

Dyslipidemia in Early Pregnancy as a Predictor of Adverse Pregnancy Outcomes

Surabhi Kumari¹, Shailendra Prasad Paswan²

¹Assistant Professor, Department of Obstetrics and Gynaecology, Madhubani medical College and hospital, Madhubani, Bihar, India

²Senior Resident, Department of Anaesthesiology, Madhubani medical College and hospital, Madhubani, Bihar, India

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Corresponding Author: Dr. Shailendra Prasad Paswan

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Abstract:

Background: Physiological hyperlipidemia occurs during pregnancy; however, pathological dyslipidemia in early gestation may adversely affect maternal and neonatal outcomes and remains under-evaluated.

Aim: To assess whether dyslipidemia in early pregnancy predicts adverse pregnancy and neonatal outcomes.

Methodology: This prospective observational cohort study was conducted at Department of Obstetrics and Gynaecology, Madhubani medical College and hospital, Madhubani, Bihar, India. A total of 596 singleton pregnant women (<32 years, <20 weeks gestation) were enrolled. Maternal lipid profiles were assessed at 18–20 weeks and at delivery, and pregnancy as well as neonatal outcomes was recorded. Statistical analysis included chi-square tests and logistic regression.

Result: Dyslipidemia was present in 20.1% of women at 18–20 weeks and increased to 91.9% at delivery. Significant rises were observed in total cholesterol, triglycerides, LDL, VLDL, and lipid ratios. Early-pregnancy dyslipidemia was not significantly associated with preterm birth or low birth weight but showed a significant association with neonatal hypoglycemia ($p < 0.001$).

Conclusion: Dyslipidemia is common in early pregnancy and is significantly associated with neonatal hypoglycemia, highlighting the potential value of early lipid screening. Larger metacentric studies are needed to establish predictive models for adverse outcomes.

Keywords: Dyslipidemia, Pregnancy, Lipid profile, Neonatal outcomes, Hypoglycemia.

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Introduction

A healthy pregnant woman's lipid profile alters as a result of several physiological changes that take place during pregnancy. Lipid synthesis and fat accumulation increase during the first anabolic phase. The breakdown of fat deposits during the third trimester results in a net catabolic phase that increases the substrate for the developing foetus [1]. Overall changes in lipid physiology during pregnancy reflect the mother's increased insulin resistance and enable the baby to receive the right nutrients.

For a foetus to grow normally, cholesterol is necessary. It contributes to the production of cell membranes, their integrity, and the precursors of hormones including steroids, vitamin D, and bile acids [2]. Endogenous production, maternal circulation, and synthesis in the placenta and yolk sac are the sources of foetal cholesterol. Cholesterol from the mother can pass through the placenta and enter the fetus's bloodstream. When a foetus is exposed to high quantities of cholesterol and its oxidative

products due to dyslipidaemia or excessive maternal cholesterol transfer, negative outcomes occur. Negative maternal and foetal outcomes, such as preterm delivery, small for gestational age, and large for gestational age, are linked to poorly managed cholesterol, triglycerides, and their metabolites.

Pregnancy outcomes and maternal health can be greatly impacted by dyslipidaemia, which is defined by unusually high blood lipid levels. Dyslipidaemia can impact both the mother and the growing foetus due to physiological changes in lipid metabolism that take place during gestation [3]. Lipids and lipoproteins are frequently not regularly assessed during pregnancy since these lipid-related disorders have long been thought to be physiological with little clinical significance. However, new research indicates that these lipid abnormalities may have significant effects on foetal and maternal outcomes, including the emergence of cardiovascular diseases (CVDs) in later life [4].

Maternal problems including preeclampsia (PE), gestational diabetes mellitus (GDM), and placental abruption are linked to elevated cholesterol and triglyceride levels during pregnancy [5]. For example, endothelial dysfunction brought on by elevated cholesterol has been associated with preeclampsia, increasing the likelihood of this potentially fatal illness. Furthermore, the risk of developing GDM is increased when insulin resistance and high cholesterol and triglyceride levels coexist, and excessive lipid levels may potentially impair placental function, raising the possibility of placental abruption [6]. The necessity of early detection and close observation of dyslipidaemia during pregnancy is highlighted by these problems.

