Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 24s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Serum Lipid Profile in Early Second Trimester as A Predictor of Pregnancy Induced Hypertension

Dr. Hepzibah Harriet Abigail[1], Dr. B. Jeyamani[2], Dr.Arun. G. Christopher[3]

[1]Post Graduate Resident, Department of Obstetrics and Gynecology, Vinayaka Mission's Kirupananda Variyar Medical College and Hospitals, Vinayaka Mission's Research Foundation (DU), Salem.

Email ID: abihepzi08@gmail.com

[2]Professor & Head of the Department, Department of Obstetrics and Gynecology, Vinayaka Mission's Kirupananda VariyarMedical College and Hospitals, Vinayaka Mission's Research Foundation (DU), Salem.

[3]MD Anesthesiology Chidambaram hospital Tisaiyanvillai, Tirunelveli

***Corresponding Author:**

Dr. Hepzibah Harriet Abigail,

Post Graduate Resident, Department of Obstetrics and Gynecology, Vinayaka Mission's Kirupananda Variyar Medical College and Hospitals, Vinayaka Mission's Research Foundation (DU), Salem.

Email ID: abihepzi08@gmail.com

Cite this paper as: Dr. Hepzibah Harriet Abigail, Dr. B. Jeyamani, Dr.Arun. G. Christopher, (2025) Serum Lipid Profile in Early Second Trimester as A Predictor of Pregnancy Induced Hypertension. *Journal of Neonatal Surgery*, 14 (24s), 170-179

ABSTRACT

Background:
Pregnancy-induced hypertension (PIH) is a significant cause of maternal and fetal morbidity and mortality. Identifying early predictors of PIH can improve management and outcomes. This study investigates the role of serum lipid profiles in the early second trimester as predictors of PIH.

Objectives:
To assess whether serum lipid profile abnormalities in the early second trimester can predict the development of pregnancy-induced hypertension.

Methods:
This was a prospective observational study conducted at Vinayaka Missions Medical College and Hospital Salem, from May 2023 to October 2024. A total of 160 pregnant women between 14-20 weeks of gestation were enrolled. Participants' lipid profiles (total cholesterol, triglycerides, HDL, LDL, and VLDL) were measured, and blood pressure was monitored throughout pregnancy to identify cases of PIH. Descriptive and inferential statistics were used for data analysis.

Results:
The study found that 16.3% of participants developed gestational hypertension (GHTN). Higher levels of total cholesterol (244.61 mg/dL), LDL (131.05 mg/dL), triglycerides (321.26 mg/dL), and VLDL (73.85 mg/dL) were significantly associated with the development of GHTN. The diagnostic accuracy of lipid profiling was high, with a sensitivity of 88.46%, specificity of 94.78%, and an AUC of 0.916.

Conclusions:
The findings suggest that serum lipid profiles, particularly total cholesterol, LDL, triglycerides, and VLDL, are valuable predictors for the development of PIH. Early lipid screening may help identify high-risk pregnancies, enabling timely intervention and better management

Keywords: *Pregnancy-induced hypertension, lipid profile, triglycerides, total cholesterol, diagnostic accuracy*

1. INTRODUCTION

Pregnancy-Induced Hypertension (PIH) is a condition that complicates a significant proportion of pregnancies, contributing to maternal and fetal morbidity and mortality. PIH encompasses a range of hypertensive disorders, including preeclampsia, gestational hypertension, and other forms of elevated blood pressure that occur during pregnancy. According to the World Health Organization (WHO), hypertensive disorders of pregnancy are among the leading causes of maternal deaths

worldwide, with preeclampsia and eclampsia accounting for a substantial proportion of these fatalities (1). Early detection and appropriate management of PIH can reduce the risks of serious complications for both the mother and the fetus, including organ damage, fetal growth restriction, and preterm birth. Therefore, there is a need to identify reliable early biomarkers that could predict the onset of PIH and facilitate timely interventions.

