Original Article **Open Access**

Effect of Maternal Anemia on Birth Weight among Newborns

Amna Younis, Iqbal Ahmad, Muhammad Irfan, Syed Usama Masood, M.I Babar

ABSTRACT:

Objectives: To evaluate the association between maternal anemia and low birth weight in newborn at SITH, Lodhran.

Study design & settings: Prospective cohort study at Department of Pediatrics nursery and gynae and obs department at Shahida Islam Teaching Hospital, Lodhran.

Materials & Methods: Pregnant women of child bearing age between 18 and 40 years with singleton pregnancies confirmed via ultrasound were included. Those who were pregnant with hemoglobinopathies, multiple pregnancies (twins, triplets, etc.), preterm pregnancy, pregnant and had such conditions as GDM, PIH, preeclampsia were excluded. Two groups of women will be divided as having been exposed and not being so. Exposed group (Anemic mothers): Hemoglobin level of less than 11 g/dL in pregnant women, as tested during their third trimester. Unexposed group (non-anemic mothers): Hemoglobin level of =11 g/dL in pregnant women, as assessed during their third trimester. The weight of babies at the time of birth was determined within 30 minutes of birth using a standard calibrated digital weighing scale, and noted in grams.

Results: Low weight of babies at birth was observed in 24(48.0%) women and was anaemic as compared to 08 (16.0%) women who were non-anaemic thus the p-value of 0.002 and relative risk of 3.00 which is noticeable and represents positive relationship of maternal anemia and low weight of babies in our study.

Conclusion: Following findings carried in the study, the likelihood of anemic women bearing low birth weight babies is greater than non-anemic women.

Keywords: Anemia, low birth weight, pregnancy.

How to cite this Article:
Younis A, Ahmad I, Irfam, Masood SU, Babar MI. Effect of Maternal Anemia on Birth Weight among Newborns. J Bahria Uni Med Dental Coll. 2026;16(3):791-7 DOI: https://doi.org/10.51985/JBUMDC2026987

INTRODUCTION:

A decrease in hemoglobin concentration below 11 g/dL during pregnancy[1] is known as maternal anemia, and it is a serious public health concern worldwide, especially in low- and middle-income nations. An estimated 40% of pregnant women globally are thought to be affected, with a higher prevalence in areas like South Asia and Sub-Saharan Africa.[2] Preterm birth, low birth weight, intrauterine growth restriction, and higher perinatal morbidity and mortality® are among the negative mother and fetal outcomes linked to this syndrome.[3-6]

The clinical consequences of anemia in pregnant women are diverse and include a large number of harm to the mothers and newborns. On the maternal side, it may cause fatigue, decreased ability to work, greater weakness to infection and difficulties during childbirth. The impact is even more worrying in terms of fetal position where maternal anemia has been strongly associated with preterm birth, intrauterine growth restriction (IUGR), low birth weight (LBW) and perinatal morbidity and mortality. Of special concern among them is low birth weight as it is a leading indicator of postpartum mortality, development, and future health history. Low birth weight among infants modulate an increased risk of childhood mortality, cognitive, and developmental disorders in adulthood.[5] Maternal anemia was shown to be a substantial risk factor for low and insufficient birth weight in a study by Figueiredo et al. In this prospective cohort study conducted in Brazil, maternal anemia raised the incidence of LBW by 38%.[4]

The biological pathway between maternal anemia and low birth weight has to do mainly with the decreased blood oxygen transporting capacity. In the case where the maternal

Amna Younis
Post Graduate Resident, Department of Pediatric Medicine
Shahida Islam Teaching Hospital, Lodhran
Email: noor.ehsan2@gmail.com

Iqbal Ahmad
Associate Professor, Department of Pediatric Medicine
Shahida Islam Teaching Hospital, Lodhran
Email: iqbalswm146@yahoo.com

Muhammad Irfan
Assistant Professor, Department of Pediatric Medicine
Shahida Islam Teaching Hospital, Lodhran
Email: khan.irfan161@gmail.com

