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COMPARISON OF SERUM ZINC LEVELS AMONG MOTHERS WITH PRETERM AND TERM BIRTHS

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ABSTRACT

Background: Preterm birth is key global sponsor to neonatal morbidity and mortality, principally in low-resource location like Bangladesh. Zinc, a critical trace element, plays a vital rol in immune modulation, antioxidant defense, and cellular growth in pregnancy. The association between maternal serum zinc levels and preterm birth remains explored in south Asian peoples. **Aim:** To determine the association of serum zinc levels between the mothers with preterm and term birth. **Methods:** This case-control study was conducted from September 2022 to August 2023 at the Department of Obstetrics and Gynaecology, Bangladesh Medical University (BMU). A total of 68 postpartum women were purposively enrolled, comprising 34 with preterm births (cases) and 34 with term births (controls). Socio-demographic and clinical data were collected through interviews and record reviews. Associations were analyzed using SPSS version 26.0, with a significance threshold of $p<0.05$. **Results:** A Statistically significant association was observed between low maternal serum zinc levels and preterm birth (p=0.000, Fisher's Exact Test). Zinc Levels were significant lower among mother of preterm infants compared to term counterparts. Higher zinc levels correlated positively with gestational age (p=0.000), birth weight (p=0.000), and better APGAR score at 1 and 5 minutes. The Cesarean section was more common with mothers with high zinc levels and full-term deliveries. Neonatal intensive care unit (NICU) admission was significantly associated with both lower zinc levels and poorer neonatal outcomes (p=0.000). **Conclusion:** Maternal zinc deficiency is significantly associated with preterm delivery and harmful neonatal outcomes in this study. These findings emphasize the need for regular zinc status assessment in antenatal care and importance of supplementation strategies to decrease preterm bith risk and improve perinatal outcomes in nutritionally vulnerable populations.

KEYWORDS: Preterm birth, Serum zinc, Pregnancy outcomes, Neonatal intensive care unit, Low birth weight.

INTRODUCTION

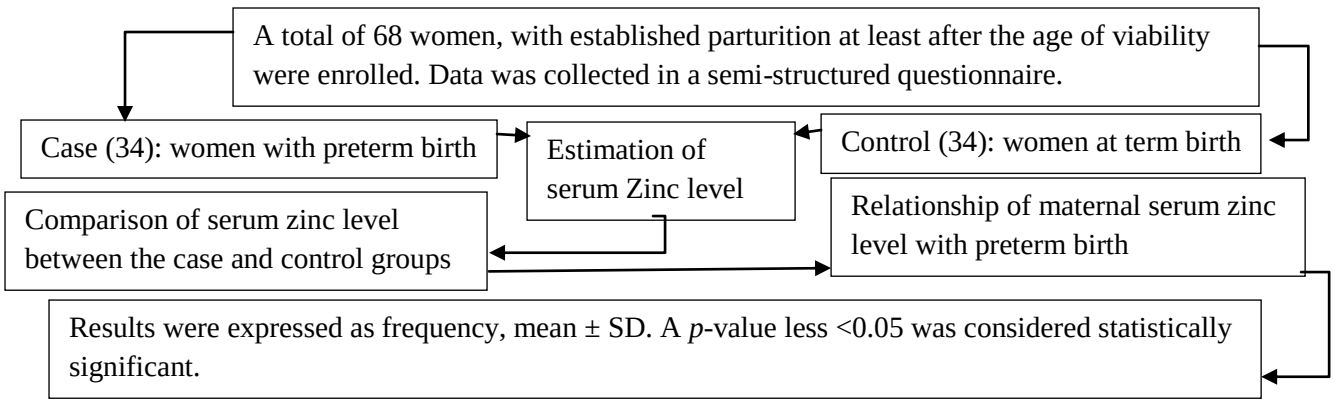
Preterm birth defined as childbirth happening before 37 completed weeks of gestationremains a major global public health concern and is the chief cause of neonatal mortality and long-term morbidity universally.[1] Globally, an estimated 15 million babies are born preterm each year, with highest burden observed in South Asia and Sub-Saharan Africa.[2] In Bangladesh, preterm birth accounts for a substantial proportion of NICU admissions, impressive a high economic and health obligation on families and the healthcare approach.[3] Several factors influence preterm labor, incorporating infections, inflammation, placental dysfunction, and nutritional deficiencies, among which zinc deficiency has been shown up as a significant provider.[4-6] Zinc is an important trace element involved in numerous physiological functions involving nucleic acid metabolism, immune modulation, cellular diversity, and antioxidative defense all vital in pregnancy.[7-9] Zinc also plays a role in supporting membrane integrity and modulating prostaglandin synthesis, both of which are involved in the timing of parturition.[10,11]

