



A Prospective cohort study of the trimester specific changes in serum lipid profile and blood pressure and their association with maternal and fetal outcome in 1000 singleton pregnancies

¹Dr. G. Bhagya Rekha, ²Dr.K. Anuradha, ³Dr.B. Anil Kumar, ⁴Dr.K.V. Phani Madhavi

Abstract: Background: Blood lipid increases during gestation are considered a physiological adaptation, and decrease after delivery. However, some adverse pregnancy outcomes are thought to be related to gestational lipid levels. Therefore, it is necessary to have a reference range for lipid changes during gestation. The present study aims to study trimester specific changes in lipid profile and blood pressure and to study maternal and foetal outcome in relation to changes in lipid profile and blood pressure. **Methodology:** A Prospective study was carried out for a period of 24 months during January 2021 to December 2022 among 1000 Singleton Pregnant mothers attending Government General Hospital, Guntur. **Results:** The mean Triglyceride level in first trimester is 144.99 ± 37.30 , in second trimester it is 159.93 ± 38.23 , in third trimester it is 172.64 ± 39.15 . The mean Total cholesterol level in first trimester is 193.10 ± 22.35 , in second trimester it is 212.40 ± 19.25 , in third trimester it is 232.20 ± 22.84 . The mean SBP in first trimester is 109.7 ± 1.31 , in second trimester it is 107.8 ± 1.41 , in third trimester it is 114.6 ± 1.71 mm of Hg respectively. In the study, 22.7% were Preterm births and 77.3% were Term deliveries. **Conclusion:** It is normal for blood triglycerides, LDL, VLDL, and total cholesterol to moderately rise throughout the third trimester. There is a natural drop in blood pressure during the middle trimester. It is easier to identify abnormal blood pressure readings and changes in lipid profiles when one is aware of the physiological changes and the reference values. This aids in the early diagnosis of pathological disorders that may have an impact on the result for both the mother and the foetus.

Keywords: maternal and foetal outcome, Lipid profile, blood pressure, pregnancy outcomes, Pregnant mothers

AFFILIATIONS

¹Final year post graduate Department of Obstetrics and Gynaecology, Guntur Medical College, Guntur.

²Associate Professor, Department of Obstetrics and Gynaecology, Government Medical College, Machilipatnam.

³Associate Professor, Department of Community Medicine, Government Medical College, Markapur

⁴Associate Professor, Department of Community Medicine, Government Medical College, Rajamahendravaram

CORRESPONDING AUTHOR

Dr.K.V. Phani Madhavi,
drmadhavikvp@gmail.com
Mobile: 8978604406

INTRODUCTION

Pregnancy is associated with changes in anatomy, physiology, biochemistry. The character of normal pregnancy is developing well to related alterations in fetus, developed placenta, increase in circulating steroids. As a result of these changes serial alteration in lipid profile, mainly increase in serum triglycerides, cholesterol occurs in pregnant women.¹

Even in normal pregnancy there is increase in plasma lipid seen, but in normal pregnancy it is not therogenic, may be physiological, due to hormonal control. Whenever this mechanism of adjusting physiologic hyperlipidemia is altered that lead to complications in pregnancy. So, in pregnancy if serum lipid profile serves the lips to identify high risk cases prone for preeclampsia.²

For the growing fetus to receive nutrients continuously despite sporadic maternal food consumption, changes in carbohydrate and lipid metabolism take place. Early in pregnancy, pancreatic beta-cell hyperplasia, an increase in insulin secretion, and a rise in serum levels of estrogen and progesterone all alter the mother's metabolic milieu.

Hyperinsulinemia is a condition that causes an increase in peripheral glucose uptake, a drop in fasting plasma glucose levels, an increase in tissue glycogen storage, an increase in fat storage, and a decrease in lipolysis.

Article Title: A Prospective cohort study of the trimester specific changes in serum lipid profile and blood pressure and their association with maternal and fetal outcome in 1000 singleton pregnancies

During pregnancy, there are significant physiological changes in the systemic hemodynamics. When attempting to measure blood pressure during pregnancy, it is critical to recognize these variations from the non-pregnant state.

Between 16th and 20th weeks of gestation, mean arterial pressure in pregnancy without complications reaches its lowest point. The decrease in diastolic pressure is a little more pronounced than the decrease in systolic pressure. The decrease is typically 8–10 mm Hg, or slightly under 10%, from pre-pregnancy levels. Mean arterial blood pressure gradually returns to pre-pregnancy levels around the 20th week, or around the 40th week of gestation.

