

Association of Maternal Serum Calcium with Neonatal Birth Weight in Term Deliveries

Ananna Sharmin Smita¹, Ferdous Jahan Binte Rashid², Kaberi Das³, Nazma Akter Ripa⁴, Rezina Afrin^{5*}, Shrabanti Mala⁶, Ayesha Siddika⁷, Ireen Akhter⁸

ARTICLE INFO

Received: 30 Apr 2026

Accepted: 8 May 2026

Published Online: 17 May 2026

DOI: 10.5281/zenodo.20258158

Volume: 9, Number: 3, Page: 6-10

e-ISSN: 2789-5912

ISSN: 2617-0817

*Corresponding author



ABSTRACT

Background: Low birth weight is a major public health issue in Bangladesh, often linked to maternal calcium deficiency during pregnancy—affected by poor intake and low vitamin D and Mg—which may impair fetal growth; this study aimed to assess the association between maternal serum calcium and neonatal birth weight in term deliveries. **Methods & Materials:** This case-control study (Jan–Dec 2021) at ICMH, Dhaka included 56 pregnant women (37–42 weeks); 28 cases (birth weight <2.5 kg) and 28 controls (≥ 2.5 –<4.0 kg), with data collected via interview, examination, and lab tests, neonatal weight measured within 48 h, maternal serum calcium analyzed from venous blood, and data processed using SPSS 27 with ethical approval obtained. **Results:** The mean ($\pm$ SD) calcium level was much lower among the cases than the controls, 8.01 ± 0.94 mg/dL and 9.05 ± 1.48 mg/dL respectively. This difference was found statistically significant ($p=0.003$). Considering calcium level of 8 mg/dL as the cut-off value, odd's ratio calculation showed the mother with calcium level <8.0 mg/dL had 4.6 times more chance to giving birth to low-birth-weight neonate compared to those with calcium level ≥ 8.0 mg/dL ($p=0.007$; OR=4.636; CI_{95%}=1.478–14.543). There was a significant positive correlation of serum calcium level with neonatal birth weight ($r = 0.398$, $p=0.002$). **Conclusion:** A low serum calcium level was commonly observed in women in term deliveries who just had delivered a LBW neonate. Therefore, maternal serum calcium status was found associated with neonatal birth weight.

Keywords: Maternal serum calcium; Low birth weight; Neonatal outcomes; Pregnancy; Calcium deficiency; Term delivery.

1. Assistant Professor & Resident Surgeon, Department of Gynaecology and Obstetrics, Shaheed Suhrawardi Medical College & Hospital, Sher E Bangla Nagar, Dhaka, Bangladesh (ORCID: 0009-0009-8210-9141)
2. Assistant Professor, Department of Gynaecology and Obstetrics, Tangail Medical College Hospital, Tangail, Bangladesh (ORCID: 0009-0002-6041-7222)
3. Assistant Surgeon, Upazila Health Complex, Harirampur, Manikganj, Bangladesh (ORCID: 0009-0006-6377-6668)
4. Assistant Professor, Department of Gynaecology and Obstetrics, One Stop Crisis Centre, Dhaka Medical College Hospital, Dhaka, Bangladesh (ORCID: 0009-0004-5719-7980)
5. Medical Officer, Department of Gynecological Oncology, National Institute of Cancer Research and Hospital, Dhaka, Bangladesh (ORCID: 0009-0003-4266-8084)
6. Medical Officer, Harirampur Upazilla Health Complex, Manikganj, Bangladesh (ORCID: 0009-0002-9091-9565)
7. Assistant Professor, Department of Gynaecology and Obstetrics, Shaheed Suhrawardy Medical College Hospital, Dhaka, Bangladesh (ORCID: 0009-0005-6649-305X)
8. Medical Officer, Department of Gynaecology and Obstetrics, Shaheed Suhrawardy Medical College Hospital, Dhaka, Bangladesh (ORCID: 0009-0006-1633-7451)

INTRODUCTION

Birth weight or size at birth is a crucial indicator of a child's vulnerability to illness and a strong predictor of future health, growth, and survival outcomes [1]. Based on birth weight, newborns are commonly classified into three categories: normal birth weight (≥ 2.5 kg to <4.0 kg), low birth weight (LBW, <2.5 kg), and macrosomia (≥ 4.0 kg) [2]. Both extremes fetal macrosomia and intrauterine growth restriction—are associated with increased risks of perinatal morbidity, mortality, and long-term neurodevelopmental complications [3].

