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Original article

Correlation and Diagnostic Value of Lipid Profile Indicators for Evaluating Health Risks Related to Shorter Breastfeeding Periods

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Abstract

Background: Breastfeeding duration influences maternal metabolic recovery, yet practical markers for identifying shorter breastfeeding patterns remain limited. ***Objectives:*** To examine associations between breastfeeding duration and maternal metabolic indicators and to evaluate lipid ratios as markers associated with breastfeeding ≤6 months. ***Methodology:*** A cross-sectional analytical study was conducted in the Department of Physiology, Ad-din Momin Medical College, South Keraniganj, Dhaka, Bangladesh, from January 2025 to December 2025. A total of 196 postpartum women aged 20–39 years were enrolled and divided equally into two groups according to breastfeeding duration: ≤6 months (n=98) and >6 months (n=98) from Jan 2025 to Dec 2025 Anthropometry, blood pressure, fasting glucose, lipid levels, and lipid ratios were assessed using standard methods. Statistical analyses were performed using SPSS version 26.0, including group comparisons, Spearman correlation, ROC curve analysis, and logistic regression. ***Results:*** Shorter-duration mothers were older (27 vs 25 years) and had higher BMI (24.46 vs 22.24 kg/m²) and BP. They showed worse metabolic values: fasting glucose (106.2 vs 91.8 mg/dL), triglycerides (142.5 vs 92.0 mg/dL), and LDL-C (106.5 vs 95.5 mg/dL). Breastfeeding duration correlated negatively with glucose, TG, LDL-C, and lipid ratios. TG/HDL showed the best discrimination (AUC 0.728) and was the only independent predictor (OR 6.17, p=0.001). ***Conclusion:*** TG/HDL may serve as a practical metabolic marker associated with shorter breastfeeding duration.

Keywords: Breastfeeding duration; Lipid profile; TG/HDL ratio; maternal metabolic health; postpartum women; metabolic risk.

Introduction:

Breastfeeding is essential for maternal and infant health, with initiation rates in Bangladesh approaching universality.[1] Longer breastfeeding duration is consistently associated with reduced risks of obesity, dyslipidemia and cardiovascular disease, while shorter breastfeeding periods increase susceptibility to metabolic complications.[2-4] Exclusive breastfeeding for six months, continued with complementary feeding up to two years, supports optimal infant development and may prevent up to 19% of

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under-five deaths.5 These long-term benefits stem from nutritional programming, as bioactive components of breast milk, including LCPUFAs, leptin and adiponectin, influence lipid metabolism and metabolic regulation in both infants and mothers.[6,7] Breastfed infants may develop more efficient cholesterol-processing pathways, while lactation promotes maternal metabolic resetting through enhanced insulin sensitivity and mobilization of fat stores.[8,9] Disturbances in lipid profiles, including elevated LDL-C, triglycerides and reduced HDL-C, are evident among individuals breastfed for shorter durations, particularly in high-risk Bangladeshi populations.[1,2] Given their predictive value, lipid indicators and atherogenic indices offer practical tools for identifying metabolic risks associated with insufficient breastfeeding. This study examines these associations to inform early detection and targeted public health strategies.

The study aims to evaluate the relationship between breastfeeding duration and maternal metabolic health while identifying specific lipid markers that offer diagnostic value for shorter breastfeeding patterns. To achieve this, the research evaluates biochemical and lipid profile indicators in relation to breastfeeding duration and determines the correlation between these metabolic markers and the length of lactation. Additionally, the study assesses the diagnostic performance of various lipid ratios to determine their effectiveness in identifying shorter breastfeeding durations.

