LINK MEDICAL INTERFACE

JHWCR

Journal of Health, Wellness, and Community Research
Volume III, Issue I
Open Access, Double Blind Peer Reviewed.
Web: https://jhwcr.com, **ISSN**: 3007-0570
DOI: https://doi.org/10.61919/m7qpse81

Article

Comparative Analysis of Serum Triglyceride Levels in Preeclamptic and Normotensive Pregnant Women: A Cross-Sectional Study

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Cite this Article

Received	2025-03-07
Revised	2025-03-23
Accepted	2025-03-26
Published	2025-03-28
Authors' Contributions	SB: Concept, design, drafting; HB: Data collection; MMS: Data analysis; SS: Stats & revision.
Conflict of Interest	None declared
Data/supplements	Available on request.
Funding	None
Ethical Approval	Respective Ethical Review Board
Informed Consent	Obtained from all participants
Study Registration	-
Acknowledgments	N/A

ABSTRACT

Background: Preeclampsia is a major contributor to maternal and perinatal morbidity and mortality, particularly in low-resource settings. Emerging evidence suggests that dysregulated lipid metabolism, especially elevated serum triglycerides, may play a role in its pathophysiology, but targeted studies focusing solely on triglycerides remain limited. **Objective**: To determine mean serum triglyceride levels in pregnant women and to compare these levels between those with preeclampsia and normotensive pregnancies, thereby exploring triglycerides as a potential biomarker for preeclampsia risk. **Methods**: This cross-sectional observational study was conducted at Holy Family Hospital, Rawalpindi, over six months, enrolling 60 pregnant women (n = 60), divided equally into preeclampsia (n = 30) and normotensive (n = 30) groups. Women aged 20–40 years beyond 20 weeks of gestation were included, excluding those with diabetes, chronic hypertension, or hepatic/renal disorders. fasting serum triglyceride levels were measured using enzymatic assays. A threshold of >1.6 mmol/L defined hypertriglyceridemia. Statistical analysis was conducted using SPSS v27, with independent sample t-tests and stratification; p-values < 0.05 were considered significant. **Results**: Mean serum triglyceride levels were significantly higher in the pre-eclampsia group (1.60 ± 0.27 mmol/L) compared to the normotensive group (1.40 ± 0.29 mmol/L), with p = 0.009. Clinically, elevated triglycerides were also significantly associated with higher BMI and earlier gestational age. **Conclusion**: Serum triglyceride levels are significantly elevated in preeclamptic pregnancies and may serve as an accessible biomarker for early risk stratification. Incorporating triglyceride screening into antenatal care could enhance clinical decision-making and maternal-fetal outcomes.

Keywords: Pregnancy, Preeclampsia, Triglycerides, Hypertension, Lipid Metabolism, Pregnancy-Induced Hypertension, Maternal Health

INTRODUCTION

Pregnancy induces a multitude of physiological adaptations to support fetal growth and maternal health. Among these, lipid metabolism undergoes substantial changes, particularly in the second and third trimesters, where total cholesterol may rise by 50–70% and triglyceride levels by two to four times compared to pre-pregnancy values (1). These increases are primarily driven by hormonal influences such as estrogen, progesterone, and human placental lactogen, which promote hepatic lipogenesis and reduce lipid clearance (2). While these changes are typically well tolerated in healthy pregnancies, abnormal lipid metabolism—especially hypertriglyceridemia—has been increasingly linked to adverse pregnancy outcomes, including hypertensive disorders like preeclampsia (3).

