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Original Research Article

MATERNAL LIPID PROFILE – A PREDICTOR OF PREECLAMPSIA

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ABSTRACT

Background: Preeclampsia is a common pregnancy complication that can lead to serious health problems for both mothers and babies. Early changes in lipid levels and body weight may be associated with the development of this condition. Identifying these factors can help in early detection and better care. **Objectives:** To study the relationship between maternal lipid profiles and the development of preeclampsia and to identify early predictors, such as body mass index (BMI) and specific lipid parameters. **Materials and Methods:** This prospective observational study was conducted at the Department of Obstetrics and Gynaecology, Government Headquarters Hospital, Kovilpatti, from September 2019 to April 2020. A total of 106 pregnant women between 14 and 20 weeks of gestation were enrolled and followed up until delivery. Lipid levels and BMI were recorded, and the data were analysed using SPSS software. **Result:** Of the 106 patients, 21 developed preeclampsia. The preeclampsia group showed significantly higher levels of total cholesterol, triglycerides, HDL, VLDL, and BMI ($p < 0.05$). LDL was slightly higher but not significant ($p = 0.052$). Strong positive correlations were observed between preeclampsia and total cholesterol ($r = 0.649$), triglyceride ($r = 0.612$), and VLDL ($r = 0.581$) levels. BMI also showed a moderate correlation ($r = 0.421$). Logistic regression confirmed that BMI (odds ratio [OR] = 1.363; $p = 0.048$) and total cholesterol (OR = 1.081; $p = 0.025$) were independent predictors. **Conclusion:** High BMI and increased lipid levels, particularly total cholesterol and triglyceride levels, are early markers of preeclampsia. Monitoring these factors during early pregnancy may aid in early risk identification and management.

INTRODUCTION

Pregnancy is a time of major changes in a woman's body, including physical, hormonal, and chemical changes. One important change is the way fats are processed in the body. As pregnancy progresses, the levels of fats in the blood, such as triglycerides and cholesterol, normally rise. This increase supports the baby's growth and the function of the placenta. These changes are mostly due to hormones like estrogen, progesterone, and insulin, which affect how the body stores and uses fats.[1]

Preeclampsia is a condition that happens only during pregnancy. It is diagnosed when a pregnant woman develops high blood pressure and protein in her urine after 20 weeks of pregnancy. It usually resolves after birth, and is dangerous for both the mother and baby. In developing countries, it causes 20% to 80% of maternal deaths.[2] In developed countries, babies born to mothers with preeclampsia have five times higher death rates, and 15% of early births are linked to this condition.[3] The cause of preeclampsia is not fully known, but it is believed to develop in two stages: the first stage involves poor blood flow to the placenta due to the abnormal development of blood vessels. The second stage happens when this leads to damage in the mother's blood vessels, causing high blood pressure and other problems.[4,5]

Certain factors may increase the risk of developing preeclampsia. One such factor is an unhealthy lipid profile. Studies have shown that women who develop preeclampsia often have high levels of triglycerides and low-density lipoprotein (LDL) and lower levels of high-density lipoprotein (HDL).[6] These fat changes can increase stress on blood vessels and lead to inflammation, both of which are common in preeclampsia.[7] Although fat levels usually rise during pregnancy, abnormal increases early in pregnancy may signal a higher risk of complications. In early pregnancy, fat is stored to support later growth; however, in preeclampsia, this process may become unbalanced. This can lead to harmful effects on blood vessels and the placenta.[8]

There are limited studies that have examined fat levels in early pregnancy as a warning sign for preeclampsia. Early testing of these levels may help doctors identify women at risk and provide them with special care.[9,10] This study aimed to assess maternal lipid levels between 14 and 20 weeks of pregnancy to determine their usefulness in predicting the risk of developing preeclampsia later in pregnancy.

MATERIALS AND METHODS

This observational prospective study was conducted in the Department of Obstetrics and Gynaecology at the District Government Headquarters Hospital, Kovilpatti, from September 2019 to April 2020, with a study population of 106 patients. Before participation, ethical clearance was obtained from the Institutional Ethics Committee. Informed consent was obtained from each patient, with assurance that their details would remain confidential throughout the study.

Inclusion and exclusion criteria

Pregnant women aged 19–38 years with a single foetus between 14 and 20 weeks of gestation and willing to attend regular follow-up visits were included. Women were excluded if their gestational age was > 20 weeks, if they had chronic medical conditions, took lipid-altering medications, used alcohol or tobacco, or had molar or multiple pregnancies.

