

## ORIGINAL ARTICLE

# MATERNAL SERUM LIPID PROFILE AND RISK OF PREECLAMPSIA AMONG PREGNANT WOMEN

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## ABSTRACT

**Background:** Preeclampsia, a hypertensive disorder of pregnancy, develops after 20 weeks of gestation and is characterized by proteinuria and hypertension. It affects 3% to 8% pregnant population worldwide, with significant morbidity and mortality. The etiology of pre-eclampsia is not well understood, and various factors have been speculated to be involved in the disease process. The objective of this study was to determine the association between maternal serum lipid profile and preeclampsia among antenatal patients presented to a tertiary care hospital.

**Materials & Methods:** It was cross-sectional observational study, conducted at the gynecology department of Lady Reading Hospital in Peshawar, from October 2022 to April 2023. A total sample of 100 pregnant women was recruited by non-probability consecutive sampling technique. Inclusion criteria was antenatal patients with singleton pregnancy, including both normotensive and pre-eclamptic patients. Patients with multiple pregnancy, chronic hypertension, renal and autoimmune diseases, liver disorders, recent viral infections history, blood disorders and body mass index more than 30kg/m<sup>2</sup> were excluded from the study. Lipid profile parameters (total cholesterol, LDL, HDL, and triglycerides) and BMI were measured. Statistical analysis included descriptive statistics and independent t-tests were used.

**Results:** The mean age of the participants was 26.9 years and the SD was  $\pm 5.58045$ . Participants with preeclampsia ( $n = 38$ ) showed elevated levels of total cholesterol ( $262.89 \pm 89.77$  mg/dl) and association with preeclampsia was significant ( $p$ -value = 0.004). LDL ( $197.11 \pm 80.55$  mg/dl) and Triglycerides levels ( $426.34 \pm 504.74$  mg/dl) were also higher in pre-eclamptics and association was significant ( $p$ -value 0.007 and 0.005 respectively). However, HDL levels ( $49.37 \pm 19.74$  mg/dl) didn't exhibit a significant association ( $p = 0.075$ ).

**Conclusion:** This study found a significant association between elevated maternal serum total cholesterol, LDL, and triglyceride levels with the risk of preeclampsia. Identifying these lipid profile alterations helps in early diagnosis and management of preeclampsia, potentially leading to better outcomes for both the mother and the fetus.

**KEY WORDS:** Lipids; Blood; Preeclampsia; Cholesterol; LDL.

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## INTRODUCTION

Preeclampsia is a metabolic syndrome associated with pregnancy that develops after 20 weeks of gestation and is characterized by the presence of proteinuria and hypertension. This condition is responsible for the majority of the adverse outcomes, i.e., morbidity and mortality in both the mother and

foetus.<sup>1,2</sup> The prevalence of preeclampsia in pregnancy is 3% to 8% worldwide in all pregnancies.<sup>3</sup> The etiology of pre-eclampsia is not well understood, however a failure of spiral artery remodeling gives rise to placental ischemia and maternal syndrome and leads to hypertension and proteinuria. Perturbation in lipid oxidation metabolites has been observed to increase, while the levels of antioxidants implicated in the pathogenesis of preeclampsia have been found to decrease. Various studies reported a positive correlation between higher levels of oxidized low-density lipoprotein (LDL) and triglycerides (TG), along with reduced circulating vitamin C levels with preeclampsia. The oxidative conversion of low-density lipoprotein (LDL) cholesterol into its oxidized LDL form represents the pivotal process responsible for the onset and progression of atherosclerosis and hypertension.<sup>2-5</sup>