Materials and methods

This cross-sectional analytical study was conducted among postpartum women aged 20–39 years at the Department of Physiology, Ad-din Momin Medical College, South Keraniganj, Dhaka, Bangladesh, during the study period from January 2025 to December 2025. Ethical approval was obtained from the Ethical Review Committee of Ad-din Momin Medical College, South Keraniganj, Dhaka, Bangladesh. Informed written consent was obtained from each participant before data collection. Confidentiality of all participants was maintained throughout the study. Participants were enrolled after completing breastfeeding and categorized into two groups based on duration: Group A (≤6 months) and Group B (>6 months). Women with known metabolic disorders, chronic illness, current pregnancy or ongoing lactation, use of lipid-altering medications, or incomplete clinical data were excluded. Anthropometric measurements including height, weight, waist circumference, and blood pressure were obtained using standardized procedures. Fasting venous blood samples were collected to measure fasting blood glucose, total cholesterol, triglycerides, HDL-cholesterol, and LDL-cholesterol using enzymatic methods. Atherogenic lipid ratios (TC/HDL, LDL/HDL, and TG/HDL) were subsequently calculated. Metabolic measurements were obtained within a defined postpartum period following cessation of breastfeeding to minimize long-term metabolic variability. Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 26.0 (IBM Corp., Armonk, NY, USA). As several variables were non-normally distributed, continuous variables were compared using the Mann–Whitney U test and categorical variables using the Chi-square test. Associations between breastfeeding duration and metabolic indicators were assessed using Spearman's rank correlation coefficients. Receiver Operating Characteristic (ROC) curve analysis was applied to evaluate the discriminative performance of lipid ratios, with area under the curve (AUC), optimal cut-off values determined by the Youden Index, and corresponding sensitivity and specificity calculated. Univariate and multivariable logistic regression analyses were conducted to identify independent associations between lipid ratios and shorter breastfeeding duration, adjusting for potential confounders including maternal age and BMI. Results were expressed as adjusted odds ratios (ORs) with 95% confidence intervals. A p-value <0.05 was considered statistically significant.

Result:

Table 1 & Fig A showed that mothers in Group A (≤6 months breastfeeding) were older (median age 27 vs 25 years) and had higher BMI (24.46 vs 22.24 kg/m²), systolic blood pressure (120 vs 100 mmHg), and diastolic blood pressure (80 vs 70 mmHg) compared to those in Group B (>6 months breastfeeding). The differences in age, BMI, systolic, and diastolic blood pressure were statistically significant ($p < 0.05$). However, waist circumference did not differ significantly between the groups ($p = 0.082$). diagnosis (Table 6). Correlation of colposcopy and histopathological examination. All women with CIN on colposcopy (100%) had CIN on histopathology, while 38.1% with CIN on colposcopy had cervicitis on histopathology (Table 7).

Table 2 showed that mothers in Group A (≤6 months breast-feeding) had significantly higher levels of fasting blood sugar (106.2 vs 91.8 mg/dL), total cholesterol (189.0 vs 172.0 mg/dL), triglycerides (142.5 vs 92.0 mg/dL), and LDL cholesterol (106.5 vs 95.5 mg/dL) compared to those in Group B (>6 months breastfeeding), with p-values all less than 0.01. The lipid ratios (TC/HDL, LDL/HDL, and TG/HDL) were also higher in Group A, with the TG/HDL ratio showing the most significant difference (2.76 vs 1.73, $p = 0.001$). HDL levels did not differ significantly between the groups ($p = 0.637$).

Table 1: Baseline characteristics of the study population

Variables	Group A (n=98)	Group B (n=98)	p-value
	f (%) Median (Range)	f (%) Median (Range)	
Age (in years)			
20-24	33 (33.7)	48 (49.0)	**0.037**
25-29	35 (35.7)	28 (28.6)	
30-34	26 (26.5)	14 (14.3)	
35-39	4 (4.1)	8 (8.2)	
Median (Range)	27 (20-36)	25 (20-39)	**0.022**
Physical parameters			
WC (cm)	83 (63-99)	79 (64-102)	0.082
BMI (kg/m^2)	24.46 (15.40-31.47)	22.24 (16.01-43.67)	**0.011**
SBP (mmHg)	120 (100-140)	100 (85-140)	**0.001**
DBP (mmHg)	80 (60-90)	70 (60-100)	**0.001**

Group A = Short breastfeeding ≤ 6 months; Group B = Longer breastfeeding > 6 months.
Chi-square test was used for categorical variables, and the Mann–Whitney U test was used for non-normally distributed continuous variables. A p-value < 0.05 was considered statistically significant.