Maternal health and nutritional status during pregnancy play a central role in determining fetal growth and birth weight [4]. Adequate intake of essential nutrients through a balanced diet is therefore critical for optimal fetal development and long-term child health outcomes [5]. Birth weight is ideally measured within the first hour

after delivery before significant postnatal weight loss occurs [6]. According to the World Health Organization (WHO), LBW is defined as a birth weight of less than 2500 grams, with further subcategories including very low birth weight (VLBW, <1500 g) and extremely low birth weight (ELBW, <1000 g) [7].

LBW may result from preterm birth, intrauterine growth restriction (IUGR), or a combination of both, and the severity of growth restriction is directly associated with increased mortality risk [8]. Globally, LBW remains a major public health concern. In 2015, approximately 20.5 million newborns—nearly one in seven births—were classified as LBW, with almost half occurring in South Asia [9]. The burden is particularly high in developing countries, where maternal undernutrition and limited access to antenatal care are prevalent. For example, Bangladesh continues to report a high prevalence of

LBW, contributing significantly to neonatal morbidity and mortality [10]. In such settings, most LBW infants are born at term but are small for gestational age (SGA), reflecting chronic maternal undernutrition rather than prematurity [11]. LBW is associated with a wide range of adverse outcomes, including increased risk of neonatal complications such as respiratory distress, hypothermia, and hypoglycemia, as well as long-term consequences like stunting, cognitive impairment, and chronic diseases in adulthood [12]. These risks highlight the importance of identifying modifiable maternal factors that influence fetal growth. Maternal nutritional and metabolic status significantly affect fetal development and birth weight. Pregnancy imposes increased nutritional demands, requiring sufficient intake of energy and micronutrients to support both maternal physiological changes and fetal growth.

Among essential micronutrients, calcium plays a vital role in skeletal development, neuromuscular function, and hormonal regulation. During pregnancy, calcium requirements increase substantially due to fetal skeletal mineralization, particularly in the third trimester. Inadequate maternal calcium intake or impaired absorption may therefore adversely affect fetal growth and birth outcomes [13].

Despite the biological plausibility of a relationship between maternal calcium status and neonatal birth weight, existing evidence remains inconsistent. Some studies have reported a significant association between maternal hypocalcemia and LBW, while others have found weak or no correlation. Given these conflicting findings, further investigation is warranted to clarify the role of maternal serum calcium in determining neonatal birth weight, particularly in resource-limited settings [14].

METHODS & MATERIALS

This case-control study was conducted in the Department of Obstetrics and Gynaecology at the Institute of Child and Mother Health, Dhaka, from January to December 2021, among women aged 18–35 years who had term deliveries (37–42 weeks of gestation). The study population comprised postnatal women, where cases included mothers who delivered low birth weight (LBW) neonates (<2.5 kg) and controls were age- (± 3 years) and gestational age-matched mothers who delivered normal birth weight neonates (≥ 2.5 to <4 kg). A non-randomized purposive sampling technique was used, yielding a total sample size of 56 participants (28 cases and 28 controls), calculated using a standard formula for comparison of two means with a 10% adjustment for non-response. Inclusion