The foetus is also at danger from dyslipidaemia. Foetal growth limitation, premature delivery, and foetal discomfort can result from elevated maternal lipid levels [7]. The efficiency of nutrition supply across the placenta is impacted by maternal lipid metabolism, which limits normal foetal development and causes foetal growth limitation [8]. Preterm pregnancies are also linked to diseases like GDM and PE, which frequently need early delivery [9]. Additionally, dyslipidaemia raises the risk of intrauterine growth restriction (IUGR), which puts the foetus at risk for discomfort because of poor placental blood supply.

Serum cholesterol levels in adults should not exceed 200 mg/dl. Even though there is a noticeable rise in triglyceride levels during a typical pregnancy, the maximum plasma cholesterol value never goes over 250 mg/dl. However, the atherogenic index (log triglyceride/HDL C) and LDL/HDL are largely constant in a typical pregnant woman. A similar rise in HDL-C in healthy pregnant women distinguishes physiological hyperlipidaemia from pathological dyslipidaemia. Pregnancy-related hypertriglyceridemia is caused by both increased triglyceride-rich lipoprotein synthesis and impaired triglyceride-rich lipoprotein clearance".

Methodology

Study Design: Observational analytical cohort study

Study Duration: Data was collected over a period of 12 Months, From January 2025 to December 2025.

Study Area: Study was conducted in Department of Obstetrics and Gynecology, Madhubani medical College and hospital, Madhubani, Bihar, India

Sample Size: Sampling population All the patient who attend obstetrics and gynecology OPD of Madhubani medical College and hospital, Madhubani, Bihar, India for antenatal care over a period of 12 months

Sampling Technique: Total enumeration method of sampling technique will be used in the study

Inclusion Criteria

- All consenting pregnant female less than 32 years of age.
- Singleton pregnancy
- Gestational age is less than 20 weeks
- Pre pregnancy BMI less than 24.9 kg/m², if not available then first ANC visit (preferably in first trimester)

Exclusion Criteria

- Multiple gestation
- History of diabetic mellitus, hypertension, HIV in current or previous pregnancy
- History of prior preterm delivery, history of second trimester losses, cervical insufficiency
- Other illness like preeclampsia, gestational diabetic mellitus, APLA syndrome, Metabolic syndrome.
- Drug history of lipid lowering agents like statins, fibrates, bile acid sequestrants

Data Collection: A standardised questionnaire was used to gather data through in-person interviews at two different times: during recruiting and following the release of investigative findings. Patients, hospital records, and the Hospital Information System (HIS) were the sources of information. Data were recorded on a pre-made proforma and put into Microsoft Excel throughout a 12-months period (January 2025 to December 2025). Demographic information (age, height, weight, BMI), obstetric history (gravida, parity, abortion, living conditions), and laboratory results at 18–20 weeks of gestation and upon delivery (total cholesterol, triglycerides, HDL, LDL, VLDL, cholesterol/HDL and LDL/HDL ratios) were all gathered. Neonatal outcomes (birth weight, Apgar scores at 1 and 5 minutes, requirement for resuscitation, NICU admission, and neonatal blood sugar levels) and delivery information (gestational age and manner of delivery) were also recorded.

Definition used in this study: There is no agreement on what constitutes normal maternal lipid levels during pregnancy. "Williams Obstetrics 24th Edition" was one of the most widely used reference standards for lipids during pregnancy. These reference levels were derived from studies in Porto (Portugal), Graz (Austria), and Warsaw (Poland) that used the 2.5th and 5th percentiles of lipid readings from pregnant women. "Williams Obstetrics 24th Edition" and Wang et al provided various lipid references. A retrospective study was conducted to determine adequate reference levels for pregnancy lipids. Between the dyslipidemia pregnant women identified with the three different reference levels, there were no significant differences in prevalence or ORs of adverse pregnancy outcomes²⁸.

However, among those with dyslipidemia identified in the above study and Wang et al, the frequency and ORs of unfavourable pregnancy outcomes were closer than in those diagnosed by "Williams Obstetrics 24th Edition". Given that the majority of the participants in the trial were Caucasians, and that lipid levels differed between Asian and European pregnant women, variances in culture and ethnicity may explain for the above discrepancies. In this study

dyslipidaemia in pregnancy was defined according to a study named Recommended reference values for serum lipids during early and middle pregnancy: a retrospective study from China by Wang et al²⁹.

