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Study on Relationship of Serum Triglyceride with Preeclampsia: A Case Control Study

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Abstract

Background: Preeclampsia (PE), a multisystem hypertensive disorder unique to pregnancy, contributes significantly to maternal and fetal morbidity and mortality worldwide. Growing evidence implicates dyslipidemia—particularly elevated serum triglycerides—in its pathogenesis, potentially through mechanisms involving endothelial dysfunction and atherogenesis. However, data on this association remain limited in South Asian populations.

Aim of the study: The aim of this study is to investigate the relationship between serum triglyceride levels and preeclampsia in Bangladeshi pregnant women.

Methods: This case-control study was conducted from January to July 2011 in the Obstetrics and Gynaecology Departments of two tertiary care centers in Dhaka, Bangladesh. A total of 100 pregnant women aged 18–35 years with gestational ages between 20–40 weeks were enrolled, comprising 50 cases of preeclampsia and 50 normotensive controls. Sociodemographic and clinical data were collected using structured questionnaires. Serum triglyceride levels were measured using enzymatic colorimetric assays. Statistical analysis was performed using SPSS version 16.0, employing t-tests, chi-square tests, Pearson's correlation, and linear regression analysis. A p-value <0.05 was considered statistically significant.

Result: The mean serum triglyceride level was significantly higher in the preeclampsia group (214.7 ± 18.6 mg/dL) compared to controls ($p<0.001$). A significant positive correlation was observed between serum triglycerides and systolic ($r = 0.3606$, $p<0.01$) as well as diastolic blood pressure ($r = 0.3754$, $p<0.01$) in the preeclampsia group. No significant correlation was found in the control group. Regression analysis yielded predictive equations for systolic ($y = 0.4339x + 172.58$) and diastolic ($y = 0.7529x + 161.35$) blood pressure based on triglyceride levels.

Conclusion: Elevated maternal serum triglyceride levels are significantly associated with preeclampsia and correlate positively with both systolic and diastolic blood pressures. These findings suggest a potential role of hypertriglyceridemia in the pathogenesis of preeclampsia and highlight its utility as a modifiable risk marker in antenatal screening.

Keywords: Preeclampsia; Serum Triglyceride; Pregnancy; Hypertension; Case-Control Study

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Introduction

Preeclampsia (PE) is a condition unique to pregnancy that affects approximately 3–5% of expectant mothers and remains a significant contributor to both maternal and fetal morbidity and mortality worldwide [1,2]. It is one of the most common medical complications encountered during pregnancy. In developing regions, where healthcare access is often limited, preeclampsia stands as a major cause of maternal deaths, accounting for an estimated 60,000 fatalities globally each year. A recent survey in Nigeria reported preeclampsia as the second leading cause of maternal mortality, responsible for 24.2% of such cases [3]. Clinically, preeclampsia is defined as a syndrome that typically arises after 20 weeks of gestation, marked by elevated systolic blood pressure (≥140 mm Hg) and diastolic blood pressure (≥90 mm Hg), along with significant proteinuria, with or without the presence of oedema [4]. The condition is more frequently observed in primigravida women and carries heightened risks for both the mother and fetus. Despite its prevalence and severity, the precise mechanisms underlying the pathogenesis of preeclampsia remain elusive. The placenta plays a central role, releasing factors into the maternal bloodstream that induce endothelial dysfunction. This dysfunction contributes to cardiovascular issues such as vasospasm, increased vascular permeability, and pro-thrombotic activity, which are considered early steps in the development of atherosclerosis [5]. Histopathological findings in preeclamptic women often reveal arterial lesions at the implantation site—similar to those seen in atherosclerosis—characterized by fibrinoid necrosis surrounded by lipid-filled macrophages [6]. Lipid accumulation is also observed in the glomeruli of affected patients, a condition known as glomerular endotheliosis, which is closely associated with proteinuria and indicates disease severity [5]. It has been proposed that elevated levels of low-density lipoproteins (LDL) and triglycerides may contribute to this renal impairment [7,8]. Altered lipid metabolism is believed to play a role in the endothelial damage seen in preeclampsia [10]. The extent of hypertension and proteinuria may correlate with the severity of this endothelial injury [11,12]. Pregnancy normally induces physiological hyperlipidemia, with notable increases in serum triglycerides and cholesterol. However, women with preeclampsia experience more pronounced lipid alterations, including higher triglyceride levels, even before 20 weeks of gestation. Triglyceride levels typically double during pregnancy, particularly in the second and third trimesters, as part of the maternal adaptation to meet fetal energy demands. Yet, in preeclampsia, this increase is exaggerated [13,14]. Studies have shown elevated triglyceride content in placentas from preeclamptic pregnancies compared to controls, and significantly higher circulating triglycerides in these women at delivery. Multiple case-control studies across diverse populations have confirmed these findings [15,16]. Although preeclamptic pregnancies often exhibit heightened hypertriglyceridemia, they are also associated with complications such as fetal growth restriction [17]. According to Xiong et al., preeclampsia increases the risk of low birth weight by 4.1 times and small-for-gestational-age infants by 2.6 times, and may also be linked to higher fetal mortality [18]. This study aimed to explore maternal hypertriglyceridemia as a modifiable risk factor potentially involved in the development of preeclampsia.

