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Association between Maternal Hemoglobin and Neonatal Birth Weight: A Hospital-Based Study

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ABSTRACT

Background: Maternal anemia is common in pregnancy and may adversely affect fetal growth and birth weight. This study assessed its association with neonatal birth weight. **Objective:** To assess the association between maternal hemoglobin status at delivery and neonatal birth weight among hospital deliveries in Sahiwal. **Study Design:** Cross-sectional study. **Settings:** Departments of Biochemistry and Gynecology & Obstetrics, Sahiwal Medical College, Sahiwal Pakistan. **Duration:** January to June 2025. **Methods:** Among 170 postpartum women enrolled using a purposive sampling technique after obtaining written informed consent. Hemoglobin levels of mothers and neonatal birth weight were recorded using a standardized pro forma at birth. Frequencies and percentages were used to summarize qualitative variables, and means ± standard deviations were reported for quantitative variables in SPSS. **Results:** The mean maternal age was 29.3 ± 5.5 years. Mean APGAR scores at one and five minutes were 6.5 ± 1.9 and 6.9 ± 2.9, respectively. Maternal anemia was present in 85.3% of participants, and low birth weight occurred in 24.1% of neonates. The available grouped analyses did not provide statistically conclusive evidence of an association between maternal anemia status and neonatal birth weight. **Conclusion:** Maternal anemia was highly prevalent. The available grouped analysis did not provide statistically conclusive evidence of an association between maternal anemia at delivery and neonatal birth weight. Findings regarding gestational duration should be interpreted only after verification of the eligibility criteria and source data.

Keywords: *Maternal anemia, Hemoglobin concentration, Birth weight, Pregnancy, Pakistan.*

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INTRODUCTION

Maternal anemia and low birth weight (LBW) have been widely reported to be closely associated, as demonstrated by numerous cohort and cross-sectional studies conducted across different regions of the world.[1] A mother having a concentration of less than 11 g/dl during pregnancy is considered anemic,[2,3] the impact of which varies based on gestational period and may significantly influence fetal growth and survival.[4]

The rate of anemia in women varies greatly between among developed and underdeveloped countries ranging from 9-51% for developed, and 44-81% in underdeveloped countries such as Sudan, India, Bangladesh, and Pakistan.[5] WHO defines low birth weight as less than 2500 grams at birth. Maternal anemia, especially during gestation, can lead to poor outcomes such as LBW due to compromised fetal oxygenation and nutrient supply.[6]

The commonest reasons for pregnancy-related anemia in low-middle income countries, which also share a major portion of global disease burden, are iron deficiency anemia. The literature reports that 52% of pregnant women have low iron levels and 25.7% have iron-deficiency anemia.[7] As per 2019 reports by the World Bank, 10.04% babies are born with low birth weight, and 44% of mothers have anemia,[8] while the WHO Eastern Mediterranean Regional Office states that more than 20% women in Pakistan are affected by anemia.

Physiological changes during pregnancy, including an increase in plasma volume relative to red blood cells, lead to a decrease in hemoglobin levels. When combined with nutritional deficiencies, it can impair blood and oxygen flow to the baby, leading to low birth weight and various adverse outcomes.[9]

This study was designed to assess the association between maternal hemoglobin status at delivery and neonatal birth weight at a tertiary care hospital in Sahiwal.

METHODS

Sahiwal Medical College Institutional Review Board provided ethical approval (Reference No. 273/IRB/SLMC/SWL) on 18 January 2025. Departments of Biochemistry and Gynecology & Obstetrics at Sahiwal Medical College and Teaching Hospital served as the study site for this cross-sectional study conducted from January 1 to June 30, 2025. The sampling technique employed was a non-probability purposive sampling technique. Sample size was based on the prevalence of 26.7% for low birth weight among anemic women,[10] with 95% confidence interval and 80% power, using the OpenEpi sample size calculator. A total of 170 eligible participants were enrolled due to time and resource limitations.

Only mothers with hemoglobin <11 g/dL and gestational age 37–42 weeks were included; however, the results include 25 non-anemic women and report an overall mean gestational age below 37 weeks were included in the study.

Information about mothers was collected on their age, number of births, last menstrual period, gestational age, previous iron intake, and medical history, gathered through interviews and verified against antenatal records after obtaining informed consent. Additionally, delivery mode and the mother's hemoglobin concentration at delivery, along with birth weight and APGAR scores for newborns at 1 and 5 minutes, were captured from labor room records. For analysis purposes, this data was then entered into a secure electronic database

All collected data were entered into a standardized pro forma, cross-checked for accuracy and completeness, and subsequently entered into a secure electronic database for statistical analysis.