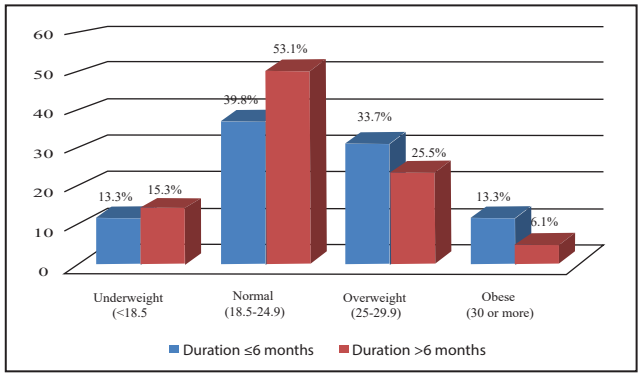

Fig A: Distribution of the participants according to BMI

Table 3 showed significant negative correlations between breastfeeding duration and BMI, fasting blood glucose, total cholesterol, triglycerides, LDL, and lipid ratios (TC/HDL, LDL/HDL, TG/HDL), indicating that longer breastfeeding was associated with better metabolic health. The strongest correlations were observed with fasting blood glucose (rs = -0.401) and triglycerides (rs = -0.264). These findings were further supported by Figure B, which illustrated that as breastfeeding duration increased, all three lipid ratios—TC/HDL, LDL/HDL and TG/HDL showed a decreasing trend.

Table 2: Biochemical parameters of the study population

Biochemical parameters	Group A (n=98)	Group B (n=98)	p-value
	Median (Range)	Median (Range)	
FBS (mg/dl)	106.20 (77.40-360.0)	91.80 (70.20-118.80)	**<0.001**
TC (mg/dl)	189.0 (120.0-293.0)	172.0 (77.0-293.0)	**0.001**
TG (mg/dl)	142.50 (65.0-293.0)	92.0 (38.0-368.0)	**<0.001**
LDL (mg/dl)	106.50 (61.0-177.0)	95.50 (30.0-169.0)	**0.009**
HDL (mg/dl)	50.0 (25.0-79.0)	50.50 (38.0-78.0)	**0.637**
TC/HDL ratio	3.75 (1.94-8.89)	3.43 (1.07-5.81)	**0.008**
LDL/HDL ratio	2.05 (0.98-5.28)	1.81 (0.65-3.39)	**0.017**
TG/HDL ratio	2.76 (1.05-7.74)	1.73 (0.60-7.48)	**0.001**

Group A = Short breastfeeding ≤ 6 months; Group B = Longer breastfeeding > 6 months.
Chi-square test was used for categorical variables, and the Mann–Whitney U test was used for non-normally distributed continuous variables. A p-value < 0.05 was considered statistically significant.

Table 3: Spearman correlation of breastfeeding duration with biochemical and lipid profile indicators

Variables	Spearman correlation coefficient (Duration of breast feeding in months)	
	r_s	p-value
BMI (kg/m^2)	-0.271	**<0.001**
FBS (mg/dl)	-0.401	**<0.001**
TC (mg/dl)	-0.275	**<0.001**
TG (mg/dl)	-0.264	**<0.001**
LDL (mg/dl)	-0.260	**<0.001**
HDL (mg/dl)	0.071	**0.320**
TC/HDL ratio	-0.232	**0.001**
LDL/HDL ratio	-0.247	**<0.001**
TG/HDL ratio	-0.287	**<0.001**

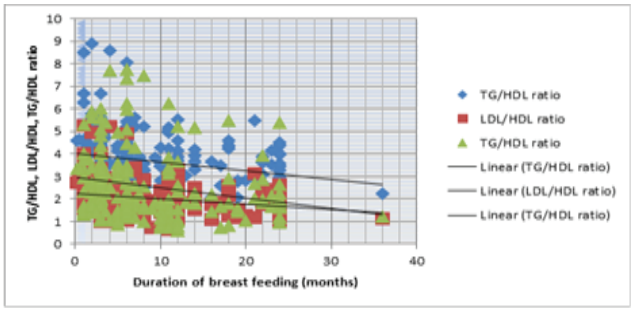

Figure B: Correlation between breastfeeding duration and lipid ratios (TC/HDL, LDL/HDL and TG/HDL)