Preeclampsia is specific to pregnancy, multi system involvement. It is hypertensive in order includes new onset hypertension and proteinuria after 20 weeks of gestation and resolves after delivery. Preeclampsia is a common medical complication in pregnancy in developing countries. It is one of the most common causes that lead to maternal and fetal morbidity and mortality. Incidence of Preeclampsia in world is 3-5%.³ In India preeclampsia complicates 5-15% of pregnancies.⁴ Even though etiopathogenesis of preeclampsia are mainly obscure and poorly understood, genetic component may play a major role. It includes complex pathophysiological state in which regulatory 15 systems of inflammation and endothelial function are altered beyond the normal physiological limits of pregnancy.

Endothelial dysfunction may be due to the changes in metabolism of lipoproteins. The mechanism that leads to endothelial dysfunction is not well defined. The spectrum of endothelial changes is provoked by multiple circulating factors including altered lipoproteins. Endothelial dysfunction explains many of the symptoms of preeclampsia including proteinuria.^{5,6} Even before, some studies evaluated lipid profile in preeclampsia and relationship between lipid concentration (serum triglycerides) and severity of preeclampsia is evaluated.

AIMS:

- To study trimester specific changes in lipid profile and blood pressure
- To study maternal and fetal outcome in relation to changes in lipid profile and blood pressure

OBJECTIVES:

1. To measure blood pressure in all pregnant women along with serum lipid profile
2. To study the association between lipid profile changes with maternal and fetal outcomes
3. To study the association between blood pressure changes with maternal and fetal outcomes.

METHODOLOGY

A Prospective study was carried out for a period of 24 months during January 2021 to December 2022 among 1000 Singleton Pregnant mothers attending Government General Hospital, Guntur.

Inclusion Criteria:

Study group consists of patients of Singleton Pregnancies with any of the following criteria

- All antenatal women
- Singleton Pregnancy

Exclusion Criteria:

- Patients with any of the following are excluded—
- Chronic hypertension, preeclampsia
- Diabetes mellitus
- Obese women with prepregnancy BMI >25, Multiple pregnancy
- With any other pre-existing comorbidities such as heart disease
- Those who are taking anti-hypertensive or hypolipidemic drugs

Article Title: A Prospective cohort study of the trimester specific changes in serum lipid profile and blood pressure and their association with maternal and fetal outcome in 1000 singleton pregnancies

The study was conducted after obtaining Institutional Ethics Committee clearance and approval

From respective authorities. Written informed consent was obtained from both families' and patients. All the patients of Singleton Pregnancies who are admitted in inpatient department and out-patient will be evaluated for lipid parameters– HDL CHOLESTEROL, LDL CHOLESTEROL and SERUM TRIGLYCERIDE. In addition to routine investigations. All the women were followed up regularly till delivery and lipid parameters were measured in all the women. The lipid parameters were analyzed and correlated with the corresponding maternal and fetal outcomes.

STATISTICAL ANALYSIS:

SPSS software 25.0 (SPSS, Chicago, IL, USA) was used to conduct all statistical analyses. Continuous variables are presented as the mean ± SD, while categorical variables are presented as numbers (proportion). The comparisons of TG levels among different periods or groups were performed by T test value <0.05 was considered as statistically significant.

RESULTS

- A total of 1000 Singleton Pregnant mothers attending Government General Hospital, Guntur were followed up till delivery.
- The mean age of the study population was 26.58±4.49 years. 35.2% belong to 19-24 years age group, 40.9% belong to 25-30 years age group, 23.9% belong to 31-34 years age group.
- Out of 1000 mothers 54.9% were Primigravida and 45.1% were Multigravida.
- The mean HDL level in first trimester is 53.43 ±3.23, in second trimester it is 49.46±2.89, in third trimester it is 46.95±3.09.
- The mean LDL level in first trimester is 107.02±6.55, in second trimester it is 124.62±7.81, in third trimester it is 132.11±8.99.
- The mean Triglyceride level in first trimester is 144.99±37.30, in second trimester it is 159.93±38.23, in third trimester it is 172.64±39.15. The mean Total cholesterol level in first trimester is 193.10 ± 22.35, in second trimester it is 212.40 ± 19.25, in third trimester it is 232.20±22.84.
- The mean VLDL level in first trimester is 27.36 ±4.68, in second trimester it is 30.36±5.19, in third trimester it is 33.34±5.59.
- The mean SBP in first trimester is 109.7±1.31, in second trimester it is 107.8±1.41, in third trimester it is 114.6 ±1.71 mm of Hg respectively. The mean DBP in first trimester is 78.44 ±5.03, in second trimester it is 83.91±5.52, in third trimester it is 86.85 ±5.27.
- Majority 72.2% had Normal vaginal delivery and 27.8% had undergone LSCS.
- The mean Gestational age at delivery was 38.09±2.43 weeks. 8±1.41, in third trimester it is 114.6 ±1.71 mm of Hg respectively.

