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Original Article

Effect of Serum Lipid Profile and Renal Functions during Pregnancy and its associated diseases in Sulaimanyah / Kurdistan Region

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ABSTRACT

Background and Objective: The physiological function of the kidneys poses significant challenges during pregnancy, impacting maternal and fetal health. Understanding the interplay between renal functions and serum lipid profiles is crucial for managing maternal health. This study aims to investigate serum lipid profiles and their association with renal function in pregnancy and compare them with non-pregnant status. The objective of this study was to conduct a prospective analysis of blood lipid concentration, namely lipoprotein, as well as the rates of urea and creatinine, in pregnant women, and thereafter compare these measurements with those of non-pregnant women.

Methods: A case- control study was conducted on pregnant women in Sulaimanyah/ Kurdistan. Both serum lipid profile tests, including triglycerides, cholesterol, and lipoprotein levels, and renal function markers, such as serum creatinine, urea, and estimated glomerular filtration rate, were measured at various stages of pregnancy. Data was analyzed by the Statistical Package for the Social Sciences version 22.0 to identify correlations between serum lipid profile, renal function, and pregnancy outcomes.

Results: This study highlights significant positive correlations of low-density lipoprotein with gestation age, cholesterol, triglyceride, and high-density lipoprotein, alongside strong negative correlations with total serum bilirubin and creatinine in pregnancy. This correlation was not found in non-pregnant status. Additionally, estimated glomerular filtration rate exhibits strong positive correlations with cholesterol and low-density lipoprotein and negative correlations with total serum bilirubin and creatinine.In non-pregnant individuals, estimated glomerular filtration rate moderately correlates with random blood sugar while strongly correlating negatively with urea and creatinine.Mean ± Standard deviation of urea and creatinine were significantly higher in non-pregnant women while cholesterol and estimated glomerular filtration rate were significantly high among pregnant women.

Conclusion: This study highlighted notable metabolic disparities between pregnant and non-pregnant women, particularly in terms of lipid profiles and renal function. Changes in hormone levels during pregnancy can elevate lipid profiles and renal function, and these metabolic and hormonal changes could affect kidney function indicators.

Keywords: Renal Function (RF); Pregnancy; Estimated Glomerular Filtration Rate (eGFR); Serum Lipid Profile (SLP).

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INTRODUCTION

It is well-recognized that pregnancy causes significant bodily changes. In addition to raising the need for metabolic fuels for the growing fetus and the development of its supporting structures, it also alters hormone levels in the body, which may affect the lipid profile throughout the course of the pregnancy's many trimesters. Examination of serum lipid profiles throughout the initial three months of pregnancy can potentially forecast the occurrence and intensity of pre-eclampsia [1]. The anabolic phase during early pregnancy stimulates lipogenesis and promotes the accumulation of fat in anticipation of the rapid growth of the fetus in late pregnancy [2]. Insulin resistance causes an increase in lipolysis, which results in a greater flow of fatty acids to the liver. This, in turn, stimulates the production of very low-density lipoproteins (LDLs) and leads to higher concentrations of triglycerides (TG). Due to a reduction in the functioning of lipoprotein lipase, very low-density lipoprotein (VLDL) persists in the bloodstream for an extended period, resulting in the buildup of low-density lipoprotein (LDL). Elevated levels of LDL are linked to the progression of atherosclerosis [3]. Disordered lipid metabolism also appears to have a significant role in the development of pregnancy-induced hypertension (PIH). The correlation between blood lipids and gestational proteinuria hypertension strongly indicates that lipid profile analysis can be used as a diagnostic tool [4]. Throughout a typical pregnancy, there is an increase in plasma triglyceride and cholesterol levels, which eventually return to normal as the pregnancy advances. Pregnancy-induced hormonal fluctuations impact lipid metabolism. Endogenous female sex hormones exert a substantial impact on serum lipids. During pregnancy, there is an elevation in hepatic lipase activity and a reduction in lipoprotein lipase activity [5]. Another study's conclusion likewise confirmed a consistent positive correlation between high levels of maternal TG and the likelihood of pre-eclampsia [6, 7]. Conversely, hyperlipidemia is considered a natural occurrence during pregnancy. Multiple studies have noticed a significant increase of 50 to 60% in cholesterol levels and a substantial increase of 100 to 200% in TG levels during uncomplicated pregnancy [8]. Furthermore, there appears to be a correlation between various pregnancy problems and the presence of extra lipid abnormalities and impaired renal function [9]. Additionally, more than half of renal function can be lost before the level of blood creatinine exceeds 120 µmol/l [10]. Pregnant women with serum creatinine levels exceeding 124 µmol/l are at a higher risk of experiencing a faster deterioration in kidney function and having a worse pregnancy outcome. When managing pregnant women with chronic kidney disease, it is important to consider various aspects to reduce the negative impact of pregnancy on the mother's kidney function and the resulting repercussions on the fetus. In addition, it is noteworthy that a significant number of individuals suffering from kidney disease and experiencing very minor impairment exhibit an unexpected rise in glomerular filtration rate (GFR) during pregnancy [11]. Prior research has indicated a potential link between lipid metabolism and renal function during pregnancy. Prior research has utilized serum creatinine as a marker for impaired RF. The categorization of renal impairment was based on the following criteria: mild, moderate, or severe [12, 13]. Finding the correlation of lipid profile with duration of pregnancy, particularly in those women who have the associated kidney problems, could help pregnancy outcome, mother's health, and

