deficiency anemia is most common cause of anemia in pregnancy, particularly in low-income regions.[2,4]

The primary perils for low birth weight are linked to critical biological, environmental & social circumstances

that occurs during or before pregnancy.[6] Nutritional factors like pre-pregnancy weight and weight gain during pregnancy, plays a key role in determining birth weight. Inadequate maternal caloric intake, often resulting from inadequate diet intake, leads to reduced absorption of essential micronutiernts like vitamin B12 and iron, which are critical for growth of the fetus.[7]

Even though the factors contributing to low birth weight are common, the exact pathology linking the maternal anemia to inadequate weight gain is not yet fully understood. There have been only a limited prospective cohort data that had explored the relationship between maternal anemia and low birth weight.[6]

Anemia during pregnancy can end up to preterm labor, intrauterine growth restriction (IUGR), decreased physical activity, immune system dysfunction and cardiac failure in the birth mother. Additionally, it can also result in low birth weight in newborns. As such, maternal anemia is considered one of the preventable causes of low birth weight. For this reason, I have planned to investigate the association between low antenatal hematocrit levels and low birth weight.

OBJECTIVE

To determine the relationship between low antenatal hematocrit level with "low birth weight"

METHOD

Our study is a retrospective cohort study conducted in the Department of Pediatrics at Pakistan Air Force Hospital Mushaf, Sargodha spanning from June 10, 2024 to December 10, 2024. The sample size was determined using the WHO calculator, with a confidence level of 95% and a power of 80%. The expected frequency of low birth weight was 12.5% in the group with low antenatal hematocrit levels, compared to 2.2% in the group with normal antenatal hematocrit levels.[7] the total sample size was divided into two groups. 100 sample sizw for Group A or low antenatal hematocrit level group while 100 sample size for Group B or antenantal hematocrit level group. Non-probability consecutive sampling technique was used. Inclusion criteria included newborn at gestational age >36weeks on LMP, neonates mother with low antenatal hematocrit as per operational definition was included in Group B or non-exposed group. Exclusion criteria included a history of maternal diabetes, maternal Thalassemia or sickle cell anemia, infants with major congenital abnormalities, and cases where consent was not obtained. A total of 200 newborns (100 exposed and 100 non-exposed) meeting the inclusion criteria from the Department of Pediatrics, PAF Hospital Mushaf were included in the study following approval fro the ethical committee. Basic demographic data, such as gestational age at birth, gender & maternal age, were collected and informed consent was obtained from each mother, ensuring confidentiality and confirming that there were no risks to the patient in participating. Data on low birth weight was recorded by the researcher using a specifically designed performa.

Data analysis was conducted using the IBM-SPSS Version 22 software.Frequency & percentages were calculated for categorical variables such as gender, family socioeconomic status, and low birth weight. Mean ± SD was used for quantitative variables such as age, maternal age and birth weight. The Chi-square test was applied to compare both the groups regarding low birth weight, with a p-value of ≤0.05 considered statistically significant. Relative risk reduction was also estimated. Stratification was done based on variables such as maternal age, family, socioeconomic status and gender to assess their impact on low birth weight. Post stratification analysis using the chi-square test was performed for the two groups, with p ≤0.05 deemed statistically significant, and relative risk was estimated.

RESULTS

Age range in this study was gestational age >36 weeks with mean age at 38.300±1.24 weeks, mean mother age 28.950±2.73 years and mean birth weight was 2.775±0.31 kg in exposed group & mean age of 38.800±1.26 weeks, mean mother age 28.000±2.98 years and mean birthweight was 2.936±0.21 kg in non exposed group. Male gender was dominant in both groups. Frequency and percentage of family socioeconomic status in both groups is also compared. Low birth weight was observed in 23 (23%) patients in exposed group as compare to 5 (5%) patients in non exposed group (P=0.0000, RR=4.6)

Stratification low birth weight in both groups with regard to age, mothers age, family socioeconomic status and gender. As shown in tables respectively.

