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ASSOCIATION BETWEEN MATERNAL ANEMIA AND LOW BIRTH WEIGHT AMONG NEWBORNS AT A TERTIARY CARE HOSPITAL

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Abstract

Background: *Maternal anemia is a prevalent health issue, often linked to low birth weight (LBW) in newborns. Some studies show a higher incidence of LBW among anemic mothers, others report insignificant difference. To resolve these inconsistencies, this study was conducted at a tertiary care hospital to explore the association between maternal anemia and LBW, accounting for various factors.*

Objective: *To determine association between maternal anemia and low birth weight among newborns at a tertiary care hospital.*

Duration: *Six months.*

Methodology: *After approval from the hospital's Ethical Review Committee, 100 pregnant women presenting at the Department of Obstetrics & Gynaecology, Combined Military Hospital (CMH), Sialkot, were enrolled in the study after informed consent. Hemoglobin levels were checked, and participants were divided into two groups: cases (anemic women) and controls (non-anemic women). They were followed until birth, with newborns classified as LBW based on the operational definition. Findings were provided by a senior consultant, and the resident recorded them to avoid bias. Confounding variables were controlled through exclusion, and treatment for anemic mothers and LBW infants followed department protocols.*

Results: *The study included 100 women with a mean maternal age of 28.18 ± 5.13 years, 62% aged 18-30, and 38% aged 31-40. The mean gestational age at delivery was 38.72 ± 1.22 weeks, with 71% delivered at 37 to 39 weeks. The mean BMI was 25.60 ± 3.97 kg/m², 60% classified were overweight. The mean number of previous pregnancies was 2.43 ± 1.03, 58% were having two or fewer children. Sixty-two percent lived in rural areas, and 56% of the newborns were boys. The baseline characteristics of the anemic and non-anemic groups were similar ($p > 0.05$). Among women with anemia, 68% had low birth weight (LBW) infants, compared to 40% in the non-anemic group, statistically significance of ($p = 0.005$). The odds ratio (OR) for LBW was 3.188 (95% CI: 1.403–7.241) in the anemic group indicating a threefold increased risk.*

Conclusion: *In conclusion, this study demonstrates that the women with anemia are more than three times at risk to deliver LBW infants compared to those without anemia. These findings emphasize the importance of addressing maternal anemia during pregnancy to reduce the risk of adverse outcomes.*

INTRODUCTION

Iron requirements during pregnancy are considerably higher than in the non-pregnant state, despite the brief reduction in iron loss due to the cessation of menstruation.[1] This increase in iron demand occurs for several reasons: to support the growing fetoplacental unit, to expand the maternal blood volume, and to replenish iron lost during delivery.[2] The overall need for iron escalates exponentially to accommodate these physiological changes.[3]

Anemia in pregnancy is a major public health issue, especially in low- and middle-income countries, and is linked to several adverse pregnancy outcomes.[3] Global statistics indicate that approximately 56% of pregnant women in these regions suffer from anemia. The highest prevalence of anemia during pregnancy is found in Sub-Saharan Africa (57%), followed by Southeast Asia (48%), and the lowest in South America (24.1%).[4,5] Low birth weight (LBW) is another critical concern, with a reported prevalence of 8.9% in Pakistan.[6] LBW is associated with increased risks of infant morbidity and mortality. Multiple factors i.e. biological, social, economic, environmental, and lifestyle may contribute to LBW, both prior to and during pregnancy.[7,8]

Several studies have highlighted the connection between maternal anemia and LBW. For instance, a study conducted by Habib et al. (2017) at Aga Khan University in Karachi, Pakistan, found a significantly higher rate of LBW in newborns born to anemic mothers compared to those without anemia (68.3% vs. 42.8%; p-value < 0.00001).[9] Similarly, Derbia et al. (2021) in Ethiopia reported a higher frequency of LBW in anemic mothers (34.6% vs. 10.8%; p-value = 0.01).[10]

These findings suggest that routine screening for anemia in pregnant women and its management could help reduce the risk of LBW. However, other studies present contradictory results. For example, Ratnam et al. (2021) in Malaysia reported a higher frequency of LBW in infants of anemic mothers (51.3% vs. 43.3%; p-value = 0.393), but the difference was not statistically significant.[11] In a study by Zafar et al. (2021) at Islamabad Medical and Dental College, Pakistan, a slightly lower frequency of LBW was found in anemic mothers compared to those without anemia (8.5% vs. 9.2%; p-value = 0.233), but again, the difference was not significant.[12]

Given the mixed evidence about the relationship between anemia and low birth weight (LBW), further exploration was necessary. This study contributes to this ongoing discussion and establishes a significant association between anemia and LBW. The findings may support the case for routine anemia screening during antenatal visits, an approach not yet widely adopted. Utilizing this study's results could enable early interventions for correction of anemia, and reduce healthcare costs associated with neonatal complications, including LBW.