Among the potential biomarkers, serum lipid profiles have garnered attention due to their association with various cardiovascular and metabolic conditions, including hypertension. Pregnancy is a period characterized by dramatic physiological changes in lipid metabolism, and dyslipidemia during this time may play a role in the development of PIH. Lipid alterations, including changes in cholesterol levels, triglycerides, and lipoprotein fractions, have been proposed as potential predictors of PIH (2). The early second trimester, often between 14 and 20 weeks of gestation, represents a crucial period for monitoring potential biomarkers because it is early enough to intervene if necessary but late enough for a significant metabolic profile to emerge. The goal of this study is to investigate whether serum lipid profiles during the early second trimester could serve as predictive markers for the development of PIH later in pregnancy.

Pregnancy induces significant alterations in lipid metabolism due to the influence of hormonal changes, particularly increased levels of estrogen and progesterone. These hormonal shifts lead to increased lipogenesis, which is necessary for fetal development and energy storage. As a result, women often experience an increase in total cholesterol, triglycerides, and low-density lipoprotein (LDL) during pregnancy. However, while these changes are considered physiological, they may also contribute to the pathophysiology of pregnancy-related complications, including PIH (3).

The lipid profile typically shows an increase in total cholesterol (TC), LDL cholesterol, and triglycerides, while high-density lipoprotein (HDL) cholesterol often decreases during pregnancy (4). Dyslipidemia, particularly elevated triglycerides and decreased HDL levels, has been implicated in the development of cardiovascular diseases in non-pregnant populations and may have a similar effect during pregnancy (5). The relationship between lipid metabolism and PIH is complex, as dyslipidemia may contribute to endothelial dysfunction, increased oxidative stress, and inflammation, all of which are key mechanisms in the development of hypertension (6). Additionally, lipid peroxidation and the resulting increase in reactive oxygen species (ROS) have been found to impair the function of the endothelium, which can trigger the onset of PIH (7).

PIH is characterized by the development of hypertension after 20 weeks of gestation, and it includes conditions such as preeclampsia, which is associated with proteinuria and multi-organ involvement. The pathophysiology of PIH involves multiple factors, including placental dysfunction, maternal immune responses, and alterations in vascular tone (8). The placenta plays a central role in the development of PIH through the release of various factors that impair endothelial function, leading to vasoconstriction and hypertension. These factors include soluble fms-like tyrosine kinase-1 (sFlt-1), a vascular endothelial growth factor (VEGF) receptor, and soluble endoglin (sEng), which together contribute to endothelial injury (9).

However, the precise mechanisms that lead to PIH are still not fully understood. Several studies have suggested that dyslipidemia may contribute to the endothelial dysfunction seen in PIH. High levels of low-density lipoprotein cholesterol (LDL-C) and low levels of high-density lipoprotein cholesterol (HDL-C) are thought to play a role in endothelial damage, which precedes the clinical manifestation of hypertension (10). Moreover, the association between lipid peroxidation and oxidative stress in PIH further supports the hypothesis that lipid abnormalities could be an early indicator of PIH risk (11).

Recent studies have focused on the potential role of serum lipid profiles as early biomarkers for PIH. Several studies have demonstrated altered lipid profiles in women who develop PIH, suggesting that lipid abnormalities might precede the onset of hypertension (12). For instance, elevated triglyceride levels and low levels of HDL-C have been observed in women with preeclampsia as early as the second trimester, well before the onset of clinical hypertension (13). These findings have led to the hypothesis that lipid abnormalities, particularly an increase in triglycerides and a decrease in HDL, may be used as predictive markers for PIH.

Moreover, the lipid profile could serve as a simple, cost-effective screening tool for identifying women at risk of developing PIH, especially in low-resource settings where more expensive screening tests may not be readily available. Monitoring lipid levels in early pregnancy may allow for the identification of high-risk women who could benefit from closer monitoring and early intervention to prevent the progression to PIH and its complications. For example, women with high triglycerides or low HDL cholesterol in the early second trimester may be flagged for additional follow-up visits to monitor blood pressure and other clinical signs of PIH (14).

Despite the growing evidence supporting the role of lipid abnormalities in PIH, the findings have been somewhat inconsistent, with some studies failing to establish a strong link between lipid levels and PIH (15). This variability may be attributed to differences in study design, population characteristics, and timing of lipid measurements. Furthermore, it is possible that other factors, such as pre-existing conditions or genetic predispositions, may influence lipid levels and their relationship with PIH (16). Therefore, further research is needed to establish a definitive causal relationship between lipid abnormalities and PIH, as well as to determine the most reliable lipid markers for early detection.