criteria encompassed singleton pregnancies with term deliveries, while women with chronic systemic diseases, pregnancy complications, multiple gestations, fetal anomalies, or lack of consent were excluded. Data were collected using a predesigned semi-structured questionnaire covering socio-demographic, obstetrical, anthropometric, and biochemical variables, with neonatal birth weight (measured within 48 hours using a calibrated electronic scale) as the dependent variable and maternal serum calcium level as the independent variable. Maternal blood (2 mL) was collected aseptically from the antecubital vein immediately postpartum, and serum calcium was analyzed using a fully automated clinical chemistry analyzer. Standard operational definitions were applied for LBW, term pregnancy, antenatal care, BMI, socioeconomic status, and serum calcium levels. Data were analyzed using SPSS version 27.0, employing unpaired t-tests, chi-square tests, Pearson's correlation, and odds ratio estimation with 95% confidence intervals; a p-value ≤ 0.05 was considered statistically significant. Ethical approval of this study was obtained from the Institutional Review Board (IRB) of Institute of Child and Mother Health (ICMH), Matuail, Dhaka, Bangladesh.

RESULTS

Table 1 shows in this case-control study, a total of 56 postnatal women with term deliveries were included, comprising 28 (50.0%) cases (mothers who delivered low birth weight neonates) and 28 (50.0%) controls (mothers who delivered normal birth weight neonates). The socio-demographic characteristics of the mothers were comparable between case and control groups. The majority of mothers in both groups were aged 21–29 years, accounting

for 15 (53.6%) in each group. A smaller proportion belonged to the ≤ 20 years [3 (10.7%) vs 5 (17.9%)] and 30–35 years [10 (35.7%) vs 8 (28.6%)] categories among cases and controls, respectively, with no statistically significant difference observed between the groups ($p=0.711$). The mean age was 27.29 ± 4.72 years among cases and 26.43 ± 5.05 years among controls, which was also not statistically significant ($p=0.515$). Regarding residence, most mothers in both groups were from rural areas, comprising 21 (75.0%) of cases and 16 (57.1%) of controls, while 7 (25.0%) cases and 12 (42.9%) controls were from urban areas; this difference did not reach statistical significance ($p=0.158$). Educational status was similarly distributed between the groups, with the highest proportion having primary-level education [11 (39.3%) in cases and 13 (46.4%) in controls], followed by secondary [8 (28.6%) vs 7 (25.0%)], illiterate [4 (14.3%) vs 3 (10.7%)], higher secondary [4 (14.3%) vs 3 (10.7%)], and graduate and above [1 (3.6%) vs 2 (7.1%)], with no significant association ($p=0.950$). In terms of occupation, the majority of mothers were housewives in both groups [23 (82.2%) of cases and 20 (71.4%) of controls], followed by day laborers [2 (7.1%) vs 5 (17.9%)] and jobholders [3 (10.7%) in each group], with no statistically significant difference ($p=0.531$). Monthly family income distribution was also comparable between the two groups, with most mothers belonging to the lower middle-class category [21 (75.0%) of cases and 20 (71.4%) of controls], followed by upper middle class [3 (10.7%) vs 6 (21.4%)], lower class [3 (10.7%) vs 2 (7.1%)], and upper class [1 (3.6%) vs 0 (0.0%)]; no significant difference was observed across income categories ($p=0.653$).

Table 1

Distribution of the respondents according to socio-demographic variables by group ($n=56$).

Socio-demographic variables	Group		p-value
	Case (n=28)	Control (n=28)	
	n (%)	n (%)	
Age (years)			
≤ 20	3 (10.7)	5 (17.9)	0.711a
21 – 29	15 (53.6)	15 (53.6)	
30 – 35	10 (35.7)	8 (28.6)	
Mean $\pm$ SD	27.29 $\pm$ 4.72	26.43 $\pm$ 5.05	0.515b
Residence			
Rural	21 (75.0)	16 (57.1)	0.158c
Urban	7 (25.0)	12 (42.9)	
Education			
Illiterate	4 (14.3)	3 (10.7)	0.950a
Primary	11 (39.3)	13 (46.4)	
Secondary	8 (28.6)	7 (25.0)	
Higher secondary	4 (14.3)	3 (10.7)	
Graduate and above	1 (3.6)	2 (7.1)	
Occupation			