Methods

A total of 21 pregnant women who developed hypertensive disorders were included as cases, identified using the criteria from the National High Blood Pressure Education Program (NHBPEP, 2000). The control group included 85 normotensive pregnant women. A detailed history was recorded for all patients, including age, parity, pre-pregnancy weight, and menstrual and drug history. Obstetric examinations and routine investigations were performed. Fasting blood samples (3 ml venous) were collected from all patients. Lipid profiles were measured using a Robonik analyser and interpreted according to the National Cholesterol Education Program (NCEP) guidelines, with values expressed in mg/dl.

Patients were followed up until delivery to assess the development of preeclampsia. Additional history of present and past pregnancies, chronic illness, drug intake, and family history of diabetes, hypertension, renal, or thyroid disorders was recorded. First-trimester height and weight were noted from antenatal records, and the body mass index (BMI) was recorded. The lipid parameters analysed included total cholesterol, HDL, LDL, and triglycerides. Total cholesterol and triglyceride levels were estimated using enzymatic colourimetric methods, and HDL was measured using a specific detergent-based enzymatic method. LDL cholesterol was calculated using Friedewald's formula: LDL = Total cholesterol – HDL – (Triglycerides/5).

Sample size calculation

The required sample size of 106 was calculated using a standard formula based on the estimated prevalence, margin of error, and confidence level for a finite population. The formula used is $n = (Z^2 \times p \times (1 - p)) / e^2 \div [1 + (Z^2 \times p \times (1 - p)) / (e^2 \times N)]$, where n = sample size, Z = Z-score, p = estimated proportion, e = margin of error, and N = population size.

Statistical analysis

Data were analysed using SPSS version 24.0. The Chi-square test was used to compare categories such as age, parity, and socioeconomic status. The unpaired Student's t-test was used to compare the average values of BMI and lipid levels between groups. Spearman's correlation and logistic regression were used to study the relationship between risk factors and preeclampsia.

RESULTS

The study patients had a mean age of 24.4 ± 3.7 years and an average socioeconomic status score of 4 ± 0.5. The mean BMI was 24.3 ± 3.4 kg/m². The mean total cholesterol level was 189.6 ± 68 mg/dL, and the average HDL was 52.3 ± 10.1 mg/dL. The mean triglyceride level was 172.1 ± 66.2 mg/dL. LDL and VLDL averaged 95 ± 24.4 mg/dL and 34.7 ± 12.9 mg/dL, respectively (Table 1). Among the patients, 21 were diagnosed with gestational hypertension or preeclampsia.

Table 1: Baseline clinical and biochemical profile of patients

Variable	Mean ± SD
Age (years)	24.4 ± 3.7
Socioeconomic status	4 ± 0.5
BMI (kg/m²)	24.3 ± 3.4
Total Cholesterol (mg/dL)	189.6 ± 68
HDL (mg/dL)	52.3 ± 10.1
Triglycerides (mg/dL)	172.1 ± 66.2
LDL (mg/dL)	95 ± 24.4
VLDL (mg/dL)	34.7 ± 12.9

Most patients in both groups were aged ≤24 years, with a higher proportion in the normal cohort (43.4%) than in the preeclampsia group (11.3%) (p=0.96). Most patients belonged to the upper-lower socioeconomic class, particularly 56.6% in the normal and 13.2% in the preeclampsia group (p=0.69). Primigravida status was significantly more common in the normal group (50.9%) than in the preeclampsia group (10.4%), whereas multiparity was more frequent among those with preeclampsia (p<0.05).[Table 2]

Table 2: Comparison of demographic and obstetric characteristics between groups

Parameter		Preeclampsia Cohort (n=21)	Normal Cohort (n=85)	p-value
Age group (years)	≤24	12 (11.3%)	46 (43.4%)	0.96
	25–29	7 (6.6%)	31 (29.2%)	
	≥30	2 (1.9%)	8 (7.5%)	
Socioeconomic status	Lower middle	3 (2.8%)	7 (6.6%)	0.69
	Upper lower	14 (13.2%)	60 (56.6%)	
	Lower	4 (3.8%)	18 (17%)	
Parity	Primi	11 (10.4%)	54 (50.9%)	<0.001
	G2A1	4 (3.8%)	0	
	G2P1L1	4 (3.8%)	0	
	G2P2L1	1 (0.9%)	27 (25.5%)	
	G3P2L2	1 (0.9%)	2 (1.8%)	
	G3P1L1A1	0	2 (1.9%)	

