Maternal Age, Lipid Profile, Selected Renal and Liver Function Tests in Apparently Healthy Pregnant Women in Auchi, Edo State

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Abstract

Background: Pregnancy is a physiological process that elicits metabolic alterations among others, to ensure foetal growth and development. There is paucity of information on the effect of maternal age on the determination of lipid profile and hepato-renal function in pregnant women is sub-Saharan Africa

Aim: This study determined lipid profile, hepato-renal function in pregnant women in second and third trimesters as a function of maternal age.

Materials and Methods: 181 apparently healthy pregnant women in second and third trimesters were randomly recruited into this cross-sectional study. They comprised 33 women aged 18-30 years and 65 women aged 31-42 years in the second trimester. The participants in the third trimester comprised 32 women aged 18-30 years and 51 women aged 31-42 years. Body mass index (BMI), systolic (SBP) and diastolic blood (DBP) pressures were determined by standard methods. Plasma from venous blood obtained from each participant was used for the determination of total cholesterol (TC), high density lipoprotein, low density lipoprotein, triglyceride, alanine aminotransferase (ALT), aspartate aminotransferase (AST), uric acid and creatinine using spectrophotometry method. Student's t-test and Pearson correlation coefficient were used for the comparison of quantitative variables and relationship among variables, respectively. P was considered significant at <0.05

Results: In pregnant women in the third trimester, SBP was significantly higher in women aged 31-42 years in comparison with women aged 18-30 years. Furthermore, AST was significantly higher in women aged 18-30 years in comparison with women aged 31-42 years. TC correlated positively with SBP in women aged 18-30 years in the second trimester. LDL correlated positively with uric acid and creatinine in women aged 18-30 years whereas, creatinine correlated inversely with DBP in women aged 30-42 years in the third trimester

Conclusion: Observations in this study suggests that maternal age could be a factor in the assessment of lipid profile and hepato-renal function in pregnant women.

Keywords: Lipid profile, hepatorenal function, pregnancy, maternal age.

Introduction

Pregnancy is characterized with significant anatomic, physiologic and biochemical alterations, that are aimed at meeting both maternal and foetal metabolic demands ¹.

An increasing average age of motherhood, globally has been reported². Certain reasons adduced to it are delayed marriage, pursuit of higher education and careers, higher rates of divorce and re-marriage among others^{3, 4}. Conception at older age has been reported to increase the risk of pregnancy complications such as hypertensive disorders in pregnancy, gestational diabetes etc.⁴. Advanced maternal age which was initially defined at 35 years has increased to about 45 years in recent times ⁴. It appears that this category of pregnant women though, important have not been properly researched.

The alteration in levels of hormones in pregnancy influences nutrient metabolism and may be the basis of the variation of lipid profile at different trimesters of pregnancy ⁵.

Reports have shown mild elevation in plasma lipids in the first trimester, which progresses into significant levels, particularly, cholesterol and triglyceride in the second and third trimesters ^{6,7,8}. Age, diet, race are some of the factors that influence lipid metabolism in pregnancy ⁹. Lipids play important roles in foetal development and maintenance of placental function ¹⁰. There are indications that maternal plasma lipid levels affect foetal growth in the second and third trimesters ¹¹. The association of maternal lipids with birth outcomes has also been reported ¹¹. Low plasma cholesterol level in pregnancy increases the risk of preterm birth, foetal growth restriction and small-for gestational age neonates 11,12 .

Pregnancy influences renal functions ¹³. Plasma uric acid level is an index of renal health. Elevated uric acid level has been linked with kidney dysfunction ¹⁴. Increased glomerular filtration rate has been reported in pregnancy. This is the basis of increased rate of creatinine clearance, particularly in the third trimester ¹⁵.

Reports of alanine aminotransferase (ALT) and aspartate aminotransferase (AST) activities in pregnancy are controversial. Certain reports showed a mild increase in the activities of these enzymes in the third trimester, while others did not observe any change ^{16,17}.

In spite of studies done on pregnant women, there is paucity of information on the effect of maternal age on the determination of lipid profile and hepato-renal functions in pregnant women. Therefore, this study was designed to determine lipid profile and indices of hepatorenal function in pregnant women in second and third trimesters considering maternal age.

