Original Article

Impact of Calcium Supplementation during Pregnancy on Neonatal Birth Weight in Term Deliveries

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ABSTRACT

Introduction: *Calcium is a vital nutrient during pregnancy, essential for fetal development, especially due to its role in maternal-fetal calcium transfer. Previous research has linked low maternal calcium levels to adverse outcomes including low birth weight, complications like preeclampsia and preterm delivery, and reduced fetal bone mineral density. This study aimed to evaluate the impact of calcium supplementation during pregnancy on neonatal birth weight.* ***Methods and materials:*** *This was a cross-sectional study that was conducted in the Department of Obstetrics and Gynaecology at the Institute of Child & Mother Health (ICMH), Dhaka, Bangladesh from September 2018 to August 2019. A total of 98 women with uncomplicated, singleton, term pregnancies attending the ICMH were purposefully enrolled as study subjects. Data were processed and analyzed using MS Excel and the SPSS version 22.0 program as necessary.* ***Results:*** *In this study, 80.6% of participants consistently used calcium supplements. Among them, 73.47% had normal serum calcium levels, and 26.53% had low levels. Regular calcium supplement users (98.6%), had statistically significant ($p < 0.0001$)*

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normal calcium levels. Lower calcium correlated with more low birth weight babies (86.36%). Conversely, 84.21% of normal-weight newborns had mothers with normal calcium levels, also statistically significant ($p < 0.0001$). ***Conclusion:*** *This study emphasizes the importance of consistent calcium supplementation during pregnancy for maintaining normal serum calcium levels, which can positively impact birth weight outcomes. It highlights the need to promote and encourage pregnant women to take recommended calcium supplements for maternal and fetal health.*

Keywords: *Serum calcium, Maternal, Neonatal, Birth weight, Term delivery*

INTRODUCTION

Pregnancy entails an increased demand for various nutrients, including minerals. The significance of maintaining mineral balance during pregnancy often goes unrecognized. The research underscores the pivotal role of trace elements and minerals in fetal development, with their transfer to the fetus occurring predominantly in the later stages of pregnancy, while also contributing to overall development throughout the gestational period [1]. Notably, calcium, a vital mineral, is transported from the mother to the fetus via the placenta, particularly during the third trimester [2]. The mother's calcium requirements are met through heightened intestinal calcium absorption, reduced calcium excretion, and increased resorption from her skeletal reserves [3]. Inadequate intake of this nutrient during pregnancy can have detrimental consequences for both the mother and the fetus, giving rise to complications such as osteopenia, muscle cramps, tremors, paresthesia, tetanus, and impaired fetal growth, potentially resulting in low birth weight [4]. An infant's birth weight, measured ideally within the first hour after delivery, represents a crucial indicator. As per the World Health Organization (WHO) classification, low birth weight (LBW) is defined as less than 2500 g, inclusive of 2499 g [5]. To address this, all pregnant women are prescribed calcium supplements (1000 mg) starting from the second trimester onwards. However, a significant number of women discontinue the supplements and fail to maintain a calcium-rich diet due to insufficient awareness regarding the significance of calcium intake during both pregnancy and lactation. Consequently, there exists a crucial necessity to educate them about the critical role of calcium. Notably, maternal calcium supplementation of approximately 2g/day during the mid-pregnancy stage holds the potential to influence fetal bone mineralization [6, 7]. Intriguingly, certain earlier studies have presented conflicting outcomes, indicating variations in the positive associations between maternal calcium intake and newborn weight [8, 9]. The primary aim of this present study was to assess the impact of calcium supplementation during pregnancy on neonatal birth weight.

METHODS AND MATERIALS

This cross-sectional study was conducted in the Department of Obstetrics and Gynecology at the Institute of Child & Mother Health (ICMH), Dhaka, Bangladesh from September 2018 to August 2019. A total of 98 women, with uncomplicated, singleton, term pregnancies and attending ICMH, were

enrolled as study subjects using a purposive sampling technique. Ethical approval from the hospital's committee was obtained, and written consent was acquired from participants before data collection. Inclusion criteria comprised ages 18 to 35 years, pregnancies between 37 to 42 weeks, singleton gestation, and willingness to participate. Exclusion criteria encompassed previous low birth weight delivery, multiple pregnancies, specific maternal conditions, and disorders. Demographic and clinical data were documented and processed using MS Excel and SPSS version 22.0. A significance level of $P < 0.05$ guided the statistical analyses.