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The risk of pre-eclampsia is increased due to dyslipidemia in early pregnancy. During the first trimester, the maternal body undergoes an anabolic state, wherein lipids serve as a source energy for both the developing fetus and the mother, especially during the third trimester.<sup>6</sup> Some studies have been done on systematic changes in lipids as these can represent metabolic state and have biomarker potential for several disorders. Mass spectrometric methods enable for untargeted measurement of several hundred lipids. Preeclampsia metabolomics studies find out 23 serum lipidomic indicators predicting preeclampsia risk as well as 11 lipid classes in maternal blood of early-onset preeclampsia women and maternal plasma ceramide species as early biomarkers of preeclampsia incidence. However, there is still a paucity of systematic analysis of lipids and their potential molecular mechanisms in severe preeclampsia.<sup>7</sup>

During the gestation, the lipid levels are significantly influenced by placental metabolism rather than maternal hepatic function.<sup>8,9</sup> Significant dyslipidemia (increased triglyceride levels and nonesterified free FA) is a characteristic of preeclampsia and these abnormalities in maternal circulation may be caused by a change in placental lipid metabolism.<sup>9</sup> Preeclampsia (PE) comprises two distinct stages. Stage 1: The initial stage is asymptomatic and distinguished by abnormal placental growth occurring in the first trimester, which leads to placental insufficiency. This first stage subsequently advanced to stage 2, known as the symptomatic phase, characterised by the presence of hypertension, renal dysfunction, and proteinuria in pregnant women.<sup>10</sup> According to a number of studies there is a significant association between high maternal pre-pregnancy BMI, and an increased risk of preeclampsia. Inflammatory markers are activated and lipid concentrations are altered in overweight people, and both of these metabolic abnormalities are signs of preeclamptic pregnancies prior to the onset of clinically symptoms.<sup>10</sup>

This study aimed to gather local data to find the association between maternal serum lipids and risk of preeclampsia and outcome among the antenatal patients admitted to the OBGYN department of tertiary care hospital Lady Reading Hospital-MTI, Peshawar, Pakistan. Such information can help identify local pattern of the disease and improve our insight into the disease process.

## MATERIALS AND METHODS

This cross-sectional observational study was conducted in a tertiary care hospital at gynecology department, Lady Reading Hospital-MTI, Peshawar, from October 2022 to April 2023. The population of the study was pregnant women who were admitted for antenatal care and a gynecology unit at LRH. A total 100 participants were recruited through non probability consecutive sampling technique. With mean level of HDL in pre eclampsia as  $51.02 \pm 16.01$

and in normotensive as  $61.08 \pm 25.03^1$ , and with 90% confidence level with a power of 80%, the sample size comes as 98 on Open Epi, rounded off to 100, hence sample size for the study was taken as 100. Inclusion criteria was antenatal patients with singleton pregnancy. Both normotensive and those diagnosed as preeclampsia after 20 weeks gestation were included. Patients with multiple pregnancy, chronic hypertension, renal and autoimmune diseases, liver disorders, recent viral infections history, blood disorders and body mass index more than  $30\text{kg/m}^2$  were excluded from the study. Maternal serum lipid profile parameters, including total cholesterol, triglycerides, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, and BMI, were measured through standardized laboratory tests. Additionally, demographic and clinical data were recorded through structured interviews and medical record.

The ethical approval was obtained from the Institutional Review Board LRH-MTI, Ref. No: 436/LRH/MTI on 25<sup>th</sup> July 2022; and a consent form were obtained from all participants. The finding of this research contributed to explore the relationship between maternal lipid profile and preeclampsia risk, and predicted preventive strategies and improving maternal and fetal health outcomes.

The data was statistically analyzed through IBM SPSS version 26. The quantitative data were presented as mean  $\pm$  standard deviation whereas the categorical variables were presented in percentage and analyzed using cross-tabulation. The independent T-test was used to analysis the association between lipid profile parameters and the risk of preeclampsia.

## RESULT

This study was included a total of 100 participants, with mean age (26.9 years) and SD of ( $\pm 5.58045$ ) as shown in table 1. The age ranged varied from a minimum 17 years to a maximum of 45 years.