Materials and methods Study participants

One hundred and eighty-one (181) apparently healthy pregnant women in second and third trimesters were randomly recruited into this cross-sectional study. They comprised 33 women aged 18-30 years and 65 women aged 31-42 years in the second trimester. Thirty-two (32) women aged 18-30 years and 51 women aged 31-42 years were participants in the third trimester. The study participants gave written informed consent before being recruited by medical personnel from antenatal clinics of the following health facilities in Auchi and its environs; Usokwili Primary Health Centre (20), Hope Hospital (20), Sancta Maria Hospital (30), Urban Primary Health Facility (41) and EDSU Teaching Hospital (70). Body mass index, systolic and diastolic blood pressures were determined in study participants as described by ¹⁸. Study participants in the first trimester, those who did not give consent and those with metabolic diseases including diabetes mellitus, hypertension, renal and liver were excluded dysfunctions from the study.Ethical approval was granted by Ethical Review Board of Edo State University Uzairue (EDSUREC 22/0080).

Sample Collection

Fasting venous blood (5 mililitres) was obtained from each study participant into lithium heparin bottle for the determination of Total Cholesterol (TC), Triglyceride (TG), High Density Lipoprotein (HDL), Low Density Lipoprotein (LDL), AST, ALT, uric acid and creatinine. The samples were centrifuged at 4000 revolutions per minutes for 10 minutes, after which, the plasma was separated into plain bottles and then stored in freezer pending analysis.

Analysis of Biochemical Parameters

Total cholesterol, HDL, LDL, and TG were determined spectrophotometrically by enzyme assay using Precision kit ^{19, 20}. AST and ALT activities were determined by the methods used by ²¹ using Randox kit. Serum uric acid and creatinine were determined by methods described by ²² and ²³, respectively.

Statistical analysis

IBM SPSS (version 21) was used for data analysis. Student's t-test was used for comparison of quantitative variables. Pearson correlation coefficient was used for determining association among variables. p<0.05 was considered statistical significant

Results

Table 1 shows the comparison of blood pressure, anthropometric and biochemical indices according to age ranges; 18-30 years and 31-42 years in pregnant women in second trimester. There was no significant difference in all the variables between the age ranges.

Table 1. Comparison of blood pressure,anthropometric and biochemical indices inpregnant women in second trimester

Variable	18-30 year (n=33)	31-42 years (n=65)	t	Р
SBP (mmHg)	121.52±12.48	123.92±10.43	- 1.010	0.389
DBP (mmHg)	75.85±9.46	77.62±7.66	- 0.995	0.672
BMI (kg/m ²)	24.53±2.54	24.89±3.19	- 0.556	0.300
TG(mg/dl)	138.58±38.39	144.97±76.68	0.450	0.124
TC (mg/dl)	230.56 ± 40.38	223.42±44.14	0.779	0.617
HDL (mg/dl)	56.87±13.72	51.73±10.50	2.060	0.536
LDL (mg/dl)	146.82±35.02	145.36±36.04	0.190	0.721
Uric acid (mg/dl)	4.97±1.90	5.08±2.02	- 0.246	0.629
ALT (U/L) 24.35±6.26		24.90±7.27	- 0.368	0.254
AST (U/L)	18.15±4.86	17.94±8.61	0.128	0.595
Creatinine (mg/dl)	0.57±0.21	0.53±0.19	0.917	0.861

n=number of participants, SBP=Systolic blood pressure, DBP=Diastolic blood pressure, BMI= Body mass index, WC=Waist circumference, TG= Triglyceride, TC=Total cholesterol, HDL=High density lipoprotein, LDL=Low density lipoprotein, ALT=Alanine aminotransferase, AST=Aspartate aminotransferase, mmHg=Milimetre mercury, cm=Centimeter, kg=Kilogram, m= Metre, mg/dl=milligram per deciliter, U/L=Unit per litre, *=significant at p<0.05 Table 2 shows the comparison of blood pressure, anthropometric and biochemical indices according to age ranges; 18-30 years and 31-42 years in pregnant women in third trimester. Systolic blood pressure was significantly higher in pregnant women aged 31-42 years in comparison with women aged years. Furthermore, 18-30 AST was significantly higher in women aged 18-30 years when compared with women aged 31-42 years. There was no significant difference in the other variables