METHODOLOGY

The cohort study was conducted at the Department of Obstetrics and Gynaecology, Combined Military Hospital (CMH), Sialkot, over a period of six months from 16-03-2024 to 15-09-2024 following approval of the research synopsis. The sample size consisted of 100 participants, divided equally into two groups, 50 women with maternal anemia and 50 without anemia. The sample size was calculated with 80% power of the test and a 5% level of significance, considering the expected frequency of low birth weight (LBW) in neonates to be 68.3% in mothers with anemia and 42.8% in those without anemia.[9] Non-probability consecutive sampling was used for participant selection.

Maternal anemia is defined as a hemoglobin level of 11 g/dL or less during the third trimester, and low birth weight was defined as a birth weight of less than 2500 grams. [13] Pregnant women aged between 18-40 years with a gestational age of 37 weeks or more, based on dating scans, and with complete medical records from the third trimester until delivery, were included in the study. Women with twin pregnancies, severe illness, hypertension, exposure to environmental pollutants, drug abuse, or any infections of reproductive organs, as well as those experiencing domestic violence, were excluded from the study to avoid confounding factors.

After obtaining informed written consent, participants underwent routine check-ups at CMH, Sialkot, where their hemoglobin levels were measured using standard laboratory procedures. Those with hemoglobin levels of ≤11 g/dL were categorized as the anemic group, while women with hemoglobin levels >11 g/dL were categorized as the

non-anemic group. Both groups were followed up until delivery, and newborns were classified as LBW if their birth weight was below 2500 grams. The findings were documented by a senior consultant, and a resident recorded the results to minimize bias in interpretation.

Data analysis was performed using SPSS version 27. Numerical variables such as maternal age, gestational age, BMI, and parity were expressed as mean ± standard deviation (SD). Categorical variables like parity, residence, gender of newborn, and LBW were presented as frequencies and percentages. A chi-square test was applied to compare the frequency of LBW between the anemic and non-anemic groups. Relative risk was calculated to determine association between maternal anemia and LBW. Stratification was done based on maternal age, BMI, gestational age, parity, residence, and gender of the newborn to control for effect modifiers. The results were considered statistically significant if the p-value was ≤0.05.

RESULTS

The study sample consisted of 100 women, with a mean maternal age of 28.18 ± 5.13 years. Among these participants, 62% were between the ages of 18 and 30 years, while 38% were aged between 31 and 40 years. The mean gestational age at delivery was 38.72 ± 1.22 weeks, with 71% of women were between 37 and 39 weeks, and 29% delivered at or beyond 39 weeks. The mean maternal body mass index (BMI) was 25.60 ± 3.97 kg/m², with 60% of the women were overweight and 40% had normal BMI. Regarding parity, the mean number of previous pregnancies was 2.43 ± 1.03, with 58% had two or fewer children, while 42% had more than two children. In terms of residential location, 62% of the participants lived in rural areas, while 38% resided in urban areas. Regarding the gender distribution of the newborns, 56% were boys and 44% were girls (Table 1.0).

The baseline characteristics of the anemic group were comparable to those of the non-anemic group across all variables were insignificant with p-value> 0.05 (Table 2.0).

The frequency of LBW between anemic and non-anemic a significant difference of 68.0% vs. 40.0% with a p-value of 0.005 (Table 3.0). The odds ratio (OR) for LBW in anemic group compared to non-anemic group was 3.188 (95% CI: 1.403–7.241) suggesting the occurrence LBW 3 times more likely in anemic mothers than non-anemic mothers (Table4.0).

The stratification of the low birth weight (LBW) frequency and odds ratios between the two groups, based on various maternal characteristics, consistently revealed a higher frequency of LBW newborns in the anemic group. However, due to the relatively small sample size, statistical significance and a strong correlation were not observed across all subgroups (Table 5.0.

