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Study of serum iron and calcium level in lactating women compared with non-lactating women in Bangladesh

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Abstract

Introduction: Lactation imposes significant physiological demands on maternal micronutrient stores. While iron and calcium are both essential during the postpartum period, their depletion patterns differ and require context-specific evaluation.

Methods: A cross-sectional, case–control study was conducted at Mymensingh Medical College and Hospital involving 120 women (60 lactating and 60 non-lactating), aged 20–40 years. Baseline demographic data were collected, and serum iron and calcium levels were measured using standard colorimetric methods. Statistical analysis was performed using the Statistical Package for the Social Sciences v25, with $P < 0.05$ considered significant.

Results: The mean age and body mass index did not differ significantly between groups. Serum iron levels were slightly higher in lactating women (93.2 ± 39.4 µg/dL) compared to non-lactating women (86.5 ± 27.6 µg/dL), but this difference was not statistically significant ($P = 0.283$). In contrast, serum calcium levels were significantly lower in lactating women (7.74 ± 0.67 mg/dL) than in non-lactating controls (8.75 ± 0.78 mg/dL), with $P = 0.001$.

Conclusion: Early lactation is associated with significant reductions in serum calcium but not iron, highlighting the need for calcium-focused nutritional interventions in postpartum care for Bangladeshi women.

Keywords: Lactation, postpartum nutrition, serum calcium, serum iron

Introduction

Micronutrient deficiencies represent a persistent and critical global public health issue, especially among women of reproductive age. Among these, iron-deficiency anemia and calcium insufficiency remain the two most widespread and impactful conditions. According to the World Health Organization, approximately 30% of women aged 15–49 years globally are anemic, with an even higher burden in low- and middle-income countries due to nutritional inadequacies, high fertility rates, and poor access to antenatal care.[1] Recent reports by UNICEF estimate that nearly 1.2 billion women and adolescent girls worldwide suffer from deficiencies in iron, folate, calcium, or other micronutrients, with 69% exhibiting at least one deficiency.[2] These deficiencies are exacerbated during the postpartum period, where nutritional requirements are elevated to support

maternal recovery and breastfeeding. Lactation introduces unique physiological demands on maternal micronutrient reserves. Iron kinetics during this period are characterized by postpartum mobilization of iron stores, continued blood loss, suppressed hepcidin levels, and a modest yet continuous iron transfer into breast milk – estimated at around 0.3 mg/day.[3] Calcium requirements also sharply increase, with about 280–300 mg/day obligatorily transferred into breast milk. This demand is met through significant skeletal demineralization, primarily driven by parathyroid hormone-related protein secretion, especially in the context of hypoestrogenism during lactation.[4] While these changes are largely physiological and reversible post-weaning, the 3–6 months postpartum period represents the peak risk window for nutrient depletion and clinical manifestations. Deficiencies in iron and calcium during lactation have far-reaching consequences for both mothers and infants. In mothers, iron deficiency has been linked to increased fatigue, impaired cognitive performance, and a higher incidence of postpartum depression, while calcium depletion is associated with temporary bone mass loss and a possible long-term risk of osteoporosis, particularly in resource-constrained settings.[3,5] In infants, low maternal iron levels correlate with suboptimal iron stores at birth and at 6 months, as well as delayed neurodevelopmental outcomes.[6] Reduced calcium content in maternal milk, though tightly regulated, may also impair infant bone accretion in extreme deficiencies.[7] In the context of Bangladesh, micronutrient inadequacy remains a pressing concern. According to the most recent data from the Bangladesh Demographic and Health Survey, nearly 44% of women of reproductive age are anemic.[8] Moreover, dietary calcium intake among Bangladeshi women is consistently reported to be well below recommended levels, with over 87% failing to meet even the minimum threshold, primarily due to limited dairy intake and cereal-heavy diets.[9] High parity and short interpregnancy intervals further exacerbate the maternal depletion of essential micronutrients, a pattern well-documented in rural Bangladeshi populations.[9] Despite the clinical importance of these deficiencies, there is considerable inconsistency in the global literature regarding biochemical outcomes in lactating versus non-lactating women. For instance, some studies report significantly lower serum ferritin levels in lactating women, while others find no difference or even temporarily elevated levels in early lactation due to suppressed hepcidin.[10] Calcium-related findings also vary widely, influenced by regional differences in supplementation, sunlight exposure, and dietary habits. One major limitation across studies is methodological heterogeneity – including small sample sizes, non-standardized definitions of lactation stage, and lack of dietary control – making cross-study comparisons and pooled inferences difficult.[11] In Bangladesh specifically, the research landscape is dominated by dietary intake assessments using 24-h recall surveys, with very few studies evaluating serum biomarkers of iron or calcium status.