Table 2. Comparison of Blood pressure,anthropometric and biochemical indices inpregnant women in third trimester

Variable	18-30 year (n=32)	31-42 years (n=51)	t	Р
SBP (mmHg)	123.09±12.59	126.57±8.08	- 1.534	0.008*
DBP (mmHg)	78.59±7.91	79.41±7.04	- 0.491	0.313
BMI (kg/m ²)	27.22±4.41	26.58±3.79	0.701	0.130
TG(mg/dl)	142.25 ± 54.18	137.33±36.76	0.493	0.429
TC (mg/dl)	260.99±60.39	245.18±50.02	1.293	0.254
HDL (mg/dl)	58.12±16.57	55.32±11.62	0.904	0.062
LDL (mg/dl)	169.78±43.04	161.99±43.26	0.800	0.581
Uric acid (mg/dl)	4.95±1.65	5.07±1.86	0.312	0.449
ALT (U/L)	25.66±7.92	24.11±6.22	0.994	0.064
AST (U/L)	19.02±6.45	17.03±4.48	1.658	0.048*
Creatinine (mg/dl)	0.60±0.33	0.55±0.19	0.865	0.279

n=number of participants, SBP=Systolic blood pressure, DBP=Diastolic blood pressure, BMI= Body mass index, WC=Waist circumference, TG= Triglyceride, TC=Total cholesterol, HDL=High density lipoprotein, LDL=Low density lipoprotein, ALT=Alanine aminotransferase, AST=Aspartate aminotransferase, mmHg=Millimeter mercury, cm=Centimeter, kg=Kilogram, m= Metre, mg/dl=milligram per deciliter, U/L=Unit per litre, *=significant at p<0.05

Table 3 shows the correlation among blood pressure, anthropometric and biochemical indices in pregnant women aged 18-30 years and 31-42 years in second trimester. TG correlated inversely with HDL, SBP and DBP in women aged 31-42 years (p<0.05).

Cholesterol correlated positively with HDL, LDL, BMI and SBP in both categories of pregnant women (p<0.05). Furthermore, HDL correlated positively with LDL, BMI and SBP in women aged 31-42 years (p<0.05). LDL correlated with BMI and SBP in both categories of women (p<0.05). BMI correlated positively with SBP in both categories of women (p<0.05). Uric acid correlated positively with ALT in both categories of women (p<0.05). Furthermore, ALT correlated with AST and SBP in women aged 18-30 years only (p<0.05). ALT correlated positively with AST, moreover, SBP significantly correlated positively with DBP in both categories of women (p<0.05)

Table 3. Association among blood pressure,anthropometric and biochemical indices inpregnant women in second trimester

		18-30		31-42	
		years		years	
Index	Index	r	Р	r	Р
TG	HDL	0.025	0.893	-0.255	0.041*
	SBP	0.159	0.386	-0.371	0.002*
	DBP	0.034	0.856	-0.388	0.001*
TC	HDL	0.513	0.003*	0.689	0.000*
	LDL	0.943	0.000*	0.951	0.000*
	BMI	0.735	0.000*	0.591	0.000*
	SBP	0.407	0.021*	0.417	0.001*
HDL	LDL	0.276	0.127	0.492	0.000*
	BMI	0.189	0.301	0.281	0.023*
	SBP	0.256	0.157	0.329	0.007*
LDL	BMI	0.723	0.000*	0.578	0.000*
	SBP	0.388	0.028*	0.398	0.001*
BMI	SBP	0.460	0.008*	0.343	0.005*
Uric	ALT	0.461	0.008*	0.331	0.007*
aciu	AST	0.411	0.020*	0.127	0.313
	SBP	0.379	0.032*	0.176	0.160
ALT	AST	0.460	0.008*	0.411	0.001*
SBP	DBP	0.585	0.000*	0.528	0.000*

r=Pearson correlation coefficient, *=significant at p<0.05, SBP=Systolic blood pressure, DBP=Diastolic blood pressure, BMI= Body mass index, WC=Waist circumference, TG= Triglyceride, TC=Total cholesterol,

Ugbenyen AM., Ajayi OO. Maternal Age, Lipid Profile, Selected Renal and Liver Function Tests in Healthy Pregnant Women in Auchi, Edo State.