fetal growth. Lipid profiles such as LDL, TG and TC could be used as indicators to assess a healthy pregnancy and fetal growth. This study aimed to prospectively examine the blood lipid concentration, namely lipoprotein, as well as the urea and creatinine rates, in pregnant women and compare them with those of non-pregnant women.

METHODS

This was case-control study conducted from August 22, 2022, until December 25, 2022. Fifty pregnant women and sixty-four non-pregnant women would enroll for obstetric care at the general health laboratory of Sulaimanyah/Darbandikhan Shahid Tofiq General Hospital. These women face various health issues during pregnancy, such as kidney function disease and elevated levels of serum lipid profiles. The study aims to evaluate the correlation between blood lipid concentrations, specifically lipoprotein, as well as the rates of urea and creatinine in pregnant and non-pregnant individuals. This paper would prospectively analyze these values. Also, to identify the most influential factors among pregnancy duration in weeks, age, and BMI. Collection of Blood Samples Blood samples were taken from 50 pregnant women and 64 non-pregnant women in both the maternity and laboratory departments of Darbandikhan Shahid Tofiq General Hospital in northern Iraq. The study received approval from the ethics centre committee at Sulaimani Polytechnic University. Subsequently, written informed consent was obtained from each participant. The participants were provided with the opportunity to voluntarily withdraw from the research based on their preferences. Five millilitres of Venus blood were utilized for all tests. The blood was collected in a simple polyethylene tube and allowed to coagulate at room temperature in laboratory department of Darbandikhan Shahid Tofiq General Hospital. The serum was then separated from the rest of the blood by subjecting it to centrifugal force at a speed of 3000 rpm for 3 minutes and repeating it three times. Gather specimens of females, encompassing both expectant and non-expectant individuals, from various age groups residing in urban areas. A subset of female patients has presented with comorbidities including hypertension, thyroid dysfunction, diabetes mellitus, hepatic disorders, and renal disorders. Then, with the assistance of laboratory expert staff, all necessary tests were performed in the laboratory department of Darbandikhan Shahid Tofiq General Hospital for all pregnant women participating in our research according to our study plan.
Serum Lipid Profile (SLP) The enzymatic colorimetric test method for quantifying cholesterol in human serum is conducted using the Biochemical Analyzer Biolis 30i apparatus. The hydrolysis of cholesterol esters by cholesterol esterase yields free cholesterol and fatty acids. Cholesterol undergoes oxidation, catalyzing the conversion of cholesterol to cholest-4-en-3-one and hydrogen peroxide. In the presence of peroxidase, the produced hydrogen peroxide oxidatively couples with phenol and 4-aminophenazone, forming a red quinone-imine dye. The intensity of the dye's color is directly proportional to the cholesterol concentration, measured at 500 nm. T.G. is enzymatically measured in serum via a series of coupled reactions, hydrolyzing triglycerides to produce glycerol. Glycerol is then oxidized by glycerol oxidase with hydrogen peroxide, a reaction product measured similarly to cholesterol absorbance measured at 500 nm. High-density lipoprotein is detected using the direct method without specimen pretreatment. Initially, LDL, VLDL particles, and chylomicrons generate free cholesterol, which, through an enzymatic reaction,