2. MATERIALS AND METHODS

1. Study Design The study employed a **prospective observational design**, aiming to assess the relationship between serum lipid profile in early pregnancy and the development of pregnancy-induced hypertension (PIH). The design was chosen because it allowed for the observation of participants over the course of their pregnancy, enabling the researchers to track changes in lipid levels and monitor the development of hypertension. The prospective nature of the study allowed for the early collection of baseline data, with subsequent follow-up to assess how lipid abnormalities in early pregnancy could potentially predict the onset of PIH. This design also helped in minimizing bias and controlling for confounding variables by collecting data sequentially over time, allowing for clearer cause-and-effect inferences.

2. Study Setting The study was conducted in the **Department of Obstetrics and Gynecology** at Vinayaka Missions Medical College and Hospital Salem, India. This setting provided access to a wide range of pregnant women receiving regular antenatal care. The hospital is well-equipped for routine prenatal check-ups and specialized care, ensuring that participants could receive necessary follow-up and monitoring throughout the study period. The research setting facilitated the collection of data on maternal health, including blood pressure measurements and lipid profiles, alongside the ability to manage participants with complications arising during pregnancy, such as PIH.

3. Study Duration The study was conducted over a **period of 1 ½ years**, beginning in **May 2023** and concluding in **October 2024.** The timeframe allowed for the recruitment of participants in the early second trimester and sufficient follow-up to observe the development of pregnancy-induced hypertension and other related complications. The study's duration also provided enough time to track the lipid profile changes throughout pregnancy and analyze the impact of these changes on the development of hypertension.

4. Participants - Inclusion and Exclusion Criteria

Inclusion Criteria:

- **Primigravida and multigravida** women with **singleton pregnancies**.
- Women between **14–20 weeks of gestation**, as determined by **last menstrual period (LMP)** or **ultrasound**.
- Pregnant women who were willing to participate in the study and provided **written informed consent**.

Exclusion Criteria:

- Women with **multiple pregnancies**.
- **Chronic hypertension** or a history of **hypertension** prior to pregnancy.
- Diagnosis of **diabetes**, including gestational diabetes.
- Women with **congenital fetal anomalies**.
- Women with **known renal disease** or history of kidney disease.
- Women with **liver dysfunction** or any other hepatic conditions.
- Women diagnosed with **dyslipidemia** or taking medications for lipid-related abnormalities before pregnancy.

5. Study Sampling The study utilized **convenience sampling** to recruit participants. This method was chosen because it allowed for efficient recruitment from a predefined group of pregnant women attending antenatal clinics at the study site. All women who met the inclusion criteria and agreed to participate were invited to join the study. Sampling continued until the required sample size of 160 participants was reached. Convenience sampling was considered appropriate due to the study setting's accessibility and the willingness of participants to undergo routine investigations during their antenatal visits.

6. Study Sample Size A total of **160 pregnant women** were enrolled in the study. The sample size was determined based on the availability of participants meeting the inclusion criteria within the study duration. This sample size was considered sufficient to detect a meaningful difference in lipid profiles between women who developed PIH and those who did not, while also accounting for possible attrition or incomplete data. Statistical power calculations were conducted before the study commenced to ensure that the sample size would allow for accurate analyses of associations between lipid abnormalities and PIH.

7. Study Groups (if applicable) The study did not require specific intervention or treatment groups, as it was observational in nature. However, participants were categorized based on whether or not they developed **pregnancy-induced hypertension** during the course of the study. The two groups were:

- **Group 1:** Women who developed PIH (i.e., those who exhibited elevated blood pressure after 20 weeks of gestation).

- **Group 2:** Women who did not develop PIH (i.e., those who maintained normal blood pressure throughout pregnancy).

This grouping allowed the researchers to compare lipid profiles and other variables between those who developed PIH and those who did not.

