

LIPID PROFILE PATTERNS IN THE THREE TRIMESTERS OF PREGNANCY

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ABSTRACT

Pregnancy necessitates an extra demand of energy vis-à-vis a well-integrated metabolic shift to ensure adequate supply of nutrients to a constantly feeding fetus from an intermittently fasting and feeding mother. This study is aimed at evaluating the lipid profile pattern in the three trimesters of pregnancy. A total of eighty subjects were enrolled for the study after obtaining ethical clearance from the ethics and collaboration committee of the hospital. Blood samples were analyzed for lipid profile using standard laboratory methods. Blood pressure of subjects was measured in the sitting position using mercury sphygmomanometer. Results were presented in table and graphs and p-values less than 0.05 was considered statistically significant. From this study, the increase in high-density lipoprotein-cholesterol was only empirical in the first trimester, however the second and third trimester values were statistically significant ($p < 0.05$). The same pattern of increase was also observed in the low-density lipoprotein cholesterol as there was no significant increase in the first trimester of pregnancy. The pattern of triglyceride increase in this study was about three fold in the first trimester and a fourfold increases in second and third trimesters respectively. In conclusion there was a pan-hyperlipidemia of pregnancy which is an essential requirement for fetomaternal well-being and safety, also the third trimester is most vulnerable to coronary artery disease.

Keywords: Lipids, Trimesters, Pregnancy

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INTRODUCTION

Lipids are high energy based class of food that are insoluble in a group of organic solvents. The major lipid in human plasma includes cholesterol, triglyceride, phospholipids and non-esterified fatty acids (NEFA). During pregnancy, carbohydrates and lipids are necessary classes of food that provide energy for the increased cellular proliferation of the fetus and the multisystem adaptation of the mother. However, to be able to perform their physiological functions, lipids are bound to specific proteins to form lipoproteins which provide solubility in the aqueous environment for metabolism¹. There are six major sub-fractions of lipoproteins which are: chylomicrons, very low density lipoprotein (VLDL), intermediate-density lipoprotein (IDL), low-density lipoprotein (LDL) and high-density lipoprotein (HDL)^{2,3}. Chylomicrons are the least dense of all the lipoprotein and they carry cholesterol from the gut to the muscles and other tissues that use fatty acids as a source of energy or for fat production⁴. Abnormal lipid metabolism with increased serum lipid profile creates a setting for atherosclerosis which is a panacea for coronary artery disease. Studies have shown that the circulating concentrations of triglycerides, low density lipoprotein, high density lipoprotein and total cholesterol increase during pregnancy⁵⁻⁸. This is necessary because of the high energy required for the increased cellular proliferation of maternal uterine enlargement, blood volume expansion, fetal implantation, formation of blood vessels in the utero placenta area, feto- placenta development and growth⁹⁻¹². Nevertheless, a high lipid profile increases the risk of coronary artery disease (CHD) and can adversely affect the health of the pregnant woman and her fetus¹³. The increased lipid profile in pregnancy is traceable to pancreatic beta cell hyperplasia, hyperinsulinemia, hyperestrogenemia and hyperprogesteronemia. Hyperinsulinemia leads to an increase in peripheral glucose utilization, a decline in fasting plasma glucose levels, increased tissue storage of glycogen, increased storage of fats and decreased lipolysis⁸. Pregnancy has been described as a state of increased insulin resistance and insulin secretion and of reduced hepatic insulin extraction¹⁴. The principal modulator of this

hypertriglyceridemia is oestrogen as pregnancy is associated with hyperoestrogenaemia. The hyperinsulinism found in pregnancy modulates the estrogen induced hepatic biosynthesis of endogenous triglycerides, which is carried by VLDL^{15,16}. Changes in the plasma lipids during pregnancy have been recognized and thought to be mostly due to alterations in the hormonal milieu in the form of rise in insulin, progesterone, 17-B estradiol and human placental lactogen^{17, 2}. Progesterone and estrogen are modulators of lipids metabolism and their concentration increase as pregnancy advances. This study is therefore undertaken to ascertain the lipid profile pattern in the three trimester of pregnancy and the trimester that is most predisposed to Coronary artery disease.