Maternal zinc deficiency is prevalent in low-and middle-income countries due to insufficient dietary intake, increased foods throughout pregnancy, and poor absorption correlated to high phytate consumption.[12-14] Studies from different populations have informed higher incidences of preterm labor and low birth weight among women with low serum zinc levels.[15-17] A prospective Chinese birth cohort supported that higher maternal zinc concentrations advised safety against mercury-induced preterm birth.[18] Similarly, a study in Southeast Queensland, Australia, observed a correlation between suboptimal maternal mineral intake incorporating zinc and preterm delivery risk.[19] The biological plausibility for zinc's role in preterm labor stems from its immunoregulatory function. Zinc deficiency is common to up regulate pro-inflammatory cytokines such as TNF-α and IL-6, which are related with premature rupture of membranes and uterine contractility.[20, 21] Furthermore, zinc regulates metallothionein expression and oxidative stress balance, both of which are essential to placental development and fetal health.[22, 23] Cochrane metal-analyses and WHO-supported reviews have regularly endorsed zinc supplementation as a potential intervention to enhance maternal and neonatal outcome in zinc-deficient populations.[24, 25] Nevertheless, there is inadequate high-quality data specific to Bangladesh a country with recorded micronutrient deficiencies in women of reproduction age. Present nutritional surveillance data in the areadenote that zinc intake frequently falls under the recommended dietary budget, yet its association with obstetric outcomes remains undrt-investignated.[13, 14] These results support the increasing consensus that micronutrient screening,l specificslly for zinc, should be added into routine antenatal care to mitigate the risk of preterm delivery. They also warrant further longitudinal and interventional research to investing the therapeutic potential of zinc supplementation in at risk inhabitants.

METHODS

This case-control study was conducted at the Department of Obstetrics and Gynaecology, BMU, Dhaka, for a year. A total of 68 women who delivered single live births were purposively selected and categorized into two groups. Women with multiple pregnancies, chronic illness, or unwilling to participate were excluded. Socio-demographic and clinical data were collected through interviews, examinations, and review of medical records using a semi-structured questionnaire. Serum zinc levels were measured from 5 ml of venous blood using a fully automated Thermo Scientific™ Indiko™ Plus Clinical Chemistry Analyzer via the colorimetric method. BMI was recorded, and socioeconomic status was classified per World Bank income levels. Data analysis was done using SPSS version 26.0. To determine associations, with $p<0.05$ considered statistically significant. Ethical approval was obtained from the Institutional Review Board of BMU, and informed written consent was collected from all participants.

Data Processing plan



RESULTS

A case-control study was conducted at Bangladesh Medical University (BMU). Total 34 preterm births women were selected as case and 34 with full term births women were selected purposively as control.

Table1: Distribution of the respondents by various characteristics.

Variables	Frequency	Percent
Dietary habit during pregnancy		
Balanced	42	61.8
Poor	26	38.2
Gestational age		
Preterm	17	25.0
Full term	51	75.0
Mode of delivery		
Vaginal	29	42.6

Cesarean section	39	57.4
Birth weight		
<2.5kg	38	55.9
>2.5kg	30	44.1
Comorbidities during pregnancy		
Hypertension	06	8.8
Gestational diabetes	16	23.5
Infection	22	32.4
Others	24	35.3
Total	**68**	**100.0**

Table 1 summarizes that most mothers stated having a balanced dietary habit during pregnancy (61.8%), while 38.2% had poor dietary habits. Preterm births were described as 25% of the cases, and 75% were full-term deliveries. Cesarean section was the predominant mode of delivery (57.4%) compared to vaginal delivery (42.6%). Regarding birth weight, 55.9% of neonates weighed less than 2.5 kg. Comorbidities in pregnancy were prevalent, with infections (32.4%) and gestational diabetes (23.5%) being the most reported, followed by other conditions (35.3%) and hypertension (8.8%).