**Table 1: Mean Age and SD of the participants**

	N	Mean	Std. Deviation
Patient Age	100	26.900	5.58045
Valid N	100		

Out of total 100 participants, 39 individuals fall in the prime gravida representing 39.0% of the total population, whereas 61 participants making up 61.0% of the sample size are multi gravida, having been pregnant two or more time. The frequency of individuals with a normal BMI (18.5-24.9) was observed in 86 individuals, accounted for 86.0% of the total sample and 14 participants 14.0% were overweight, BMI range from 25 to 29.9. The Mild- Pre-eclampsia BP (140-159/90-99 mmHg) was accounted 61% whereas the severe Pre-eclampsia BP (160-179/100-109 mmHg) were found in 39% out of preeclamptic patients. The mode of delivery was as: 79.0% were delivered normally

vaginal delivery (NVD) and 21.0% undergone caesarean sections (C-section), as illustrated in table 2.

**Table 2: Descriptive Statistic of categorical variables (Gravida, BMI, BP, and MOD)**

Gravida		
	Frequency	Percent
Prime-Gravida	39	39.0
Multi-Gravida	61	61.0
Body Mass Index		
Normal (18.5-24.9)	86	86.0
Over Weight (25-29.9)	14	14.0
Blood Pressure		
Mild Pre-eclampsia PB (140-159/90-99)	61	61.0
Sever Pre-eclampsia BP (160 and <100 and <)	39	39.0
Mode of Delivery		
Normal Virginal Delivery	79	79.0
C-Section	21	21.0

The mean and standard deviation of the total cholesterol level was found 245.34 ±68.923 mg/dl. The mean with a standard deviation of low-density lipoprotein (LDL) were 182.55 ±64.577 mg/dl while the mean and standard deviation of high-density lipoprotein (HDL) were observed as 51.730 ±18.08 mg/dl. As for triglycerides their mean & SD was 327.420 ±326.065 mg/dl as shown in table 3.

**Table 3: the Mean and .Std. Deviation for Total Cholesterol, LDL, HDL and Triglycerides**

Variable	N	Mean	Std.Deviation
Total cholesterol	100	245.3400	68.92321
LDL	100	182.5500	64.57732
HDL	100	51.7300	18.08055
Triglycerides	100	327.4200	326.06538

**Table 4: The independent T test for association of maternal lipid profile with pre-eclampsia risk**

	Pre-eclampsia	N	Mean	Std. Deviation	P-value
Total Cholesterol	Yes	38	262.8947	89.76991	.004
	No	62	234.5806	50.12004	
LDL	Yes	38	197.1053	80.54872	.007
	No	62	173.6290	51.18409	
HDL	Yes	38	49.3684	19.74489	.075
	No	62	53.1774	16.98459	
Triglycerides	Yes	38	426.3421	504.74250	.005
	No	62	266.7903	90.48850	

\*\* shows significant P-value

The subjects diagnosed with pre-eclampsia were 38, and 62 individuals were presented without pre-eclampsia on the lipid profile parameters, including total cholesterol, LDL (Low-Density Lipoprotein), HDL (High-Density Lipoprotein), and Triglycerides. The mean and SD for total cholesterol levels for the pre-eclampsia presence were 262.8947±89.76991 whereas on the other hand, for those without pre-eclampsia the mean and SD was 234.58±50.12 and the p-value is 0.004, which indicates a statistically significant association between total cholesterol level and the occurrence of pre-eclampsia.

The LDL also has a significant association with pre-eclampsia; the LDL Mean and SD were 197.1053±80.54872 and 173.6290±51.18409 for the participants with and without pre-eclampsia respectively, with a P-Value 0.007 reveals a statistically correlation between LDL levels and the presence of pre-eclampsia. The mean and SD of HDL levels among the individuals with pre-eclampsia and those without pre-eclampsia were 49.3684±19.74489 and 53.1774±16.98459, respectively. The P-value greater than 0.05 (0.075) indicates no association between pre-eclampsia and HDL levels.