MATERIALS AND METHODS

Subjects

This study was a longitudinal study in St. Philomena Catholic Hospital Benin City, Edo State. A total of 60 women between the ages of 20 and 30 years volunteered for the study. The control was thirty non-pregnant staff of St. Philomena Catholic Hospital. The test subjects were a total of thirty. They were studied at the 37th week of pregnancy and at the end of puerperium i.e. end of 6 weeks post-delivery. Ethical clearance was obtained from the Ethics and Collaboration Committee of the St Philomena Catholic Hospital where the study was done. Informed consent was also obtained from the subjects.

Sample collection and analysis

All subjects were made to fast overnight at least for a minimum of 8hrs. 5ml of fasting venous blood was collected from the antecubital vein under aseptic precaution from each subject into plain bottles. The blood was then centrifuged after clotted blood has retracted at 4000rpm for 5 minutes and the serum removed and stored at 4 °C pending assay for lipid profile. Serum Triglycerides (TG), Total

cholesterol (TC) and HDL cholesterol (HDL) were analyzed by enzymatic methods with the help of Glaxo kits on ERBA Chem-5 semi auto analyzer.

Enzymatic Estimation of Total Cholesterol: Plasma total cholesterol was estimated by cholesterol oxidase - pheny antipyrine method (CHOD-PAP) ¹⁸.

Enzymatic Estimation of Triglyceride: Plasma triglycerides (TG) were estimated using glycerol phosphate oxidase method (GPD method) ¹⁹.

Enzymatic Estimation of High Density Lipoprotein- Cholesterol: High density lipoprotein-cholesterol was estimated using phosphotungstic acid and magnesium chloride method ².

Estimation of Low Density Lipoprotein- Cholesterol (LDL-C):LDL- cholesterol was estimated using the Friedewald formular ²⁰.

LDL- cholesterol (mg/dl) = Total cholesterol – (TG/2.2 – HDL-cholesterol)

Measurement of Body Mass Index

We measured body weight in kilogram using Bathroom Scale Hana BR-9011 UK. Subjects put off their shoes and any piece of items on them before they mounted the scale. We measured height without footwear in meters using a standard stadiometer. Body Mass Index (BMI) was calculated using the formula; weight in kilogram divide by height in meter squared.

Measurement of blood pressure: Following a rest period of about 30 minutes in the hospital, the systolic and diastolic pressures were measured in each subject on the brachial artery using auscultatory method. Diastolic pressure was determined as the disappearance of the Korotkoff's sound.

Statistical analysis

Data were presented as mean± standard deviation using the Microsoft excel 2010. The student t- test was used for analyses of data and $p < 0.05$ were considered statistically significant.

RESULTS

Eighty subjects took part in the study with twenty subjects in each trimester and twenty control subjects. The mean age in years for the subjects were 24.5 ± 3.2 , 26.1 ± 1.1 , 25.5 ± 3.5 , 24.7 ± 2.2 for control, first, second and third trimesters respectively. There were no significant difference ($p > 0.05$) between the systolic and diastolic blood pressures of the test subjects and control. The systolic and diastolic blood pressures were 121.4 ± 10.2 and 80.2 ± 11.1 mmHg, 123.4 ± 9.3 and 79.2 ± 12.1 mmHg, 122.5 ± 9.2 and 82.2 ± 9.1 mmHg, 123.3 ± 12.2 and 81.2 ± 9.9 mmHg for the control, first, second and third trimesters respectively. There were statistical difference ($p < 0.05$) between the body mass indices (BMI) for control and the second and third trimesters. The BMI were 23.4 ± 2.2 Kg/M², 26.4 ± 2.1 Kg/M² and 28.4 ± 2.4 Kg/M² for control, second and third trimesters respectively. However, there was no significant difference ($p > 0.05$) between control and first trimester BMI of 23.6 ± 2.4 Kg/M².

The mean plasma lipid profile values for the control and the test subjects are shown in table 1.