8. Study Parameters The study focused on the following **key parameters**:

- **Lipid profile measurements:** including total cholesterol, triglycerides, HDL, LDL, and VLDL levels, which were measured at baseline (during the early second trimester, between 14-20 weeks).
- **Blood pressure readings:** which were monitored regularly during each antenatal visit to detect the onset of PIH. Blood pressure was measured using a calibrated sphygmomanometer.
- **Demographic data:** including maternal age, gestational age, parity (primigravida or multigravida), and relevant medical history.
- **Obstetric history:** including prior pregnancies, any history of hypertensive disorders, and any other complications that might impact lipid metabolism or blood pressure regulation.

9. Study Procedure Upon recruitment, participants underwent a detailed clinical assessment that included a review of their medical and obstetric history. They were informed about the study and provided written informed consent. Participants' **venous blood samples** were drawn under strict aseptic conditions after a **12-hour fasting period**, to ensure accurate lipid profile readings. Samples were then processed in the laboratory for lipid analysis. Alongside the blood collection, **blood pressure measurements** were taken. These measurements were recorded at every antenatal visit during the study period. Participants were then monitored throughout their pregnancy for the development of PIH. If a woman's blood pressure exceeded the diagnostic criteria for PIH (i.e., systolic BP $\geq$ 140 mmHg or diastolic BP $\geq$ 90 mmHg after 20 weeks of gestation), she was categorized into the PIH group.

10. Study Data Collection Data collection involved systematic recording of clinical data, including **lipid profiles** (total cholesterol, triglycerides, HDL, LDL, and VLDL levels), **blood pressure measurements**, and demographic information. These data were collected at the **baseline** (early second trimester) and during each **subsequent antenatal visit** to monitor any changes in blood pressure. The lipid profile measurements were recorded in a structured proforma, and follow-up visits provided additional data on the development of PIH. The study ensured that all data were handled confidentially and stored securely.

11. Data Analysis Data were entered into **Microsoft Excel 2013** for preliminary organization, and **SPSS version 16** was used for statistical analysis. Descriptive statistics were used to summarize the demographic characteristics of the participants, and the lipid profiles were categorized based on the established cut-off values. Continuouss variables were expressed as **mean** ± **standard deviation**, while categorical variables were expressed as **frequencies** and **percentages**. A **Chi-square test** was used to assess associations between categorical variables, and **t-tests** were used to compare lipid profile values between women who developed PIH and those who did not. A **p-value of < 0.05** was considered statistically significant. The data were also analyzed for any potential correlations between abnormal lipid profiles and the development of PIH.

12. Ethical Considerations The study adhered to ethical principles outlined in the Declaration of Helsinki, ensuring the safety, rights, and confidentiality of the participants. All participants were fully informed about the purpose of the study, the procedures involved, and the potential risks and benefits. **Informed consent** was obtained from all participants, and they were given the option to withdraw from the study at any point without any negative impact on their care. All patient data were kept confidential, and identifying information was not disclosed in the study results.

3. RESULTS

1. Age Wise Distribution of Participants

Interpretation:
The majority of participants in the study were in the **18-24 years** age group, accounting for **56.9%** of the total population. The **25-29 years** group made up **31.9%**, while the **30-34 years** group had only **11.3%**. This distribution indicates that a significant portion of the participants were younger women, which is common in many antenatal care studies. The higher participation from the younger age groups might also reflect an increased focus on maternal health among younger women seeking care during early pregnancy.

Table 1: Age Wise Distribution of Participants

Age Group	No. of Patients	Percentage (%)
18-24 yrs	91	56.9
25-29 yrs	51	31.9
30-34 yrs	18	11.3
Total	**160**	**100**

2. Distribution Based on Obstetric Score

Interpretation:
The study showed that **73.1%** of the participants were **primigravida** (first-time pregnancies), with a total of **117 women** in this category. The next largest group, **G2P1L1** (two pregnancies, one live birth, one miscarriage), comprised **21.2%** of the participants. A small percentage of women had more complex obstetric histories, such as **G3P1L1A1** and **G3P2L2**, representing **1.9%** and **2.5%**, respectively. The high number of primigravida women indicates that this population was mostly composed of women experiencing their first pregnancy.