Syed Usama Masood
Senior Registrar, Department of Pediatric Medicine
Shahida Islam Teaching Hospital, Lodhran
Email: saam0779@gmail.com

M.I Babar
Professor, Department of Pediatric Medicine
Shahida Islam Teaching Hospital, Lodhran
Email: masudbabar@yahoo.com

Received: 15-03-2026
1st Revision: 28-03-2026
Accepted: 20-06-2026
2nd Revision: 15-06-2026

hemoglobin is low, the fetus and placental oxygen supply is impaired. This may cause poor fetal growth and development hence low birth weight. Moreover, placental functioning, and the transfer of nutrients may also be impacted by anemia, which will also lead to under-optimal fetal development. Iron deficiency that is the leading cause of anemia in pregnancy is also a critical factor in the development of fetal brain and general growth and hence its deficiency is very detrimental.[6]

These results were supported by a cross-sectional study conducted in central India by Verma et al. (2020), which shown that maternal anemia increased the incidence of low birth weight by a statistically significant margin (27.8%). This study further emphasized the relevance of iron supplementation, which enhanced maternal hemoglobin levels and thus reduced the prevalence of LBW.[7] Additionally, Rauf et al. (2022) found a strong correlation between LBW and maternal anemia, especially in multigravida women. The research was carried out in Pakistan and showed that 39.37 of mothers had maternal anemia with 16.62% of the children born having LBW. The results indicated that anemia and poor maternal dieting covered significant contributes an infant underweight status.[8] The rate of LBW was 29.41 when a woman is anemic and 9.04 when a woman is not anemic.[9] Though there is ample evidence across the world that maternal anemia is associated with low birth weight there is no region specific data available and issues like this are mostly underreported in a number of underdeveloped countries such as South Punjab. Local factors such as, diet, cultural beliefs, socioeconomic inequality and access to services in relation to maternal anemia can be colossal in terms of prevalence and severity of maternal anemia and its consequences. That is why, it is necessary to carry out the localized research in order to learn more about the extent of this issue among the definite populations. This study is motivated by the fact that a large amount of research has been conducted all over the world that has found a very strong relationship between maternal anemia and bad birth, especially low birth weight that is a primary cause of morbidity and mortality among newborns. But even then, given this enormous amount of international data, a significant lacuna in local studies on this subject in our south punjab is remarkable. The local context is important to understand, as the level of maternal anemia severity and impact on birth weight might be affected by the availability of healthcare, nutrition habits, as well as socioeconomic status. The proposed study aims to fill the gap by offering locally specific data that can be used to develop targeted interventions and improve maternal and neonatal health-related outcomes in our locality.

METHODOLOGY:

The ethical review committee approved (No. SIMC/ET.C./0001/24 dated 04-10-2024) this prospective cohort study, which involved 100 women and ran from 16th October 2025 to 14th January 2026. Sample size of 100 i.e. 50 exposed and 50 unexposed is estimated by WHO calculator taking significance level as 5%, power of study as 80% and percentage of low birth weight babies in anemic group as 29.41% and in non-anemic group as 9.04%.[9] Pregnant women of child bearing age between 18 and 40 years with singleton pregnancies confirmed via ultrasound were included. Pregnant women with hemoglobinopathies, multiple pregnancies (twins, triplets, etc.), preterm birth, and pregnant women with disorders such as GDM, PIH, and preeclampsia were not included.

