International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Effect Of Iron and Folic Acid Supplementation and Parity on Maternal Hemoglobin and Neonatal Outcomes.

Dr Jatin Haritash[1], Dr Kanika Negi[2], Dr Siddharth[3], Dr Sunil Kumar Solanki[4], Dr Brijesh Kumar[5], Dr Jatin Prajapati[6]

[1] Primary DNB Resident, Department of Paediatrics, Shri Dada Dev Matri Avum Shishu Chikitsalaya, New Delhi, India.
[2] Specialist, Department of Paediatrics, Shri Dada Dev Matri Avum Shishu Chikitsalaya, New Delhi, India.
[3] Senior Medical Officer, Shri Dada Dev Matri Avum Shishu Chikitsalaya, New Delhi, India.
[4] Specialist and Head, Department of Paediatrics, Shri Dada Dev Matri Avum Shishu Chikitsalaya, New Delhi, India.
[5] Professor, Department of Paediatrics, ESIC Medical College and Hospital, Alwar, Rajasthan, India.
[6] Senior Resident, Department of Community Medicine, World College of Medical Sciences & Research, Jhajjar, Haryana, India.

OPEN ACCESS

Corresponding Author:

Dr Jatin Haritash
Department of Paediatrics, Shri Dada Dev Matri Avum Shishu Chikitsalaya, New Delhi, India. PIN: 110045
Email Id: jatin.haritash@gmail.com

Received: 15-01-2026
Accepted: 04-02-2026
Available online: 07-03-2026

ABSTRACT

Background: Maternal anemia remains a major public health concern in developing countries, particularly in India, where prevalence rates remain high despite national control programs. Iron and folic acid (IFA) supplementation is a key intervention aimed at reducing anemia and improving pregnancy outcomes. However, the combined influence of supplementation compliance, duration, and parity on maternal hemoglobin levels and neonatal outcomes requires further evaluation.
Objective: To assess the effect of iron and folic acid supplementation and parity on maternal hemoglobin status and neonatal anthropometric outcomes in a tertiary care setting.
Methods: A cross-sectional analytical study was conducted from July 2024 to July 2025 involving 500 term singleton mother–neonate dyads. Maternal hemoglobin levels in the first and third trimesters were obtained from antenatal records and categorized according to WHO criteria. Information regarding IFA supplementation and duration of intake was collected through record review and questionnaire. Neonatal birth weight, length, and head circumference were measured within 48 hours of birth using standardized techniques. Chi-square test, independent t-test, and one-way ANOVA were applied for statistical analysis. A p-value <0.05 was considered statistically significant.
Results: Anemia prevalence was higher in the first trimester and showed significant improvement by the third trimester, with normal hemoglobin levels increasing substantially. IFA compliance was high (97.6%), and most women consumed supplements for more than six months. Primigravida women had significantly higher hemoglobin levels in both trimesters compared to multigravida women (p <0.001). Neonates born to multigravida mothers had slightly higher mean birth weight and length, while head circumference differences were not significant. Duration of IFA supplementation did not demonstrate statistically significant differences in neonatal anthropometric parameters. No association was observed between neonatal gender and maternal hemoglobin status.
Conclusion: IFA supplementation contributes to significant improvement in maternal hemoglobin levels, while parity remains an important determinant of anemia status. Comprehensive anemia control strategies integrating supplementation, nutritional counseling, and family planning are essential to optimize maternal and neonatal outcomes.

***Keywords**:* Maternal anemia; Iron and folic acid supplementation; Parity; Neonatal anthropometry; Antenatal care; Hemoglobin status; Public health.

INTRODUCTION

Anemia during pregnancy remains one of the most significant public health challenges in developing countries, with far-reaching implications for maternal and neonatal health. According to the World Health Organization (WHO), anemia affects approximately 36.5% of pregnant women globally [1]. In India, the burden is substantially higher, with national surveys indicating prevalence rates exceeding 70% among pregnant women [2]. Iron deficiency anemia (IDA) is the most common nutritional disorder during pregnancy and continues to contribute significantly to maternal morbidity, adverse birth outcomes, and intergenerational cycles of malnutrition [3].