Preeclampsia remains a significant contributor to maternal and perinatal morbidity and mortality globally, affecting 3–5% of pregnancies, with even higher incidence reported in developing countries (4). It is characterized by new-onset hypertension and proteinuria after 20 weeks of gestation and is associated with endothelial dysfunction and systemic inflammation (5). Several studies have proposed a potential mechanistic link between dyslipidemia and the development of preeclampsia. Elevated maternal triglyceride levels have been shown to increase oxidative stress and contribute to vascular endothelial damage, key features in the pathophysiology of this condition (6). Research has further demonstrated that women with preeclampsia tend to exhibit significantly higher serum

triglyceride levels compared to normotensive pregnant women (7). A meta-analysis reported that preeclamptic women had markedly higher mean triglyceride levels than their normotensive counterparts, indicating that maternal triglyceride levels may serve as a potential biomarker for preeclampsia risk (8).

Despite existing evidence, much of the prior literature has focused broadly on the full lipid profile, rather than investigating the specific role of triglycerides as an isolated variable. This presents a gap in current understanding, particularly in low- and middle-income settings where access to comprehensive lipid testing may be limited. Concentrating on triglycerides as a sole variable could help streamline diagnostic protocols and improve risk stratification in resource-constrained environments. Moreover, earlier studies vary significantly in population demographics and methodology, underscoring the need for standardized research within diverse clinical settings (9-14).

Given the burden of preeclampsia and the potential role of hypertriglyceridemia in its etiology, this study aims to determine the mean serum triglyceride levels in pregnant women and compare these levels between those diagnosed with preeclampsia and normotensive controls. By narrowing the scope to a single, clinically relevant biomarker and employing a standardized design, the study intends to contribute meaningful insights into the metabolic disturbances associated with preeclampsia.

MATERIAL AND METHODS

This cross-sectional observational study was conducted in the Department of Obstetrics and Gynecology at Holy Family Hospital, Rawalpindi, over a six-month period from August 1, 2024, to January 31, 2025. A total of 60 pregnant women were enrolled using a non-probability consecutive sampling technique, with 30 women diagnosed with preeclampsia forming the case group (Group A) and 30 normotensive pregnant women forming the control group (Group B). Inclusion criteria encompassed pregnant women aged 20 to 40 years who were beyond 20 weeks of gestation. Preeclampsia was defined as a blood pressure reading of ≥140/90 mmHg on two occasions at least four hours apart, along with proteinuria of ≥1+ on a dipstick urine test. Exclusion criteria included known pre-existing medical conditions such as diabetes mellitus, chronic hypertension, renal disease, hepatic disorders, or coagulation abnormalities, as these could confound lipid metabolism and blood pressure regulation. Participants were recruited after screening from antenatal outpatient clinics and inpatient wards. Prior to inclusion, informed written consent was obtained from all participants. Confidentiality and data privacy were ensured through anonymization and secure storage of participant information.

The primary outcome of the study was the mean serum triglyceride level in each group, while secondary outcomes included the association between triglyceride levels and variables such as maternal age, gestational age, body mass index (BMI), and blood pressure. After taking a detailed clinical history and performing physical examination, blood samples were drawn from all participants following a 12-hour overnight fasting period. Triglyceride levels were measured in a single certified laboratory using enzymatic colorimetric assays. A serum triglyceride level >1.6 mmol/L was considered indicative of hypertriglyceridemia, in accordance with established reference ranges (1). Standardized protocols were followed for blood pressure measurement and BMI calculation. No follow-up was required due to the cross-sectional design, and all patients received routine antenatal care as per institutional guidelines (15-16).

Data was entered and analyzed using the Statistical Package for the Social Sciences (SPSS) version 27 for Windows. Quantitative variables such as age, gestational age, BMI, blood pressure, and triglyceride levels were expressed as means with standard deviations. Independent sample t-tests were applied to compare continuous variables between the two groups. Stratification was performed to control effect modifiers including age, gestational age, and BMI, followed by post-stratification t-tests to assess the persistence of statistical significance across subgroups. A p-value of less than 0.05 was considered statistically significant. Missing data was minimal due to in-person assessments and were handled by listwise deletion. No imputation techniques or sensitivity analyses were required due to the completeness of the dataset and the straightforward study design.