produces hydrogen peroxide. The generated peroxide undergoes a peroxidase reaction with N, N-bis(4-sulphobutyl)-m-toluidine-disodium (DSBmT), resulting in a colorless product. Subsequently, specific detergents solubilize HDL-cholesterol. In conjunction with the action of cholesterol oxidase (CO) and cholesterol esterase (CE), peroxidase (POD) and 4-aminoantipyrine (4 -AAP) develop a colored reaction proportionate to HDL-cholesterol concentration. Absorbance is measured at 600 nm. LDL-cholesterol is calculated from measured values of total cholesterol, triglycerides, and HDL-cholesterol according to the relationship: [LDL-cholesterol] = [Total Chol] - [HDL-chol] - [TG]/5, where [TG]/5 estimates VLDL-cholesterol, with all values expressed in mg/dL. Renal Function Test (RFT) Creatinine is an in vitro assay used to precisely measure the concentration of creatinine in human serum using the Biochemical Analyzer Biolis 30i apparatus. This enzymatic method relies on the conversion of creatinine with the assistance of creatininase, creatinase, and sarcosine oxidase to glycine, formaldehyde, and hydrogen peroxide. Catalyzed by peroxidase, the liberated hydrogen peroxide reacts with 4-aminophenazone and HTIBa to form a quinone imine chromogen. The intensity of the color of the formed quinone imine chromogen is directly proportional to the creatinine concentration in the reaction mixture. This coloration, indicative of the creatinine concentration in the specimen, is measured at 550 nm. Blood urea is assessed by a kinetic method based on the specific action of urease, which hydrolyzes urea into ammonium ions and carbon dioxide. Ammonium ions then react with chloride and salicylate to form a blue-green complex. This coloration, proportional to the urea concentration in the specimen, is measured at 340 nm. Data Analysis The results of this investigation were displayed in a table using the statistical software for social sciences (SPSS) version 22.0. Descriptive analysis was conducted on the mean and standard deviation of a biochemical indicator for both pregnant and non-pregnant women. A t-test was then used to see if there were any significant differences between the two groups. Pearson correlation has been done to figure out each relationship between the duration of pregnancy and para and biochemical indicators in pregnant and non-pregnant women differently. A multiple linear regression model was constructed to identify the characteristics that are indicative of high cholesterol in pregnant women. A P-value of less than 0.05 was used to determine statistical significance. And eGFR has been measured using the following formula: eGFR = 175 × (SCr) ^-1.154 × (age) ^-0.203 × (0.742). Exclusion criteria: women aged more than 50 years were excluded from the analysis. Ethical Concerning This study has been done with the general health laboratory of Sulaimanyah/ Darbandikhan Shahid Tofiq General Hospital. The authorization letter was taken from the Nursing Department, Darbandikhan Technical Institute, Sulaimani Polytechnic University. All patients were provided with a clear explanation of the study's objectives, and consent letters were obtained from all participants.

RESULT

Table 1 demonstrated that the mean age (35.54±8.7), urea (23.94±8.08), and creatinine (0.57±0.128) were significantly higher in non-pregnant women compared with pregnant women. While the mean of cholesterol (182.53±36.94), HDL (54.28±11.67), and eGFR (158.34±44.40) were significantly high among pregnant women (P-value<0.05).