Physiological changes during pregnancy, including plasma volume expansion and increased iron demands, result in relative hemodilution and a fall in hemoglobin concentration [4]. However, in many women, particularly in low-resource settings, this physiological decline is compounded by pre-existing iron deficiency, inadequate dietary intake, short interpregnancy intervals, and repeated pregnancies [5]. Increased iron requirements during the second and third trimesters further exacerbate the risk of anemia, especially when maternal iron reserves are already depleted [3]. Multigravida women are particularly vulnerable due to cumulative depletion of iron stores across successive pregnancies, especially when birth spacing is inadequate [5].

Maternal anemia has been associated with a wide spectrum of adverse outcomes during pregnancy and childbirth. These include preterm labor, intrauterine growth restriction (IUGR), low birth weight (LBW), increased susceptibility to infection, and elevated maternal and neonatal mortality [6]. A doubling of low birth weight rates and a two- to three-fold increase in perinatal mortality have been reported in mothers with hemoglobin levels below 8 g/dL [7]. In addition, maternal iron deficiency adversely affects fetal iron endowment, leading to lower cord blood ferritin levels and reduced neonatal iron stores at birth [8]. Such deficiencies may have long-term consequences on cognitive development, behavior, and future cardiovascular health [9-11].

Given the magnitude of the problem, national programs have emphasized universal iron and folic acid (IFA) supplementation during pregnancy. The Anemia Mukt Bharat strategy adopts a life-cycle approach to reduce anemia prevalence through prophylactic IFA supplementation, periodic deworming, behavior change communication, fortified foods, and systematic screening and treatment [12]. Continuous iron supplementation during pregnancy has been shown to improve maternal hemoglobin levels and protect against complications in current and subsequent pregnancies [13]. However, despite policy-level efforts, variations in compliance, duration of supplementation, and individual maternal factors continue to influence anemia status.

Parity represents another important determinant of maternal hemoglobin levels. Repeated pregnancies increase iron demands and often deplete maternal reserves, particularly in women with inadequate interpregnancy intervals [5]. Studies have demonstrated that multiparous women are more likely to exhibit lower hemoglobin levels compared to primigravida women [14,15]. These differences may translate into variations in neonatal anthropometric outcomes. While some investigations have reported significant associations between maternal anemia severity and reduced birth weight, length, and head circumference [14,16,17], others have shown inconsistent findings depending on trimester and severity of anemia [18].

Neonatal anthropometry, including birth weight, length, and head circumference, is widely used as an indicator of intrauterine growth and fetal well-being [19-22]. Birth weight, in particular, is a strong predictor of neonatal survival and future health outcomes [23]. In developing countries, intrauterine growth restriction remains a major contributor to low birth weight [24]. Maternal nutritional status, anemia, and supplementation compliance play critical roles in influencing fetal growth trajectories [25-27].

Although the relationship between maternal anemia and neonatal outcomes has been studied extensively, fewer studies have examined the combined influence of iron supplementation compliance, duration of supplementation, and parity on maternal hemoglobin levels and subsequent neonatal anthropometry. Understanding these determinants is essential for evaluating the effectiveness of public health interventions and identifying vulnerable subgroups that may require targeted counseling or enhanced monitoring.

The present study was undertaken to assess the effect of iron and folic acid supplementation and parity on maternal hemoglobin levels and neonatal outcomes in a tertiary care setting. By examining anemia prevalence across trimesters and evaluating the impact of supplementation and gravidity status on neonatal anthropometric parameters, this study aims to provide evidence relevant to strengthening antenatal anemia control strategies and improving neonatal health outcomes.