HDL=High	density	lipoprotein,	LDL=Low	density	
lipoprotein,	ALT=Alanine		aminotransferase,		
AST=Aspart	ate amino				

Table 4 shows the correlation among blood pressure, anthropometric and biochemical indices in pregnant women aged 18-30 and 31-42 years in the third trimester. There was a correlation between TG positive and cholesterol as well as between TG and HDL in women aged 18-30 years, conversely, there was an inverse correlation of TG with HDL in women aged 31-42 years (p<0.05). Furthermore, TG correlated inversely with SBP and DBP in women aged 31-42 years (p<0.05). Cholesterol correlated positively with HDL, LDL and BMI in both groups of women (p<0.05). Cholesterol correlated positively with SBP in women aged 31-42 years (p<0.05). There was a positive correlation between HDL and LDL as well as between HDL and BMI in both groups of women (p<0.05). Positive correlation was observed between HDL and SBP in women aged 31-42 years (p<0.05). LDL correlated positively with BMI in both groups of women, there was however, a significant positive correlation of LDL with uric acid and creatinine in women aged 18-30 years (p<0.05). Furthermore, LDL correlated and positively with SBP in women aged 31-42 years (p<0.05).

The correlation of BMI with SBP in both groups of women was positive (p<0.05. Uric acid correlated positively with ALT in women aged 31-42 years (p<0.05. A positive correlation was observed between ALT and AST in both groups of women, there was also a correlation positive between ALT and creatinine in women aged 18-30 years AST (p<0.05). Additionally, correlated positively with creatinine in women aged 18-30 years (p<0.05). There was a positive correlation between SBP and DBP in both categories of women (p<0.05). In women aged 31-42 years, creatinine correlated positively with DBP (p<0.05).

Table 4. Association among blood pressure,anthropometric and biochemical indices inpregnant women in third trimester

		18-30		31-42	
Index	Index	r	Р	r	Р
TG	TC	0.528	0.002*	-0.164	0.193
	HDL	0.567	0.001*	-0.255	0.041*
	SBP	0.128	0.486	-0.371	0.002*
	DBP	0.109	0.552	-0.388	0.001*
TC	HDL	0.780	0.000*	0.689	0.000*
	LDL	0.907	0.000*	0.951	0.000*
	BMI	0.758	0.000*	0.591	0.000*
	SBP	0.331	0.065	0.417	0.001*
HDL	LDL	0.503	0.003*	0.492	0.000*
	BMI	0.453	0.009*	0.281	0.023*
	SBP	0.064	0.730	0.329	0.007*
LDL	BMI	0.769	0.000*	0.578	0.000*
	Uric acid	0.352	0.049*	-0.079	0.533
	SBP Creatinine	0.316 0.419	0.078 0.017*	0.398	0.001* 0.284
DM	CDD	0.517	0.002*	0.242	0.005*
BMI	SBP	0.517	0.002*	0.343	0.005*
Uric acid	ALT	0.171	0.349	0.331	0.007*
ALT	AST	0.909	0.000*	0.411	0.001*
	Creatinine	0.419	0.01/*	0.047	0.708
AST	Creatinine	0.462	0.008*	-0.150	0.234
SBP	DBP	0.550	0.001*	0.528	0.000*
Creatinine	DBP	0.109	0.553	-0.277	0.049*

r=Pearson correlation coefficient, *=significant at p<0.05, SBP=Systolic blood pressure, DBP=Diastolic blood pressure, BMI= Body mass index, WC=Waist circumference, TG= Triglyceride, TC=Total cholesterol, HDL=High density lipoprotein, LDL=Low density lipoprotein, ALT=Alanine aminotransferase, AST=Aspartate aminotransferase

Discussion

In this study, SBP was significantly elevated in third trimester pregnant women aged 31-42 years in comparison with pregnant women in the age range of 18-30 years old. This observation contrasted with a report that showed an association between older maternal age and lower third trimester systolic blood pressure, though within the physiological range²⁴. Our observation therefore suggests the involvement of maternal age in the elevated blood pressure of participants in the third trimester.

Certain reports showed that AST level didn't change in the course of pregnancy ^{25, 26}. In another report, there was a significant elevation of AST in women in the third trimester pregnancy ²⁷. In this study, AST level was significantly higher in third trimester pregnant women aged 18-30 years in comparison with pregnant women aged 31-42 years in the third trimester. It is uncertain if this observation is maternal-age dependent, and may require further studies.