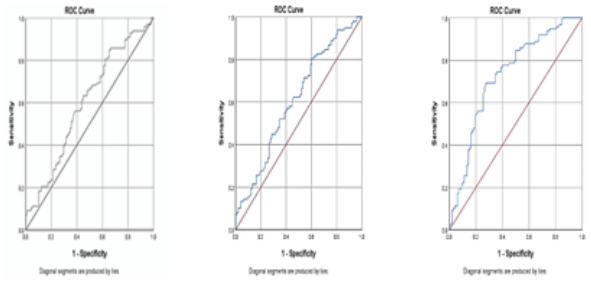

Fig C–E: ROC curves of lipid ratios (C: TC/HDL, D: LDL/HDL, E: TG/HDL)

ROC curve analysis (Fig C–E and Table 4) demonstrated that the TG/HDL ratio had the strongest diagnostic performance for identifying mothers who breastfed ≤6 months, with the highest AUC and a balanced sensitivity and specificity profile. In contrast, TC/HDL and LDL/HDL showed weaker discriminatory ability.

Table 4: Diagnostic performance of lipid ratios for predicting short breastfeeding duration

Lipid Ratio	AUC (95% CI)	p-value	Best Cut-off (Youden)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
TC/HDL	0.609 (0.530–0.688)	0.008	≥ 3.0421	80.6	39.8	57.25	67.24	60.20
LDL/HDL	0.598 (0.519–0.678)	0.017	≥ 1.5465	85.7	33.7	56.38	70.21	59.69
TG/HDL	0.728 (0.657–0.799)	<0.001	≥ 2.224	69.4	72.4	71.58	70.30	70.92

Table 5 showed that all lipid ratios were significantly associated with short breastfeeding duration in univariate analysis, with TG/HDL demonstrating the strongest effect. However, in the multivariate model, only TG/HDL remained a significant independent predictor, while TC/HDL and LDL/HDL lost significance. This indicates that the TG/HDL ratio is the most robust marker linked to shorter breastfeeding duration.

Table 5: Univariate and Multivariate logistic regression analysis of lipid ratios associated with short breastfeeding duration

Lipid ratios	Univariate Logistic Regression		Multivariate Logistic Regression	
	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
TC/HDL	2.74 (1.44-5.23)	**0.0021**	0.61 (0.21-1.72)	0.355
LDL/HDL	3.04 (1.50-6.15)	**0.0019**	1.87 (0.69-5.09)	0.218
TG/HDL	5.96 (3.21-11.04)	**<0.0001**	6.17 (2.90-13.11)	**0.001**

Discussion

In this study, mothers who breastfed for ≤6 months were older than those who breastfed for longer durations (median age 27 vs 25 years, p = 0.022), with a lower proportion in the youngest age group (20–24 years: 33.7% vs 49.0%). Comparable age trends appear in Choi et al., where Korean parous women showed incremental age differences across breastfeeding durations (≤5 mo: 39.78, 6–11 mo: 39.45, 12–23 mo: 39.44, ≥24 mo: 40.50 years, p = 0.001)8. Other studies provided older or broader age ranges; Project Viva modeled outcomes for women aged 35–40, 10, Villegas et al. reported a mean cohort age of 52.1±9.1, and the WHI included women aged 50–79 years11 while Hayosh et al. examined younger adults (mean 29.9, 28.8, 27.0 years across groups).12 These differences largely reflect methodological variation in timing of assessment, as most comparison studies evaluated women years or decades after breastfeeding rather than in the immediate postpartum period.

BMI showed a consistent pattern with breastfeeding duration. Mothers who breastfed for ≤6 months had higher BMI compared to those with longer breastfeeding duration (median 24.46 vs 22.24 kg/m², p = 0.011). Choi et al. reported modest BMI variation by breastfeeding length (≤5 months: 22.85, 6–11 months: 22.55, 12–23 months: 23.03, ≥ 24 months: 23.43 kg/m², p<0.001).8 Stuebe et al. found lower BMI three years postpartum among women exclusively breastfeeding >6 months (25.2) versus never-exclusive (27.0 kg/m², p = 0.05).10 Hayosh et al. observed uniformly lean BMIs across their young adult groups (21.1, 22.5, 22.2 kg/m²).12 Together, these patterns

consistently show that women who sustain longer breastfeeding tend to exhibit more favorable BMI profiles across populations and study designs. These disparities arise because our study captured active postpartum metabolic effects, whereas others assessed women long after lactation, when BMI reflects accumulated lifestyle and aging influences rather than breastfeeding behavior.