MATERIALS AND METHODS

Study Design and Setting: A cross-sectional analytical study was conducted in the Department of Paediatrics at Shri Dada Dev Matri Avum Shishu Chikitsalaya, New Delhi, a tertiary care maternity hospital catering to a large urban population. The study was carried out over a one-year period from July 2024 to July 2025.

Study Population: The study included mother–neonate dyads admitted to the postnatal wards during the study period. Only term singleton deliveries were considered to minimize confounding due to prematurity or multiple gestations.

Inclusion Criteria

- Term neonates (≥37 completed weeks of gestation)
- Singleton pregnancies
- Mothers aged 21–35 years
- Mothers with documented hemoglobin values in both first and third trimesters
- Mothers who provided written informed consent

Exclusion Criteria

- Preterm neonates
- Multiple pregnancies
- Neonates with congenital malformations
- Mothers with chronic systemic illnesses (diabetes mellitus, hypertension, thyroid disorders, HIV, syphilis, TORCH infections)
- Mothers with history of smoking or alcohol intake
- Unbooked pregnancies

Sample Size: The sample size was calculated based on a reported anemia prevalence of 52.2% among pregnant women. Using the standard formula for single proportion estimation at 95% confidence interval and 5% margin of error, the minimum calculated sample size was 384. To improve statistical power and ensure adequate subgroup analysis for parity and supplementation duration, 500 mother–neonate dyads were included using random sampling.

Data Collection: After obtaining institutional ethical approval and informed consent, data were collected using a pre-tested semi-structured questionnaire and antenatal record review.

Maternal Variables Collected

- Age
- Gravida status (Primigravida / Multigravida)
- Hemoglobin level in first trimester
- Hemoglobin level in third trimester
- Iron and folic acid supplementation (Yes/No)
- Duration of IFA intake (in months)

Hemoglobin estimation had been performed during routine antenatal visits using automated hematology analyzers in the hospital laboratory.

Maternal hemoglobin levels were categorized according to WHO criteria:

- Mild anemia: 10.0–10.9 g/dL
- Moderate anemia: 7.0–9.9 g/dL
- No anemia: ≥11 g/dL

Neonatal Outcome Measures

Neonatal anthropometric parameters were recorded within the first 48 hours of life using standardized techniques:

- Birth weight measured using a calibrated digital weighing scale (10 g sensitivity)
- Length measured using an infantometer
- Head circumference measured using a non-stretchable measuring tape at the supraorbital and occipital prominences

Measurements were recorded to the nearest 0.1 kg and 0.1 cm.

Study Variables

Independent Variables

- Iron and folic acid supplementation (Yes/No)
- Duration of IFA supplementation (categorized in months)
- Parity (Primigravida / Multigravida)

Dependent Variables

- Maternal hemoglobin status (categorical)
- Neonatal birth weight
- Neonatal length
- Neonatal head circumference

Statistical Analysis: Data were entered in Microsoft Excel and analyzed using SPSS version 26.0. Qualitative variables were expressed as frequency and percentage. Quantitative variables were presented as mean ±standard deviation. For determinant analysis chi-square test was used to assess association between categorical variables (e.g., parity and anemia status). Independent t-test was used to compare mean hemoglobin levels and neonatal anthropometry between primigravida and multigravida groups. One-way ANOVA was applied to compare neonatal anthropometric parameters across different durations of IFA supplementation. Paired comparison of first and third trimester hemoglobin levels was performed to assess improvement across pregnancy. A p-value <0.05 was considered statistically significant.

Ethical Considerations: The study was conducted after approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants. Confidentiality and anonymity were maintained throughout the study, and data were used solely for research purposes.