Factors including age, ethnicity, among others have been reported to influence the alterations of lipid levels in pregnancy²⁸. In this study, there was no significant difference in the lipid levels at the age ranges in women in both second and third trimesters. Associations were observed among certain lipid fractions, blood pressure and anthropometric indices in this study.

TG correlated inversely with blood pressure in pregnant women in second trimester aged 31-42 years. Similar observation was observed in participants in the third trimester in the same age range. Positive association of TG with blood pressure was reported in a Japanese population²⁹. It is uncertain if the observation this study is pregnancy-dependent. in Furthermore, TG correlated inversely with HDL in women aged 31-42 years in both second and third trimesters.Conversely, a positive correlation was observed between TG and HDL in women aged 18-30 years in the third trimester. This could be peculiar to this age group in third trimester pregnancy.

Reports have shown increase in serum levels of TG and cholesterol in pregnancy, particularly in the third trimester^{1, 8, 30}. The positive association of TG with total cholesterol in women aged 18-30 years in the third trimester may be due to foetal demand associated with the third trimester.

A positive correlation of TC with BMI, LDLc and TG as well as an inverse correlation of TC with HDLc has been widely reported³¹. Another study on non-pregnant women showed a positive association of total cholesterol with BMI ³². In this study, the positive correlation of TC with LDL and BMI in both categories of women in second and third trimestersmay be irrespective of pregnancy. However, the positive correlation of TC with HDL may be due to the pregnancy of the participants. Furthermore, the positive association of TC with SBP in women aged 18-30 years in the second trimester may be maternal agedependent.

In this study, HDL correlated positively with LDL, BMI and SBP in women aged 31-42 years in the second trimester. Furthermore, a positive association was observed between HDL and LDL as well as HDL and BMI in women of both age ranges in the third trimester, whereas, positive association was observed between HDL and SBP only in women aged 31-42 years in the third trimester. The positive association of HDL with these variables may be considered beneficial considering the favourable effect of HDL that is known as a good cholesterol ³³. It thus suggests that HDL may mitigate pregnancy-induced cardiovascular disorders.

In this study, there was a positive association of LDL with BMI in both age ranges of women in both trimesters. Furthermore, LDL correlated positively with SBP in women of both age ranges in the second trimester. There was a positive association of LDL with SBP in women aged 31-42 years in the third trimester. There are indications that these associations may not be maternal age or trimester-specific.

Serum lipid levels and investigations of renal function can be influenced by physiological alterations that accompany normal pregnancy ³⁴.Further investigations may be required to ascertain the veracity of the positive association of LDL with uric acid and creatinine observed in women aged 18-30 years in the third trimester in this study.

The positive association of uric acid with ALT in women aged 18-30 and 31-42 in the second trimester as well as in women aged 30-42 years in the third trimester appears physiological. Chen *et al* ³⁵ in s study involving the general population reported a positive association between serum uric acid and increased ALT.

In this study, uric acid correlated positively with AST and SBP in women aged 18-30 years in the second trimester. The positive association of uric acid with SBP in this category of study participants could be physiological as it suggests the involvement of uric acid in the renin-angiotensin and nitric oxide system ³⁶.

The positive association of BMI with SBP, ALT with AST and SBP with DBP in the study participants appears physiological, irrespective of pregnancy

The positive association of ALT and AST with creatinine in women aged 18-30 years in the third trimester as well as the inverse association of creatinine with DBP in women aged 30-42 years in the third trimester could reflect associations of variables which may be peculiar to the third trimester.

Conclusion

Observations of significantly elevated SBP in women aged 31-42 years in comparison with women aged 18-30 years as well as elevated AST level in women aged 18-30 years in comparison with women aged 30-42 years in the third trimester suggest the involvement of maternal age in the variability of the indices assessed. The positive association of LDL with uric acid and creatinine in women aged 18-30 years in third trimester may require further investigations.

Study limitation

The cross-sectional design of this study may not give adequate information on the variables assessed in the participants. It is expected that a prospective study design that ensures that participants are followed up throughout the gestation period will give better information. This will be in addition to a larger sample-sized study population

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