Women in the preeclampsia cohort had significantly higher mean BMI, total cholesterol, HDL, triglycerides, and VLDL levels than those in the normal cohort ($p < 0.05$ for all). The LDL level was also higher in the preeclampsia group, but did not reach significance ($p = 0.052$). [Table 3]

Table 3: Comparison of lipid profile and BMI between groups

Variable	(Mean ± SD)		p-value
	Preeclampsia Cohort	Normal Cohort	
BMI (kg/m²)	27.7 ± 3.7	23.5 ± 2.8	<0.001
Total Cholesterol (mg/dL)	259.8 ± 121.4	172.0 ± 27.1	<0.001
HDL (mg/dL)	58.3 ± 12.4	50.8 ± 8.9	0.002
Triglycerides (mg/dL)	258.4 ± 70.2	150.8 ± 44.6	<0.001
LDL (mg/dL)	104.9 ± 28.3	92.7 ± 23.0	0.052
VLDL (mg/dL)	50.9 ± 12.4	30.68 ± 9.5	<0.001

he strongest correlation was observed with total cholesterol ($r = 0.649$) and triglyceride ($r = 0.612$) levels, followed by VLDL ($r = 0.581$). BMI also showed a moderate positive correlation ($r = 0.421$). HDL and LDL had weaker but still significant correlations, with coefficients of 0.275 and 0.214, respectively; all associations were significant ($p < 0.05$).[Table 4]

Table 4: Correlation of lipid profile and BMI with preeclampsia

Predictor Variable	Correlation Coefficient (r)	p-value
BMI	0.421	<0.001
Total Cholesterol	0.649	<0.001
HDL	0.275	0.004
Triglycerides	0.612	<0.001
LDL	0.214	0.028
VLDL	0.581	<0.001

A higher BMI was associated with increased odds of preeclampsia (OR = 1.363, $p = 0.048$), and elevated total cholesterol levels also significantly increased the risk (OR = 1.081, $p = 0.025$). Other lipid parameters, including HDL, triglyceride, LDL, and VLDL levels, were not significantly associated with preeclampsia ($p > 0.05$). [Table 5]

Table 5: Multivariate logistic regression analysis of risk factors for preeclampsia

Variable	Beta Coefficient	Standard Error	Wald Statistic	P-value	Odds Ratio
BMI	0.31	0.157	3.894	0.048	1.363
Total Cholesterol	0.078	0.035	4.993	0.025	1.081
HDL	0.046	0.054	0.731	0.393	1.047
Triglyceride	0.019	0.029	0.417	0.519	1.019
LDL	-0.048	0.035	1.883	0.17	0.953
VLDL	-0.027	0.141	0.036	0.849	0.973

DISCUSSION

Our study found that elevated total cholesterol, triglyceride, VLDL, and BMI levels were significantly associated with preeclampsia, with total cholesterol and BMI emerging as independent predictors. In our study, the patients had a mean age of 24.4 ± 3.7 years. Similarly, Surbhi and Majhi found the age of the patients to be 27.52 ± 3.7 years. Most patients in both groups were aged 24 years or

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younger, with 43.4% in the normal cohort and 11.3% in the preeclampsia group.[11] Kumari et al. reported that most women were between 20 and 25 years (30%), but more preeclampsia cases were seen in those aged 20 or younger (22.1%).[12] These findings suggest that younger maternal age may be common across groups, with early maternal age potentially contributing to a higher preeclampsia risk.

Our study showed that most patients belonged to the upper-lower socioeconomic class, with 56.6% of the normal group and 13.2% of the preeclampsia group. Primigravida was common in the normal group, whereas multiparity was frequent in the preeclampsia group. Similarly, Ejaz et al., in a case-control study of 150 pregnant women in Karachi, reported that 43.3% of preeclampsia cases and only 9.3% of normotensive controls belonged to the lower socioeconomic group.[13] In contrast, Maeda et al. found that women who had been pregnant more than once had a much lower chance of developing preeclampsia, with the risk reduced by approximately 92%.[14] These findings indicate that women from lower socioeconomic backgrounds may be at higher risk of developed preeclampsia, while previous pregnancies reduce this risk.

