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Original Research Article

Association of maternal serum calcium with neonatal birth weight in term deliveries

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ABSTRACT

Background: Calcium is an essential nutrient during pregnancy that supports the growth and development of the foetus, especially because of its maternal-foetal transfer. A few previous studies reported that decreased calcium in mothers can lead to low birth weight and some other complications like pre-eclampsia, preterm delivery, and fetal low bone mineral density. We do have not enough research-based information regarding this issue. The aim of the study was to evaluate the association of maternal serum calcium with neonatal birth weight in term deliveries.
Methods: This was a cross-sectional study that was conducted in the Department of Obstetrics and Gynecology at the Institute of Child and Mother Health (ICMH), Dhaka, Bangladesh from September 2018 to August 2019. In total 98 women attending the ICMH having an uncomplicated, singleton, term pregnancy were enrolled in this study as the study subjects. A purposive sampling technique was used in sample selection. All the demographic and clinical information were recorded. All data were processed, analyzed and disseminated by using MS Office and SPSS version 22.0 program as per necessity.
Results: Among the pregnant mothers who regularly took calcium supplements, 98.6% had normal s. calcium levels, whereas 69.2% of those with irregular supplement intake had low serum calcium levels; the distinction was statistically significant ($p<0.001$). Of the 98 newborns, 72.4% had normal birth weight, averaging 2.81±0.37 kg, while 27.6% had Low birth weight. Maternal serum calcium levels correlated with birth weight, with 86.36% of low-birth-weight babies born to mothers with lower serum calcium levels and 84.21% of normal birth weight babies born to mothers with normal serum calcium levels. This correlation was statistically significant ($p<0.001$), showing a positive association ($p<0.001$) between maternal serum calcium level (mg/dl) and neonatal birth weight (kg).
Conclusions: There was a statistically significant association between maternal serum calcium level and neonatal birth weight in term deliveries where the birth weight of neonates reduces when maternal serum calcium level reduces.

Keywords: Maternal, Serum calcium, Neonatal, Low birth weight, Term delivery

INTRODUCTION

In a study it was reported that maternal gestational circulating calcium may be modifiable factors that impact fetal growth and hence birth weight.[1]

Another observational study employing conventional multivariable regression analyses indicates a positive correlation between maternal 25(OH) D and calcium levels and infant birth weight.[2] However, these findings

might be influenced by unaccounted confounding variables.

Systematic evaluations of randomized controlled trials (RCTs) focusing on gestational calcium supplementation.[3] propose that such supplementation leads to an increase in birth weight. In the systematic review on calcium supplementation, the authors highlighted that most of the trials exhibited a low risk of bias, as per a scoring system that didn't include intention-to-treat as one of the bias criteria. Nevertheless, considerable heterogeneity among the trial outcomes raises concerns about the clinical significance of calcium supplementation's impact on birth weight.[3] Inadequate intake of this essential nutrient during pregnancy can result in negative consequences for both the expectant mother and the developing fetus. These consequences encompass conditions such as osteopenia, tremors, tingling sensations, muscle cramps, tetany, impaired fetal growth, and reduced birth weight.[4]

An infant's birth weight is the initial weight measurement taken shortly after birth, ideally within the first hour, to capture an accurate reading before substantial postnatal weight reduction occurs. According to the WHO classification, low birth weight (LBW) is defined as a birth weight below 2500 g (inclusive of weights up to 2499 g).[5] Across the globe, LBW stands as a significant risk factor contributing to infant morbidity and mortality, particularly in developing nations like Bangladesh.[6] The statistics indicate that approximately 15-20% of all births worldwide, exceeding 20 million newborns annually, fall into the category of low birth weight.[5] Research suggests that infants born within the weight range of 2000-2500 g and 2500-3000 g carry a four-fold and two-fold higher risk of post-neonatal mortality compared to those born within the 3000-3500 g range, respectively.[7] Serum calcium levels are judiciously regulated in the body, maintaining a narrow range.

Consequently, they have limited utility in assessing calcium nutritional status, both for individuals and populations. At the broader population level, calcium intake emerges as a more informative indicator of nutritional status.[8] During pregnancy, healthcare professionals commonly recommend calcium supplements (1000 mg) starting from the second trimester. However, a significant number of pregnant women discontinue these supplements and fail to maintain a diet rich in calcium due to insufficient awareness regarding calcium's significance in both pregnancy and lactation. Therefore, there is a pressing need to educate pregnant women about the importance of calcium.