This study recommends that the reference values of serum Total cholesterol, Triglyceride and LDL should be less than the 95th percentile and that of HDL should be greater than the 5th percentile.

Table 3: Recommended Reference Values for Serum Lipids at 18–20 Weeks of Pregnancy [29]		
Serum lipid parameter	mmol/L	mg/dL
Total cholesterol	< 5.64	< 218.09
Triglyceride	< 1.95	< 172.40
HDL-C	> 1.23	> 47.56
LDL-C	< 3.27	< 126.45

Table 4: Recommended Reference Values for Serum Lipids at the Time of Delivery [29]		
Serum lipid parameter	mmol/L	mg/dL
Total cholesterol	< 7.50	< 290.02
Triglyceride	< 3.56	< 137.66
HDL-C	> 1.41	> 54.52
LDL-C	< 4.83	< 186.77

Dyslipidemia in pregnant women will be considered when at least one lipid fraction is altered. In this study preterm birth is defined as those delivered before 37 completed weeks in this study low birth weight is defined as neonates weighing 1500 to 2500 grams.

Procedure: After receiving informed permission, pregnant women under the age of thirty-two were enrolled in the research. A comprehensive clinical examination and a full history were conducted at the time of enrolment and recorded using a pre-made proforma. A repeat history and clinical examination were performed during the first follow-up, which took place between 18 and 20 weeks of gestation. A blood sample was also taken for the initial assessment of the lipid profile. Another blood sample was taken for the second lipid profile study during the second follow-up, which happened at the time of delivery. The newborn's blood glucose level was measured within an hour after delivery. Maternal and neonatal outcomes were recorded following delivery. Neonatal outcomes comprised birth weight and the APGAR score at one minute, whereas maternal outcomes included the frequency of preterm birth and low birth weight in term births.

Statistical Analysis: Google Forms was used to electronically enter the data of the research participants, while a pre-made proforma sheet in physical

copy was simultaneously recorded. The Statistical Product and Service Solutions (SPSS) software, version 22, Student Edition for Windows, was used to conduct statistical analysis. Frequencies were used to summarise categorical data, and relationships between categorical variables were evaluated using the chi square test. Odds ratios were then computed to ascertain the degree of correlation. Q-Q plots were used to evaluate the normality of continuous data. To make predictions, binary logistic regression analysis was used, and Spearman's correlation test was used to assess correlations".

Result

"Table 1 illustrates the baseline demographic and obstetric profile of the research population (n = 596). A primarily youthful reproductive cohort was indicated by the mean mother age of 25.5 ± 2.74 years, with the majority (81.54%) falling into the 23–30 year age range. According to the inclusion criteria, the mean BMI was 22.12 ± 1.66 kg/m², indicating a normal pre-pregnancy nutritional state. The distribution of delivery methods appears to be about equal, with 49.66% of the women giving birth vaginally and 50.34% using LSCS. The population had minimal baseline metabolic risk and was mostly homogenous.

Table 1: Baseline Maternal Characteristics (n = 596)

Variable	Mean $\pm$ SD / n (%)
Maternal age (years)	25.5 $\pm$ 2.74
BMI (kg/m ²)	22.12 $\pm$ 1.66
Age group 23–30 years	486 (81.54%)
Primigravida	Majority
Mode of delivery – NVD	296 (49.66%)
Mode of delivery – LSCS	300 (50.34%)

Table 2 compares maternal lipid parameters at 18–20 weeks according to gestational age at delivery. The median total cholesterol, triglycerides, and HDL levels were comparable between women with preterm and term deliveries, with no statistically significant differences ($p=0.124$, 0.496 , and 0.330 , respectively). In contrast, LDL levels were significantly lower among women who subsequently

delivered preterm (90.40 vs. 96.41), with corresponding mean ranks of 267.74 and 308.12 ($p=0.015$; $Z=-2.439$). Thus, among the lipid parameters assessed at 18–20 weeks, only LDL demonstrated a statistically significant association with subsequent preterm delivery, whereas total cholesterol, triglycerides, and HDL did not show significant differences.