Table 2: Distribution Based on Obstetric Score

Obstetric Score	No. of Patients	Percentage (%)
Primigravida (PRIMI)	117	73.1
G2A1	2	1.3
G2P1L1	34	21.2
G3P1L1A1	3	1.9
G3P2L2	4	2.5
Total	**160**	**100**

3. Distribution Based on Booking Status

Interpretation:
A large majority of the participants were **booked** for antenatal care, with **97.5%** of women having accessed prenatal care at the time of their enrollment in the study. This high rate of booking indicates that the population in the study is relatively health-conscious and has access to healthcare services. Only a small percentage of **2.5%** were **unbooked**, which may suggest either a lack of awareness or access to prenatal care in a limited number of women.

Table 3: Distribution Based on Booking Status

Booking Status	No. of Patients	Percentage (%)
Booked	156	97.5
Unbooked	4	2.5
Total	**160**	**100**

4. Distribution Based on Socioeconomic Status

Interpretation:
The majority of participants were from the **upper middle** and **lower middle** socioeconomic classes, with **39.4%** and **38.1%** of participants belonging to these categories, respectively. The **upper class** represented only **4.4%** of the study population, while **upper lower** and **lower** classes made up **14.4%** and **3.8%**, respectively. This distribution shows that the study largely includes women from middle-income backgrounds, which is typical in urban health studies.

Table 4: Distribution Based on Socioeconomic Status

Socioeconomic Status	No. of Patients	Percentage (%)
Upper	7	4.4
Upper Middle	63	39.4
Lower Middle	61	38.1
Upper Lower	23	14.4
Lower	6	3.8
Total	**160**	**100**

5. Distribution Based on BMI

Interpretation:
Most participants (92.5%) had a **normal BMI** range of **18.5-24.9**, reflecting a generally healthy weight for the majority of the population. The remaining **7.5%** of women were in the **overweight** range (BMI of **25-29.9**). This suggests that the majority of women in the study did not have weight-related health complications at the time of enrollment, which might influence their pregnancy outcomes and associated risk factors.

Table 5: Distribution Based on BMI

BMI Range	No. of Patients	Percentage (%)
18.5 - 24.9	148	92.5
25 - 29.9	12	7.5
Total	**160**	**100**

6. Distribution Based on Previous History of GHTN and Gestational Hypertension in Present Pregnancy

Interpretation:
Participants with a history of **gestational hypertension (GHTN)** had a significantly higher incidence of **gestational hypertension** in the current pregnancy. Specifically, **100%** of the women with a history of GHTN developed gestational hypertension again. In contrast, only **12.98%** of participants without a history of GHTN developed gestational hypertension, highlighting a clear relationship between previous hypertensive pregnancies and the likelihood of developing GHTN in subsequent pregnancies.

Table 6: Distribution Based on Previous History of GHTN and Gestational Hypertension in Present Pregnancy

Past History of GHTN	Gestational Hypertension	No. of Patients	Percentage (%)
Yes	Yes	6	3.75
No	Yes	20	12.98
No	No	134	83.01
Total	**160**	**100**	

7. Descriptive Statistics for Key Variables

Interpretation:
The **mean age** of participants was **24.39 years**, with a range from **18 to 34 years**, indicating that most women in the study were relatively young. The **mean BMI** was **22.85**, which falls within the normal weight range. Lipid profiles also varied, with **total cholesterol** ranging from **132.3 to 312 mg/dL**, and **triglycerides** showing a broad range from **80.6 to 394.9 mg/dL**, indicating variability in lipid metabolism among the participants. These measurements provide a comprehensive overview of the study sample's characteristics.

Table 7: Descriptive Statistics for Key Variables

Variable	Minimum	Maximum	Mean	Standard Deviation (SD)
Age	18	34	24.39	3.59
BMI	19.4	28.6	22.85	1.75
Total Cholesterol	132.3	312	184.07	38.08
HDL	32.9	76	51.97	7.66
LDL	36.56	204.2	95.02	28.40
VLDL	14.4	89	36.68	18.02
Triglycerides (TG)	80.6	394.9	177.38	73.62

8. Distribution Based on Incidence of Gestational Hypertension

Interpretation:
Out of **160 participants**, **26 women** (16.3%) developed **gestational hypertension** during their pregnancy. The remaining **134 women** (83.7%) did not develop any hypertensive complications. This result highlights the relatively low prevalence of gestational hypertension in the study sample.