Methodology and Materials

This case-control study was conducted from January 2011 to July 2011 in the Department of Obstetrics and Gynaecology at two tertiary care teaching hospitals: Bangabandhu Sheikh Mujib Medical University (BSMMU) Hospital and Dhaka Medical College Hospital (DMCH), Dhaka, Bangladesh.

Ethical Considerations

The research protocol was reviewed and approved by the Ethical Review Committees of BSMMU and DMCH, as well as the Bangladesh College of Physicians and Surgeons (BCPS). Written informed consent was obtained from all participants after explaining the objectives and procedures of the study. The study adhered to the principles outlined in the Declaration of Helsinki.

Study Population

A total of 100 pregnant women were enrolled in the study, comprising 50 preeclampsia cases and 50 normotensive controls. Participants were selected from both outpatient and inpatient services of the obstetrics departments. The cases and controls were matched for maternal age and gestational age to reduce potential confounding effects.

Inclusion Criteria

For Cases:

- Pregnant women aged 18–35 years
- Gestational age between 20 and 40 weeks
- Systolic blood pressure >140 mmHg and/or diastolic blood pressure >90 mmHg
- Presence of proteinuria confirmed by urine dipstick in at least two midstream samples 6 hours apart, in the absence of urinary tract infection

For Controls:

- Pregnant women aged 18–35 years
- Gestational age between 20 and 40 weeks
- Normotensive (both systolic and diastolic blood pressure within normal range)
- Absence of proteinuria

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Exclusion Criteria

- Known cases of systemic illness including diabetes mellitus, essential hypertension, chronic renal disease, liver disease, or autoimmune disorders
- Multiple pregnancies
- History of lipid-lowering medication use
- Refusal to provide informed consent

Data Collection Procedure

Eligible participants were recruited after meeting the inclusion and exclusion criteria. A detailed history was obtained, followed by clinical examination. A structured questionnaire was used to collect sociodemographic and clinical data, including age, gestational age, parity, and relevant medical history. All participants underwent thorough clinical examination, and their blood pressure was measured after at least 10 minutes of rest using a standard sphygmomanometer. Systolic and diastolic pressures were recorded based on Korotkoff phase I and phase V sounds, respectively. For the assessment of proteinuria, midstream urine samples were collected and tested using dipstick analysis; a positive result was confirmed if proteinuria was present in two samples taken six hours apart, without evidence of urinary tract infection. Venous blood samples (5 mL) were collected under aseptic conditions using sterile disposable syringes. The samples were transferred into clean, dry test tubes and allowed to clot, then centrifuged to separate the serum. If immediate biochemical analysis was not feasible, the serum was stored at −20°C to preserve sample integrity. Serum triglyceride concentrations were determined using an enzymatic colorimetric method, following standard laboratory protocols.

Statistical Analysis

All data were entered and analyzed using SPSS software version 16.0 (SPSS Inc., Chicago, IL, USA). Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. Group comparisons were performed using independent sample t-tests for continuous variables and chi-square (χ^2) tests for categorical variables. Correlation between serum triglyceride levels and blood pressure parameters was assessed using Pearson's correlation coefficient and linear regression analysis. A p-value of <0.05 was considered statistically significant.