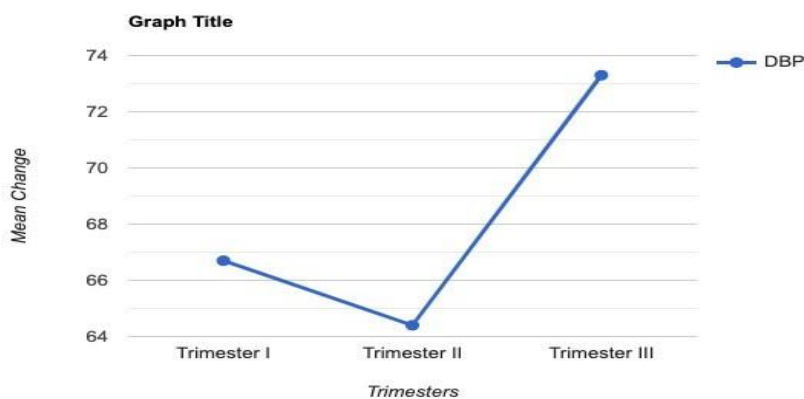


Figure: 2 showing mean SBP in all 3 trimesters

The mean DBP in first trimester is 78.44 ±5.03, in second trimester it is 83.91±5.52, in third trimester it is 86.85 ±5.27.

Table: 1 Distribution of babies based on Birth weight in Kgs

Article Title: A Prospective cohort study of the trimester specific changes in serum lipid profile and blood pressure and their association with maternal and fetal outcome in 1000 singleton pregnancies

	Frequency	Percentage
<2.5	305	30.5%
2.6– 3.5	484	48.4%
>3.5	211	21.1%
Total	1000	100%
Mean Birthweight in Kg	2.92±0.61	

Table 1 shows distribution based on Birthweight in Kg, 30.5% had Birthweight of

<2.5kg, 48.4% had Birthweight of 2.6-3.5kg, 21.1% had Birthweight of >3.5kg. The mean Birthweight in the study is 2.92±0.61 Kgs.

In the study, 22.7% were Preterm births and 77.3% were Term deliveries.

About 5.9% babies had score of 4, 4.8% had score of 5, 26.4% had score of 6, 25.1% had score of 7, 20.2% had score of 8, 17.6% had score of 9.

Table: 2 COMPARISON OF LIPID PROFILE IN 1ST AND 2ND TRIMESTERS

Lipid Profile	1 st Trimester	2 nd Trimester	P Value
HDL	54.43 ±3.23	49.46 ±2.89	<0.03
LDL	107.02±6.55	124.62±7.81	<0.01
Triglyceride	144.99 ±37.30	159.93 ±38.23	<0.01
Total Cholesterol	193.10±2.35	212.40 ±19.25	<0.01
VLDL	27.36 ±4.68	30.36 ±5.19	<0.01

The above table shows statistically significant difference in the lipid profile of patients from 1st trimester to 2nd trimester with p values <0.05.

Article Title: A Prospective cohort study of the trimester specific changes in serum lipid profile and blood pressure and their association with maternal and fetal outcome in 1000 singleton pregnancies

Table: 3 COMPARISON OF LIPID PROFILE IN 1ST AND 3RD TRIMESTERS

Lipid Profile	1 st Trimester	3 rd Trimester	P Value
HDL	54.43 ±3.23	46.95 ±3.09	<0.01
LDL	107.02 ±6.55	132.11 ±8.99	<0.01
Triglyceride	144.99 ±37.30	172.64 ±39.15	<0.01
Total Cholesterol	193.10 ±2.35	232.20 ±22.84	<0.01
VLDL	27.36 ±4.68	33.34 ±5.59	<0.01

The above table shows statistically significant difference in the lipid profile of patients from 1st trimester to 3rd trimester with p values <0.05.

Table: 4 COMPARISON OF LIPID PROFILE IN 2ND AND 3RD TRIMESTERS

Lipid Profile	2 nd Trimester	3 rd Trimester	P Value
HDL	49.46 ±2.89	46.95 ±3.09	<0.05
LDL	124.62 ±7.81	132.11 ±8.99	<0.02
Triglyceride	159.93 ±38.23	172.64 ±39.15	<0.01
Total Cholesterol	212.40 ±19.25	232.20 ±22.84	<0.01
VLDL	30.36 ±5.19	33.34 ±5.59	<0.01

The above table shows statistically significant difference in the lipid profile of patients from 1st trimester to 3rd trimester with p values <0.05.