Our study preeclampsia group had a significantly higher mean BMI of 27.7 ± 3.7 kg/m² compared to 23.5 ± 2.8 kg/m² in the normal group ($p < 0.001$). Similarly, Dantas et al. found in a study of 218 women that those with preeclampsia had a higher mean BMI (25.3 ± 4.8 kg/m²) than normotensive women (23.5 ± 3.7 kg/m²; $p = 0.02$).[15] In contrast, Sharami et al. found a higher BMI in normotensive women (28.66 ± 3.32 kg/m²) than in preeclampsia (27.83 ± 2.20 kg/m²; $p = 0.18$).[16]

In our study, total cholesterol, HDL, triglycerides, and VLDL levels were significantly higher in the preeclampsia group, while LDL levels were not significant. Similarly, Thathagari et al. found mean levels of total cholesterol (198.5 ± 18.91), HDL (50.63 ± 9.35), LDL (84.5 ± 16.16), VLDL (42.75 ± 4.72), and triglycerides (74.92 ± 11.95) were higher in preeclampsia ($p<0.05$).[17] Oyeniran et al. reported higher total cholesterol, triglycerides, and VLDL ($p < 0.001$, $p < 0.001$, $p = 0.007$), and lower HDL ($p < 0.001$), while LDL was not significant ($p = 0.068$).[18] Higher BMI and raised lipid levels, especially cholesterol, triglycerides, and VLDL, are strongly linked with preeclampsia across multiple studies.

Our study found strong positive correlations for total cholesterol ($r = 0.649$), triglycerides ($r = 0.612$), and VLDL ($r = 0.581$); moderate for BMI ($r = 0.421$); and weaker but significant for HDL ($r = 0.275$) and LDL ($r = 0.214$) ($p < 0.05$). Kamel et al. found significantly higher levels of total cholesterol, triglycerides, and VLDL in preeclampsia ($p \leq 0.05$), while LDL and HDL levels showed no difference.[19] Ghodke et al. reported no significant difference in second-trimester VLDL ($p = 0.93$).[20] These results support the positive associations of cholesterol, triglycerides, and VLDL with preeclampsia.

Enquobahrie et al. found that women who developed preeclampsia had higher LDL, triglyceride, and LDL/HDL ratios and lower HDL levels ($p < 0.05$), with a 3.6 times higher risk for cholesterol >205 mg/dL and a 4.15 times higher risk for triglycerides >133 mg/dL.[21] This confirms that lipid elevation is a strong predictor.

In our study, higher BMI (OR = 1.363; $p = 0.048$) and total cholesterol (OR = 1.081; $p = 0.025$) were independent predictors. Similarly, Paré et al. reported a 1.65 times higher risk with BMI 25–30 (OR = 1.65).22 Li et al. found that cholesterol raised the adverse risk by 56.2% (OR = 1.562; $p < 0.001$).[23] Sharami et al. found that BMI was not significantly different ($p = 0.18$). Triglycerides >175 mg/dL (OR = 2.75) and HDL 40–50 mg/dL (OR = 3.37) were significantly associated, while cholesterol >205 mg/dL and LDL >108 mg/dL were not.[16] The analysis showed that BMI and cholesterol are independent risk factors, while triglycerides and HDL also help predict the risk of preeclampsia. The role of total cholesterol, triglycerides, and VLDL as predictors of preeclampsia was consistent. BMI is an independent risk factor, whereas LDL and HDL levels show variable influences across studies.

Limitations

The study was limited by its small sample size, which may have affected the generalisability. It was conducted at a single centre, limiting the population diversity. Only lipid levels during early pregnancy were measured without follow-up in later trimesters. Potential confounding factors, such as diet, activity level, and genetic predisposition, were not assessed in the analysis.

CONCLUSION

Elevated levels of total cholesterol, triglycerides, and VLDL were significantly associated with preeclampsia. BMI and total cholesterol were identified as independent risk factors, indicating their potential role in predicting the risk of disease. Although HDL and LDL levels showed weaker associations, they were still significant. These results suggest that monitoring the lipid profile and BMI in early pregnancy may help identify women at a higher risk. Early detection and intervention can reduce complications. Further studies with larger and more various populations are needed to confirm these associations and improve the preventive strategies.

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