Table 8: Distribution Based on Incidence of Gestational Hypertension

Gestational Hypertension	No. of Patients	Percentage (%)
Yes	26	16.3
No	134	83.7
Total	**160**	**100**

9. Distribution Based on Lipid Profile

Interpretation:
A majority of participants, **81.25%** (130 participants), had a **normal lipid profile**, while a smaller group of **18.75%** (30 participants) had **deranged lipid profiles**. This suggests that a significant portion of the population had lipid profiles within the healthy range, but a notable number of participants exhibited lipid abnormalities, which could be related to future pregnancy complications such as gestational hypertension.

Table 9: Distribution Based on Lipid Profile

Lipid Profile	No. of Patients	Percentage (%)
Normal	130	81.25
Deranged	30	18.75
Total	**160**	**100**

10. Diagnostic Accuracy of Lipid Profile in Predicting Gestational Hypertension

Interpretation:
The lipid profile showed strong diagnostic performance in predicting gestational hypertension. Of the **30 women** with dyslipidemia, **23** (76.66%) developed gestational hypertension, and only **7** did not. The lipid profile had a **high sensitivity** (88.46%) and **specificity** (94.78%), with an **AUC** of **0.916**, confirming its potential as an early screening tool for gestational hypertension.

Table 10: Diagnostic Accuracy of Lipid Profile in Predicting Gestational Hypertension

Lipid Profile	Gestational Hypertension (Yes)	Gestational Hypertension (No)	Total
Dyslipidemia	23	7	30
Normal	3	127	130
Total	26	134	160

Sensitivity: 88.46%, **Specificity:** 94.78%, **AUC:** 0.916

4. DISCUSSION

This prospective observational study aimed to investigate the role of **serum lipid profiles in early second trimester** as a predictor for the development of **gestational hypertension (GHTN)** and **pregnancy-induced hypertension (PIH)**. The results indicated that serum lipid levels, particularly **total cholesterol**, **triglycerides (TG)**, and **LDL cholesterol**, were significantly associated with the onset of gestational hypertension during pregnancy, suggesting the potential utility of lipid profiling as an early screening tool for identifying women at risk for hypertensive disorders in pregnancy. These findings were consistent with previous studies, which have highlighted the link between lipid metabolism and hypertension in pregnancy.

Age Distribution and Demographics: The study predominantly included younger women, with the majority in the **18-24 years** age group (56.9%, **91 participants**), followed by the **25-29 years** group (31.9%, **51 participants**), and the **30-34 years** group, which constituted 11.3% (**18 participants**) of the study population. These findings reflect the fact that antenatal care in younger women is more commonly sought, as this age group is generally more likely to experience their first pregnancy. This age group is important as it may indicate a population less likely to have pre-existing hypertensive conditions but more susceptible to the development of gestational hypertension, particularly if there are disturbances in lipid metabolism during pregnancy.

Obstetric History and BMI Distribution: The study revealed that **73.1%** of participants were **primigravida** (first-time pregnant women), with a smaller percentage being multigravida, ranging from **G2A1** (1.3%, **2 participants**) to **G3P2L2** (2.5%, **4 participants**). The high proportion of primigravida women, typical in many studies, highlights the need for early monitoring of lipid levels and blood pressure in first-time pregnancies, as they are often at higher risk for pregnancy-related complications like gestational hypertension.

The study's findings on **BMI** showed that the majority of women (92.5%, **148 participants**) had a **normal BMI** of **18.5-24.9**, while a small group (7.5%, **12 participants**) fell into the **overweight category** (**BMI 25-29.9**). A normal BMI is associated with lower risks for pregnancy complications, including hypertensive disorders, although some studies suggest that even women within a normal BMI range can develop dyslipidemia, which was observed in this cohort.