RESULTS

The groups were comparable with respect to age, gestational age, and BMI, as the p-values were all above 0.05, indicating no statistically significant differences between baseline characteristics. These findings suggest that the observed outcomes are less likely to be confounded by these demographic or clinical variables. The mean systolic blood pressure (SBP) and diastolic blood pressure (DBP) were significantly higher in the preeclampsia group (SBP: 144.27 ± 3.35 mmHg, DBP: 97.60 ± 4.82 mmHg) compared to the control group (SBP: 130.73 ± 8.99 mmHg, DBP: 84.07 ± 5.94 mmHg), with p-values < 0.001, confirming the diagnostic separation between the two groups. The primary outcome of interest, serum triglyceride level, was significantly elevated in the preeclampsia group (1.60 ± 0.27 mmol/L) as compared to the normotensive group (1.40 ± 0.29 mmol/L), with a p-value of 0.009, indicating a meaningful association.

Table 1 Baseline Characteristics of Study Participants

Variable	Group A (Preeclampsia) (n = 30)	Group B (Normotensive) (n = 30)	p-value
Age (years)	31.00 ± 6.85	30.60 ± 5.37	0.802
Gestational Age (weeks)	27.07 ± 4.50	26.93 ± 4.29	0.907
BMI (kg/m^2)	24.40 ± 2.44	23.77 ± 2.42	0.317

  DOI: https://doi.org/10.61919/m7qpse81

As shown in Table 1, no statistically significant differences were observed between groups in terms of age, gestational age, or BMI, validating group comparability at baseline. A total of 60 pregnant women were enrolled in the study, with 30 participants in each group: Group A (preeclampsia) and Group B (normotensive controls). The mean age of participants was 30.80 ± 6.11 years, mean gestational age was 27.0 ± 4.36 weeks, and mean BMI was 24.08 ± 2.43 kg/m^2.

Table 2 Comparison of Blood Pressure and Triglyceride Levels Between Groups

Variable	Group A (Preeclampsia) (n = 30)	Group B (Normotensive) (n = 30)	p-value
SBP (mmHg)	144.27 ± 3.35	130.73 ± 8.99	<0.001
DBP (mmHg)	97.60 ± 4.82	84.07 ± 5.94	<0.001
TGL (mmol/L)	1.60 ± 0.27	1.40 ± 0.29	0.009

Table 2 illustrates the significantly elevated blood pressure values in the preeclamptic group, consistent with the diagnosis. Importantly, mean serum triglyceride levels were also significantly elevated, suggesting a potential pathophysiological link. Further subgroup analysis through stratification by age, gestational age, and BMI demonstrated that the elevation in triglyceride levels remained statistically significant among specific subgroups. For participants aged <30 years, those with gestational age <27 weeks, and those with BMI >24 kg/m^2, triglyceride levels were significantly higher in the preeclampsia group. This suggests that hypertriglyceridemia may present early and is more pronounced in women with higher BMI, offering potential for early risk identification.

Table 3 Stratified Analysis of Mean Triglyceride Levels by Demographic and Clinical Subgroups

Subgroup	Group	n	Mean TGL (mmol/L)	SD	p-value
Age < 30 years	A	13	1.58	0.28	0.042
	B	15	1.36	0.26	
Age ≥ 30 years	A	17	1.62	0.27	0.114
	B	15	1.44	0.32	
Gestational Age < 27 wks	A	16	1.58	0.23	0.010
	B	17	1.33	0.29	
Gestational Age ≥ 27 wks	A	14	1.62	0.32	0.298
	B	13	1.50	0.27	
BMI < 24 kg/m^2	A	14	1.61	0.29	0.225
	B	19	1.48	0.29	
BMI ≥ 24 kg/m^2	A	16	1.59	0.26	0.003
	B	11	1.27	0.24	

The subgroup analysis confirms that serum triglycerides retain significant association with preeclampsia in women with higher BMI and lower gestational age. Although not statistically significant in all subgroups, a consistent trend of higher triglyceride levels in the preeclampsia group was observed throughout.