Data were analyzed in SPSS version 23. Continuous variables were summarized using mean ± standard deviation when appropriate, and categorical variables using frequencies and percentages. Because the study title and objective concern maternal hemoglobin and birth weight as continuous variables, the primary revised analysis should include a scatterplot, assessment of linearity and outliers, Pearson or Spearman correlation as appropriate, and multivariable linear regression with birth weight (g) as the dependent variable and hemoglobin (g/dL) as the main predictor. Correlation coefficients, regression coefficients, exact p-values and 95% confidence intervals cannot be validly added from summary tables alone and require the cleaned participant-level dataset.

For secondary grouped comparisons, Welch's t-test should be used when variances are unequal; markedly skewed variables should be analyzed using the Mann–Whitney U test. Sparse contingency tables should be assessed using Fisher's exact or an exact/Monte Carlo test. Effect measures for low birth weight (risk ratio, prevalence ratio or odds ratio) should be reported with 95% confidence intervals. The comparison of mean hemoglobin between groups defined by the hemoglobin threshold should not be interpreted inferentially.

RESULTS

Baseline characteristics are shown in Table 1.

Caesarean section was the mode of delivery in 70% of cases. Prior iron supplementation was reported by 51.8% of participants, while chronic illness was documented in only 1.8%. Maternal anemia was observed in 85.3% of women. Low birth weight was recorded in 24.1% of newborns.

Table 1: Baseline characteristics of study participants (N=170)

Parameters	Mean	SD
Age (years)	29.3	5.5
Marriage (years)	7.1	6.4
Maternal Weight (kg)	67.4	13.4
BMI (kg/m2)	26.9	3.01
Period Gestation	36.3	2.2
Hemoglobin at delivery	10.1	6.9
APGAR Score 1-min	6.5	1.9
APGAR Score 5-min	6.9	2.9
Qualitative Parameters	***n***	***%***
Gravida 1 – 3	85	54.9
Gravida 4 – 5	106	68.4
Gravida 6 – 8	86	55.5
Para 0	19	12.6
Para 1 – 3	104	68.8
Para 4 – 5	23	15.2
Para 6 – 7	7	4.6
Miscarriages 1 - 3	30	20.8
Mode Delivery: Caesarean section	119	70
Mode Delivery: SVD	51	30
Previous History of Iron Intake	88	51.8
Chronic Illness	3	1.8
Anemia	145	85.3
Low Birth Weight	41	24.1

The comparison of maternal and neonatal parameters between anemic and non-anemic participants is presented in Table 2. Women with anemia had a mean age of 29.3 ± 5.5 years, a mean APGAR score at 1 minute of 6.6 ± 2.0, and a mean APGAR score at 5 minutes of 6.9 ± 2.8. In comparison, non-anemic women had a mean age of 30.1 ± 6.1 years, a mean APGAR score of 6.6 ± 1.9 at 1 minute and 7.1 ± 2.7 at 5 minutes.

Hemoglobin values may be described within anemic and non-anemic groups, but the p-value comparing hemoglobin between groups defined by the hemoglobin threshold has been removed from interpretation because this comparison is circular. Other continuous-group comparisons require verification of distributional assumptions, outliers and variance equality, with effect estimates and 95% confidence intervals.

Table 2: Comparison of maternal and neonatal parameters between anemic and non-anemic groups

Parameters	Anemic (n=145)	Anemic (n=145)	Non-Anemic (n=25)	Non-Anemic (n=25)	p-value
Parameters	**Mean**	**SD**	**Mean**	**SD**	**p-value**
Age (years)	29.3	5.5	30.1	6.1	0.48
Marriage (years)	7.3	6.8	6.5	4.1	0.60
Maternal Weight (kg)	67.3	14.0	68.6	10.5	0.66
BMI (kg/m2)	27.2	2.9	25.8	3.5	0.06
Period Gestation	36.2	2.2	37.3	1.9	0.02*
Hemoglobin at delivery	9.2	1.0	15.2	17.5	<0.01*
Baby Birth Weight (kg)	2.5	0.4	2.6	0.4	0.45
APGAR Score 1-min	6.6	2.0	6.6	1.9	0.95
APGAR Score 5-min	6.9	2.8	7.1	2.7	0.73
*p<0.05 was considered statistically significant using independent sample t-test	*p<0.05 was considered statistically significant using independent sample t-test	*p<0.05 was considered statistically significant using independent sample t-test	*p<0.05 was considered statistically significant using independent sample t-test	*p<0.05 was considered statistically significant using independent sample t-test	*p<0.05 was considered statistically significant using independent sample t-test

Table 3 presents grouped associations.