Interestingly, maternal calcium supplementation of around 2 g per day during the mid-pregnancy phase can potentially impact the mineralization process of fetal bones.[9] Nonetheless, it's worth noting that previous research has yielded conflicting outcomes concerning the existence of positive associations between maternal calcium intake and the weight of newborns.[10] The primary aim of this ongoing study was to examine the link between maternal serum calcium levels and the birth weight of neonates delivered at full term.

METHODS

This was a cross-sectional study that was conducted in the Department of Obstetrics and Gynecology in the Institute of Child and Mother Health (ICMH), Dhaka, Bangladesh from September 2018 to August 2019. In total 98 women attending the ICMH having an uncomplicated, singleton, term pregnancy were enrolled in this study as the study subjects. A purposive sampling technique was used in sample selection. The study was approved by the ethical committee of the mentioned hospital. Properly written consent was taken from all the participants before data collection. As per the inclusion criteria of this study, pregnant women aged between 18 to 35 years, pregnancies between 37 to 42 weeks admitted for delivery, singleton pregnancy and willing to participate were included. On the other hand, according to the exclusion criteria of this study, cases with a previous history of low-birth-weight delivery, cases of twin and multiple pregnancies, patients with maternal hyper/ hypo-parathyroids, pre-eclampsia, eclampsia, uterine cervical abnormalities, antenatal bleeding and oligo-and polyhydramnios were rejected. Moreover, cases with maternal disorders such as diabetes mellitus, systemic lupus erythematosus, chronic hypertension, chronic renal disease, malignancies, obesity, seizure disorders and drug or alcohol abuse were also excluded. All the demographic and clinical information of the participants was recorded. All data were processed, analyzed and disseminated by using MS excel and SPSS version 22.0 program as per necessity. In statistical analysis, a $p<0.05$ was considered as the indicator of significance.

RESULTS

In this study, as per age distribution among the total participants, we found that the highest number of participants (49%) were aged between 21 and 25 years, 33.7% were aged between 26-30 years, 11.2% were aged by ≤20 years and the rest of 6.1% were aged between 31-35 years. In this study, the majority of the participants (76%) had full-term pregnancies followed in decreasing order by early term (20%) and late-term pregnancy (4%). Among the total of 98 participants, serum calcium level was within normal limits in 72 (73%) of them while in 26 (27%) pregnant mothers, it was below the normal range. The mean ±SD value of serum calcium level was 8.94±0.93 mg/dl.

All the mothers were bearing singleton pregnancies before inclusion in the study. Out of the 98 newborns, 71 (72.4%) had normal body weight at birth while the rest 27 (27.6%) were LBW babies. The mean±SD value of the birth weight of the newborns was 2.81±0.37 kg. In this study, the pregnant mothers who had lower levels of serum calcium gave birth to the majority 19 (86.36%) of the LBW babies,

while the majority of the newborns 64 (84.21%) with normal body weight were born to those mothers whose serum calcium levels were within normal limit. The difference between these two groups was statistically significant (p<0.001). The scatter diagram also shows a significant positive correlation (r=0.361; p<0.001) between maternal serum calcium level (mg/dl) and neonatal birth weight (kg).

Table 1: Distribution of participants as per age (N=98).

Variables	N	%
	Age (in years)	
≤20	11	11.2
21-25	48	49
26-30	33	33.7
31-35	6	6.1
Mean±SD	24.57±3.94	

Table 2. Gestational age in weeks of the study subjects (N=98).

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

Table 3: Serum calcium level among study subjects (N=98).

Serum calcium level (mg/di)	N	%
Below normal (<8.1)	26	27
Normal (8.1-10.4)	72	73
Total	98	100
Mean±SD (mg/dl)	8.94±0.93	

Table 4: Distribution of the newborns according to their birth weight (N=98).

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

Table 5: Association of birth weight concerning serum calcium level of the mothers (N=98).

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

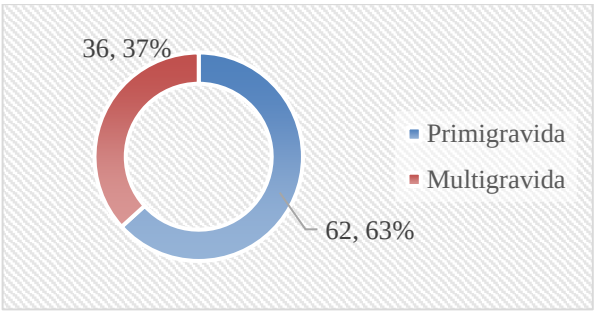

Figure 1: Distribution of participants as per the gravidity (N=98).