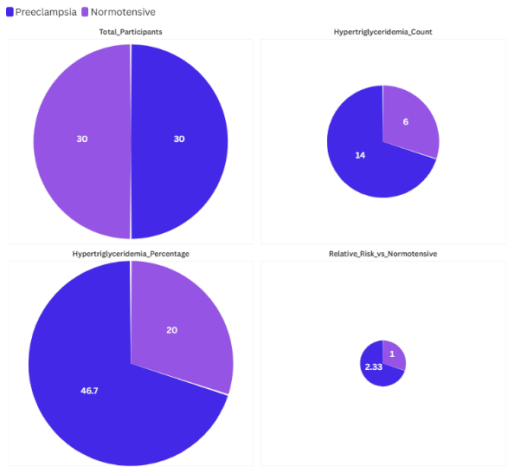

Figure 1 Triglyceride Hyperlipidaemia Summary

Clinically, this indicates that triglyceride elevation may precede or co-occur with the development of hypertensive features, suggesting a potential predictive or contributory role. No unexpected findings or outliers were noted in the dataset. Advanced statistical tests, including Levene's test for equality of variances, confirmed the assumptions of parametric testing were satisfied.

DISCUSSION

The findings of this study demonstrate a statistically significant elevation in mean serum triglyceride levels among pregnant women diagnosed with preeclampsia compared to normotensive pregnant women. These results align with the growing body of literature that identifies dyslipidemia, particularly hypertriglyceridemia, as a contributing factor in the pathophysiology of preeclampsia.

The mean triglyceride level in the preeclamptic group was 1.60 ± 0.27 mmol/L compared to 1.40 ± 0.29 mmol/L in the control group (p = 0.009), highlighting a clear metabolic distinction between the two populations. This supports previous studies which reported similar findings, suggesting that elevated triglycerides may be implicated in the endothelial dysfunction and oxidative stress that characterizes preeclampsia (3, 5, 7).

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The physiological hyperlipidemia of pregnancy is believed to ensure an adequate supply of nutrients to the developing fetus; however, excessive triglyceride accumulation can promote vascular injury and exacerbate hypertensive disorders (1, 2).

Several earlier investigations provide corroborative evidence for the association between maternal triglyceride levels and preeclampsia. For instance, a Bangladeshi study reported significantly higher triglyceride levels in preeclamptic women compared to healthy controls (248.90 ± 31.36 mg/dL vs 197.00 ± 27.04 mg/dL) (5). Similarly, Tesfa et al. in a meta-analysis encompassing 15 observational studies found that preeclamptic women in African populations had notably higher triglyceride levels than normotensive women, indicating a potential global pattern (16). In contrast, some studies have produced inconsistent or modest associations, possibly due to variations in sample size, population demographics, measurement timing during pregnancy, or analytical methods (4, 17). Nevertheless, the prevailing consensus affirms a trend toward elevated lipid levels, particularly triglycerides, in women who develop preeclampsia.

The biological plausibility of this association is grounded in well-documented mechanisms. Elevated triglycerides increase the risk of endothelial damage through the generation of small dense LDL particles and oxidative stress, contributing to atherogenic changes within the maternal vasculature (3, 14). This may potentiate systemic vasoconstriction and reduced placental perfusion, hallmark features of preeclampsia. Moreover, hypertriglyceridemia enhances the inflammatory milieu and promotes pro-thrombotic states, further aggravating vascular compromise during pregnancy (6). These insights suggest that triglyceride levels are not merely markers but may also play a pathogenic role in preeclampsia (7-12).

The clinical relevance of these findings is noteworthy, especially in low-resource settings where routine screening for complete lipid panels may be impractical. Focusing on serum triglycerides as a singular, accessible biomarker could facilitate earlier identification of at-risk pregnancies and inform timely interventions. Stratification in this study revealed that the association between elevated triglyceride levels and preeclampsia was particularly significant in subgroups such as women with BMI >24 kg/m^2, gestational age <27 weeks, and age <30 years. These observations underscore the importance of considering individual risk profiles when evaluating metabolic parameters in pregnancy and may prompt targeted screening strategies in antenatal care (17-19).