Table No.1 Stratification Of Low Birth Weight With Respect To Age In Both Groups

For Age 36-39 weeks

Group	Low Birth Weight		P value
	Yes	No	
Exposed	14 (17.7%)	65 (82.3%)	0.012
Non-exposed	4 (5%)	75 (94.9%)	0.012

For Age >39 weeks

Group	**Low Birth Weight**		**P value**
	Yes	No	
Exposed	9 (42.9%)	12 (57.1%)	0.004
Non-exposed	1 (4.8%)	20 (95.2%)	0.004

Table No 2. Stratification of Low Birth Weight With respect To Mother Age in Both Groups For ≤30 Years

Group	Low Birth Weight		P Value
	Yes	No	
Exposed	8 (24.7%)	(75.3%)	0.000
Non-exposed	4 (5.1%)	(94.9%)	0.000
For >30 years			
Group	**Low Birth weight**		**P Value**
	Yes	No	
Exposed	5 (18.5%)	22 (81.5%)	0.138
Non-exposed	1 (4.5%)	21 (95.5%)	0.138

Table No.3 Stratification Of Low Birth Weight With Respect To Family Socioeconomic Status In Both Groups For Poor

Group	Low Birth Weight		P Value
	Yes	No	
Exposed	5 (39.5%)	3 (60.5%)	852
Non-exposed	4 (36.4%)	7 (63.6%)	852
For Middle			
Group	**Low Birth Weight**		**P Value**
	Yes	No	
Exposed	7 (12.3%)	50 (87.7%)	0.010
Non-exposed	1 (1.4%)	72 (98.6%)	0.010
For Rich			
Group	**Low Birth Weight**		**P Value**
	Yes	No	
Exposed	1 (20%)	4 (80%)	0.066
Non-exposed	0 (0%)	16 (100%)	0.066

DISCUSSION

Low Antenatal Hematocrit: it was defined as hematocrit level < 33% by lab investigation

"Low Birth Weight": It was defined as a newborn weight at delivery < 2500 gm measured on weighing machine

Hypothesis: It was hypothesized that low antenatal hematocrit is associated with "low birth weight"

Despite of an extensive search of numerous electronic databases, only cohort studies were found that explored the relationship between maternal anemia and inadequate birth weight.[8,9] More studies have investigated the connection among maternal anemia and insufficient birth weight, but research on low birth weight is less common. While the existing literature on this specific subject is limited, the main findings of this study indicate that maternal anemia is a s risk factor for insufficient birth weight[8] consequently these findings add valuable insight into this essential public health issue. Other analyses from the present study, using linear regression, further confirmed this association, as females with lower Hb levels were found to have infants with marked reduced birth weights. One study, however reported opposing findings[9], depicting no association among maternal anemia and insufficient birth weight. Additionally the prevalence of maternal anemia. in the other studies was approx 25%.[10-13]

The biological mechanism underlying the connection among maternal anemia and low birth weight are not completely revealed.[14,15] However earlier researches suggest that maternal anemia may lead to IUGR, which could affect birth weight[16,17] From physiological perspective around the mid of the second trimester, pregnant women experience an increase in plasma volume, leading to hypervolemia. If the number of red blood cells do not increase proportionally, hemodilution can occur resulting in maternal anemia.[18] This condition may impair placental angiogenesis,which in turn can cause fetal hypoxaemia. According to this theory, insufficient hemoglobin levels may reduce the amount of oxygen & nutrients available to the growing fetus due to inadequate placental transport. The potential mechanism for intrauterine growth restriction involves reduced blood flow to the uterus , increased vascular resistance, and restricted growth of the trophoblastic surface, which is responsible for transferring the maternal blood to the placenta. These factors can limit the gas exchange between the mother and fetus, further contributing to low birth weight.[18]

In this study, only one investigation clearly identified an association among maternal anemia and a birth weight of <3kg (8) as most studies focused on inadequate birth weight alone[19] without considering low birth weight.