Housewife	23 (82.2)	20 (71.4)	0.531a
Day laborer	2 (7.1)	5 (17.9)	
Jobholder	3 (10.7)	3 (10.7)	
Monthly family income (in taka)			
Lower class ($\leq 7,378$)	3 (10.7)	2 (7.1)	0.653a
Lower middle class (7,379–28,810)	21 (75.0)	20 (71.4)	
Upper middle class (28,811–89,280)	3 (10.7)	6 (21.4)	
Upper class ($\geq 89,281$)	1 (3.6)	0 (0.0)	

Fisher's Exact test was done to measure the level of significance; Un-paired t-test was done to measure the level of significance. Chi-square test was done to measure the level of significance. Figure within parentheses indicates in percentage.

Table II presents regarding gravida status, 13 (46.4%) mothers in the case group and 20 (71.4%) in the control group were primigravida, while 15 (53.6%) cases and 8 (28.6%) controls were multigravida.

Although a higher proportion of primigravida mothers was observed in the control group, the difference was not statistically significant ($p=0.057$). The mean gestational age was 38.46 ± 0.96

weeks among cases and 38.82 ± 1.25 weeks among controls, with no statistically significant difference between the groups ($p=0.236$).

Table II

Distribution of the respondents according to obstetric history by group ($n=56$).

Obstetric variables	Group		p-value
	Case (n=28)	Control (n=28)	
	n (%)	n (%)	
Gravida			
Primigravida	13 (46.4)	20 (71.4)	0.057c
Multi gravida	15 (53.6)	8 (28.6)	
Gestational age (in weeks)			
Mean $\pm$ SD	38.46 ± 0.96	38.82 ± 1.25	0.236b

Un-paired t-test was done to measure the level of significance; Chi-square test was done to measure the level of significance; Figure within parentheses indicates in percentage.

Table III shows the distribution of mothers according to ante-natal visits was comparable between the case and control groups. Among the cases, 17 (60.7%) mothers had regular ante-natal check-ups,

whereas 23 (82.1%) mothers in the control group received regular care. Conversely, irregular ante-natal visits were reported in 11 (39.3%) cases and 5 (17.9%) controls. Although a higher proportion of mothers in

the control group had regular ante-natal check-ups, the difference was not statistically significant ($p=0.076$).

Table III

Distribution of the respondents according to ante-natal visits by group ($n=56$).

Parameter	Group		p-value
	Case (n=28)	Control (n=28)	
	n (%)	n (%)	
Ante-natal check-up			
Regular	17 (60.7)	23 (82.1)	0.076c
Irregular	11 (39.3)	5 (17.9)	

Chi-square test was done to measure the level of significance; Figure within parentheses indicates in percentage.

Table IV shows among the cases, 6 (21.4%) mothers had normal BMI, 21 (75.0%) were overweight, and 1 (3.6%) was obese. In the control group, 8 (28.6%) mothers had normal BMI, 20 (71.4%) were

overweight, and none (0.0%) were obese. The majority of mothers in both groups were overweight, and no statistically significant difference was observed in BMI categories between the groups ($p=0.758$).

The mean BMI was 26.29 ± 1.81 kg/m² among cases and 26.02 ± 1.71 kg/m² among controls, which was also not statistically significant ($p=0.566$).

Table IV

Distribution of the respondents according to BMI by group ($n=56$).

BMI (kg/m ²)	Group		p value
	Case (n=28)	Control (n=28)	
	n (%)	n (%)	
Normal (18.5–24.9)	6 (21.4)	8 (28.6)	0.758a
Overweight (25.0–29.9)	21 (75.0)	20 (71.4)	
Obese (≥ 30.0)	1 (3.6)	0 (0.0)	
Mean $\pm$ SD	26.29 ± 1.81	26.02 ± 1.71	0.566b