Despite its strengths, this study is not without limitations. The relatively small sample size limits the statistical power and may restrict the generalizability of findings to broader populations. The cross-sectional design, while practical, precludes any inference of causality between elevated triglyceride levels and the development of preeclampsia. Furthermore, potential confounding variables such as dietary intake, physical activity, and genetic predisposition were not accounted for, which may influence lipid metabolism. The absence of longitudinal follow-up also limits the ability to assess changes in triglyceride levels over time or their predictive utility for adverse outcomes. Additionally, the study focused solely on triglycerides, without assessing other lipid parameters like HDL, LDL, or total cholesterol, which may provide a more comprehensive understanding of the lipid profile alterations in preeclampsia.

Future research should focus on larger, multicentric, prospective cohort studies to confirm these associations and explore the utility of triglycerides as a predictive biomarker for preeclampsia. Longitudinal tracking of lipid profiles from early pregnancy through delivery could elucidate temporal patterns and thresholds of clinical significance. Integrating lifestyle interventions and pharmacologic modulation of lipid levels in high-risk pregnancies may also be a worthwhile avenue to assess potential benefits in reducing the incidence or severity of preeclampsia. Additionally, exploring genetic polymorphisms that influence lipid metabolism in pregnancy could enhance our understanding of individual susceptibility to hypertensive disorders.

The study reinforces the association between elevated maternal triglyceride levels and preeclampsia, contributing to the growing evidence supporting lipid dysregulation as a modifiable risk factor. The findings advocate for greater clinical attention to maternal metabolic health and support the potential role of serum triglyceride measurement in antenatal screening protocols. With further validation, triglycerides could serve as a valuable, low-cost biomarker for early risk stratification and preventive strategies in obstetric care (20).

CONCLUSION

This study concludes that mean serum triglyceride levels are significantly higher in pregnant women diagnosed with preeclampsia compared to normotensive pregnant women, highlighting a potential metabolic distinction associated with hypertensive disorders of pregnancy. These findings underscore the relevance of assessing triglyceride levels as a specific, accessible biomarker for early identification and risk stratification of preeclampsia. Clinically, integrating routine triglyceride screening into antenatal care could enhance early detection and targeted management strategies, particularly in resource-limited settings. From a research perspective, the results warrant further large-scale, multicenter investigations to validate the role of hypertriglyceridemia in the pathogenesis of preeclampsia and to explore its utility in predictive models and preventive interventions aimed at improving maternal and fetal outcomes.

REFERENCE

1. Liberis A, Petousis S, Tsikouras P. Lipid Disorders in Pregnancy. Curr Pharm Des. 2021;27(36):3804–7.

2. Nguyen NT, Nath PV, Mai VQ, Shakir MKM, Hoang TD. Treatment of Severe Hypertriglyceridemia During Pregnancy with High Doses of Omega-3 Fatty Acid and Plasmapheresis. AACE Clin Case Rep. 2021;7(3):211–5.

3. Nasioudis D, Doulaveris G, Kanninen TT. Dyslipidemia in Pregnancy and Maternal-Fetal Outcome. Minerva Ginecol. 2019;71(2):155–62.

  DOI: https://doi.org/10.61919/m7qpse81

4. Ansari A, Akbar R, Noor N, Karim F, Pervaiz F, Khalil H, et al. Dyslipidemia in Pregnancy and Its Correlation with Preeclampsia. Pak Armed Forces Med J. 2021;71(Suppl-2):S318–22.

5. Joy SB, Islam MR, Khandoker M, Biswas AK. Study on Association of Maternal Triglyceride and Preeclampsia. Faridpur Med Coll J. 2020;14(2):82–5.