Informed permission was obtained from all individuals before registration in the study. Women were divided into exposed and non-exposed groups. Exposed group (Anemic mothers): Hemoglobin level of < 11 g/dL in pregnant women, as tested during their third trimester. Unexposed group (non-anemic mothers): Hemoglobin level of =11 g/dL in pregnant women, as assessed during their third trimester. An elderly aged structured proforma was used to gather demographic factors like the maternal age, gestational age, parity, and socioeconomic status. The third trimester assessment of hemoglobin levels of the participants was to verify maternal anemia (hmoglobin level < 11 g/dL). Birth weight of infants was obtained after 30 minutes of delivery and the measurement weight of the infant taken in grams using a standard calibrated digital weighing scale. Other records like maternal antenatal care history, nutritional status and any complication during pregnancy were also recorded. Respondents will be monitored until delivery and the data of birth weight will be taken then. A pre-made proforma will be used to assemble all of the data. Some of the confounding variables included maternal age, the age of gestation, parity, place of residence as well as the socioeconomic status. SPSS version 25.0 was used for data analysis. The data was compiled using descriptive statistics. Continuous variables like maternal age, gestational age, BMI and birth weight were expressed as mean ± SD, while parity, antenatal care, previous h/o LBW (yes/no), place of living (rural/urban), socioeconomic status were presented as frequencies and percentages. The frequency of low birth weight newborns among anemic and non-anemic moms was compared using chi square. P value =0.05 was evaluated as significant. Relative risk was estimated to see the association between low birth weight newborns and maternal anemia and RR >1 was classified as significant. Data was further stratified by maternal age, gestational age, parity, body mass index, previous h/o LBW (yes/no), place of residence (rural/urban), socioeconomic status and post-stratification chi square was applied and P value =0.05 was evaluated as significant. Additionally, relative risk was computed.

RESULTS:

The respondents in the study were aged between 18-40 years, and the mean age was 25.49 +/-4.29 years. The mean age of women who were exposed was 26.04 ± 4.37 years

and the mean age of women who were not exposed was 25.22 ± 4.22 years. Eighty-seven (87.0) out of the patients used to be aged 18 to 30. The mean gestational age was 39.15 weeks with a range of 0.98 weeks. The mean gestation weeks of the exposed group was 39.14 +/- 0.99 and the unexposed group was 39.18 +/-0.98. The average height was 153.66 ± 10.42 cm. The average weight was 79.32 ± 7.32 kg. The average BMI for the exposed group was 25.09 ± 4.56 kg/m2, while it was 26.65 ± 4.71 kg/m2 for the unexposed group. There is a distribution of different variables as indicated in table I. Our study found that 24 (48.0%) of the women with anemia had low birth weight babies, while only 08 (16.0%) of the women without anemia had low birth weight babies. The p-value was 0.002 and the odds ratio was 3.00, which is significant and shows a positive link between maternal anemia and low birth weight in babies (Table II).

Table III shows the stratification of low birth weight (LBW) against all the possible confounding factors such as maternal age, gestational age, parity, body mass index (BMI), previous low birth weight history, residence, and socioeconomic status. This was done in an attempt to examine the consistency of the relationship between maternal anemia and low birth weight within various subgroups. Regarding maternal age, 45.24% of anemic mothers gave birth to low weight babies among women that were 18-30 year old compared to 17.78% among women who were not anemic. This was statistically significant (p = 0.010) with a relative risk (RR) of 2.54, which suggests that in this age group anemia was a significant risk factor increasing the chances of LBW. Conversely, even though a greater percentage of LBW remained in the anemic women were noted to be aged 31-40 years (62.50 vs. 0) the association was not significant (p = 0.149), probably because of smaller sample in this group. In terms of gestational age there were considerable findings of associations in both categories. With gestational age 37-39 weeks, 47.06% of blood-deficient mothers carried LBW babies as compared to 21.21% of non-deficient mothers (p = 0.037, RR = 2.22). On the same note, a high level of association was observed in 40 41 weeks group where 50.0 of the anemic mothers delivered LBW babies, in contrast to a low level of association between non-anemic mothers at 5.88 (p = 0.033, RR = 8.50). These results indicate that maternal anemia has a negative impact on birth weight even when there is gestational age.

Both groups had statistically significant results in terms of parity. Among women with parity 1–2, 41.94% of anemic mothers had LBW babies compared to 15.63% in the non-anemic group (p = 0.033, RR = 2.68). In a like manner, in women with parity 34, the incidence of LBW was found to be 57.89% in anemic mothers, 16.67 in non-anemic mothers (p = 0.027, RR = 3.47). This shows that anemia is an important risk factor of LBW irrespective of parity.