RESULTS

A total of 500 mother–neonate dyads were included in the analysis. The effect of iron and folic acid (IFA) supplementation and parity on maternal hemoglobin status and neonatal anthropometric outcomes was evaluated. Nearly 85% of mothers were below 31 years. Two-thirds were multigravida, allowing meaningful assessment of parity as a determinant.(Table 1)

Table 1. Baseline Characteristics and Parity Distribution (n = 500)

Variable	Category	Frequency (n)	Percentage (%)
Maternal Age (years)	21–25	239	47.8
	26–30	188	37.6
	31–35	73	14.6
Gravida	Primigravida	168	33.6
	Multigravida	332	66.4

Anemia prevalence reduced significantly by the third trimester, with normal hemoglobin increasing from 35.6% to 65.8%, indicating substantial improvement during pregnancy.(Table 2)

Table 2. Prevalence and Trimester-wise Change in Maternal Hemoglobin Status (n = 500)

Hb Status	First Trimester n (%)	Third Trimester n (%)
Moderate Anemia	124 (24.8)	59 (11.8)
Mild Anemia	198 (39.6)	112 (22.4)
No Anemia	178 (35.6)	329 (65.8)
Mean Hb (g/dL)	10.58 ± 1.13	11.37 ± 1.31

Primigravida women had significantly higher hemoglobin levels in both trimesters. Neonates of multigravida mothers had slightly higher birth weight and length. Head circumference difference was not statistically significant.(Table 3)

Table 3. Association of Parity with Maternal Hemoglobin and Neonatal Anthropometry

Parameter	Primigravida (Mean ± SD)	Multigravida (Mean ± SD)	p-value
Hb – 1st trimester (g/dL)	10.90 ± 1.02	10.40 ± 1.18	<0.001
Hb – 3rd trimester (g/dL)	11.72 ± 1.25	11.21 ± 1.33	<0.001
Birth weight (kg)	2.8 ± 0.4	2.9 ± 0.4	<0.001
Length (cm)	50.2 ± 1.6	50.6 ± 1.7	0.014
Head circumference (cm)	33.5 ± 0.9	33.6 ± 1.1	0.120

IFA compliance was very high (97.6%), and three-fourths of women consumed supplements for more than six months.(Table 4)

Table 4. Iron and Folic Acid Supplementation Status and Maternal Hemoglobin (n = 500)

Variable	Category	Frequency (%)

IFA Taken	Yes	488 (97.6)
	No	12 (2.4)
Duration of IFA (months)	<2	8 (1.6)
	2–4	51 (10.4)
	5–6	60 (12.3)
	>6	369 (75.6)

Although numerical improvement in birth weight and length was observed with longer IFA duration, differences were not statistically significant.(Table 5)

Table 5. Neonatal Anthropometry According to Duration of IFA Supplementation

Duration (months)	Birth Weight (kg) Mean ± SD	Length (cm) Mean ± SD	Head Circumference (cm) Mean ± SD
<2	2.8 ± 0.5	49.8 ± 2.1	33.6 ± 1.1
2–4	2.7 ± 0.4	50.1 ± 1.6	33.2 ± 1.1
5–6	2.9 ± 0.4	50.5 ± 1.4	33.6 ± 1.1
>6	2.9 ± 0.4	50.5 ± 1.7	33.6 ± 1.0
ANOVA p-value	0.272	0.502	0.679

No significant association was found between neonatal gender and maternal hemoglobin status.(Table 6)

Table 6. Gender Distribution and Maternal Hemoglobin Status

Hb Status (3rd trimester)	Female n (%)	Male n (%)	p-value
Moderate anemia	29 (12.2)	30 (11.4)	0.944
Mild anemia	52 (21.9)	60 (22.8)	
No anemia	156 (65.8)	173 (65.8)	

DISCUSSION

The present study evaluated the influence of iron and folic acid (IFA) supplementation and parity on maternal hemoglobin levels and neonatal anthropometric outcomes in a tertiary care setting. The findings demonstrate a substantial reduction in anemia prevalence from the first to the third trimester, high compliance with IFA supplementation, and a significant association between parity and maternal hemoglobin levels. However, the duration of supplementation did not show statistically significant differences in neonatal anthropometric parameters.