Table 2: Comparison of Maternal Lipid Parameters at 18–20 Weeks According to Gestational Age at Delivery

Maternal lipid parameters	Preterm – Yes Median (IQR)	Preterm – No Median (IQR)	Mean Rank – Yes	Mean Rank – No	p-value	Z-value
Total cholesterol	184.85 (29.9)	186.95 (25.2)	279.1	304.57	0.124	-1.539
Triglyceride	113.15 (20.3)	112.40 (16.9)	307.08	295.82	0.496	0.68
HDL	67.30 (20.8)	65.70 (15.6)	310.78	294.66	0.33	0.974
LDL	90.40 (27.7)	96.41 (23.4)	267.74	308.12	0.015	-2.439

Table 3 compares maternal lipid parameters at 18–20 weeks according to newborn birth weight. The median levels of total cholesterol were identical in the low birth weight and normal birth weight groups (186.40 vs. 186.40), while triglyceride levels were also comparable (112.40 vs. 112.50). HDL levels were slightly lower among mothers of low-birth-

weight newborns (64.50 vs. 67.20), whereas LDL levels were slightly higher (96.40 vs. 94.40). However, none of these differences were statistically significant, with p -values of 0.984, 0.828, 0.304, and 0.215, respectively. Thus, maternal lipid parameters at 18–20 weeks were not significantly associated with newborn low birth weight.

Table 3: Comparison of Maternal Lipid Parameters at 18–20 Weeks According to Newborn Birth Weight

Maternal lipid parameters	Low birth weight – Yes Median (IQR)	Low birth weight – No Median (IQR)	Mean Rank – Yes	Mean Rank – No	p-value	Z-value
Total cholesterol	186.40 (26.0)	186.40 (28.7)	298.71	298.4	0.984	-0.02
Triglyceride	112.40 (16.4)	112.50 (17.1)	300.71	297.44	0.828	-0.217
HDL	64.50 (18.0)	67.20 (15.9)	288.02	303.52	0.304	1.028
LDL	96.40 (26.6)	94.40 (23.3)	311.13	292.45	0.215	-1.239

Table 4 presents the binary logistic regression analysis of various predictor variables for preterm delivery as an adverse foetal outcome. Dyslipidemia was not significantly associated with preterm birth ($p=0.564$), with a crude odds ratio of 1.145 (95% CI: 0.723–1.816) and an adjusted odds ratio of 1.136 (95% CI: 0.716–1.802). Maternal age >30 years was

also not a significant predictor ($p=0.384$), although the crude odds ratio was 2.529 (95% CI: 0.314–20.396) and adjusted odds ratio was 1.316 (95% CI: 0.745–2.325). Similarly, multigravida status showed no significant association with preterm birth ($p=0.372$), with an adjusted odds ratio of 0.391 (95% CI: 0.048–3.166).

Table 4: Binary Logistic Regression Analysis Summary of Various Predictor Variables for Preterm Delivery as an Adverse Foetal Outcome							
Variables in the Equation	Category	Preterm Birth Yes, n	Preterm Birth – No, n	Significance (p-value)	Crude Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)	
Lipid parameters	Normal	111	365		1	1	
	Dyslipidemia	31	89	0.564	1.145 (0.723–1.816)	1.136 (0.716–1.802)	
Age (years)	18–30	141	446		1	1	
	>30	1	8	0.384	2.529 (0.314–20.396)	1.316 (0.745–2.325)	
Gravida	Primigravida	17	68		1	1	
	Multigravida	125	386	0.372	1.295 (0.734–2.287)	0.391 (0.048–3.166)	

Discussion

The goal of this study was to utilise maternal lipid parameters as a predictor of unfavourable foetal outcomes and develop a prediction model for unfavourable foetal outcomes utilising different maternal lipid profile characteristics, age, and gravida as different predictive factors. This will enable appropriate advice and careful monitoring of high-risk pregnancies. In this prospective research, 596 singleton pregnancies were assessed for maternal risk factors such as age, gravida, and BMI".

"A total of 120 women were diagnosed with dyslipidaemia between the 18th and 20th weeks of gestation. 31 ladies (25.83%) gave birth before their due date. The study population included 142 preterm births. 111 women (23.31%) had preterm births out of 476 women with normal lipid profiles at 18 to 20 weeks. 36 (30%) of the 120 women with dyslipidaemia who were 18–20 weeks pregnant gave birth to babies who were underweight. In this research group, 193 mothers had low birth weight babies. 157 women (32.9%) had low birth weight babies out of 476 mothers with normal lipid profiles at 18 to 20 weeks. Of the 596 pregnant women, 300 had caesarean sections (50.3%) and 296 gave birth vaginally (49.6%).