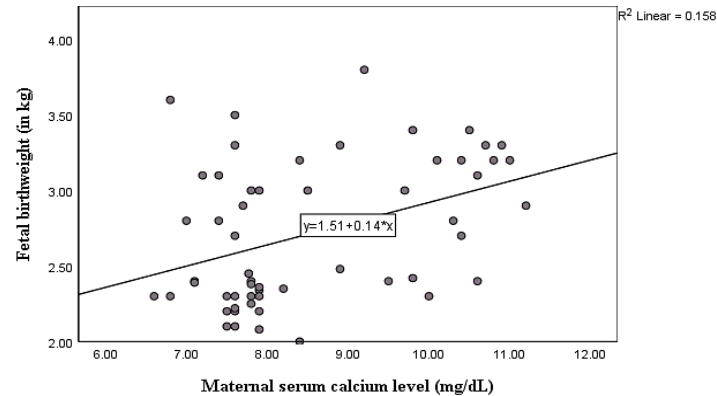
Fisher's Exact test was done to measure the level of significance; Unpaired t-test was done to measure the level of significance; Figure within parentheses indicates in percentage.

Table V shows the mean ($\pm$ SD) serum calcium level among cases was 8.01 ± 0.94 mg/dL, whereas it was higher in controls at 9.05 ± 1.48 mg/dL. This difference was statistically significant ($p=0.003$).

Table V
Distribution of mean ($\pm$ SD) maternal calcium level by group ($n=56$).

Maternal serum Ca level (mg/dL)	Group		p value
	Case (n=28)	Control (n=28)	
	n (%)	n (%)	
Mean $\pm$ SD	8.01 ± 0.94	9.05 ± 1.48	0.003b

Unpaired t test was done to measure the level of significance.



(R^2 = percentage of variability of neonatal birth weight due to low serum calcium level and vice versa , r = Pearson's correlation coefficient).

Figure 1 Scatterplot diagram showing correlation between maternal serum calcium level and neonatal birth weight ($n=56$).

Figure 1 show a positive linear correlation was observed, indicating that higher maternal serum calcium levels were associated with higher neonatal birth weights. The regression line ($y = 1.51 + 0.14 \times x$) suggests that for each unit increase in maternal serum calcium level (mg/dL), neonatal birth weight increased by approximately 0.14 kg. The coefficient of determination ($R^2 = 0.158$) indicates that about 15.8% of the variation in neonatal

birth weight can be explained by maternal serum calcium levels.

Table VI presents the association between maternal serum calcium level and neonatal birth weight was assessed using odds ratio analysis. Among mothers with serum calcium levels <8.0 mg/dL, 21 (75.0%) were in the case group and 11 (39.3%) were in the control group. In contrast, among those with serum calcium levels ≥ 8.0 mg/dL, 7 (25.0%) were cases and 17

(60.7%) were controls. The difference between the groups was statistically significant ($p=0.007$). Mothers with serum calcium levels <8.0 mg/dL had 4.636 times higher odds of delivering low birth weight neonates compared to those with serum calcium levels ≥ 8.0 mg/dL (OR = 4.636; 95% CI: 1.478–14.543). Overall, low maternal serum calcium level was significantly associated with an increased risk of low birth weight in neonates.

Table VI
Odds ratio (OR) and 95% confidence interval (CI) for neonatal birth weight according to maternal serum calcium level in pregnancy ($n=56$).

Serum Ca level (mg/dL)	Groups		p-value	Odds Ratio (95% CI)
	Case (n=28)	Control (n=28)		
	n (%)	n (%)		
< 8.0 mg/dL	21 (75.0)	11 (39.3)	0.007*	4.636 (1.478-14.543)
≥ 8.0 mg/dL	7 (25.0)	17 (60.7)		

*Chi-square test was done to measure the level of significance. Figure within parenthesis indicates in percentage. CI = Confidence Interval

DISCUSSION

There has been considerable speculation regarding the role of trace metals, including calcium, in influencing the occurrence of low birth weight (LBW). This case-control study aimed to determine the association between maternal serum calcium level and neonatal birth weight by comparing serum calcium concentrations between mothers who delivered LBW neonates (<2.5 kg) and those with normal birth weight neonates (≥ 2.5 kg). A total of 56 singleton pregnant women at term (37–