Result

A total of 100 participants were enrolled, with 50 in both the case and control groups. The mean age was similar between groups (cases: 27.33 ± 1.11 years; controls: 26 ± 1.01 years), with the 26–30 year group being most common (56% cases, 50% controls). Age and socioeconomic distributions showed no significant differences, with the lower class being predominant in both groups (60% cases, 56% controls). Gravida status also showed no significant variation: Gravida 1 was more common in cases (46%) than controls (38%), while Gravida 2 and 3 were higher among controls (26% and 24%) compared to cases (12% and 18%). Gravida 4 and 5 were reported more in cases (16% and 8%) than controls (6% each). Preterm delivery occurred in 90% of cases and 84% of controls; term deliveries were 10% and 16%, respectively—differences were not significant. Normal BMI (<25 kg/m²) was noted in 54% of cases and 40% of controls, while overweight/obesity (≥25 kg/m²) was more prevalent in controls (60%) than cases (46%), also without statistical significance (Table 1). Systolic and diastolic blood pressures were significantly higher in the case group, with means of 153.0 ± 20.1 mmHg and 103.1 ± 12.1 mmHg, respectively. Serum triglyceride levels were also markedly elevated among cases at 214.7 ± 18.6 mg/dL (Table 2). Table 3 presented that, across all age groups, serum triglyceride levels remained significantly higher in cases, with the highest mean observed in the 31–35 year group (235.3 ± 20.6 mg/dL). In the preeclampsia group, serum triglycerides showed a significant positive correlation with both systolic ($r = 0.3606$, $R^2 = 0.13$, $p < 0.01$) and diastolic blood pressure ($r = 0.3754$, $R^2 = 0.1409$, $p < 0.01$). Regression equations were $y = 0.4339x + 172.58$ and $y = 0.7529x + 161.35$, respectively. No significant correlations were found in the control group (systolic: $r = 0.248$, $p = 0.082$; diastolic: $r = 0.1655$, $p = 0.212$) (Table 4).

Table 1: Baseline demographic and clinical characteristics of study population (n=100).

Variables	Case (n=50)		Control (n=50)		p-value
	n	%	n	%	
Age (years)					
20-25	15	30	17	34	>0.05
26-30	28	56	25	50	
31-35	7	14	8	16	
Mean +SD	27.33+1.113		26+1.01		
Socioeconomic Status					
Lower class	30	60	28	56	0.512
Middle class	15	30	13	26	
Upper class	5	10	9	18	
Gravida					
Gravida 1	23	46	19	38	0.149
Gravida 2	6	12	13	26	
Gravida 3	9	18	12	24	
Gravida 4	8	16	3	6	
Gravida 5	4	8	3	6	
Gestational Age (weeks)					

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< 37 (Preterm)	45	90	42	84	>0.10
≥ 37 (Term)	5	10	8	16	
BMI (kg/m²)					
< 25 (normal)	27	54	20	40	>0.10
≥ 25 (overweight & obese)	23	46	30	60	

Table 2: Comparison of blood pressure and serum triglyceride levels between groups

Parameter	Case (n=50)	Control (n = 50)	p-value
Systolic Blood Pressure (mmHg)	153.0 ± 20.1	112.0 ± 8.6	<0.001*
Diastolic Blood Pressure (mmHg)	103.1 ± 12.1	75.5 ± 6.5	<0.001*
Serum Triglyceride (mg/dL)	214.7 ± 18.6	138.1 ± 3.9	<0.001*

Table 3: Serum triglyceride levels across age groups

Age Group (years)	Case (n=50)	Control (n = 50)	p-value
20–25	187.2 ± 27.5	132.1 ± 5.97	<0.001*
26–30	221.6 ± 6.9	138.5 ± 0.43	<0.001*
31–35	235.3 ± 20.6	143.6 ± 5.53	<0.001*

Table 4: Correlation between serum triglyceride and blood pressure parameters

Group	Parameter	Pearson's r	Regression Equation	R^2	p-value
Preeclampsia (Group I)	Systolic BP	0.3606	y = 0.4339x + 172.58	0.13	<0.01*
	Diastolic BP	0.3754	y = 0.7529x + 161.35	0.1409	<0.01*
Control (Group II)	Systolic BP	0.248	y = 0.3279x + 147.03	0.0615	0.082
	Diastolic BP	0.1655	y = 0.3738x + 155.30	0.0274	0.212