Blood pressure findings in this study further support the metabolic benefits of longer breastfeeding. Mothers who breastfed for more than six months had lower systolic and diastolic blood pressure compared to those who breastfed for ≤6 months (median SBP: 100 vs 120 mmHg; DBP: 70 vs 80 mmHg; $p < 0.05$). Choi et al. reported a similar directional pattern, observing gradual reductions in SBP across breastfeeding categories (110.49 → 108.55 mmHg, $p<0.001$) and modest DBP variation (71.7–73.2 mmHg, $p<0.001$).8

Biochemically, shorter-duration mothers demonstrated less favorable metabolic profiles. Median fasting blood glucose (106.2 vs 91.8 mg/dL), triglycerides (142.5 vs 92.0 mg/dL), total cholesterol (189.0 vs 172.0 mg/dL), and LDL cholesterol (106.5 vs 95.5 mg/dL) were all higher among mothers who breastfed for ≤6 months. In contrast, HDL levels did not differ significantly between the groups. Choi et al., however, showed fasting glucose nearly unchanged across breastfeeding durations (92–93 mg/dL, $p=0.375$),8 while Shub et al. (early postpartum) found exclusive breastfeeding associated with lower fasting glucose (4.60 vs 4.90 mmol/L, $p<0.0001$).9 These differences largely reflect timing, as our measurements captured the immediate postpartum metabolic shift when lactation most strongly influences glucose and lipid regulation, whereas Choi's national dataset reflects later, stabilized metabolic states.

Correlation analysis revealed significant negative associations between breastfeeding duration and BMI, fasting glucose, total cholesterol, triglycerides, LDL cholesterol, and lipid ratios, indicating that longer breastfeeding duration is associated with improved metabolic profiles (<0.001). HDL cholesterol showed no significant correlation, consistent with its relatively stable behavior in the postpartum period. A similar pattern was seen in the Shanghai Women's Health Study, although their correlation was far weaker (BMI $r = 0.22$),11 likely because measurements occurred decades after childbirth rather than during active postpartum metabolic adaptation.

Regression analysis further reinforced these findings. Although all lipid ratios (TC/HDL, LDL/HDL, and TG/HDL) were significantly associated with shorter breastfeeding duration in univariate models, only the TG/HDL ratio remained an independent predictor after adjustment (OR 6.17, $p = 0.001$). This highlights the robustness of TG/HDL as a marker of metabolic risk in relation to breastfeeding duration. Choi et al.'s adjusted regression likewise demonstrated protective metabolic effects of longer breastfeeding, reporting reduced odds for elevated blood pressure (OR 0.67–0.68), elevated glucose (OR 0.62–0.78), elevated triglycerides (OR 0.76), and metabolic syndrome (OR 0.70–0.73).8 Shub et al. also observed favorable lipid shifts with exclusive breastfeeding, with adjusted differences for TG (–0.24 mmol/L), LDL (–0.02 mmol/L), and HDL (+0.098 mmol/L), though smaller in magnitude due to their earlier postpartum window.9 Collectively, these comparisons show that stronger associations in our study likely reflect real-time postpartum metabolic responses, whereas population-based or later postpartum studies capture more attenuated long-term effects.

This study has several limitations. First, its cross-sectional design precludes causal inference between breastfeeding duration and metabolic parameters. Second, potential residual confounding from lifestyle factors such as diet and physical activity could not be fully excluded. Third, metabolic measurements were taken after completion of breastfeeding and may not fully capture long-term metabolic adaptation. Finally, the findings may not be generalizable beyond similar Bangladeshi populations.

Conclusion

Overall, the study's findings consistently indicate that longer breastfeeding duration is associated with more favourable maternal anthropometric, biochemical, and lipid profiles. These results highlight the importance of supporting breastfeeding beyond six months, not only for infant health but also for maternal metabolic well-being. Healthcare providers should consider incorporating TG/HDL ratio into postpartum metabolic risk assessments, particularly for mothers who breastfed for six months or less.

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Duality of Interest

The authors declare that there is no conflict of interest and no financial or personal relationships that could have influenced the work reported in this manuscript.

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