Of the 142 pre-term births, 11 were iatrogenic (7.7%) and 131 were spontaneous (92.25%). Of the 31 women with dyslipidaemia between 18 and 20 weeks of pregnancy, 26 had spontaneous preterm birth (83.87%) and 5 had iatrogenic preterm birth (16.12%). Antepartum haemorrhage and intrahepatic cholestasis during pregnancy were the causes of iatrogenic premature births. To date, no other research has incorporated as many lipid profile measures as this one, including total cholesterol, triglycerides, LDL, VLDL, HDL, CHOLESTEROL/HDL ratio, and LDL/HDL ratio. The majority of research have only looked at the levels of triglycerides and total serum cholesterol.

In a study conducted in Mexico, the average age of 230 participants was 25.3 years. Of them, 117 were between the ages of 25 and 35, and 113 were

between the ages of 18 and 24. In this study, the average age was 25.50 ± 2.74 years. Of the 596 pregnant women, 486 (81.54%) were between the ages of 23 and 30, 101 (16.94%) were between the ages of 18 and 22, and 9 (1.51%) were older than 30. Compared to women with normal total cholesterol, preterm birth was 6.89 times more likely in those with high maternal cholesterol (38.5 percent vs. 5.4 percent; $P=0.029$). LBW was found in 14.4% of term-born babies in the Maymunah et al. study, and it was 7.99 times more common in women with high total maternal cholesterol than in mothers with normal cholesterol (87.5% vs. 10.5%, $P=0.019$). The average birth weight (989.5 g) of term infants delivered to women with high cholesterol was significantly lower (2460.5 vs. 3450.0-g) than mothers with normal cholesterol levels [10].

an increased risk of spontaneous preterm delivery in pregnant women with high HDL and LDL blood levels. First of all, they neglected to take into consideration possible confounders including the mother's age, race, socioeconomic status, and BMI. Second, the Ottawa Quality Assessment study quality evaluation scale gave them a low score. Therefore, caution should be exercised when interpreting these results. However, it's critical to acknowledge some limitations. This study did not evaluate dietary intake, physical activity, or genetic predisposition, all of which may impact lipid metabolism. Furthermore, neonatal outcomes other than gestational age and birth weight were not assessed. The study highlights how early-pregnancy lipid screening may assist identify women who are at risk for unfavourable foetal outcomes despite these disadvantages.

Familial hypercholesterolaemia (FH) is an autosomal dominantly inherited disorder of lipid metabolism caused by mutations in the low-density lipoprotein (LDL)-receptor gene. A Norwegian study of 895 women with familial hypercholesterolaemia (FH) found no evidence of an increased risk of adverse pregnancy outcomes, such as preterm delivery [11]. Recent research suggests that one in 250 people, or about 40 million people worldwide, may have FH [12]. Only two women with pure

hypercholesterolaemia would be expected to have FH in the current investigation, assuming an incidence of 1 in 250 for heterozygous FH, which is unlikely to affect the findings. 193 newborns (32.38%) in the current research weighed less than 2500 grams at delivery. Early in pregnancy, the mother of 36 of these 193 newborns had dyslipidaemia.

The current study's prospective design, thorough lipid profile, and long-term follow-up till delivery are its main advantages. This study examined many lipid indicators, including LDL, VLDL, HDL, and lipid ratios, in contrast to the majority of earlier research that only measured total cholesterol and triglycerides, offering a more thorough picture of maternal lipid dynamics. Furthermore, recording the average variations in lipid markers from mid-pregnancy to delivery provides important information on the course of gestational lipid in the Indian population".

Conclusion

Thirty-one (25.83%) of the 120 women with dyslipidaemia at 18–20 weeks of gestation in this 16-month research gave birth before their due date. 36 (30%) of the 120 mothers with dyslipidaemia at 18–20 weeks of gestation had low birth weight babies. One of the study's objectives was to create a prediction model for unfavourable foetal outcomes utilising different lipid profile, age, and gravida characteristics as predictive factors. There was a statistically significant positive connection between total cholesterol and gestational age at birth, but the limited sample size precluded the creation of a combined prediction model. For gestational age at delivery, other maternal lipid markers were not shown to be significant. For the neonate's birth weight at delivery, no maternal lipid markers were found to be statistically significant. As a secondary aim, 10 out of 120 women with dyslipidaemia at 18 to 20 weeks of gestation experienced neonatal hypoglycemia (within one hour of birth). The newborn's blood sugar level at delivery was statistically significantly correlated with the mother's lipid profile (18–20 weeks). To establish a prediction model and associate unfavourable foetal outcomes with maternal lipid profiles, very large cohort research is needed. To advocate estimating the maternal lipid profile as a prenatal inquiry, a large multicentric cohort research is required. Future research might examine the relationship between the lipid profiles of mothers and newborns.