42 weeks gestation) who delivered at the Institute of Child and Mother Health, Matuail, Dhaka, were included, divided equally into case and control groups matched by age and delivery time. The age distribution was similar between groups, with the majority (53.6%) aged 21–29 years, and mean ages of 27.29 ± 4.72 years and 26.43 ± 5.05 years in cases and controls, respectively. Most participants resided in rural areas (cases 75.0%, controls 57.1%), and primary education was the most common educational level in

both groups. Homemakers predominated (cases 82.2%, controls 71.4%) with the majority belonging to the lower middle-class income bracket. No statistically significant differences were found in socio-demographic variables between groups, consistent with Bhaskar et al. [15], who similarly reported no significant association of maternal age, residence, or income with LBW. Furthermore, Doi et al. [16] highlighted the influence of socio-economic status on calcium levels in cord blood, reinforcing the importance of

considering these factors in maternal and neonatal outcomes. Regarding obstetric history, no significant differences were noted between cases and controls in gravida status, antenatal visit frequency, or gestational age at delivery.

The mean gestational ages were comparable (38.46 ± 0.96 weeks vs. 38.82 ± 1.25 weeks). The majority in both groups had regular antenatal check-ups (cases 60.7%, controls 82.1%). BMI distributions were also similar, with most mothers classified as overweight. This contrasts with Liu et al. [17], who found maternal BMI to be strongly associated with both fetal overgrowth and LBW outcomes, likely due to differences in population characteristics and sample size.

Importantly, maternal serum calcium levels were significantly lower in the case group (8.01 ± 0.94 mg/dL) compared to controls (9.05 ± 1.48 mg/dL), with a positive correlation observed between serum calcium and neonatal birth weight ($r = 0.398$, $p = 0.002$). Mothers with calcium levels below 8.0 mg/dL had 4.63 times higher odds of delivering LBW neonates (OR = 4.636; 95% CI: 1.478–14.543). These findings align with previous research by Yang et al. [18], who reported a decreasing risk of very LBW with increasing calcium levels in drinking water. Sabour et al. [19] demonstrated that adequate maternal calcium and vitamin D intake was associated with improved neonatal outcomes, including birth length and Apgar scores. Similarly, Doi et al. [16] found a significant association between maternal serum calcium and newborn size and weight, supporting our observed positive correlation. Khoushabi et al. [20] reported higher calcium concentrations in cord blood of normal birth weight neonates compared to LBW counterparts. Yadav et al. [21] identified inadequate calcium consumption as a significant risk factor for LBW. Debbarma and Mehta [22] also observed that normal maternal serum calcium levels were linked with delivery of full-term neonates with normal birth weight, whereas low calcium levels were associated with LBW, further emphasizing the potential role of calcium supplementation. Taken together, the current study reinforces concerns about the impact of low maternal serum calcium on fetal growth restriction and subsequent LBW at term. These findings underscore the need for adequate calcium

supplementation and consumption of calcium-rich foods during pregnancy to support optimal fetal development, potentially improving perinatal outcomes and child survival rates.

CONCLUSION

Based on the results presented in this study, findings suggest that women with inadequate serum calcium level (<8.0 mg/dL) carry higher risk of giving birth to LBW neonates than women with serum calcium level (≥ 8.0 mg/dL). So, low maternal serum calcium level may be considered as a risk factor for neonatal lower birth weight.

LIMITATIONS OF THE STUDY

This study had some limitations as well. The study population was relatively small and pregnant women were chosen from ICMH, Matuail Dhaka; so, the results of this study may not reflect the exact picture of the whole country. The present study was conducted in short period of time. The sample was taken purposively. So, there may be a chance of bias that can influence the results. Other potential risk factors for low birth weight including maternal urinary tract or genital infections, anemia, other toxic exposures, dietary deficiencies, were not evaluated. Therefore, the study findings cannot be generalized to the entire population.