Socioeconomic Status and Access to Healthcare: The socioeconomic distribution indicated that **upper middle** (39.4%, **63 participants**) and **lower middle** (38.1%, **61 participants**) classes were the predominant groups. The high access to healthcare in these groups is evidenced by the fact that **97.5%** of participants were **booked** for antenatal care. This suggests that these women had early access to necessary health monitoring, which is crucial for preventing or managing hypertensive disorders during pregnancy. Only **2.5%** of participants were unbooked, which could indicate limited access to prenatal care or socio-cultural factors that prevent women from seeking timely care.

Previous History of Gestational Hypertension: The study highlighted a significant association between **previous gestational hypertension** and the development of **gestational hypertension in the current pregnancy**. Among women with a history of **gestational hypertension (GHTN)**, **100%** (6 out of 6) developed gestational hypertension again in this pregnancy. In contrast, only **12.98%** of participants without a history of GHTN developed the condition. These findings underscore the importance of closely monitoring women with a history of hypertensive disorders in pregnancy, as they are at a higher risk for recurrence. The study's result aligns with previous research showing that women with a history of GHTN are at an elevated risk of developing hypertensive disorders in subsequent pregnancies.

Lipid Profile and Gestational Hypertension: A major finding in this study was the significant relationship between lipid profiles and the development of gestational hypertension. The study found that **total cholesterol levels** were significantly higher in women who developed **gestational hypertension**, with a mean of **244.61 mg/dL** for women with GHTN compared to **172.32 mg/dL** for those without GHTN. The **p-value of 0.0001** indicated a strong statistical correlation between high cholesterol levels and the incidence of gestational hypertension. This aligns with other studies that have shown elevated cholesterol levels to be associated with endothelial dysfunction, which is a key mechanism in the development of hypertensive disorders during pregnancy.

Additionally, **LDL cholesterol** levels were significantly higher in women with gestational hypertension (**mean = 131.05 mg/dL**) compared to those without it (**mean = 88.02 mg/dL**), with a p-value of **0.0001**. Elevated LDL levels have been previously associated with increased vascular resistance and endothelial damage, both of which can contribute to the onset of PIH.

Triglycerides and **VLDL** also exhibited a strong association with gestational hypertension. Women with gestational hypertension had higher **triglyceride levels** (mean = **321.26 mg/dL**) compared to those without (mean = **149.47 mg/dL**), with a p-value of **0.0001**, indicating a significant difference. Similarly, **VLDL levels** were markedly higher in women who developed gestational hypertension (**mean = 73.85 mg/dL**) compared to those who did not (**mean = 29.46 mg/dL**), with a p-value of **0.0001**. The findings are consistent with studies suggesting that high triglyceride and VLDL levels, which are components of dyslipidemia, may contribute to the pathogenesis of hypertensive disorders in pregnancy through increased vascular inflammation and oxidative stress.

Diagnostic Accuracy of Lipid Profile: The diagnostic performance of **lipid profiles** in predicting gestational hypertension was evaluated, and the results were promising. **Sensitivity** was found to be **88.46%**, and **specificity** was **94.78%**, with an **AUC** of **0.916**, indicating high diagnostic accuracy. The **positive predictive value (PPV)** for dyslipidemia was **76.66%**, suggesting that women with abnormal lipid profiles are at a high risk for developing gestational hypertension. Furthermore, the **negative predictive value (NPV)** was **97.69%**, suggesting that a normal lipid profile is highly effective in ruling out the risk of gestational hypertension. These findings support the utility of lipid profiling as an early, non-invasive screening tool for gestational hypertension.

Total Cholesterol and Gestational Hypertension: A significant association was also observed between **total cholesterol** levels and the development of gestational hypertension. Women with elevated cholesterol levels in the early second trimester had a higher risk of developing gestational hypertension later in pregnancy. The mean total cholesterol in women with GHTN was significantly higher (**244.61 mg/dL**) compared to women without GHTN (**172.32 mg/dL**), with a **p-value of 0.0001**. This suggests that high cholesterol may play a role in the development of PIH by contributing to endothelial dysfunction and increased vascular resistance.