Table 3: Association of maternal anemia with birth weight and other variables

Variables		Anemia				p-value
		No (n)	No (%)	Yes (n)	Yes (%)	
Low Birth Weight	No	20	80.0	109	75.2	0.60
Low Birth Weight	Yes	5	20.0	36	24.8	0.60
Gravida	1 – 3	12	52.2	73	55.3	0.51
Gravida	4 – 5	10	43.5	45	34.1	0.51
Gravida	6 – 8	1	4.3	14	10.6	0.51
para	0	2	9.1	17	13.2	0.73
para	1 – 3	17	77.3	87	67.4	0.73
para	4 – 5	2	9.1	21	16.3	0.73
para	6 - 7	1	4.5	4	3.1	0.73
Miscarriage	No	15	71.4	99	80.5	0.34
Miscarriage	Yes	6	28.6	24	19.5	0.34
Previous History of Iron Intake	Yes	16	64.0	72	49.7	0.18
Previous History of Iron Intake	No	9	36.0	73	50.3	0.18
Chronic Illness	Yes	0	0.0	3	2.1	0.46
Chronic Illness	No	25	100.0	142	97.9	0.46
Mode Delivery	Caesarean section	18	72.0	101	69.7	0.81
Mode Delivery	SVD	7	28.0	44	30.3	0.81
*p<0.05 was considered statistically significant using Pearson Chi Square test	*p<0.05 was considered statistically significant using Pearson Chi Square test	*p<0.05 was considered statistically significant using Pearson Chi Square test	*p<0.05 was considered statistically significant using Pearson Chi Square test	*p<0.05 was considered statistically significant using Pearson Chi Square test	*p<0.05 was considered statistically significant using Pearson Chi Square test	*p<0.05 was considered statistically significant using Pearson Chi Square test

DISCUSSION

The study identified a high proportion of maternal anemia at delivery; however, the currently available grouped analyses and internally inconsistent descriptive data do not permit a definitive conclusion regarding the continuous relationship between maternal hemoglobin and neonatal birth weight. The gestational-age finding should not be interpreted biologically until the eligibility criteria and source data have been verified.

The prevalence of maternal anemia in this study exceeds rates reported in several earlier studies (48–58%) conducted in comparable settings.[11,12] This difference could be due to differences in nutrition levels, types of antenatal care used, and health factors across different areas. The shorter pregnancy time among women with anemia matches other findings that show a link between anemia in mothers and shorter pregnancy or early birth. Low hemoglobin levels may cause problems, combined with poor oxygen transport and placental function, which could lead to labor.[13]

The available analysis did not provide statistically conclusive evidence of an association between maternal anemia status and low birth weight. This should not be interpreted as proof of no association because the non-anemic group was small, the groups were imbalanced, confidence intervals were not reported, and the row-level data require audit.

Recent studies have shown that maternal hemoglobin concentration at both extremes (high or low) is associated with adverse outcomes. The timing of hemoglobin level checks, particularly during the last few months of pregnancy, may partly explain why different studies have found different results. Thus, these variations across studies highlight the importance of considering anemia severity, timing, and iron status when exploring relationships between maternal hemoglobin and neonatal outcomes.[16-19]

No conclusion should be drawn that maternal anemia affects gestational duration more than neonatal outcomes until the inclusion criteria, gestational-age data and potential confounders have been verified and analyzed in an adjusted model.

CONCLUSION

Maternal anemia was common in this hospital sample. The study did not provide statistically conclusive evidence of an association between maternal anemia at delivery and neonatal birth weight; clinically important effects may still be compatible with the data. A definitive conclusion requires a cleaned participant-level dataset, continuous correlation and adjusted regression analyses, and reporting of effect estimates with 95% confidence intervals.

LIMITATIONS

The study is limited by its single-center cross-sectional design, small and imbalanced comparison groups, hemoglobin measurement only at delivery, unmeasured confounding and the absence of reported effect estimates with confidence intervals.

SUGGESTIONS / RECOMMENDATIONS

More multicenter researches using bigger sample sizes are advised to further assess the relationship between maternal hemoglobin level and the birth weight of the infant. There would be a better comprehension of the timing and extent of anemia on fetal growth and birth results by longitudinal studies that measure hemoglobin levels in each trimester of pregnancy. Other areas that should be considered in future studies are biochemical indicators of iron status, nutritional status, socioeconomic factors and prenatal care practices so as to control any confounding factors perceptions. It is also suggested to strengthen the routine antenatal screening, early diagnosis, nutritional counselling and timely treatment of anemia in pregnancy to enhance the outcomes of both the mother and the newborn.

CONFLICT OF INTEREST / DISCLOSURE

The authors indicate that they have no conflict of interest.