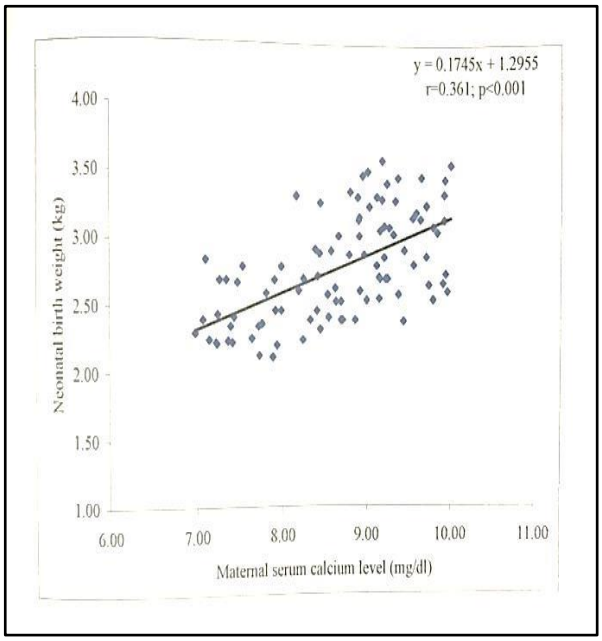

Figure 2: Scatter diagram between maternal serum calcium level and neonatal birth weight.

DISCUSSION

This study aimed to evaluate the association of maternal serum calcium with neonatal birth weight in term deliveries. Among the total participants, the majority of the participants were relatively young, aged between 21-25 years (49%) with a mean age of 24.57±3.94 years. Considering the region, in which this study took place it is understandable that the socio-demographics illustrate a common picture for a developing country like Bangladesh.[11]

Most of the pregnant mothers (63.3%) were carrying their first child and the rest of 37% were multigravida. Since most of the study cases were relatively younger, the distribution of the prim gravidity in this study is justifiable as can be observed in a large country context. In this study, as per the gestational age distribution among total participants, we observed that the majority of the participants (76%) had full-term pregnancies followed in decreasing order by early term (20%) and late-term

pregnancy (4%). The prenatal growth rate is usually measured concerning what weight is expected for any gestational age.[12]

Around 80.6% of the respondents regularly took their calcium supplements in their antepartum. Kumar et al and Chandrasekaran e al had similar observations in their separate studies.[13,14] Every 1 out of 4 mothers in this study had a deficiency of serum calcium (<8.1 mg/di). Despite an overhauling 80.6% of participants having regular calcium supplementation as mentioned earlier, this calcium-deficient" population as reflected by serum calcium level is noteworthy. Similar results were found by studies in the neighboring countries.[13,14] The incidence of LBW (27.6%) observed in this study is comparable to that observed (19%-23%) in the study carried out in Pakistan.[15] In another study conducted by Jalil et al the incidence of LBW babies was found to be 24.5%.[16]

In this study, pregnant mothers who had lower levels of serum calcium gave birth to the majority 19 (86.36%) of the low-birth-weight babies, while the majority of the newborns 64 (84.21%) with normal birth weight were born to those mothers who serum calcium levels were within normal limit. The differences observed between these two groups were statistically significant (p<0.001). The result echoes the findings of multiple studies.[13,14] Several studies have suggested that very-low maternal calcium intake may be a risk for low bone mass in neonates.[17]

The low serum calcium levels during pregnancy limit fetal mineral accretion, which affects infant growth and bone mineral accretion.[18] In this present study, through the scatter diagram, it was also observed that a significant positive correlation (r=0.361; p<0.001) was found between maternal serum calcium level (mg/dl) and neonatal birth weight (kg). Another study conducted by Mehtaet al.[19] showed that women with normal serum calcium levels delivered full-term babies with normal birth weight and women with low serum calcium levels delivered full-term babies with low birth weight which was comparable to this present study.

Limitations

This was a single-centered study with small-sized samples. Moreover, the study was conducted over a very short period. So, the findings of this study may not reflect the exact scenario of the whole country.

CONCLUSION

The study findings suggested that maternal serum calcium plays a significant role in neonatal birth weight. More than half of the low-birth-weight children had come from hypocalcaemic mothers. Moreover, the normal level of calcium was higher in mothers who gave birth to the normal weight child and the relation is statistically significant. This study also revealed that hypocalcemia is more common in the case of mothers who were taking calcium irregularly. Therefore, it can be concluded that the reduction of maternal serum calcium is associated with reduced neonatal birth weight. For getting more specific results, we would like to recommend conducting similar studies in several places with larger-sized samples.

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