Maternal anemia remains a major public health challenge in India, where prevalence rates are reported to exceed 70% in pregnant women [2]. Globally, anemia affects more than one-third of pregnant women [1]. In our study, a high proportion of women were anemic in the first trimester, consistent with national trends. This reflects the fact that many women enter pregnancy with pre-existing iron deficiency, particularly in low-resource settings [3]. Factors such as inadequate dietary intake, diminished absorption, infections, and repeated pregnancies contribute significantly to this burden [5].

A notable finding of this study was the marked improvement in hemoglobin levels by the third trimester, with the proportion of women having normal hemoglobin increasing substantially. This improvement likely reflects the high compliance with IFA supplementation observed in our cohort, where 97.6% of women reported taking iron and folic acid tablets. Continuous iron supplementation during pregnancy has been shown to improve maternal iron status and reduce complications in current and subsequent pregnancies [13]. The findings suggest that antenatal supplementation programs, when effectively implemented, can lead to measurable improvements in maternal hematological status.

The Anemia Mukt Bharat strategy emphasizes prophylactic IFA supplementation, behavior change communication, screening, and treatment as part of a life-cycle approach to anemia reduction [12]. The high supplementation coverage observed in this study indicates successful program uptake at the institutional level. However, despite prolonged supplementation (with more than three-fourths of women consuming IFA for over six months), neonatal anthropometric differences across supplementation duration groups were not statistically significant. This suggests that while supplementation improves maternal hemoglobin levels, neonatal growth outcomes may be influenced by multiple interacting determinants beyond iron intake alone, including maternal nutritional status, socioeconomic factors, and interpregnancy intervals [24-27].

Parity emerged as an important determinant of maternal hemoglobin levels. Primigravida women had significantly higher hemoglobin concentrations in both trimesters compared to multigravida women. This finding is biologically plausible, as repeated pregnancies increase iron demands and often deplete maternal iron reserves, particularly when birth spacing is inadequate [5]. Similar observations have been reported in previous studies demonstrating lower hemoglobin levels among multiparous women [14,15]. These findings underscore the importance of family planning counseling and adequate interpregnancy intervals as part of comprehensive anemia control strategies.

Neonatal outcomes also showed variations according to parity. Although multigravida mothers had slightly higher neonatal birth weight and length, the differences were modest. It has been hypothesized that the first pregnancy primes the body and with each subsequent pregnancy the body is more efficient [28,29]. Maternal anemia has been associated with intrauterine growth restriction, preterm birth, and low birth weight [6]. Severe anemia has been linked with doubling of low birth weight rates and increased perinatal mortality [7]. However, in the present study, the relatively modest differences observed may reflect effective antenatal monitoring and supplementation.

Importantly, no significant association was found between neonatal gender and maternal hemoglobin status, indicating that anemia distribution and supplementation effects were independent of fetal sex. This suggests equitable antenatal care delivery without gender-based differences in maternal health status.

From a public health perspective, the findings highlight both achievements and gaps in anemia control efforts. High supplementation coverage and trimester-wise hemoglobin improvement demonstrate the effectiveness of structured antenatal care services. However, the persistence of moderate anemia in a subset of women indicates the need for earlier screening, enhanced dietary counseling, and possibly preconception anemia correction. Maternal anemia is not merely a hematological issue but reflects broader nutritional and social determinants of health [3].

The absence of strong associations between supplementation duration and neonatal anthropometry also suggests that improving hemoglobin levels alone may not be sufficient to optimize neonatal growth. Comprehensive maternal nutrition strategies—including dietary diversification, fortified foods, and management of infections—are essential complements to IFA supplementation [12].
In conclusion, this study reinforces the critical role of IFA supplementation programs in improving maternal hemoglobin levels and highlights parity as an important determinant of maternal anemia. Strengthening trimester-specific screening, ensuring sustained supplementation compliance, and integrating family planning and nutritional counseling into antenatal services are essential policy measures to further reduce maternal anemia and improve neonatal outcomes.