RESULT

The study's participants exhibited a mean age of 24.57±3.94 years, ranging from 18 to 35 years. A considerable portion (49.00%) fell within the 21-25 years bracket. The majority of participants (82.7%) resided in urban areas, and the predominant religion was Muslim (86.7%). Educational attainment exhibited variability, with the largest segment of pregnant women not exceeding the secondary school certificate exam threshold (43.9%), followed by those who cleared SSC (21.4%), and those who were illiterate (16.3%). Around 9.2% of the population had completed higher secondary exams and college graduation. The majority of participants were engaged as housewives (81.0%) **(Table I)**.

Table I: Distribution of sociodemographic variables (N=98)

Variables	n	%
Age (in years)		
≤20 years	11	11.2%
21-25 years	48	49%
26-30 years	33	33.7%
31-35years	6	6.1%
Mean ±SD	24.57±3.94	
Residence		
Urban	81	82.7%
Rural	17	17.3%
Religion		
Islam	85	86.7%
Hinduism	13	13.3%
Educational status		
Illiterate	16	16.3%
Below SSC	43	43.9%
SSC	21	21.4%
HSC	9	9.2%
Graduate and above	9	9.2%
Occupational status		
Housewife	79	80.6%
Government service	4	4.1%
Non govern employee	7	7.1%
Business	2	2.1%
Others	6	6.1%

Among the participants, full-term pregnancy predominated (75.5%), succeeded by early-term pregnancy (20.4%) and late-term pregnancy (4.1%), arranged in decreasing order of prevalence **(Table II)**.

Table II: Gestational age distribution (N=98)

Gestational age (weeks)	n	%
Early term (37-38 weeks)	20	20%
Full term (39-40 weeks)	74	76%
Late-term (41-42 weeks)	4	4%
Total	98	100%

This study involved 98 respondents, with a substantial portion of 79 individuals (80.6%) reporting consistent usage of their calcium supplements. Among the participants, 72 (73.47%) demonstrated serum calcium levels within the normal range, while 26 pregnant mothers (26.53%) had levels below the normal range. The mean ± SD value of serum calcium level was determined to be 8.94 ± 0.93 mg/dl **(Table III)**.

Table III: History of taking calcium supplements (N=98)

Taking calcium supplement	n	%
Regular taking	79	81%
Irregular taking	19	19%

Serum Calcium level was below normal for 27% of the participants, while it was within the normal range for 73% of the participants, with a mean ±SD distribution of 8.94±0.93 mg/dl **(Table IV)**

Table IV: Serum calcium level among study subjects (N=98)

Serum calcium level (mg/di)	n	%
Below normal (<8.1 mg/di)	26	27%
Normal (8.1-10.4 mg/dl)	72	73%
Mean ±SD (mg/dl)	8.94 ±0.93	

27.6% of the participants had low birth weight, and 72.4% had normal birthweight. The Mean±SD weight of the participants was 2.81±0.37 kg **(Table V).**

Table V: Distribution of the newborns according to their birth weight (N=98)

Body weight at birth (Kg)	n	%
Low birth weight (<2.5 Kg)	27	27.6
Normal BW (2:2.5-4 Kg)	71	72.4
Mean± SD (Kg)	2.81 ±0.37	

A significant majority of pregnant mothers, particularly 71 (98.6%) who consistently took calcium supplements, showed normal serum calcium levels. In contrast, among pregnant women with irregular calcium supplement intake, 18 (69.2%) had low serum calcium levels. This discrepancy between the two groups demonstrated statistical significance, indicated by a p-value of less than 0.0001 **(Table VI)**.

Table VI: Association of s. calcium level with the status of calcium supplementation of the pregnant mothers (N=98)

Calcium supplement	Serum calcium level (mg/dl)		Mean± SD	P-value
	Below normal	Normal		
	n (%)	n (%)	(mg/dl)	
Regular taking (n=79)	8 (30.8)	71 (98.6)	9.21±0.70	0.0001
Irregular taking (n=l9)	18 (69.2)	l (1.4)	7.73±0.68	

Mothers with lower serum calcium levels during pregnancy were responsible for the majority, specifically 19 (86.36%), of low birth weight (LBW) babies. In contrast, the majority of newborns, comprising 64 (84.21%) with normal body weight, were born to mothers whose serum calcium levels remained within the normal range. This observed differentiation between the two groups held significant statistical value, as evidenced by a p-value of less than 0.0001 **(Table VII).**