Table 1: Lipid Profile in non-pregnant control and the three trimesters of pregnancy

Parameters	control	1 st trimester	2 nd trimester	3 rd trimester
TC	137.4±11.4	176.4±18.1	200.0±13.4	209.3±12.2
HDL-C	40.1±4.4	43.7±3.2	46.0±3.3	54.0±3.8
LDL-C	88.8±13.5	87.3±6.3	127.7±9.9	161.5±12.6
TG	43.7±6.6	138.7±11.1	168.5±10.4	171.7±10.8

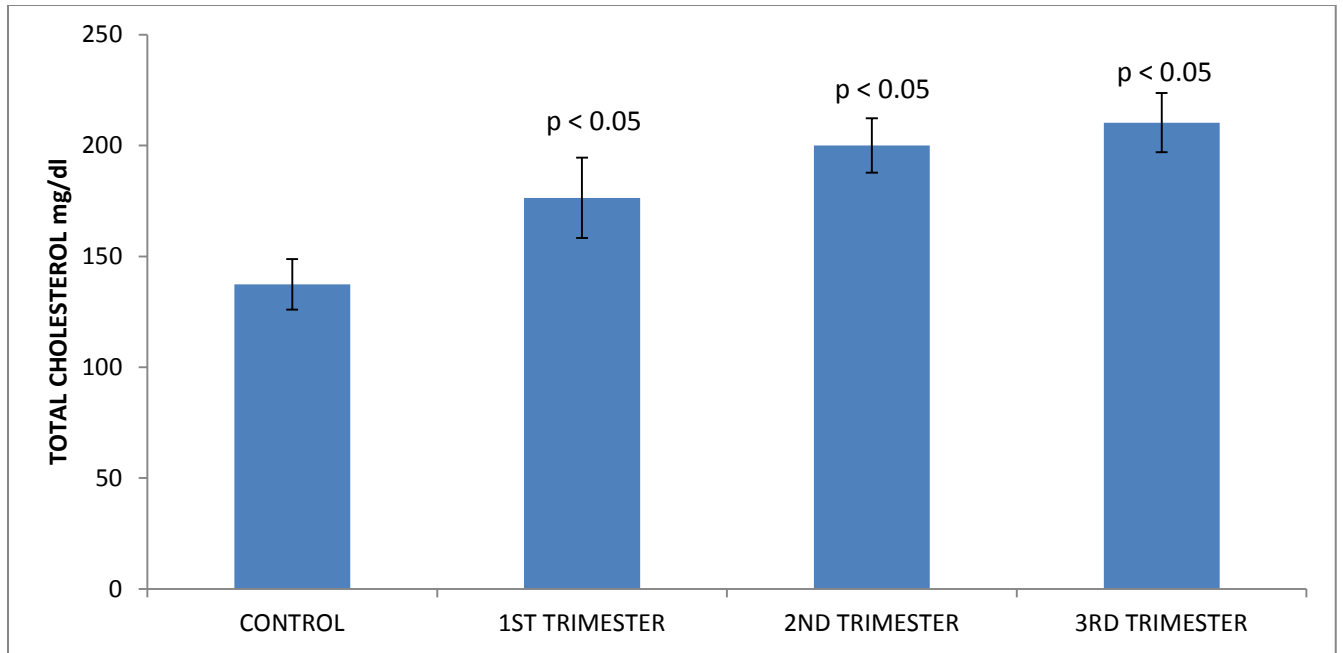


Figure 1: Total Cholesterol in the Three Trimesters of Pregnancy.