In this context, the present study aims to provide updated, biochemical evidence by comparing serum iron and calcium levels in lactating versus non-lactating women residing in Bangladesh. By focusing on direct measurement of nutrient biomarkers and using a standardized case–control design, this study seeks to fill an important evidence gap in the national and international literature.

Methods

This comparative cross-sectional study was conducted at Mymensingh Medical College and Hospital, Bangladesh, over a 6-month period from January to June 2023. The primary objective was to compare serum iron and calcium levels between lactating and non-lactating women of reproductive age. A total of 120 apparently healthy women were enrolled through purposive sampling, of whom 60 were lactating (within 6 months postpartum and exclusively breastfeeding) and 60 were non-lactating (neither pregnant nor breastfeeding for at least the past 6 months). Inclusion criteria for both groups included age between 20 and 40 years, absence of known chronic illness, and willingness to participate. Women with a history of chronic

kidney disease, metabolic bone disorders, recent blood transfusion, iron or calcium supplementation within the past 2 months, or acute infections were excluded from the study. All participants provided written informed consent before enrollment, and ethical approval for the study was obtained from the Institutional Review Board of Mymensingh Medical College. Following enrollment, a structured questionnaire was administered to collect socio-demographic and clinical data, including age, parity, dietary habits, educational level, and obstetric history. After ensuring aseptic precautions, 5 mL of venous blood was collected from each participant using standard phlebotomy techniques. The blood samples were allowed to clot and then centrifuged to separate the serum. Serum calcium and serum iron levels were measured in the central laboratory using automated analyzers based on colorimetric methods: Serum calcium was analyzed using the Arsenazo III method, while serum iron was determined by the Ferene method. All biochemical analyses were performed using standardized protocols with appropriate internal and external quality controls. Data were entered and analyzed using IBM Statistical Package for the Social Sciences Statistics version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were expressed as means and standard deviations for continuous variables and as frequencies and percentages for categorical variables. The normality of continuous data was checked using the Shapiro-Wilk test. Between-group comparisons of serum iron and calcium levels were conducted using the independent samples t-test for normally distributed data. $P < 0.05$ was considered statistically significant. All findings were presented in tabulated and graphical formats as appropriate.

Results

The age range across both groups was 20–40 years, with no significant difference in mean age between the groups (mean age: Lactating = 28.3 ± 4.1 years; non-lactating = 27.7 ± 4.6 years; $P = 0.48$) [Table 1].

Although the mean serum iron level was slightly higher among lactating women, the difference was not statistically significant ($P = 0.283$). However, the mean serum calcium level was significantly lower in lactating women compared to non-lactating women ($P = 0.001$), indicating a notable depletion in calcium status during lactation [Table 2].

This bar chart displays the mean serum calcium concentrations in lactating (case) and non-lactating (control) women. The mean serum calcium level in lactating women was 7.74 mg/dL, while it was significantly higher in non-lactating women at 8.75 mg/dL. The difference was statistically significant ($P < 0.001$), indicating a marked reduction in calcium levels associated with lactation.

Discussion

The present study set out to clarify whether lactation per se alters serum iron and calcium homeostasis among Bangladeshi women in the early postpartum period. Baseline comparability between groups was confirmed: Neither mean age nor mean body mass index (BMI) differed significantly between lactating and non-lactating participants, mirroring the absent or minimal demographic gaps reported in urban Indian mothers studied by Goel *et al*.[12] Because weight loss and BMI divergence tend to emerge only after prolonged (>12 month) breastfeeding in resource-limited settings, the lack of difference in our cohort (<6 months postpartum) was expected and reduces the likelihood that body-size-related confounding influenced biochemical outcomes.[13] With respect to iron, we found no statistically significant difference in mean serum iron concentration between lactating and non-lactating women, although the direction of the mean suggested slightly higher values in the lactating group. Our neutral finding is consistent with a controlled U.S. trial in which serum ferritin did not differ between lactating and nonlactating mothers during the 1st postpartum year.[10] It also parallels observations from Peru, where neither maternal anemia nor therapeutic iron supplementation altered milk iron content or maternal serum levels during early lactation.[14] However, regional heterogeneity is evident: Nigerian researchers documented markedly higher serum iron in exclusively

breastfeeding mothers than in controls, while Kenyan data indicate substantial iron depletion linked to poor dietary quality and low ferritin.[15,16] Collectively, these studies suggest that maternal iron status in early lactation is buffered by suppressed hepcidin and enhanced intestinal absorption, but can deteriorate when underlying diet, infection burden, or prolonged breast-feeding (>6–8 months) create sustained negative iron balance.[17] The absence of a deficit in our cohort therefore likely reflects the short postpartum window sampled, moderate dietary iron intake, and routine iron–folate supplementation during pregnancy in Bangladesh.