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REFERENCES

1. Figueiredo AC, Gomes-Filho IS, Silva RB, Pereira PPS, Da Mata FAF, Lyrio AO, et al. Maternal Anemia and Low Birth Weight: A Systematic Review and Meta-Analysis. Nutrients. 2018 May;10(5):601.
2. Cunningham FG, Leveno KJ, Bloom SL, Hauth JC, Gilstrap LC, Wenstrom KD. Abnormalities of the Reproductive Tract. In: Williams Obstetrics. 22nd ed. New York: McGraw-Hill; 2005. p. 949-970.
3. World Health Organization. The Global Prevalence of Anemia in 2011. Geneva: World Health Organization; 2015.
4. Rahmati S, Delpishe A, Azami M, Hafezi Ahmadi MR, Sayehmiri K. Maternal Anemia During Pregnancy and Infant Low Birth Weight: A Systematic Review and Meta-Analysis. Int J Reprod Biomed. 2017 Mar;15(3):125-134.
5. Kumari S, Garg N, Kumar A, Guru PKI, Ansari S, Anwar S, et al. Maternal and Severe Anaemia in Delivering Women Is Associated With Risk of Preterm and Low Birth Weight: A Cross-Sectional Study From Jharkhand, India. One Health. 2019 Aug;8:100098.
6. Novianti S, Aisyah IS. Hubungan Anemia Pada Ibu Hamil dan BBLR. J Siliwangi Seri Sains Teknol. 2018;4(1).
7. Srour MA, Aqel SS, Srour KM, Younis KR, Samarah F. Prevalence of Anemia and Iron Deficiency Among Palestinian Pregnant Women and Its Association With Pregnancy Outcome. Anemia. 2018 Dec;2018:9135625.
8. Iltaf G, Shahid B, Khan MI. Incidence and Associated Risk Factors of Low Birth Weight Babies Born in Shaikh Khalifa Bin Zayad Al-Nayan Hospital Muzaffarabad, Azad Jammu and Kashmir. Pak J Med Sci. 2017 May-Jun;33(3):626-630.
9. Safithri SF, Kania N, Diana A. Correlation Between Maternal Hemoglobin Level and Birth Weight. Althea Med J. 2019 Jun;6(2):91-94.
10. Khan H, Khan K, Shehzadi N, Riaz H. Correlation of Maternal Hemoglobin With Birth Weight: A Hospital-Based Study. J Bahria Univ Med Dent Coll. 2021 Mar;11(1):13-16.

11. Carpenter RM, Billah SM, Lyons GR, Siraj MS, Rahman QS, Thorsten V, et al. U-Shaped Association Between Maternal Hemoglobin and Low Birth Weight in Rural Bangladesh. Am J Trop Med Hyg. 2022 Feb;106(2):424-431.
12. Xiong J, Zhou W, Huang S, Xu K, Xu Y, He X. Maternal Anaemia and Birth Weight: A Cross-Sectional Study From Jiangxi Province, China. Fam Pract. 2023 Oct;40(5-6):722-727.
13. Chen Y, Zhong T, Song X, Zhang S, Sun M, Liu X, et al. Maternal Anaemia During Early Pregnancy and the Risk of Neonatal Outcomes: A Prospective Cohort Study in Central China. BMJ Paediatr Open. 2024 Jan;8(1):e001931.
14. Belete NK, Belete AG, Assefa DT, Sorrie MB, Teshale MY. Effects of Maternal Anemia on Low-Birth-Weight in Sub-Sahara African Countries: Systematic Review and Meta-Analysis. PLoS One. 2025 Jun;20(6):e0325450.
15. Engidaw MT, Eyayu T, Tiruneh T. The Effect of Maternal Anaemia on Low Birth Weight Among Newborns in Northwest Ethiopia. Sci Rep. 2022 Sep;12(1):15280.
16. Liu D, Li S, Zhang B, Kang Y, Cheng Y, Zeng L, et al. Maternal Hemoglobin Concentrations and Birth Weight, Low Birth Weight (LBW), and Small for Gestational Age (SGA): Findings From a Prospective Study in Northwest China. Nutrients. 2022 Feb;14(4):858.
17. Kabir MA, Rahman MM, Khan MN. Maternal Anemia and Risk of Adverse Maternal Health and Birth Outcomes in Bangladesh: A Nationwide Population-Based Survey. PLoS One. 2022 Dec;17(12):e0277654.
18. Lauer JM, Bhaise S, Dhurde V, Gugel A, Shah M, Hibberd PL, et al. Maternal Anemia During Pregnancy and Infant Birth Outcomes: A Prospective Cohort Study in Eastern Maharashtra, India. Curr Dev Nutr. 2024 Nov;8(11):104476.
19. Stevens GA, Paciorek CJ, Flores-Urrutia MC, Borghi E, Namaste S, Wirth JP, et al. National, Regional, and Global Estimates of Anaemia by Severity in Women and Children for 2000-19: A Pooled Analysis of Population-Representative Data. Lancet Glob Health. 2022 May;10(5):e627-e639.