CONCLUSION
This study demonstrates that iron and folic acid supplementation is associated with significant improvement in maternal hemoglobin levels across pregnancy, reflecting the effectiveness of structured antenatal care programs. The marked reduction in anemia prevalence from the first to the third trimester highlights the positive impact of supplementation adherence. Parity emerged as an important determinant, with multigravida women exhibiting lower hemoglobin levels compared to primigravida women, underscoring the cumulative depletion of iron stores across successive pregnancies. However, duration of supplementation did not show statistically significant differences in neonatal anthropometric parameters, suggesting that fetal growth is influenced by multiple determinants beyond hemoglobin levels alone. These findings reinforce the importance of early anemia screening, sustained supplementation compliance, adequate birth spacing, and integrated nutritional counseling. Strengthening public health strategies under national anemia control programs can further reduce maternal anemia and contribute to improved maternal and neonatal health outcomes.

DECLARATIONS
Ethical Approval and Consent to Participate
The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Institutional Ethics Committee of Shri Dada Dev Matri Avum Shishu Chikitsalaya, New Delhi, prior to commencement of the study (IEC Letter No.: F.1(15)/DNBcourse/sddmasc/2017-18/Part-IV/1715; Date of Approval: 28/6/24). Written informed consent was obtained from all participating mothers before their inclusion in the study. Confidentiality and anonymity of all participants were strictly maintained throughout the research process.

Availability of Data and Materials
The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

Competing Interests
The authors declare that they have no competing interests.

Funding

The study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors 'Contributions

The study was conceptualized and designed as part of postgraduate thesis work. Data collection, statistical analysis, interpretation of results, manuscript drafting, and critical revision were carried out collaboratively by the authors. All authors read and approved the final manuscript.

Acknowledgements

The authors acknowledge the support of the Department of Paediatrics, Shri Dada Dev Matri Avum Shishu Chikitsalaya, New Delhi, for facilitating the conduct of the study. The authors also thank all participating mothers and neonates for their cooperation.