Table VII: Association of birth weight with serum calcium level of the mothers (N=98)

S. calcium level (mg/dl)	Birt weight		P- value
	Low	Normal	
	n=22	n=76	
	n (%)	n (%)	
Below normal(<8.1mg/dl)	19 (86.36)	7 (9.21)	0.0001
Normal (8.1-10.4 mg/dl)	8 (36.4)	64 (84.21)	
Mean ± SD (mg/dl)	8.09 ± 0.75	9.18 ± 0.84	0.0001

DISCUSSION

This study aimed to evaluate the impact of calcium supplementation during pregnancy on neonatal birth weight. Pregnancy constitutes a natural physiological event accompanied by multiple biochemical shifts, among them alterations in calcium (Ca) metabolism [9]. Calcium concentrations wield a significant influence over a diverse range of extracellular and intracellular processes, encompassing functions such as neural transmission, maintenance of membrane integrity, bone structure, blood coagulation, muscle mobility, and intracellular signaling. To ensure the optimal and proper operation of these processes, maintaining total serum calcium concentrations within the precise range of 8.1 to 10.4 mg/dl is crucial [10]. In this investigation, examining the distribution of gestational ages among the total participants revealed that the predominant proportion (76%) experienced full-term pregnancies, followed by early-term (20%) and late-term pregnancies (4%) in descending order. The evaluation of prenatal growth rate typically involves assessing the expected weight for a given gestational age [11]. Notably, approximately 80.6% of the respondents consistently adhered to calcium supplementation during their antepartum period. Similar observations were reported by Kumar et al. and Chandrasekaran et al. in their respective studies [12,13]. Furthermore, it was noted that one in every four mothers in this study exhibited a deficiency in serum calcium (<8.1 mg/dL). Despite the substantial 80.6% of participants following regular calcium supplementation, the presence of a calcium-deficient population, as indicated by serum calcium levels, remains remarkable. Comparable findings were reported in studies conducted in neighboring countries [12, 13]. The observed incidence of low birth weight (LBW) in this investigation, accounting for 27.6%, aligns with the findings of a study conducted in Pakistan, where the reported incidence ranged from 19% to 23% [14].

Another study by Jalil et al. reported an LBW incidence of 24.5% [15]. Remarkably, in the present study, it was noted that pregnant mothers with lower serum calcium levels gave birth to the majority of LBW infants, specifically 19 out of 22 (86.36%). Conversely, the majority of newborns, totaling 64 out of 76 (84.21%), with normal birth weight were born to mothers whose serum calcium levels fell within the normal range. The differences observed between these two groups were statistically significant (P<0.00I). The result echoes the findings of multiple studies [12.13]. Several investigations have indicated that maternal calcium intake at very low levels might pose a risk for low bone mass in neonates [16]. The diminished levels of maternal serum calcium during pregnancy can curtail fetal mineral accumulation, subsequently impacting both infant growth and bone mineral accretion [17]. Notably, in this current study, an observable scatter diagram revealed a significant positive correlation (r=0.361; p<0.001) between maternal serum calcium levels (mg/dl) and neonatal birth weight (Kg). A study conducted by Debbarma and Mehta (2018) similarly demonstrated that women with adequate serum calcium levels delivered full-term babies with appropriate birth weights, while those with lower serum calcium levels gave birth to full-term babies with lower birth weights, aligning with the findings of the present study [18]. All the findings of this current study may be helpful in further similar studies.

LIMITATION OF THE STUDY

This was a single-center study with a small sample size. Furthermore, the study was conducted over a relatively short period. Therefore, the findings of this study may not be fully representative of the entire country.

CONCLUSION & RECOMMENDATION

This study underscores the significant role of consistent calcium supplement usage among participants. It reveals that maintaining regular calcium intake during pregnancy contributes to maintaining normal serum calcium levels, which in turn has a positive association with birth weight outcomes. The observed link between maternal calcium intake and birth weight emphasizes the importance of nutritional support during pregnancy for optimal maternal and fetal health. These findings highlight the potential benefits of encouraging pregnant women to adhere to recommended calcium supplementation as a means to promote both maternal well-being and healthy fetal development.

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CONFLICT OF INTEREST

None declared

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee

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