Article Title: A Prospective cohort study of the trimester specific changes in serum lipid profile and blood pressure and their association with maternal and fetal outcome in 1000 singleton pregnancies

DISCUSSION

In this study trimester specific changes of lipid profile and blood pressure are taken. The mean value of total cholesterol, triglycerides, LDL, VLDL are increased in third trimester when compared to first and second trimesters with significant p value. The mean systolic and diastolic blood pressure is reduced in second trimester with progressive increase till term.

The mean HDL level in first trimester is 53.43 ± 3.23 , in second trimester it is 49.46 ± 2.89 , in third trimester it is 46.95 ± 3.09 . Whereas in the mean HDL – Cholesterol levels in second and third trimester were 49.13 ± 6.15 mg/dl and 43.07 ± 4.34 mg/dl respectively in **Pusukuru R et al**⁷.

The mean LDL level in first trimester is 107.02 ± 6.55 , in second trimester it is 124.62 ± 7.81 , in third trimester it is 132.11 ± 8.99 . Whereas the mean LDL – Cholesterol levels in second and third trimester were 92.41 ± 18.94 mg/dl and 137.82 ± 13.45 mg/dl respectively in a study done by **Pusukuru R et al**⁷.

The mean Triglyceride level in first trimester is 144.99 ± 37.30 , in second trimester it is 159.93 ± 38.23 , in third trimester it is 172.64 ± 39.15 . Whereas the mean triglyceride levels in second and third trimester were 188.68 ± 20.88 mg/dl and 216.78 ± 20.09 mg/dl respectively in a study done by **Pusukuru R et al**⁷.

The mean Total cholesterol level in first trimester is 193.10 ± 22.35 , in second trimester it is 212.40 ± 19.25 , in third trimester it is 232.20 ± 22.84 . Whereas the mean cholesterol levels in second and third trimester were 214.6 ± 18.16 mg/dl and 242.65 ± 20.44 mg/dl respectively in a study done by **Pusukuru R et al**⁷.

The mean VLDL level in first trimester is 27.36 ± 4.68 , in second trimester it is 30.36 ± 5.19 , in third trimester it is 33.34 ± 5.59 . Whereas the mean VLDL – Cholesterol levels in second and third trimester were 28.22 ± 7.66 mg/dl and 36.27 ± 6.72 mg/dl respectively in a study done by **Pusukuru R et al**.

In the present study We found a significant increase in the cholesterol, triglyceride, LDL-Cholesterol and VLDL-Cholesterol level in third trimester as compared to second trimester. We found HDL-Cholesterol levels decreased in third trimester when compared to second trimester. Similar findings were reported in a study done by **Pusukuru R et al**⁷.

In a case control by **Giuseppe Lippi et al.**, a comprehensive lipid and lipoprotein profile was evaluated in 57 women at different gestational ages (20 in first, 20 in second and 17 in third trimesters, respectively). They concluded that all the lipid parameters were significantly modified particularly in second and third trimester when compared to non-pregnant females as well as when compared to the values in first trimester⁸.

In a study done by **Abdelhai AT, Jamil et al.**, a total of 115 pregnant women at different stages of pregnancy were included in the study, with 35 age-matched, healthy, non-pregnant women selected as control. They concluded that there was a significant decrease in high density lipoprotein cholesterol with increased low density lipoprotein concentrations. No significant difference was found in total cholesterol and triglycerides concentrations between pregnant women and non-pregnant controls⁹.

A study was done on 160 women {120 pregnant women during normal gestation (40 women in each trimester) and 40 non-pregnant, healthy women as control} by **Idonije O. Blessing et al.**, to evaluate the estimated serum concentrations of total cholesterol, high density lipoprotein, low density lipoprotein and triglycerides.¹⁰

The mean SBP in first trimester is 109.7 ± 1.31 , in second trimester it is 107.8 ± 1.41 mm Hg, in third trimester it is 114.6 ± 1.71 mm Hg. The mean DBP in first trimester is 66.7 ± 1.10 mm Hg, in second trimester it is 64.4 ± 1.10 , in third trimester it is 73.3 ± 1.35 mm Hg. BP measured repeatedly by two different noninvasive devices during pregnancy and postpartum showed a statistically significant drop in mid-pregnancy, followed by a progressive increase until term. Similar findings were reported from a study done by **Grindheim et al.**¹¹

Grindheim et al. have followed a cohort with four visits during pregnancy to evaluate change in blood pressure which showed similar mid trimester drop in blood pressure in second trimester.¹¹

The majority of previous studies did not measure pre-pregnancy BP, and reports on the pattern of BP changes were usually limited within the pregnancy. Studies reporting a mid-trimester BP drop were heterogeneous with respect to measurement device, time of measurement, study design, inclusion criteria, sample size, and statistical methods.