Table 2: Association between serum zinc levelswith preterm and full term birth.

Serum zinc level	Gestational age category		*p*-value
	Preterm	Full term	
Normal	09	46	.000[f]
Low	08	00	
Total	17	46	63

*f-Fisher's Exact Test. 1 cells (25.0%) have expected count less than 5.

Table 2 shows a statistically significant association was stated between serum zinc levels and gestational age category (p = .000). Among women with full-term births, 100% (46/46) exhibited normal serum zinc levels, whereas only 52.9% (9/17) of preterm birth cases had normal levels. In contrast, 47.1% (8/17) of mothers with preterm births had low zinc levels, and none among term deliveries had zinc deficiency.

Table 3: Comparison between serum zinc levels, gestational age, and birth weight with mode of delivery.

Characteristics	Mode of delivery	N	Mean ±SD	t	*p*-value
Serum zinc level	Vaginal	25	1.0000 ±.00000	-2.541	.014
	Cesarean section	38	1.2105 ±.41315		
Gestational age	Vaginal	29	2.00 ±.000	4.664	.003
	Cesarean section	39	1.56 ±.502		
Birth weight (grams)	Vaginal	29	1.00 ±.000	-9.686	.000
	Cesarean section	39	1.77 ±.427		

Table 3 indicates women who undertook cesarean sections had higher serum zinc levels (Mean ± SD: 1.21 ± 0.41) compared to those with vaginal deliveries (1.00 ± 0.00; p = .014). Gestational age was significantly lower in the cesarean section group (Mean = 1.56 ± 0.50) versus vaginal delivery (Mean = 2.00 ± 0.00; p = .003). Birth weight was also notably higher in cesarean deliveries (1.77 ± 0.43) than in vaginal births (1.00 ± 0.00; p < .001).

Table 4: Comparison between two continuous variables (serum zinc levelsand gestational age).

Variables	Mean	Std. Deviation	N	*p*-value
Serum zinc level	1.1270	.33563	63	.000
Gestational age	1.75	.436	68	.000

** Correlation is significant at the 0.01 level (2-tailed). * Pearson correlation.

Table 4 a statistically significant positive correlation was observed between serum zinc levels and gestational age (Pearson correlation, p< .001). Mothers with higher serum zinc levels managed to carry pregnancies to term, whereas lower zinc levels were associated with preterm deliveries.

Table5: Association between gestational age and NICU admission with APGAR score.

APGAR score at 1 minute at birth	**Gestational age category**		***p*-value**
	Preterm	**Full term**	
Good	17	32	.003
Poor	00	19	
NICU admission			
APGAR score at 5 minute at birth	**Yes**	**No**	.000
Good	00	49	
Poor	08	11	
Total	**17**	**51**	**68**

Table 5 confirms a significant association was found between gestational age and APGAR scores at 1-minute post-birth (p = .003), with all preterm newborns scoring "good" and 37.2% (19/51) of term newborns scoring "poor." This counterintuitive pattern may reflect selection bias or immediate postnatal interventions for term babies with unanticipated complications.

APGAR scores at 5 minutes were significantly associated with NICU admission status (p = .000). All neonates with good scores keep away NICU admission, while 42.1% (8/19) of neonates with poor scores expected NICU care.

DISCUSSION

This study examined the association between maternal serum zinc levels and gestational results among Bangladeshi women, showing a significant relationship between zinc deficiency and preterm birth. The results confirm previous universal research and underline zinc as a critical micronutrient in the maintenance of pregnancy and fetal development.