Table 1: Mean of biochemical indicators in pregnant and non-pregnant women

Variables	Non-pregnant women Meant and standard deviation (N=44)	Pregnant women Mean and standard deviation (N= 49)	P-value
Age	35.54±8.7	29.24± 6.2	< 0.001
TSB	0.66±0.22	0.59±0.21	0.148
Diabetes	108.79±30.32	110.81±31.93	0.756
Urea	23.94±8.08	18.34±5.90	< 0.001
Creatinine	0.57±0.128	0.50±0.139	0.011
Cholesterol	162.29±34.81	182.53±36.94	0.008
TG	171.13±69.76	194.46±45.32	0.057
HDL	49.25±8.97	54.28±11.67	0.023
LDL	96.45±26.25	102.14±30.93	0.344
eGFR	127.48±32.33	158.34±44.40	< 0.001

Table 2 indicates that LDL has a significant positive correlation with the women's gestation age (R = 0.354, P-value < 0.01), cholesterol (R = 0.802, P-value < 0.001), TG (R = 315, P-value <0.05.), and HDL (R = 0.454, P-value< 0.001), and a strong negative correlation with TSB (R = -0.431, P-value = 0.002) and creatinine (R = -0.413, P-value < 0.01). Similarly, the study found a strong correlation of eGFR with cholesterol (R = 0.305, P-value < 0.05) and LDL (R = 0.449, P -value < 0.001) and a strong negative correlation with TSB (R = -0.405, P < 0.01) and creatinine (R = -0.967, P-value < 0.001). The study also found a significant moderate correlation of cholesterol with TG (R = 0.399, P-value < 0.01) and HDL (R = 0.385, P-value < 0.01), and serum creatinine had a significant correlation with the TSB (R = 0.475, P-value < 0.001). The correlation of random blood sugar was close to being significant with the TG (R = 0.285, P-value < 0.05).

Table 2: Correlation of biochemical indicators and gestational age in pregnant women

Control Variables Age & Para	Age of pregnancy in Weeks	TSB	Diabetes	Urea	Creatinine	Cholesterol	TG	HDL	LDL
TSB	-0.045								
P-value	0.762								
Diabetes	0.237	0.180							
P-value	0.105	0.221							
Urea	-0.043	-0.031	-0.084						
P-value	0.771	0.836	0.569						
Creatinine	-0.242	0.475	-0.155	0.196					
P-value	0.097	0.001	0.293	0.182					
Total **Cholesterol**	0.279	-0.254	0.217	-0.040	-0.265			.	
P-value	0.055	0.081	0.138	0.789	0.069	.			
TG	0.173	-0.052	0.284	-0.235	-0.020	0.399			
P-value	0.239	0.728	0.050	0.107	0.894	0.005	.		
HDL	0.239	-0.250	-0.095	0.186	-0.186	0.385	-0.072		.
P-value	0.102	0.086	0.523	0.206	0.206	0.007	0.626	.	
LDL	0.354	-0.431	0.123	-0.251	-0.413	0.802	0.315	0.454	
P-value	0.014	0.002	0.406	0.085	0.004	0.000	0.029	0.001	.
eGFR	0.216	-0.405	0.138	-0.257	-0.967	0.305	0.003	0.166	0.449
P-value	0.140	0.004	0.350	0.078	< 0.001	0.035	0.981	0.261	< 0.001

Table 3 shows the correlation coefficient among biochemical indicators and gestational age of pregnancy. The study has shown a moderate positive correlation of eGFR with random blood sugar (R = 0.434, P-value < 0.001) and a negative strong to moderate correlation with urea (R = -0.365, P-value < 0.01) and creatinine (R = -0.916, P-value < 0.001).

Serum creatinine also has a significant positive correlation with urea level (R = 0.300, P-value < 0.05) and a negative correlation with random blood sugar (R = -0.394, P-value < 0.001). Cholesterol also has a significant moderate correlation with TG (R = 0.364, P-value < 0.01).