In case of body mass index (BMI), there was a significant distribution in the women with the BMI of 25 or less where 59.26 of the anemic mothers but not 14.29 of non-anemic mothers delivered LBW babies (p = 0.004, RR = 4.15). Nonetheless, the difference was not statistically significant in women with BMI >25 (p = 0.225), which implies that normal or even lower BMI with anemia is the predictor of an increased risk of LBW.

Comparing past history of LBW, it was no longer statistically significant when there was a history of it among women (p = 0.080) but the proportion was higher among anemic mothers (75.0% vs. 14.29%). Nevertheless, there was a significant association with anemia in women who had never been at risk before (p = 0.013, RR = 2.63) and this implies that anemia is a contributor to LBW in its own right.

In terms of residence, there was a very high association in urban populations where 55.17% of anemic mothers had LBW babies when compared with 14.81% of non-anemic mothers (p = 0.007, RR = 3.72). The correlation was however, not statistically important in rural populations (p = 0.141) but the trend followed was similar. Finally, at the socioeconomic level, statistically significant both the kind of association (p = 0.007, RR = 3.24) was observed in the middle socioeconomic group where the role of anemia significantly increased LBW. On the contrary, low and high socioeconomic groups showed no correlation, possibly due to the smaller sample size in these groups or it might not be associated with high variance.

DISCUSSION:

The results of this study demonstrate the strong link between maternal anemia and lower neonatal birth weight, and they are in good agreement with a large body of national and international research. In our study, low birth weight babies were observed in 24 (48.0%) anemic women compared to 8 (16.0%) anemic women. The p-value of 0.002 and odds ratio of 3.00 are significant, indicating a positive correlation between low birth weight babies and maternal anemia. Moreover, Rauf et al. (2022) noted a significant correlation between LBW and maternal anemia and multigravida women in particular. This Pakistani-based study reported a prevalence of 39.37% maternal anemia among the mothers with 16.62% of the born neonates born with LBW. The results demonstrated that underweight status of infants caused by anemia and lack of maternal nutrition was crucial. LBW was prevalent among anemia women (29.41% and non-anaemic women (9.04%).[9]

Singh et al.[10] and Kumar et al.[11] further verified these results across varied settings in India, proving maternal anemia as a substantial risk factor for intrauterine growth restriction (IUGR) and LBW. Parallel international research conducted in low-resource situations, including sub-Saharan Africa and Southeast Asia, have consistently repeated same findings.[12] For example, a comparable study by Figueiredo et al.[13] and a systematic review and meta-analysis by Rahmati et al.[14] showed strong correlations between maternal anemia

Table-1: Distribution of different variables (n=100)

		Exposed (n=50) Number (%)	**Unexposed (n=50)** Number (%)
Age (years)	**18-30**	42 (84.0%)	45 (90.0%)
	31-40	08 (16.0%)	05 (10.0%)
Gestational age (weeks)	**38-39**	34 (68.0%)	33 (66.0%)
	40-41	16 (32.0%)	17 (34.0%)
Parity	**1-2**	31 (62.0%)	32 (64.0%)
	3-4	19 (38.0%)	18 (36.0%)
BMI (kg/m^2)	**<=25**	27 (54.0%)	28 (56.0%)
	>25	23 (46.0%)	22 (44.0%)
Residence	**Rural**	21 (42.0%)	23 (46.0%)
	Urban	29 (58.0%)	27 (54.0%)
Previous h/o LBW	**Yes**	08 (16.0%)	07 (14.0%)
	No	42 (84.0%)	43 (86.0%)
Mode of delivery	**Low**	09 (18.0%)	09 (18.0%)
	Middle	25 (50.0%)	27 (54.0%)
	High	16 (32.0%)	14 (28.0%)