Some of the previous observations were descriptive and statistical approaches were outdated. Repeated measurement nested within individuals are highly dependent on each other, and neglect of this intra-class correlation by treating each measurement as an independent observation will lead to erroneous statistical conclusions¹². Our finding contradicts the work by **Nama et al**¹³, that reported a progressive increase in mean SBP and DBP throughout healthy pregnancy without mid-trimester BP drop. In that study, participants were homogenous population (white normotensive and primiparous

Article Title: A Prospective cohort study of the trimester specific changes in serum lipid profile and blood pressure and their association with maternal and fetal outcome in 1000 singleton pregnancies

women), and statistical methods were robust in dealing with intra-class correlation. Their finding undermines the widely accepted mid-trimester drop in BP. However, the homogeneity of study population limited the generalization of their conclusion. Moreover, the timing of measurement was categorized into several intervals in that study and most of the related studies owing to the deficiency of models to deal with sparse longitudinal data.

CONCLUSION

Moderate rise in serum triglycerides, LDL, VLDL, total cholesterol in third trimester is physiological. There is physiological mid-trimester fall in blood pressure. Understanding the physiological changes and being aware of the reference values aids in spotting altered blood pressure readings and changes in lipid profiles, which can help in the early diagnosis of pathological diseases that can affect both maternal and fetal outcome.

Conflict of Interest: Nil

Finding Sources: Nil

REFERENCES

1. Obstetric and Intrapartum Emergencies A Practical Guide to Management, pp. 1 – 9. DOI: <https://doi.org/10.1017/9781108790932.003>.
2. Sridhara SK. A comparative analysis of serum lipid profile between normotensive and hypertensive pregnant women. *Int J Reprod Contracept Obstetrics and Gynecology*. 2019; 8:2060-4.
3. Butwick AJ, Druzin ML, Shaw GM, Guo N. Evaluation of US state-level variation in hypertensive disorders of pregnancy. *JAMA Net Open*. 2020;3(10): e2018741.
4. Armaly Z, Jadaon JE, Jabbour A, Abassi ZA. Preeclampsia: Novel mechanisms and potential therapeutic approaches. *Front Physiol*. 2018; 9:973.
5. Adiga U, D'souza V, Kamath A, Mangalore N. Antioxidant activity and lipid peroxidation in preeclampsia. *J Chin Assoc*. 2007;70(10):435-8.
6. Cekman MB, Erbagci AB, Balat A, Puman C, Maral H, Ergen K, et al. Plasma lipid and lipoprotein concentrations in pregnancy induced hypertension. *Clin Biochem*. 2003;36(7):575-8.
7. Pusukuru R, Shenoi AS, Kyada PK, Ghodke B, Mehta V, Bhuta K, Bhatia A. Evaluation of Lipid Profile in Second and Third Trimester of Pregnancy. *J Clin Diagn Res*. 2016 Mar;10(3):QC12-6.
8. Lippi G, Albiero A, Montagnana M, et al. Lipid and Lipoprotein profile in physiological pregnancy. *Clin Lab*. 2007; 53:173–77.
9. Jamil AAT, Elsoni B, Zaki HY, Elbadawi NE, Ahmed EG, Ibrahim EK, et al. Assessment of lipid profile in sudanese pregnant women. *Key Research Journal of Biotechnology*. 2013;1(1):4–15.
10. Okojie FO, Idonije OB, Esegbe MA, Okhiai O, Unuabonah F, Dike M, et al. Comparative study of lipid profile of normal pregnant women in the different trimesters. *Archives of Applied Science Research*. 2011;3(3):528–32.
11. Grindheim G, Estensen ME, Langesaeter E, Rosseland LA, Toska K. Changes in blood pressure during healthy pregnancy: a longitudinal cohort study. *J Hypertens*. 2012 Feb;30(2):342-50.
12. Snijders, T. A. B. & Bosker, R. J. *Multilevel Analysis: An Introduction to Basic and Advanced Multilevel Modeling*, 2nd Edition. (Sage Publications, 2011). [Ref list]
13. Nama V, Antonios TF, Onwude J, Manyonda IT. Mid-trimester blood pressure drop in normal pregnancy: myth or reality? *J. Hypertens*. 2011; 29:763–768.