Table 3: Correlation of biochemical indicators and gestational age in non-pregnant women.

Control for age. Non-pregnancy women	Diabetes	Urea	Creatinine	Cholesterol	TG	HDL	LDL	Egfr
TSB	0.073	0.066	-0.115	-0.083	-0.001	-0.183	-0.077	0.177
P-value	0.570	0.609	0.370	0.518	0.994	0.151	0.551	0.165
Diabetes		-0.145	-0.394	-0.105	0.022	-0.132	-0.034	0.434
P-value		0.256	0.001	0.414	0.862	0.304	0.792	0.000
Urea			0.300	0.069	-0.086	-0.050	0.107	-0.365
P-value			0.017	0.592	0.503	0.695	0.402	0.003
Creatinine				-0.076	-0.065	-0.121	-0.167	-0.916
P-value				0.554	0.610	0.345	0.190	0.000
Cholesterol					0.364	0.180	0.715	0.062
P-value					0.003	0.158	0.000	0.627
TG						-0.251	0.126	0.008
P-value						0.047	0.324	0.952
HDL							0.053	0.118
P-value							0.679	0.355
LDL								0.132
P-value								0.302

Table 4 demonstrate a linear regression model of multiple variables with the cholesterol level in pregnant women. The linear regression model has explored a 70 % variance in cholesterol level, significantly explained by Para, LDL, Diabetes, BMI, Urea, and age of pregnancy in weeks, TG, Creatinine, Age, HDL, and eGFR. The regression model has shown a significant coefficient of LDL and urea with cholesterol. The model shows that urea and LDL indicate 1.398 % and 0.913 % variances in cholesterol levels, respectively.

Table 4: Coefficient linear regression of cholesterol

Predictor variables	Unstandardized Coefficients		Standardized Coefficients	t-value	P-value	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	-125.245	107.770		-1.162	0.252	-343.415	92.924
TG	0.163	0.084	0.202	1.954	0.058	-0.006	0.332
HDL	0.138	0.336	0.043	0.409	0.685	-0.543	0.818
LDL	0.913	0.148	0.764	6.178	0.000	0.614	1.212
Diabetes	0.130	0.108	0.113	1.211	0.233	-0.087	0.348
Urea	1.398	0.615	0.223	2.276	0.029	0.154	2.642
Creatinine	124.263	92.882	0.470	1.338	0.189	-63.766	312.293
eGFR	0.377	0.300	0.452	1.257	0.216	-0.230	0.985
Age	0.414	0.576	0.080	0.719	0.477	-0.752	1.580
Gestational period in Weeks	-0.124	0.306	-0.038	-0.405	0.688	-0.744	0.496
BMI	0.217	0.614	0.031	0.353	0.726	-1.027	1.460
Para	-1.298	3.203	-0.042	-0.405	0.688	-7.783	5.187

Discussion

The objective of this study was to determine the metabolic differences in lipid profile and kidney function between pregnant and non-pregnant individuals. Pregnancy status was known by a high level of lipid profile and a decreased level of urea and creatinine. The latest research has shown that the mean urea and creatinine levels were significantly decreased in pregnant women, whereas the average levels of cholesterol, HDL, and eGFR were observed to be significantly high. Another study has confirmed that TC, TG, LDL-C, HDL-C, and eGFR all increase significantly during pregnancy. Pregnant women exhibited decreased levels of urea, creatinine, and uric acid. [14, 15]. Lower levels of urea, creatinine, and uric acid in pregnancy are mostly related to high renal blood flow and GFR in pregnant women [15]. Compared to non-pregnant status, in pregnancy status, the metabolism of biochemical profiles such as LDL and TC has a high correlation with protein excretion products such as TSB and creatinine. Gestational age has more indicated the lipid profile. This finding has been proven by many other studies. TC, TG, and LDL have been increasing with gestational age [16, 17]. A study has confirmed that there is an association between lipid profile and uric acid in preeclampsia and dyslipidemia and raised uric acid levels are symptoms of preeclampsia in nullipara pregnant women in their third trimester [18]. This study could not find a significant association between urea and lipid profiles in pregnant women. Among pregnant women, the current study has indicated that LDL has a significant positive correlation with the woman's gestation period, cholesterol, TG, and HDL, and a strong negative correlation with TSB, and creatinine. The study also found a significant moderate correlation between cholesterol and TG and HDL, and serum creatinine had a significant