Table 1.0 Baseline Characteristics of Study Population

Characteristics	Study Sample n=100	Mean ± SD
Maternal Age (years)		28.18±5.13
• **18-30 years**	62 (62.0%)	
• **31-40 years**	38 (38.0%)	
Gestational Age (weeks)		38.72±1.22
• **37-39 weeks**	71 (71.0%)	
• **≥39 weeks**	29 (29.0%)	
Maternal BMI (Kg/m²)		25.60±3.97
• **Normal Weight**	40 (40.0%)	
• **Overweight / Obese**	60 (60.0%)	
Parity		2.43±1.034
• **≤2**	58 (58.0%)	
• **>2**	42 (42.0%)	

Residence		-
• Rural	62 (62.0%)	
• Urban	38 (38.0%)	
Gender of Newborn		-
• Boy	56 (56.0%)	
• Girl	44 (44.0%)	

Table 2.0 Baseline Characteristics of Each Group

Characteristics	Anemic Women n=50	Non-Anemic Women n=50	p-value
Maternal Age (years)	28.45±5.12	27.92±5.17	
• 18-30 years	32 (64.0%)	31 (62.0%)	0.836
• 31-40 years	18 (36.0%)	19 (38.0%)	
Gestational Age (weeks)	38.57±1.12	38.86±1.30	
• 37-39 weeks	37 (74.0%)	34 (68.0%)	0.509
• ≥39 weeks	13 (26.0%)	16 (32.0%)	
Maternal BMI (Kg/m^2)	25.70±4.05	25.50±3.93	
• Normal Weight	20 (40.0%)	21 (42.0%)	0.839
• Overweight / Obese	30 (60.0%)	29 (58.0%)	
Parity	2.47±1.02	2.39±1.06	
• ≤2	30 (60.0%)	28 (56.0%)	0.685
• >2	20 (40.0%)	22 (44.0%)	
Residence			
• Rural	28 (56.0%)	34 (68.0%)	0.216
• Urban	22 (44.0%)	16 (32.0%)	
Gender of Newborn			
• Boy	26 (52.0%)	30 (60.0%)	0.420
• Girl	24 (48.0%)	20 (40.0%)	

*Independent sample t-test, ** Chi square test, taking p-value≤0.05 as significant

Table 3.0 Comparison of LBW between anemic and Non-Anemic Women & Risk Estimate

	Anemic Women (n=50) n (%)	Non-Anemic Women n (%)	P-value	Odds Ratio
Low Birth Weight (<2500g)				
• Yes	34 (68.0%)	20 (40.0%)	0.005	3.188
• No	16 (32.0%)	30 (60.0%)		

Chi square test, taking p-value≤0.05 as significant

Table 5.0 Comparison of Frequency of LBW between the Groups and Relative Risk Stratified for Various Sub Groups

Subgroups	Low Birth Weight		P-value	Odds Ratio
	Anemic Women (n=50) n (%)	Non-Anemic Women (n=50) n (%)		
Maternal Age (years)				
• 18-30 years	22/32 (68.8%)	11/31 (35.5%)	0.008	4.000 (1.401-11.417)
• 31-40 years	12/18 (66.7%)	9/19 (47.7%)	0.236	2.222 (0.587-8.410)
Gestational Age (weeks)				
• 37-39 weeks	26/37 (70.3%)	14/34 (41.2%)	0.014	3.377 (1.265-9.011)
• ≥39 weeks	8/13 (61.5%)	6/16 (43.8%)	0.198	2.667 (0.591-12.042)
Maternal BMI (Kg/m^2)				
• Normal Weight	12/20 (60.0%)	9/21 (42.9%)	0.272	2.000 (0.577-6.938)
• Overweight / Obese	22/30 (73.3%)	11/29 (37.9%)	0.006	4.500 (1.493-13.564)
Parity				
• ≤2	19/30 (63.3%)	8/28 (28.6%)	0.008	4.318 (1.429-13.053)
• >2	15/20 (75.0%)	12/22 (54.5%)	0.167	2.500 (0.671-9.310)
Residence				
• Rural	20/28 (71.4%)	12/34 (35.3%)	0.005	4.583 (1.556-13.500)
• Urban	14/22 (63.6%)	8/16 (50.0%)	0.401	1.750 (0.472-6.483)
Gender of Newborn				
• Boy	18/26 (69.2%)	14/30 (46.7%)	0.089	2.571 (0.857-7.718)
• Girl	16/24 (66.7%)	6/20 (30.0%)	0.015	4.667 (1.299-16.761)

Chi square test, taking p-value≤0.05 as significant

DISCUSSION

Maternal anemia is a significant global health problem, often linked to adverse pregnancy outcomes, including low birth weight (LBW) in newborns.[14,15] While several studies have reported a higher frequency of LBW among anemic mothers, others have found insignificant differences, suggesting conflicting results in the literature. This disparity may arise from variations in study design, sample size, and population characteristics.[9,12] To address these inconsistencies, this study was planned to investigate the association between maternal anemia and LBW at a tertiary care hospital. By focusing on a well-defined cohort and examining various maternal factors, the study aims to provide clearer insights into this critical issue.