Table 2: Association of maternal iron deficiency anemia with low birth weight

	Exposed (n=50)		**Unexposed (n=50)**		**P-value**	**RR**
	yes	no	yes	no		
Unexposed (n=50)	24 (48.0%)	26 (52.0%)	08 (16.0%)	42 (84.0%)	**0.002**	**3.00**

Table 3: Stratification of low birth weight with respect to confounders

		Exposed (n=50)		**Unexposed (n=50)**		**P-value**	**RR**
		low birth weight		**low birth weight**			
		Yes	No	Yes	No		
Age (years)	**18-30**	19 (45.24%)	23 (54.76%)	08 (17.78%)	37 (82.22%)	0.010	2.54
	31-40	05 (62.50%)	03 (37.50%)	00 (0.0%)	05 (100.0%)	0.149	7.33
Gestational age (weeks)	**37-39**	16 (47.06%)	18 (52.94%)	07 (21.21%)	26 (78.79%)	0.037	2.22
	40-41	08 (50.0%)	08 (50.0%)	01 (5.88%)	16 (94.12%)	0.033	8.50
Parity	**1-2**	13 (41.94%)	18 (58.06%)	05 (15.63%)	27 (84.37%)	0.033	2.68
	3-4	11 (57.89%)	08 (42.11%)	03 (16.67%)	15 (83.33%)	0.027	3.47
BMI (kg/m^2)	**=25**	16 (59.26%)	11 (40.74%)	04 (14.29%)	24 (85.71%)	0.004	4.15
	>25	08 (34.78%)	15 (65.22%)	04 (18.18%)	18 (81.82%)	0.225	1.91
Previous H/o LBW	**Yes**	06 (75.0%)	02 (25.0%)	01 (14.29%)	06 (85.71%)	0.080	5.25
	No	18 (42.86%)	24 (57.14%)	07 (16.28%)	36 (83.72%)	0.013	2.63
Residence	**Rural**	08 (38.10%)	13 (61.90%)	04 (17.39%)	19 (82.61%)	0.141	2.19
	Urban	16 (55.17%)	13 (44.83%)	04 (14.81%)	23 (85.19%)	0.007	3.72
Socioeconomic status	**Low**	02 (22.22%)	07 (77.78%)	03 (33.33%)	06 (66.67%)	0.604	0.66
	Middle	15 (60.0%)	10 (40.0%)	05 (18.52%)	22 (81.48%)	0.007	3.24
	High	07 (43.75%)	09 (56.25%)	00 (0.0%)	14 (100.0%)	0.068	13.2

and unfavorable pregnancy outcomes, particularly LBW.

Kemppinen et al.[15] found that women and newborns with anemia are more likely to have serious complications such PTB, FGR, and infections after giving birth. Khezri et al. demonstrated that maternal anemia during pregnancy in Iranian women was associated with adverse pregnancy outcomes, even after controlling for confounding variables.[16] A retrospective cohort study by Biswas et al. found that anemia during pregnancy greatly increases the risk of LBW.[17] In a similar vein, Wahyuni et al.[18] discovered a substantial correlation between the prevalence of LBW newborns and anemia during pregnancy. These results align with the current body of research.

One important risk factor for childhood anemia is low birth weight (LBW), which is linked to low iron reserves at or after 37 weeks of pregnancy.[9,19] Also, babies who are born with low birth weight (LBW) are more likely to develop insulin resistance and other health problems later in life.[20] There are many things that might cause low birth weight (LBW) in children, such as the mother's age (young or old), her BMI being too low or too high, her having a chronic illness, or her having had a premature birth. Expectant women with anemia, especially in low-income nations like Pakistan, exhibit a heightened likelihood of delivering low birth weight (LBW) infants.[21]

In the current investigation, the mean age of women in exposed group was 26.04 ± 4.37 years and in unexposed group was 25.22 ± 4.22 years. Majority of the patients 87 (87.0%) were between 18 to 30 years of age. According to a study done in Muzaffarabad, the only risk factors that significantly correlated with LBW were socioeconomic demographics.[22] There is conflicting research about the association between serum ferritin levels and LBW, despite serum ferritin's correlation with other conditions such as chronic patent ductus arteriosus, sepsis, and bronchopulmonary dysplasia.[23]