Many studies have linked maternal anemia with low birth weight[1-3] while other studies only considered low birth weight as the result[20] making the relationship contentious. Although the adverse effects of low birth weight have been discussed for over 30 years, only a few studies have examined its relationship with various undesirable pregnancy outcomes typically focusing only on extreme birth weight ranges like low gestational age and large for gestational age.[19]

While there is some similarity between low birth weight and insufficient birth weight, the latter is generally considered less severe for the newborn. Nevertheless, the negative impact of insufficient birth weight should not be overlooked as it can affect cognitive development, growth of infant and raised morbidity & mortality in this age.[21]

The finding of our current study are significant because they provide a deeper perception of the significance of low birth weight for infant health. When correlating these results to prior research, factors like sample size, diagnostic basis for maternal anemia and the management of confounding variables must be cautiously considered.

The sample size in this study overstepped the minimal criteria required to calculate the effect size, while the data by one study [9] involved approx half the sample size of this investigation, which may explain the lack of observed association in their study, likely due to insufficient statistical power. In contrast another study [8] used a much larger sample of 290,622 pregnant women

and identified a strong association, supporting the results of this study.

To diagnose anemia the present study used a lab tests to define maternal anemia applying a Hb levels of <11 g/dl and reassuring it with a hematocrit (hct) <33% as recommended by WHO. Mesa et al.[9] used the same diagnostic criteria but they didn't confirm maternal anemia with a HCT measurement. Raisanen et al.[8] defined anemia solely using hospital chart info.

Sub classifying maternal anemia is crucial for proper monitoring and management. For example, diagnosing iron deficiency anemia may lead to appropriate iron supplementation. Iron deficiency anemia is increasingly recognized as a major reason of "maternal anemia" as many studies suggest ferritin deficiency is the sole driver of anemia in pregnant women.[22]

Regarding the severity of anemia participants in this study most commonly had mild anemia, a finding consistent with the results of other studies[23] In this study the effect measurement was adjusted for potential confounders as these variables could influence both the exposure (maternal anemia) and the outcome (low birth weight). This approach was also used by Raisanen et al.[9] did not adjust for confounders, which may explain the contrasting findings in their study

The conceptual structure adopted in this study recognized the multi-causal nature of the relationship among maternal anemia and low birth weight. Key confounders considered in the complete model included maternal age, family earning, urinary tract infections, parity, alcohol intake and body mass index during pregnancy.

Socio-economic variables can impact both the influence and the gestational outcome. Age of mother, especially at the extremes, is a classic con-founder because young women may not have full biological maturity for pregnancy, while old women are more likely to have co-existing conditions like maternal anemia.[24] low family income is another important factor, as pregnant women with limited resources often face poor living conditions that can negatively affect their health.[12]

Infections such as urinary tract infections can disrupt hemoglobin metabolism and contribute to maternal anemia and intrauterine growth restriction (IUGR), which in turn can affect birth weight.[25] parity is another significant factor as multiple pregnancies can increase the risk of both low birth weight and maternal anemia[24] alcohol intake during gestation can lead to inflammatory disruption that impairs intrauterine growth of fetus, adding to low birth weight.[26] Alcohol use can also reduce diet intake, further exacerbating maternal anemia[26] Females with poor nutritional status are more prone to both maternal anemia and children with low birth weights, likely due to insufficient intake of essential nutrients during gestation.[26]

CONCLUSION

Our study found that low antenatal hematocrit is linked to "low birth weight" making it a significant risk factor for the pregnancy outcome. Therefore, it is crucial to implement appropriate course of action to address this condition so as to reduce the incidence of "low birth weight" in infants.

ETHICAL APPROVAL

Ethical approval was granted by the Ethical Review Committee of PAF Hospital Mushaf, Sargodha, vide reference No MSF(H)/308/3/1/TRG dated: 01/06/2024.

CONFLICT OF INTEREST

Authors declare no conflict of interest.

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AUTHOR'S CONTRIBUTIONS

MS: Concept, design, manuscript writing, data collection
HBS: Manuscript writing, data analysi,
MKUR: Manuscript writing, data analysis
AS: Critical review, proof reading
SN: Manuscript writing, data collection
SK: Statistical analysis, Critical review
All Authors: Approval of the final version of the manuscript to be published

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