In the study, mothers who delivered preterm infants had significantly lower serum zinc levels evaluated to those with term deliveries. This finding is associated with vast literature that recognizes maternal zinc deficiency as a risk factor for spontaneous preterm labor.[5,7,18,19] Biological plausibility supports this association, as zinc plays an essential role in regulating inflammatory pathways, preserving membrane integrity, and proving placental development.[8,9,10,20]

The positive relationship detected between serum zinc levels and gestational age in this study supports earlier reports by Tamura and Goldenberg[5], who recommended that insufficient zinc during pregnancy negotiations fetal development and may bring early labor. Similarly, a study from China exhibited that higher maternal zinc levels advised protection against preterm birth, even in the existence of environmental pollutants like mercury.[18] In low-and middle-income countries, where diets are regularly zinc-deficient due to low bioavailability and high phytate intake, this risk may be increased.[12,13]

The association between zinc levels and birth weight detected in this study further improves the known connection between zinc status and fetal growth. Previous studies have always shown that zinc-deficient mothers are more likely to deliver low birth weight infants.[6,11,24] In this study, higher zinc levels corresponded with significantly greater birth weights and gestational age at delivery.

The results also demonstrated that serum zinc concentrations were significantly associated with delivery. Mothers who experiencedthe cesarean section had higher zinc levels linked to those who delivered vaginally. This may be reflective of underlying obstetric decision-making in reply to fetal size or gestational age, rather than a direct causal association. Nevertheless, it also raises essential questions about the clinical management of at-risk pregnancies and the role of micronutrient screening in early antenatal care.[14,15]

The connection between low zinc and adverse neonatal outcomes was further proven through APGAR score differences. Neonates born to mothers with low zinc status were more expected to have poor APGAR scores at 1 and 5 minutes and needed NICU admission. These findings echo interpretation by Osendarp et al.[16] and Prasad[17], who observed that zinc deficiency impairs neonatal immune replies and improves vulnerability to perinatal obstacles.

Notably, zinc influences various physiological systems beyond immune regulation. It alleviates cellular membranes, acts as a cofactor for over 300 enzymes, and modulates oxidative stressall of which are critical for sustaining pregnancy.[9,20,22] Zinc's anti-inflammatory things may inhibit preterm labor mechanisms initiated by maternal infections or systemic inflammation.[21]

However, this findings have significant public health consequences. In areas such as Bangladesh, where zinc deficiency is prevalent, routine screening for zinc levels in pregnancy could serve as a low-cost approach to identify women at risk for preterm birth and poor neonatal outcomes. The World Health Organization and Cochrane reviews have previously endorsed zinc supplementation in pregnancy in populations with identified deficiency, citing improvements in birth weight and decreased preterm birth risk.[24,25]

CONCLUSION

This study confirms a clear and statistically significant association between low maternal serum zinc levels and preterm birth, highlighting the critical role of zinc in sustaining pregnancy and advancing optimal fetal development. The findings also emphasize the guidance of zinc status on delivery outcomes, birth weight, and immediate neonatal health guides such as APGAR scores and NICU admissions. Given the high prevalence of zinc deficiency in resource-limited situations like Bangladesh, routine screening and suitable supplementation in antenatal care should be prioritized as a cost-effective policy to decrease the burden of preterm births and recover perinatal outcomes. Upcoming multicenter, longitudinal studies are suggested to extra validate these results and inform national maternal nutrition guidelines.

Declaration of Interest

The authors declare no competing interests.

Conflict of Interest

The authors have no conflicts of interest to disclose related to this study.

Authors Contributions: Prof. Dr. Tripti Rani Das and Dr. Sabiha Islam conceptualized the study and designed the methodology. Dr. Dipika Majumder and Dr. Iffat Rahman contributed data management and statistical analysis. Dr. Shah Noor Sharmin, Dr. Jinat Fatema and Dr. Bidisha Chakma assisted in manuscript drafting and critical revisions. Prof. Dr. Tripti Rani Das and Dr. Tanzina Iveen Chowdhury supervised the research and provided final manuscript approval. All authors reviewed and approved the final version.

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