For individuals with pre-eclampsia, the mean and standard deviation were 426.3421±504.74250 whereas for those without pre-eclampsia, the mean and SD were 266.7903±90.48850. The P-value is 0.005, which shows that there is a statistical correlation between elevated triglycerides and the presence of pre-eclampsia. Overall, there is a statistical association between the lipid profile parameters and pre-eclampsia.

## DISCUSSION

This study examined the association between maternal serum lipid profile and the risk of pre-eclampsia among the antenatal patients admitted to the OBGYN department of the tertiary care hospital Lady Reading Hospital-MTI, Peshawar. The statistical analysis revealed a significant (P-value: 0.004) relationship between total cholesterol and the presence of

preeclampsia. A cross-sectional study was carried out by Sadiq Jan et al. to observe the relationship between lipid profile abnormalities and preeclampsia among women in third trimester. The participants with mild eclampsia had a Total Cholesterol of  $243.40 \pm 55.9$  while those with severe eclampsia had an average of total cholesterol  $271.74 \pm 45.55$ . Similarly, LDL and TG levels were higher in patients with severe eclampsia.<sup>11</sup>

In our study, the triglycerides levels were found to be significantly associated with pre-eclampsia with a p-value 0.005. A cohort study conducted in 2022, on 486 healthy pregnant participants, followed prospectively from first trimester pregnancy onward to third trimester. Their lipids profiles TG, TC, HDL and LDL were observed in the first and in the third trimester. In the pre-eclampsia group the serum lipids profile levels including TC, TG, LDL and HDL were significantly raised in the third trimester, with TG having the highest increase among lipid profile compare to other values.<sup>12</sup>

In our study, the correlation between LDL and Pre-eclampsia was also statistically significant (P-value: 0.007). Conversely, the HDL levels did not indicated a significant association with pre-eclampsia (P-Value: 0.075). A cross-sectional study was conducted by Ananya Dutta Mou et al. to find the prevalence and associated risk factors and biochemical variables among pregnant women. The lipid profile levels of TC, LDL, HDL, ALT, and uric acid were greatly higher in pre-eclamptic pregnancies.<sup>13</sup> In 2022, a case-control study conducted by Umme Salma, found that there was a significant relationship between total lipid profile (P value=0.000), BMI (P=0.005) and age ( $24.71 \pm 2.56$  and  $23.09 \pm 2.1$ ) with preeclampsia pregnant women and normal pregnant women respectively<sup>14</sup> and statistically in support of our research. Other cross-sectional studies have also found out higher levels of lipid profile in pregnant women with pre-eclampsia than in normal hypertensive pregnant women.<sup>15,16</sup> Endalamaw Tesfa et al. performed a systematic review an meta-analysis on the relationship between lipid profile and pre-eclampsia in African women. A total of 15 observational studies were considered in this analysis. Pre-eclamptic pregnant women had significantly higher mean triglyceride, total cholesterol, low density lipoprotein-cholesterol (LDL-c), and very low density lipoprotein-cholesterol (VLDL-c) values than normotensive pregnant women (TG =  $229.61 \pm 88.27$  and  $147.00 \pm 40.47$ , TC =  $221.46 \pm 45.90$  and  $189.67 \pm 39.18$ , LDL =  $133.92 \pm 38.77$ ).<sup>1</sup> This systematic review endorses our study as in our TG, TC and LDL has significant statistical association with the risk of pre-eclampsia.

## CONCLUSION

This study showed a significant association between maternal serum lipid profile and preeclampsia. The

findings reveal that elevated levels of total cholesterol, LDL, and triglycerides significantly correlate with the presence of preeclampsia in pregnancy, while the HDL levels did not showed a significant association with pre-eclampsia in pregnant women.

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#### CONFLICT OF INTEREST

Authors declare no conflict of interest.  
GRANT SUPPORT AND FINANCIAL DISCLOSURE  
None declared.

#### AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	WS, NH
Acquisition, Analysis or Interpretation of Data:	WS, NH, SB, TB
Manuscript Writing & Approval:	WS, NH, SB, TB

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.



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