In contrast, a clear and clinically meaningful reduction in serum calcium was observed among lactating women (-1.01 mg/dL, P = 0.001). The magnitude is comparable to the declines reported in North-Indian and Ghanaian cohorts, where lactation-associated hypocalcaemia has been attributed to the obligatory transfer of ≈300 mg Ca/day into breast-milk and concomitant skeletal resorption.[18,19] Our finding also aligns with the negative calcium balance and reduced serum calcium documented among rural Mexican mothers consuming cereal-based diets low in bio-available calcium.[20] Hormonal studies in lactating women have shown that rising parathyroid-hormonere-lated peptide and 1,25-dihydroxy-vitamin D concentrations, together with hypo-oestrogenism, accelerate bone turnover to maintain milk calcium supply.[21] Given that typical daily calcium consumption among Bangladeshi women is significantly below recommended levels (87% insufficiency), the considerable hypocalcaemia identified here likely reflects physiological redistribution and insufficient nutritional replenishment.[9] Importantly, visualization of these data in Figure 1 provided an intuitive demonstration of the gap: The bartobar separation and annotated P-value (<0.001) meet recommended bestpractice for enhancing reader comprehension of clinically relevant differences.[22]

Taken together, the current results corroborate a growing international consensus that early lactation can be calcium-depleting even when iron stores remain relatively protected. The disparities

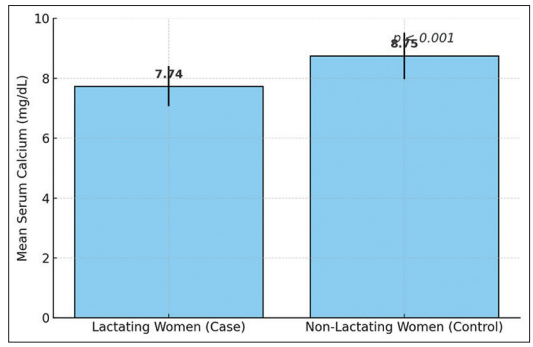

Figure 1: Comparison of mean serum calcium levels in lactating versus non-lactating women

Table 1: Baseline characteristics of the study participants (n=120)

Characteristics	Lactating women (n=60) Mean±SD	Non-lactating women (n=60) Mean±SD	P-value
Age (years)	28.3±4.1	27.7±4.6	0.48
BMI (kg/m^2)	23.5±3.2	24.1±3.5	0.33

SD: Standard deviation, BMI: body mass index

Table 2: Comparison of serum iron and calcium levels between lactating and non-lactating women (n=120)

Biochemical parameter	Lactating women (n=60) Mean±SD	Non-lactating women (n=60) Mean±SD	P-value
Serum iron (µg/dL)	93.2±39.4	86.5±27.6	0.283
Serum calcium (mg/dL)	7.74±0.67	8.75±0.78	0.001

SD: Standard deviation

across studies regarding iron outcomes, and the consistency of calcium depletion, highlight the need for context-specific postpartum nutrition strategies. In Bangladesh, where diets are plant-based, dairy intake is low and inter-pregnancy intervals short, calcium supplementation, or food-fortification initiatives may be more urgent than routine postpartum iron therapy. Strengths of our study include biochemical assessment rather than dietary recall alone, strict exclusion of recent supplement users, and careful

age/BMI matching. Limitations include a single time-point design, absence of bone-turnover markers and Vitamin D status, and restriction to the first 6 months post-partum; longer-term followup is warranted to map recovery trajectories and fracture risk.

Limitations of the study

The study was conducted in a single hospital with a small sample size. Hence, the results may not represent the whole community.

Conclusion

This study highlights a significant biochemical distinction between lactating and non-lactating Bangladeshi women in the early postpartum period, particularly in relation to calcium metabolism. While no statistically significant difference was observed in serum iron levels, the markedly lower serum calcium concentrations among lactating women underscore the physiological demands of lactation and the potential inadequacy of dietary calcium intake in this population. These findings suggest that while maternal iron homeostasis may remain buffered during early lactation, calcium stores are more vulnerable to depletion, especially in settings with limited nutritional diversity and low dairy consumption. The absence of age or BMI differences between the groups further strengthens the attribution of calcium deficit specifically to lactation status. In light of these findings, public health strategies in Bangladesh should consider prioritizing calcium supplementation or food-based interventions for lactating mothers to safeguard their skeletal health and ensure adequate nutrient supply for breastfed infants. Future research should incorporate longitudinal tracking of calcium and bone markers to better understand the timeline of depletion and post-weaning recovery.

Funding

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Conflicts of Interest

None declared.

Ethical Approval

The study was approved by the Institutional Ethics Committee.