REFERENCES

- Sebayang SK, Dibley MJ, Kelly PJ, Shankar AV, Shankar AH. Determinants of low birthweight, small-for-gestational-age and preterm birth in Lombok, Indonesia. *Paediatr Perinat Epidemiol*. 2012;26(3):273–83.
- Abubakari A, Kynast-Wolf G, Jahn A. Maternal determinants of birth weight in Northern Ghana. *PLoS One*. 2015;10(8):e0135641.
- Nahum GG. Intrauterine growth restriction and fetal macrosomia. *Obstet Gynecol Clin North Am*. 2003;30(2):321–36.
- Muthayya S. Maternal nutrition & low birth weight—what is really important? *Indian J Med Res*. 2009;130(5):600–8.
- Tunçalp Ö, Pena-Rosas JP, Lawrie T, Bucagu M, Oladapo OT, Portela A, et al. WHO recommendations on antenatal care for a positive pregnancy experience. *Lancet*. 2020;395(10225):156–8.
- Cutland CL, Lackritz EM, Mallett-Moore T, Bardaji A, Chandrasekaran R, Lahariya C, et al. Low birth weight: Case definition & guidelines. *Vaccine*. 2017;35(48 Pt A):6492–500.

- World Health Organization. Low birth weight: Country, regional and global estimates. Geneva: WHO; 2004.
- World Health Organization. Global nutrition targets 2025: Low birth weight policy brief. Geneva: WHO; 2014.
- World Health Organization, UNICEF. Low birthweight estimates: Levels and trends 2000–2015. Geneva: WHO; 2019.
- Shaheen N, Ahmed T, Rahman SM, et al. Maternal and neonatal health indicators in Bangladesh. *BMC Pregnancy Childbirth*. 2020;20:123.
- Qadir M, Bhutta ZA. Low birth weight in developing countries. *Lancet*. 2009;374(9690):1747–8.
- Gladstone M, Oliver C, Van den Broek N. Survival, morbidity, growth and developmental delay for babies born preterm in low-income settings. *Lancet*. 2021;398(10295):389–403.
- Kovacs CS. Calcium and bone metabolism during pregnancy and lactation. *J Clin Endocrinol Metab*. 2016;101(2):509–18.
- Doi M, Yonemoto N, Shibuya K. Calcium supplementation during pregnancy and low birth weight: systematic review and meta-analysis. *BMC Pregnancy Childbirth*. 2011;11:67.
- Bhaskar RK, Patra S, Roy TK, Pradhan S, Mahapatra SC. Socio-demographic factors and low birth weight: A hospital based study from Eastern India. *Indian J Public Health*. 2015;59(2):129–134.
- Doi T, Koyama S, Imai S, Ishizaki T. Socioeconomic status and calcium levels in cord blood: A study of maternal factors affecting neonatal size. *J Obstet Gynaecol Res*. 2011;37(12):1759–1765.
- Liu X, Ding G, Li H, et al. Maternal body mass index and risk of adverse birth outcomes: A population-based study. *BMC Pregnancy Childbirth*. 2019;19(1):210.
- Yang CY, Chiu HF, Cheng BH, Chen PC. Calcium levels in drinking water and risk of low birth weight. *Arch Environ Health*. 2002;57(5):422–426.
- Sabour H, Turrioni S, Bertolozzi I, et al. Maternal calcium and vitamin D intake and neonatal outcomes. *Eur J Clin Nutr*. 2006;60(10):1156–1162.
- Khoushabi F, Hossaini M, Gharavi F. Cord blood calcium levels and neonatal birth weight: A comparative study. *J Matern Fetal Neonatal Med*. 2016;29(22):3703–3707.
- Yadav A, Bharti B, Mahajan P. Risk factors for low birth weight in rural India: A case-control study. *Int J Community Med Public Health*. 2019;6(9):3907–3912.
- Debbarma S, Mehta S. Effect of maternal serum calcium on birth weight of newborns. *Int J Reprod Contracept Obstet Gynecol*. 2018;7(7):2765–2769.