REFERENCES

1. WHO. Prevalence of anemia in pregnant women (aged 19-45 years), Geneva, World Health Organisation 2022.
2. Kalaivani K. Prevalence & consequences of anaemia in pregnancy. Indian J Med Res. 2009 Nov;130(5):627-33.
3. Suryanarayana R, Chandrappa M, Santhuram AN, Prathima S, Sheela SR. Prospective study on prevalence of anemia of pregnant women and its outcome: A community based study. J Family Med Prim Care. 2017 Oct-Dec;6(4):739-743.
4. Tandon R, Jain A, Malhotra P. Management of Iron Deficiency Anemia in Pregnancy in India. Indian J Hematol Blood Transfus. 2018 Apr;34(2):204-215. doi: 10.1007/s12288-018-0949-6. Epub 2018 Mar 14.
5. D.C. Dutta's textbook of Obstetrics, Medical and Surgical Illnesses Complicating Pregnancy, 247.
6. Zulfiqar H, Shah IU, Sheas MN, Ahmed Z, Ejaz U, Ullah I, et al.Dietary association of iron deficiency anemia and related pregnancy outcomes. Food Sci Nutr 2021; 9(8):4127-4133.
7. Kalaivani K. Prevalence & consequences of anaemia in pregnancy. Indian J Med Res. 2009 Nov;130(5):627-33.
8. Singla PN, Tyagi M, Shankar R, Dash D, Kumar A. Fetal iron status in maternal anemia. Acta Paediatr. 1996 Nov;85(11):1327-30.
9. Basu S, Kumar D, Anupurba S, Verma A, Kumar A. Effect of maternal iron deficiency anemia on fetal neural development. J Perinatol. 2018 Mar;38(3):233-239.
10. Carlo WA. Prematurity and intra uterine growth restriction. In Nelson textbook of pediatrics. 19th edition Philadelphia: Elsevier Saunders. 2012: 91 (2): 555-57.
11. Lone FW, Qureshi RN, Emanuel F. Maternal anemia and its impact on perinatal outcome. Trop med int health. 2004: 9(4):486-90.
12. National Health Mission. Anaemia Mukt Bharat [Internet]. New Delhi: National Health Mission; [cited 2025 Feb 27]. Available from: https://nhm.gov.in/index1.php?lang=1&level=3&sublinkid=1448&lid=797
13. Allen LH. Anemia and iron deficiency: effects on pregnancy outcome. Am J Clin Nutr. 2000 May;71(5 Suppl):1280S-4S. doi: 10.1093/ajcn/71.5.1280s.
14. Behal M, Vinayak R, Sharma A. Maternal anemia and its effects on neonatal anthropometric parameters in patients attending a tertiary care institute of Solan, Himanchal Pradesh, India. Int J Reprod Contracept Obstet Gyenecol 2018; 7(2): 553.
15. Srimani P, Sengupta D, Bharati P, Bharati S. The effect of maternal anemia on different anthropometric parameters of newborns - A case-control study. J Family Med Prim Care. 2025 May;14(5):1735-1740.
16. Dhole D, Kolhe S, Saxena A, Sharif M, Hedaginal VP. (2022). Effect of Maternal Hemoglobin on Neonatal Anthropometry: A prospective Observational Study.
17. Anwar A, Kafait Y, Harris Bin Afzal, Manzoor A, Tooba Kafait, Tarrar SH. Anthropometric Measurements in Term Neonates at Birth in Pregnant Patients with and without Anemia. JHWCR. 2025 Jul. 15; 3(8):e487.
18. Bakacak M, Avci F, Ercan O, Köstü B, Serin S, Kiran G, Bostanci MS, Bakacak Z. The effect of maternal hemoglobin concentration on fetal birth weight according to trimesters. J Matern Fetal Neonatal Med. 2015;28(17):2106-10.
19. Das JC. Anthropometric Parameters of Newborn Infants. J Chittagong Med Coll Teachers Ass [Internet]. 2013 Mar. 31 [cited 2025 Dec. 5];23(2):38-41.
20. Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. World Health Organ Tech Rep Ser. 1995;854:1-452.
21. Behrman RE. Nelson textbook of pediatrics.
22. Shastry C, Bhat B. Anthropometric measurements of newborns. Int J Contemp Pediatr. 2015 May;2(2):85.
23. Pankaj S, Kanchan K. Correlation of birth weight with other anthropometric parameters of newborns in Himachal Pradesh. Int J Cur Res Rev. 2017 Aug;9:49-54.
24. Siza JE. Risk factors associated with low birth weight of neonates among pregnant women attending a referral hospital in northern Tanzania. Tanzan J Health Res. 2008 Jan;10(1):1-8.
25. World Health Organization. Regional Office for Europe: Health 21 x The introduction to the health for all policy for the WHO European region. World Health Organization. x Copenhagen. 2006.
26. Tema T. Prevalence and determinants of low birth weight in Jimma Zone, Southwest Ethiopia. East Afr Med J. 2006 Jul;83(7):366-71.

27. Moghaddam Tabrizi F, Saraswathi G. Maternal anthropometric measurements and other factors: relation with birth weight of neonates. Nutr Res Pract. 2012 Apr;6(2):132-7.
28. Khong TY, Adema ED, Erwich JJ. On an anatomical basis for the increase in birth weight in second and subsequent born children. Placenta. 2003;24:348–353.
29. Prefumo F, Ganapathy R, Thilaganathan B, Sebire NJ. Influence of parity on first trimester endovascular trophoblast invasion. Fertility Sterility. 2006;85:1032–1036.