correlation with the TSB. Other studies have found that serum levels of uric acid, creatinine, and blood urea indicate the pre-eclamptic status of pregnant women [19]. In this study, urea and creatinine were significantly decreased in pregnant women [20], and creatinine and TSB were negatively correlated with LDL [21]. Among non-pregnant women, TSB and serum creatinine did not have a significant correlation with LDL [22]. Decreased levels of TSB and serum creatinine in pregnant women are related to kidney function during pregnancy, which leads to an increase in eGFR and the excretion of proteins such as creatinine and TSB. In addition, during pregnancy, physiological adaptations occur to support fetal growth and development; these adaptations can affect renal function and lipid metabolism, leading to changes in the correlation between eGFR and cholesterol/LDL [23].Similarly, the study found a strong positive correlation between eGFR and cholesterol and LDL, but this correlation was not significant among non-pregnant women. Among non-pregnant women, this study has shown a moderately positive correlation of eGFR with random blood sugar and a strong to moderately negative correlation with urea. This correlation was not found among pregnant women. Normally, during pregnancy, eGFR increases by 50%, which also leads to a substantial decrease in serum creatinine, urea, and uric acid values [20]. Overall, the combination of increased renal blood flow, hormonal influences, and changes in lipid metabolism, physiological adaptations, and gestational hypertensive disorders can lead to a strong positive correlation between eGFR and cholesterol/LDL during pregnancy, whereas this correlation may not be as significant among non-pregnant women due to differences in hormonal and physiological status. A high cholesterol rate is indicated by several variables. The linear regression model has explored a 70 % variance in cholesterol level, which is significantly explained by Para, LDL, Diabetes, BMI, Urea, Age of Pregnancy in Weeks, TG, Creatinine, Age, HDL, and eGFR. The regression model has shown a significant coefficient of LDL and urea with cholesterol [24]. The model has shown that urea and LDL indicate a 1.398% and 0.913% variance in cholesterol levels, respectively. A lipid profile can help predict the risk of gestational diabetes [25, 26], while the current study could not find a significant correlation between lipid profile and random blood sugar [27].

CONCLUSION

To sum up, this study highlights notable metabolic disparities between pregnant and non-pregnant women, namely in terms of lipid profiles and kidney function. In pregnant women, LDL shows significant positive correlations with gestation age, cholesterol, TG, and HDL, alongside strong negative correlations with TSB and creatinine. Moreover, eGFR demonstrates strong positive associations with cholesterol and LDL and negative correlations with TSB and creatinine, while moderate correlations exist between cholesterol and TG as well as HDL. Serum creatinine also exhibits a significant correlation with TSB. Conversely, in non-pregnant individuals, eGFR moderately correlates with random blood sugar but strongly negatively correlates with urea and creatinine. Serum creatinine shows a significant positive correlation with urea and a negative correlation with random blood sugar, while cholesterol displays a significant moderate correlation with TG. These findings emphasize the complexity of biomarker interactions and their implications for health in diverse physiological contexts.

Author's Declaration

Conflicts of interest: The authors declare that they have no conflicts of interest. In this manuscript, all tables have been authored by us. The authors have signed a welfare statement at the nursing department at The Sulaimani Polytechnic University. The authors signed the ethical consideration's approval.

Ethical clearance: our work has been approved by the scientific and ethical committee at The Sulaimani Polytechnic University.

Author's Contribution Statement

All authors of this study participated equally in all stages of the writing process; they also reviewed and approved the submission of this work.

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