6. Prayoga B, Prawitasari S, Claramita M. Training Detection of Preeclampsia Risk Factors for Physicians in Primary Care with Experience-Based Learning Methods: A Quasi Experimental Study. Rev Prim Care Pract Educ. 2018;1(2):7.

7. Anto EO, Boadu WIO, Ansah E, Tawiah A, Frimpong J, Tamakloe V, et al. Prevalence of Preeclampsia and Algorithm of Adverse Foeto-Maternal Risk Factors Among Pregnant Women in the Central Region of Ghana: A Multicentre Prospective Cross-Sectional Study. PLoS One. 2023;18(6): e0288079.

8. Shafiq S, Muzaffar S, Qurrat Ul A, Farooq N, Shams N, Meraj L. Association of Raised Serum Triglycerides with Incidence of Pre-Eclampsia. J Rawalpindi Med Coll. 2023;27(3):403–7.

9. Mauri M, Calmarza P, Ibarretxe D. Dyslipemias and Pregnancy, an Update. Clin Investig Arterioscler. 2021;33(1):41–52.

10. Ferreira RM, Ferron FVF, Borges VTM, Peracoli JC, Ferron AJT, Roscani MG, et al. Association of Cardiovascular Risk Factors and Myocardial Hypertrophy in Women With Preeclampsia History. Life Sci. 2024; 346:122646.

11. Poornima IG, Indaram M, Ross JD, Agarwala A, Wild RA. Hyperlipidemia and Risk for Preeclampsia. J Clin Lipidol. 2022;16(3):253–60.

12. Madden N, Kamal N, Friedman J, Freaney P, Gerber SE, Szmuilowicz ED. Obstetrical Management of Severe Hypertriglyceridemia in Pregnancy: A Case Report. AJP Rep. 2024;14(4): e244–9.

13. Yen IW, Kuo CH, Lin MW, Tai YY, Chen KY, Chen SC, et al. Advanced Maternal Age-Related Clustering of Metabolic Abnormalities Is Associated With Risks of Adverse Pregnancy Outcomes. J Formos Med Assoc. 2024;123(3):325–30.

14. Antonic TD, Ardalic DC, Vladimirov SS, Banjac GS, Cabunac PJ, Zeljkovic AR, et al. Cholesterol Homeostasis Is Dysregulated in Women With Preeclampsia. Pol Arch Intern Med. 2021;131(12):1605–13.

15. Perry A, Stephanou A, Rayman MP. Dietary Factors That Affect the Risk of Pre-Eclampsia. BMJ Nutr Prev Health. 2022;5(1):118–33.

16. Tesfa E, Nibret E, Munshea A. Maternal Lipid Profile and Risk of Preeclampsia in African Pregnant Women: A Systematic Review and Meta-Analysis. PLoS One. 2020;15(12): e0243538.

17. Al-Maiahy TJ, Al-Gareeb AI, Al-Kuraishy HM. Role of Dyslipidemia in the Development of Early-Onset Preeclampsia. J Adv Pharm Technol Res. 2021;12(1):73–8.

18. Olalere FDH, Okusanya BO, Oye-Adeniran BA. Maternal Serum Lipid in Women with Preeclampsia in Lagos: A Case Control Study. J Matern Fetal Neonatal Med. 2020;33(5):794–8.

19. Liu WY, Zhu YT, Xu XM, Zhang JR, Gan XP, Cheng DC, et al. Associations of Thyroid Function Tests with Lipid Levels and Adverse Pregnancy Outcomes During the First Trimester. Diabetes Metab Syndr Obes. 2022; 15:973–81.

20. Wang X, Zhang E, Tian Z, Zhao R, Huang K, Gao S, et al. The Association Between Dyslipidemia in the First Trimester and Adverse Pregnancy Outcomes in Pregnant Women with Subclinical Hypothyroidism: A Cohort Study. Lipids Health Dis. 2024;23(1):13.