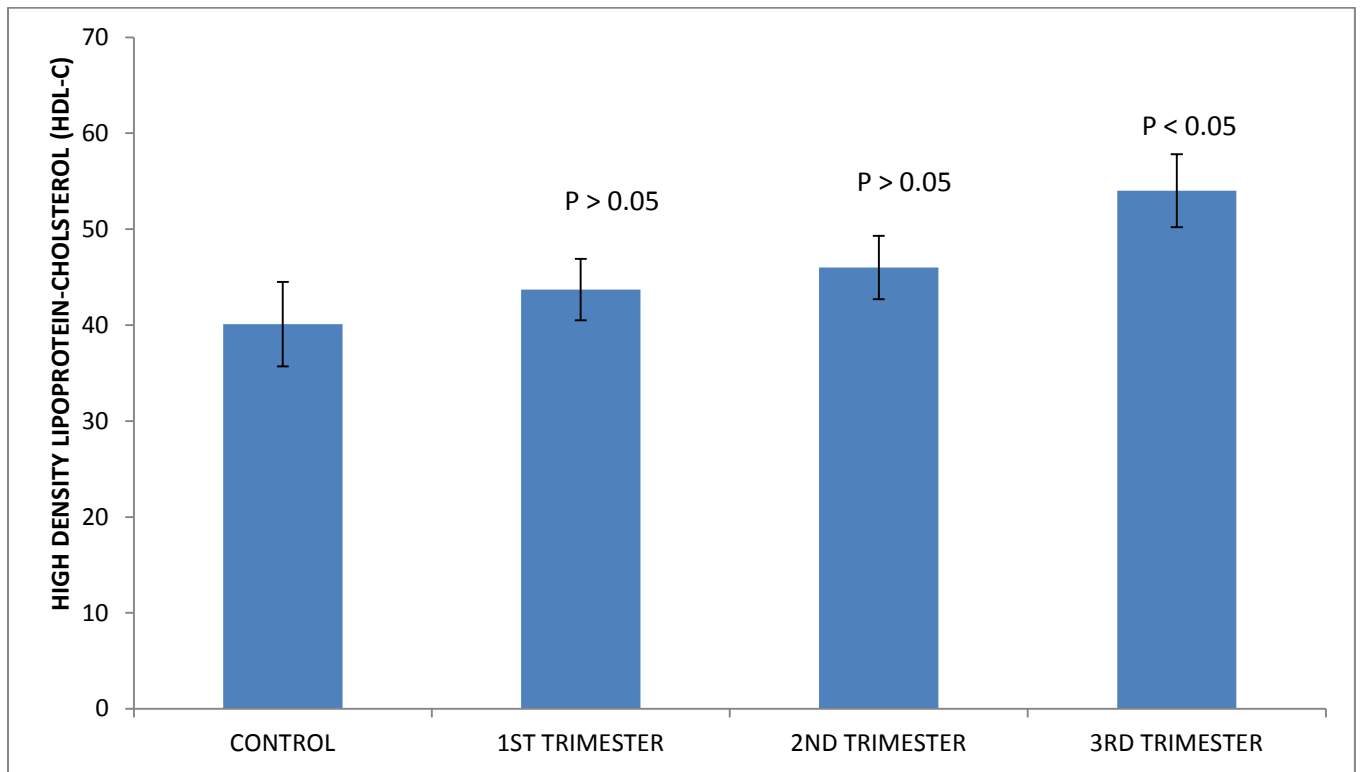


Figure 2: High Density Lipoprotein-Cholesterol in the three Trimesters of Pregnancy.