Discussion

Pregnancy represents a state of physiological stress marked by numerous internal changes, with particular emphasis on the biochemical alterations in the blood that occur during normal gestation. These changes become more pronounced in pregnancy-related complications such as preeclampsia. One of the most frequently associated factors in preeclampsia is placental vasculopathy. If preeclampsia is considered a multifactorial condition, triglyceride-related vasculopathy may be one potential contributing cause [19]. Women with preeclampsia exhibit elevated levels of circulating serum triglycerides, which play a key role in lipid-induced endothelial dysfunction. In the present study, the case and control groups were closely matched in terms of age. Obstetric factors such as parity and gestational age were evenly distributed across both groups. Approximately 60% of the cases and 56% of the controls were from lower socioeconomic backgrounds. Ogden et al. reported that rising triglyceride levels correspond with the increasing prevalence of obesity among young women [20]. Kocyigit Y. Atamer et al. demonstrated that pregnant women who develop preeclampsia are not necessarily more overweight than those who do not develop the condition [21]. In the present study, nearly half of the participants in both the case and control groups were classified as overweight or obese, with no statistically significant difference observed between the groups ($P > 0.1$). Maseki et al. and Kharb et al. defined preeclampsia as the presence of blood pressure exceeding 140/90 mmHg or a diastolic increase of more than 15 mmHg after 20 weeks of gestation. This definition aligns well with the present study's findings, where the mean (±SD) systolic blood pressure was significantly higher in Group I (153.0 ± 20.1 mmHg) compared to Group II (112.5 ± 8.6 mmHg), with a statistically significant difference ($P < 0.05$). Similarly, the mean (±SD) diastolic blood pressure was also significantly elevated in Group I (103.1 ± 12.1 mmHg) compared to Group II (75.5 ± 6.5 mmHg), with the difference reaching statistical significance ($P < 0.05$) [22]. Ziaei S, et al. have reported that hypertriglyceridemia could be involved in the pathogenesis of hypertensive disorder during pregnancy [23]. In the present study we also found a significant and positive association between proteinuria and triglyceride. The present study also demonstrated a significant increase in triglyceride (TG) levels among preeclamptic patients compared to those with normal pregnancies. Similar elevations in plasma TG levels in preeclampsia have been reported in several previous studies (5, 8). These findings support a consistent positive association between elevated maternal TG levels and the risk of developing preeclampsia [24]. Kashinakunti S.V. et al. reported a strong positive correlation between systolic blood pressure and serum triglyceride levels ($r = 0.721$), as well as between diastolic blood pressure and serum triglycerides ($r = 0.583$) [25]. The present study supports this observation, reinforcing the hypothesis that elevated serum triglyceride levels contribute to the development of preeclampsia. In this study, increases in both systolic and diastolic blood pressure were accompanied by corresponding rises in serum triglyceride levels. These findings suggest a clear association between elevated maternal triglyceride concentrations and the increased risk of preeclampsia. The presence of dyslipidemia—particularly elevated triglyceride levels—in patients with preeclampsia suggests a shared pathophysiological link

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between preeclampsia and the endothelial damage observed in atherosclerosis. This connection raises the possibility that such vascular lesions may predispose affected women to adverse cardiovascular outcomes later in life. Supporting this hypothesis, a systematic review by Bellamy et al. found that women with a history of preeclampsia had a significantly increased risk of developing cardiovascular conditions, including cardiovascular disease (RR = 3.7), hypertension (RR = 2.16), ischemic heart disease (RR = 1.81), venous thromboembolism (RR = 1.79), and overall mortality (RR = 1.49) [23]. These findings underscore the potential long-term cardiovascular implications of hypertensive disorders during pregnancy.

Limitations of the study:

This study had several limitations. Firstly, the sample size was relatively small, which may limit the generalizability of the findings. Secondly, it was conducted at a single center, reducing external validity across diverse populations. Thirdly, confounding factors such as diet, body mass index, and genetic predisposition influencing serum triglyceride levels were not controlled. Additionally, the cross-sectional nature of the study restricts causal inference between triglyceride levels and preeclampsia. Finally, other lipid parameters and inflammatory markers were not assessed, which could provide a more comprehensive understanding of the pathophysiological mechanisms involved. Future multicenter studies with larger cohorts and longitudinal design are recommended.

Conclusion and Recommendations

This study highlights a significant association between elevated serum triglyceride levels and preeclampsia, supporting the role of lipid abnormalities in its pathogenesis. Serum triglycerides showed positive correlations with hypertension and proteinuria, the key diagnostic features of preeclampsia, indicating their potential as predictive biomarkers. Routine lipid profiling in pregnancy, particularly triglyceride assessment, may help in early identification of high-risk women, enabling timely interventions and improved maternal-fetal outcomes. Future research should focus on evaluating lipid-lowering therapies, such as pharmacological agents or lifestyle modifications, for their potential in preventing or managing preeclampsia. Systematic reviews and clinical trials are warranted to refine predictive models, develop effective screening tools, and assess the impact of early lifestyle interventions in reducing the burden of this life-threatening condition.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee.

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