By offering a thorough hospital-based study that links low birth weight to poor maternal nutrition and health inequities, Devaguru et al.[24] support these connections. All these researches highlight the importance of maternal iron status, dietary therapy and prenatal care in reducing the prevalence of low birth weight (LBW). Low birth weight (LBW) would not be prevalent in most of the populations with an all rounded approach where routine ferritin screening, better maternal nutrition, and better prenatal care services are integrated. Anemia is a preventive health problem and its treatment is likely to reduce the occurrence of the low birth weight (LBW) and even postnatal mortality among the general population. Arsyi et al.[25] propose that increased prenatal care usage has a drastic effect in reducing low birth weight newborns by four ASEAN countries. This demonstrates how crucial it is to increase access to maternity healthcare.

Lack of iron is the main cause of anemia during pregnancy in Pakistan. This is commonly linked to a poor background, lack of nutrition, and having several children. Taking iron supplements when pregnant is thought to lower the incidence of anemia and low birth weight in newborns. Research conducted in the United States has similarly elucidated this.[14]

Anemia impacts 36% of pregnant women worldwide, with around 40% of instances resulting from iron deficiency (ID).[26] The elevated incidence of low birth weight babies documented in this study may be associated with heightened levels of inbreeding resulting from frequent unions among closely related individuals of diverse ethnic backgrounds. A prospective cohort study identified low birth weight (LBW) as a significant public health issue in this area. Factors such as maternal undernutrition, iron deficiency (ID) during pregnancy negatively impacted birth weight. To enhance maternal and neonatal health, customized treatments promoting better nutrition and extensive availability of iron and folic acid supplementation are essential.[27]

A study conducted in Nigeria demonstrated that lower birth weight is a good predictor of reduced serum ferritin levels.[28] A study done in India showed that preterm babies had less iron stored than full-term babies. The main factor that affected iron levels at birth was how far along the baby was in its pregnancy. Also, a lack of iron was linked to chronic and long-term problems with brain development.[29] The elevated prevalence of LBW observed in this study and others in Pakistan may be partially attributable to insufficient iron supplementation. The percentage of people who take iron supplements for 90 days or more has gone substantially over the years, from 22% in the 2012-13 PDHS to 29% in 2017-18. However, this is still not enough to properly treat iron deficiency and its linked problems, such as LBW.[30]

These results further emphasized the imperative of improving maternal iron status through enhanced iron supplementation and nutritional therapies to reduce the incidence of low birth weight (LBW). Since many pregnant women in Pakistan are iron deficient, fixing this problem could dramatically lower the number of LBW babies and improve the health of mothers and babies.

There are minimal study constraints. Firstly, that we could not differentiate between low birth weight and preterm infants in both anemic and non-anemic populations. Future studies should therefore focus on these two different groups (Preterm and LBW) to find out their association with maternal hemoglobin and ferritin levels to help decision-makers decide what to do to best meet the interests of the mother and child.

CONCLUSION:

The outcomes of the study reveal that anaemic women are more likely to deliver babies with poor birth weights as compared to those who are not anaemic. Our proposals include the creation of community educational programs

dealing with this important issue in women of reproductive age and the training of treating doctors on the early diagnosis and treatment of maternal anemia to abate the occurrence of low birth weight babies.

Conflicts of Interest: Nil

Source of Funding: Nil

Acknowledgement: Nil

Authors Contribution:
Amna Younis: Conception and Design, acquisition of data, analysis and interpretation of data, drafting and critical revision, final approval of the version to be published.
Iqbal Ahmad: Conception, acquisition of data, critical revision of the manuscript.
Muhammad Irfan: Conception and Design, acquisition of data, analysis and interpretation of data, drafting and critical revision, final approval of the version to be published.
Syed Usama Masood: Acquisition of data, drafting and final approval of the manuscript.
M.I Babar: Conception, Acquisition of data, critical revision of manuscript.

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