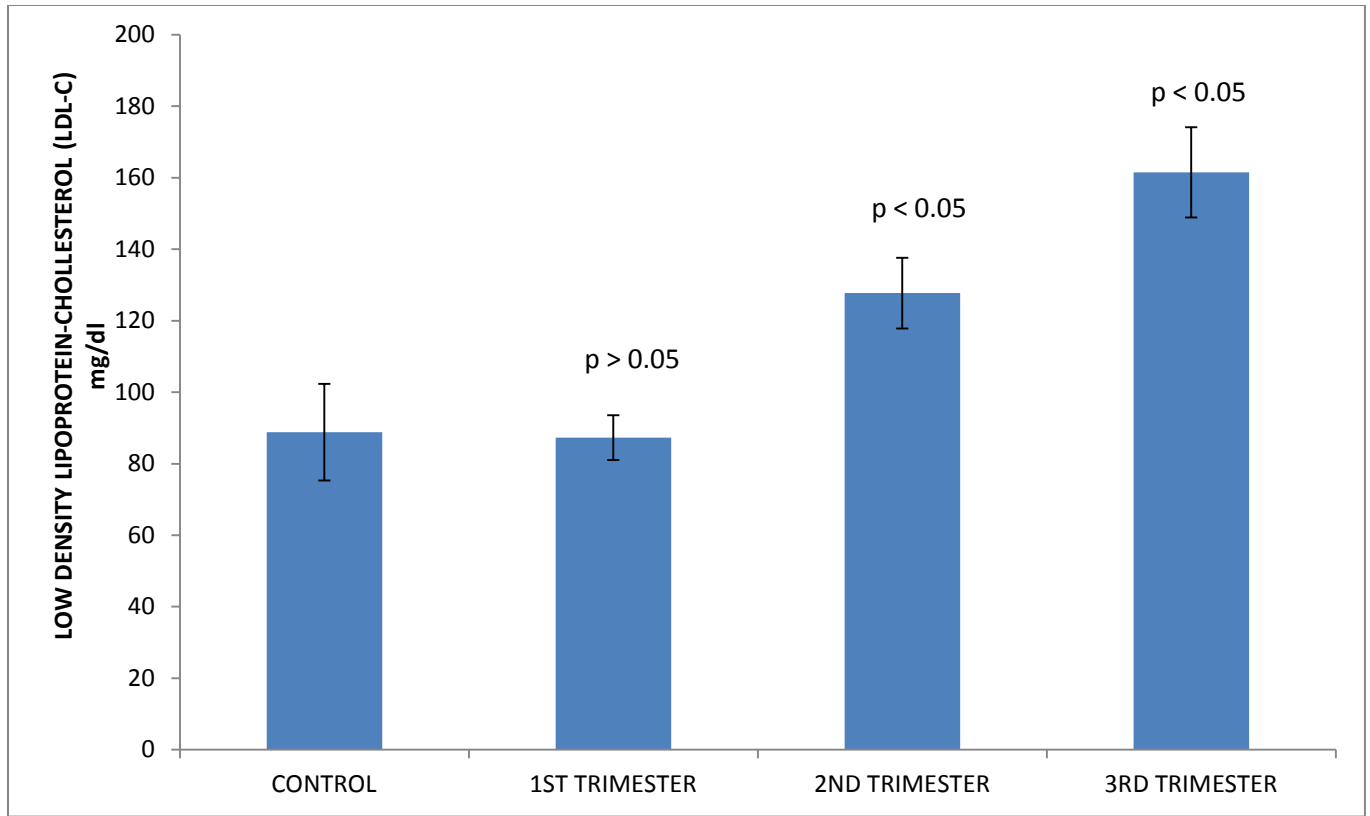


Figure 3: Low Density Lipoprotein-Cholesterol in the three Trimesters of Pregnancy.

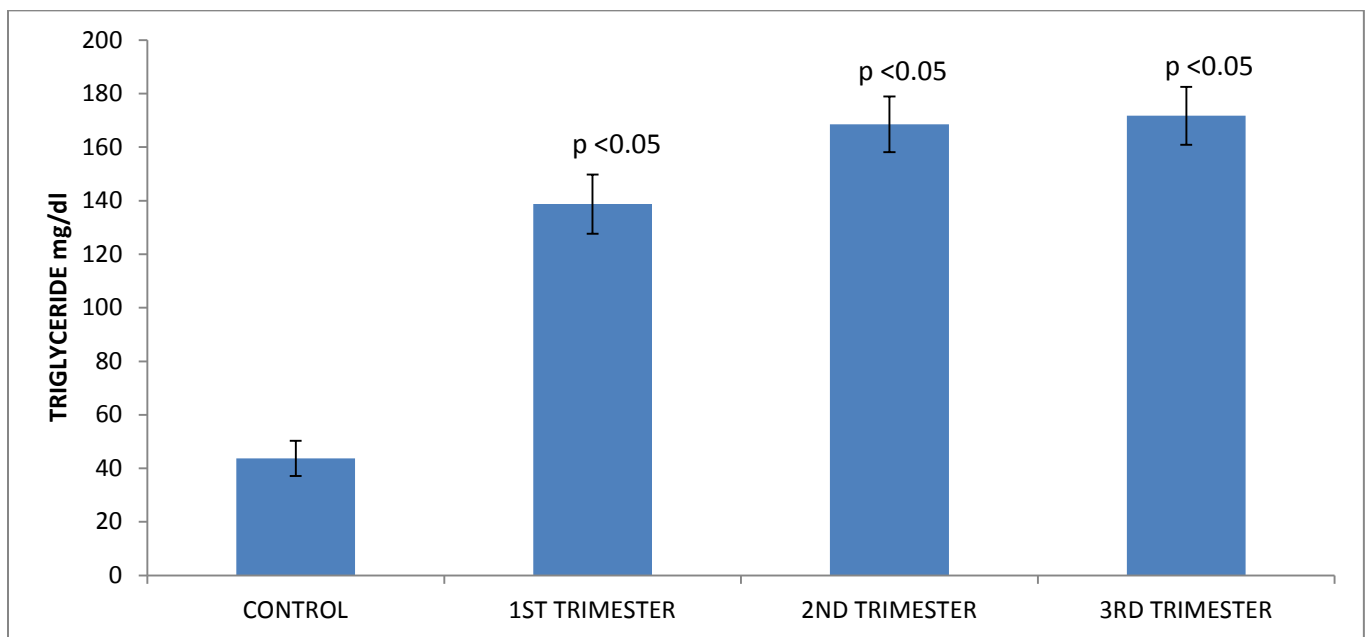


Figure 4: Triglyceride in the three Trimesters of Pregnancy.