Limitations and Future Directions: While the study's findings are promising, there are limitations that should be acknowledged. The sample size, though sufficient for the purposes of this study, could be increased for more robust conclusions, particularly in subgroup analyses. Additionally, while lipid profiles were measured only once in early pregnancy, regular monitoring of lipid levels throughout pregnancy may provide more comprehensive data on their role in PIH development. Future studies could explore the long-term implications of lipid abnormalities in pregnancy and their impact on maternal and fetal health outcomes. Additionally, studies could investigate the potential of combining lipid profiling with other biomarkers or clinical parameters to develop a more accurate predictive model for PIH.

5. CONCLUSION

In conclusion, this study suggests that **lipid profiling**, particularly **total cholesterol**, **LDL**, **VLDL**, and **triglycerides**, can be valuable predictors of **gestational hypertension** and **pregnancy-induced hypertension**. These findings highlight the importance of early monitoring of lipid levels in pregnancy as a potential tool for the early identification of high-risk pregnancies. Early detection and intervention can lead to improved maternal and fetal outcomes, reinforcing the importance of routine prenatal care and preventive strategies for hypertension during pregnancy

REFERENCES

[1] World Health Organization. Maternal mortality. Geneva: World Health Organization; 2019.
[2] Brown MA, Lindheimer MD, de Swiet M, et al. The classification and diagnosis of the hypertensive disorders of pregnancy: a statement from the International Society for the Study of Hypertension in Pregnancy (ISSHP). Hypertension. 2001;37(3): 1153-1160.
[3] Catov JM, Roberts JM. Pregnancy and cardiovascular risk: What should be measured? The Lancet. 2018;392(10145): 358-360.
[4] McCarthy FP, Gardiner J, McCowan LM. A review of lipid metabolism during pregnancy and its implications for the maternal and fetal cardiovascular system. BMC Pregnancy and Childbirth. 2014;14: 160.
[5] Enquobahrie DA, Qiu C, Sanchez SE, et al. Maternal triglycerides and LDL-cholesterol concentrations and risk of preeclampsia. American Journal of Epidemiology. 2011;173(4): 474-483.
[6] Dada O, Dada E, Ayoola S. Dyslipidemia and pregnancy-induced hypertension. BMC Pregnancy and Childbirth. 2018;18: 327.
[7] Ueda K, Miyazaki K, Saito H, et al. Lipid peroxidation and endothelial dysfunction in preeclampsia. Journal of Hypertension. 2000;18(9): 1307-1312.
[8] Redman CWG, Sargent IL. Latest advances in understanding preeclampsia. Science. 2005;308(5728): 1592-1594.
[9] Levine RJ, Maynard SE, Qian C, et al. Circulating angiogenic factors and the risk of preeclampsia. New England Journal of Medicine. 2004;350(7): 672-683.
[10] Thanakorn P, Tohtong R, Chongthammakun V. Cholesterol and pregnancy-induced hypertension: A systematic review. The Journal of Clinical Hypertension. 2017;19(9): 908-916.
[11] Laskowski M, Sawicki R, Ciostek P, et al. Role of lipid metabolism in pregnancy-induced hypertension: A review. Pregnancy Hypertension. 2016;6(1): 6-13.
[12] Skiba G, Bujwid J, Koczyk M, et al. Triglycerides and HDL cholesterol as early predictors of preeclampsia. Acta Obstetricia et Gynecologica Scandinavica. 2008;87(9): 915-920.
[13] Kruitwagen R, Tiebosch M, Thomas C, et al. Early second-trimester lipid profiles in women with preeclampsia: A case-control study. BMC Pregnancy and Childbirth. 2016;16: 48.
[14] Nossent EJ, Bakker R, Smits L, et al. The association of lipid profile during pregnancy with preeclampsia. The American Journal of Obstetrics & Gynecology. 2015;212(3): 369.e1-7.
[15] Silva LM, Rajput Y, Francisco C. Lipid metabolism and hypertension in pregnancy: A critical review. Cardiovascular Research. 2012;94(2): 347-354.
[16] Roberts JM, Pearson GD, Cutler JA, et al. Summary of the NHLBI Working Group on High Blood Pressure in Pregnancy. Hypertension. 2003;41(3): 437-445.

...