References

1. World Health Organization. Anaemia; 2025. Available from: https://www.who.int/health/topics/anaemia [Last accessed on 2025 Apr 21].
2. UNICEF. Undernourished and Overlooked. A Global Nutrition Crisis in Adolescent Girls and Women. UNICEF Report No. UN0791879; 2023. Available from: https://www.unicef.org/reports/undernourished-overlooked-nutrition-crisis [Last accessed on 2025 Apr 21].
3. Beard JL, Hendricks MK, Perez EM, Murray-Kolb LE, Berg A, Vernon-Feagans L, *et al*. Maternal iron deficiency anemia affects postpartum emotions and cognition. J Nutr 2005;135:267-72.
4. Reid IR. The skeleton in pregnancy and lactation. Int Med J 2002;32:433-4.
5. Carneiro RM, Prebehalla L, Tedesco MB, Sereika SM, Hugo M, Hollis BW, *et al*. Lactation and bone turnover: A conundrum of marked bone loss in the setting of coupled bone turnover. J Clin Endocrinol Metab 2010;95:1767-76.
6. Perez EM, Hendricks MK, Beard JL, Murray-Kolb LE, Berg A, Tomlinson M, *et al*. Mother-infant interactions and infant development are altered by maternal iron deficiency anemia. J Nutr 2005;135:850-5.
7. Jougleux JL, Rioux FM, Church MW, Fiset S, Surette ME. Mild maternal iron deficiency anemia during pregnancy and lactation in guinea pigs causes abnormal auditory function in the offspring. J Nutr 2011;141:1390-5.
8. Kabir MA, Rahman MM, Khan MN. Maternal anemia and risk of adverse maternal health and birth outcomes in Bangladesh: A nationwide population-based survey. PLoS One 2022;17:e0277654.
9. Islam S, Jubayer A, Nayan MM, Islam MH, Nowar A. Assessment of nutrient adequacy and associated factors among lactating women of rural Bangladesh using observed intake: Findings from Bangladesh integrated household survey 2018-2019. Food Sci Nutr 2022;11:126-36.
10. Kalkwarf HJ, Harrast SD. Effects of calcium supplementation and lactation on iron status. Am J Clin Nutr 1998;67:1244-9.
11. Wable Grandner G, Dickin K, Kanbur R, Menon P, Rasmussen KM, Hoddinott J. Assessing statistical similarity in dietary intakes of women of reproductive

age in Bangladesh. Matern Child Nutr 2021;17:e13086.

12. Goel A, Thirumani Devi A, Kalaivani K, Ramachandran P. Effect of lactation on nutritional status in Urban women from low middle income families. Indian J Nutr Dietetics 2020;57:222-39.
13. Sarkar NR, Taylor R. Weight loss during prolonged lactation in rural Bangladeshi mothers. J Health Popul Nutr 2005;23:177-83.
14. Zavaleta N, Nombera J, Rojas R, Hambraeus L, Gislason J, Lönnerdal B. Iron and lactoferrin in milk of anemic mothers given iron supplements. Nutr Res 1995;15:681-90.
15. Ejezie FF, Nwagha UI, Ikekpeazu JE, Maduka IC, Neboh E, Nwachukwu DC, *et al*. Evaluation of serum Iron status of lactating mothers on exclusive breastfeeding in Enugu, South East Nigeria. Int J Med Health Dev 2009;14:15-21.
16. Ettyang GA, Van Marken Lichtenbelt WD, Oloo A, Saris WH. Serum retinol, iron status and body composition of lactating women in Nandi, Kenya. Ann Nutr Metab 2003;47:276-83.
17. Mensah K, Abbam G, Gadzeto FF, Marfo L, Daud S, Kuntah S, *et al*. Iron deficiency anaemia and its associated risk factors among lactating mothers in Ghana. J Med Sci Res 2024;12:315-22.
18. Marya RK, Rathee S, Arora SR. Concentrations of Calcium, inorganic phosphorus and alkaline phosphatase in the sera of lactating women in North India. Ann Nutr Metab 1981;25:59-64.
19. Fenuku RI, Earl-Quarcoo SN. Serum calcium, magnesium and inorganic phosphate during lactation. Trop Geogr Med 1978;30:495-8.
20. DeSantiago S, Alonso L, Halhali A, Larrea F, Isoard F, Bourges H. Negative calcium balance during lactation in rural Mexican women. Am J Clin Nutr 2002;76:845-51.
21. Greer FR, Tsang RC, Searcy JE, Levin RS, Steichen JJ. Mineral homeostasis during lactation- relationship to serum 1,25-dihydroxyvitamin D, 25-hydroxyvitamin D, parathyroid hormone and calcitonin. Am J Clin Nutr 1982;36:431-7.
22. Weissgerber TL, Milic NM, Winham SJ, Garovic VD. Beyond bar and line graphs: Time for a new data presentation paradigm. PLoS Biol 2015;13:e1002128.