The mean age of the participants in this study was 28.18±5.13 years. Among these participants, 62% were between the ages of 18 and 30 years, while 38% were aged between 31 and 40 years. Previously mean age reported in similar studies was 24.07±5.09 years and 22.69±3.37 years by Bhaskar et al. (2015) in Nepal and Hadia et al. (2021) in India respectively.[16,17] Habib et al. (2021) reported that 24.1% participants were of age <20 years, 50.9% were in age group of 20-30 years and remaining 25% had age of > 30 years. The mean gestational age at delivery was 38.72±1.22 weeks.[9] The mean BMI in our study was 25.60±3.97 while, Bhaskar et al. (2015) reported BMI of <18.5 and <25.0 in 16.5% and 64.15% participants respectively.[15]

Regarding the parity, 58% of the women were having two or fewer children, while 42% had more than two children. This is similar to Deriba et al. (2021) where 44.5% were primipara and 55.5% multipara.[10] In contrast Bhaskar et al. (2105) reported that 93%

participants had one child.[15] In our study, majority 62% of the women came from rural areas, while 38% were from urban. While Hadia et al. (2021) reported that majority 73% of the participants belonged to rural area.[16] In the index study, newborns 56% were boys and 44% were girls. The baseline characteristics of the anemic group were comparable to those of the non-anemic group across all variables, indicating insignificant differences between the two groups (p-value>0.05).

The comparison of birth weight <2500g between anemic and non-anemic women showed that 68% in anemic group and only 40% in non-anemic group experienced LBW. This difference was statistically significant, with a p-value of 0.005. The odds ratio (OR) of 3.188 (95% CI: 1.403–7.241) indicated that women with maternal anemia are more than 3 times as likely to have a low birth weight baby compared to those without anemia.

Similarly, in studies by Habib et al. and Deriba et al. frequency of LBW infants was reported as 68.3% vs. 42.8% (p-value<0.001) and 34.6% vs. 10.8% (p-value=0.001) AOR 2.34 (1.21-4.53) in anemic and non-anemic mothers, respectively.[9,10] In contrast, Ratnam et al. (2021) reported high frequency of LBW infants in anemic women than non-anemic women and results were not significant (51.3% vs.43.3%; p-value=0.393).[11] Moreover, inverse findings were given by Zafar et al. (2021) where frequency of LBW infants was insignificantly less in anemic women than non-anemic women (8.5% vs. 9.2%; p-value=0.233).[12] Figueiredo et al. (2019) reported that women with maternal anemia had a higher risk of delivering infants with birth weights under 3000 g compared to those without anemia (crude RR = 1.36; 95% CI: 1.06–1.76).[18] Hence the higher frequency of LBW in the anemic group emphasizes the importance of addressing maternal anemia during pregnancy to reduce the risk of neonatal outcomes such as LBW and its consequences, particularly in vulnerable populations.

CONCLUSION

The study demonstrates that the women with anemia are more than three times at risk to deliver LBW infants compared to those without anemia. These findings emphasize the importance of addressing maternal anemia during pregnancy to reduce the risk of adverse outcomes.

LIMITATIONS & RECOMMENDATIONS

This study's strengths include its focused investigation of the relationship between maternal anemia and low birth weight (LBW) in a well-defined cohort from a tertiary care hospital, providing robust statistical evidence of a significant association. However, its limitations include being conducted at a single hospital, which may limit generalizability, and its cross-sectional design, which restricts causal inferences. Additionally, variations in regional dietary practices, healthcare access, and socioeconomic factors could affect the broader applicability of the findings. Future research should aim for multi-center studies with larger sample sizes and longitudinal follow-ups to better understand causal pathways. Investigating the effectiveness of anemia interventions in reducing LBW would further inform maternal healthcare policies.

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Authors Contribution

Author 1

Substantial contributions to study design, acquisition of data Analysis & Interpretation of Data, Manuscript writing Has given final approval of the version to be published Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

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Has given final approval of the version to be published
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