References

1. Grimes SB, Wild R. Effect of Pregnancy on Lipid Metabolism and Lipoprotein Levels. In: Feingold KR, Anawalt B, Boyce A, Chrousos G, Dungan K, Grossman A, et al., editors. Endotext [Internet]. South Dartmouth (MA): MDText.com, Inc.; 2000 [cited 2020 Jun 29]. Available from:
2. Baardman ME, Kerstjens-Frederikse WS, Berger RMF, Bakker MK, Hofstra RMW, Plösch T. The Role of Maternal-Fetal Cholesterol Transport in Early Fetal Life: Current Insights 1. Biol Reprod [Internet]. 2013 Jan 1 [cited 2020 Jul 11];88(1). Available from: <https://academic.oup.com/biolreprod/article-lookup/doi/10.1095/biolreprod.112.102442>
3. Mulder, J.W.C.M.; Kusters, D.M.; Roeters van Lennep, J.E.; Hutten, B.A. Lipid metabolism during pregnancy: Consequences for mother and child. Curr. Opin. Lipidol. 2024, 35, 133–140.
4. Wang, Q.; Würtz, P.; Auro, K.; Mäkinen, V.-P.; Kangas, A.J.; Soininen, P.; Tiainen, M.; Tynkkynen, T.; Jokelainen, J.; Santalahti, K.; et al. Metabolic profiling of pregnancy: Cross-sectional and longitudinal evidence. BMC Med. 2016, 14, 205
5. Poornima, I.G.; Indaram, M.; Ross, J.D.; Agarwala, A.; Wild, R.A. Hyperlipidemia and risk for preclampsia. J. Clin. Lipidol. 2022, 16, 253–260.
6. He, Y.; Huang, Z.; Wei, C.; Chen, J. Case Report: Abruptio placentae and epileptic seizure after occurrence of perinatal hyperglycaemia in woman with gestational diabetes mellitus and hypertriglyceridemia-induced acute pancreatitis. Front. Endocrinol. 2023, 14, 1220957.
7. Jelliffe-Pawłowski, L.L.; Ryckman, K.K.; Bedell, B.; O'Brodovich, H.M.; Gould, J.B.; Lyell, D.J.; Borowski, K.S.; Shaw, G.M.; Murray, J.C.; Stevenson, D.K. Combined elevated mid-pregnancy tumor necrosis factor alpha and hyperlipidemia in pregnancies resulting in early preterm birth. Am. J. Obstet. Gynecol. 2014, 211, 141.e1–141.e9
8. Hajar Sharami, S.; Abbasi Ranjbar, Z.; Alizadeh, F.; Kazemnejad, E. The relationship of hyperlipidemia with maternal and neonatal outcomes in pregnancy: A cross-sectional study. IJRM 2019, 17, 739.
9. Barclay, K.; Koysombat, K.; Padmagirison, R.; Kaplan, F. Hypertriglyceridaemia in pregnancy: An unexpected diagnosis and its management. BMJ Case Rep. 2022, 15, e249000.
10. Smith CJ, Baer RJ, Oltman SP, Breheny PJ, Bao W, Robinson JG, et al. Maternal dyslipidemia and risk for preterm birth. PLoS ONE [Internet]. 2018 Dec 21 [cited 2020 Jun 29];13(12).
11. Garduño-Alanís A. PREDICTORES DE HIPERLIPIDEMIA DURANTE LA PRIMERA MITAD DEL EMBARAZO EN. Nutr Hosp. 2015 Jan 1;(1):508–13
12. Maymunah AO, Kehinde O, Abidoye G, Oluwatosin A. Hypercholesterolaemia in pregnancy as a predictor of adverse pregnancy outcome. Afr Health Sci. 2014 Dec;14(4):967- 73.

doi: 10.4314/ahs. v14i4.28. PMID: 25834509;
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