DISCUSSION

Pregnancy is accompanied by extra demand of energy with a well-integrated metabolic shift to ensure adequate supply of nutrients to a constantly feeding fetus from an intermittently fasting and feeding mother^{21, 8}. Maternal hyperlipidemia and accumulation of fats in maternal tissues and are two consistent manifestations of altered metabolism of fat during uncomplicated pregnancy. The increase in adipose tissue store as anticipation for fetal growth spurt²² is indicated in this study by the concomitant increase in cholesterol concentration as pregnancy advanced (figure1). The high energy demand associated with advancing pregnancy necessitates an increase in maternal lipid profile and metabolism which is a collateral pathway for production of energy. This maternal switch from carbohydrate to fat metabolism is accompanied by an increase in hepatic lipase activity and a decrease in lipoprotein lipase activity²³. Furthermore, the increase in cholesterol may be an adaptation by the body to serve its function as a precursor for the formation of the steroid hormones of pregnancy. Cholesterol is also the precursor of steroid hormones such as progesterone and of metabolic mediators such as oxysterol¹¹. Hyperinsulinemia of pregnancy leads to an increase in peripheral glucose utilization, a decline in fasting plasma glucose levels, increased tissue storage of glycogen, increased storage of fats and decreased lipolysis. Maternal fuel adjustments during late pregnancy include a sparing of glucose (for the fetus) and an increased concentration of fatty acids in plasma⁸. Estrogen and progesterone rise considerably during pregnancy to modify the maternal metabolic environment²⁴. From this study, the increase in high density lipoprotein-cholesterol was only empirical in the first trimester, however the second and third trimester values were statistically significant ($p < 0.05$). The same pattern of increase was also observed in the low-density lipoprotein cholesterol, as there was no significant increase in the first trimester of pregnancy (figure 3). The possible empirical increase in lipid profile in the first trimester may be due to the counter effect of anorexia, nausea and vomiting on the hyperlipidemic effect of the hormones of pregnancy. The total cholesterol level during the first, second and third trimesters when compared with that of the control subjects was significantly high²⁵. LDL-C levels peak at mid-third trimester, probably as a consequence of the hepatic effect of estradiol and progesterone². It has been suggested that the increase in plasma triglycerides and LDL-C patterns during pregnancy might be used to identify women who will develop atherogenic changes later in life. The study showed that there was a discrepancy in the pattern of increase of serum concentration of LDL-C and HDL-C. for instance, relative to the first trimester, the increase in LDL-C in the second and third trimesters of pregnancy

were 46.3% and 85% respectively, whereas the pattern of increase for serum HDL-C concentration were 5.9% and 23.3% respectively. This discrepancy can be explained by Studies which showed that the daily production of progesterone increases thirtyfold, while that of oestrogen increases tenfold during pregnancy ²⁶. Progesterone increases plasma levels of LDL cholesterol and total cholesterol while lowering HDL-cholesterol but oestrogen has an opposite effect ^{11, 26}. With reference to the control, the pattern of triglyceride increase in this study was about three fold increase in the first trimester and about four fold increases for the second and the third trimesters. Generally, normal pregnancy is also associated with high concentrations of estrogens which may contribute to the rise in total cholesterol, low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), and triglyceride especially in the late half of pregnancy ²⁷. The concentrations of lipids, lipoproteins and apolipoproteins in the plasma increase appreciably during pregnancy ²⁸ because of the rise in insulin, progesterone, 17- β estradiol and Human Placental Lactogen ²⁹.

CONCLUSION

This study strengthens the results of previous work that revealed panhyperlipidemia in pregnancy which is required to meet up with the energy needs of the pregnant state. The panhyperlipidemia was highest in the third trimester of pregnancy with triglycerides having the highest percentage increase. Thus the third trimester of pregnancy may be the most vulnerable for coronary heart disease for women who are atherosclerotic.

LIMITATIONS

The control subjects were not the same as the test subjects and their antepartum dietary history was not taken in the history. Furthermore, the serum progesterone and estrogen concentrations of the subjects were not assessed.

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