ORIGINAL ARTICLE

Biochemical Profiles of Pregnant and Non-pregnant Women Attending at the University of Gondar Hospital, Northwest Ethiopia: A Comparative Cross-sectional Study

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ABSTRACT

BACKGROUND: ***Pregnancy is a natural physiological statement with hormonal and metabolic changes that helps the growth and survival of the fetus. However, biochemical profiles derangement may lead to pregnancy complications. Therefore, there is a need for determining biochemical profiles among pregnant women.***

METHODS: ***A comparative cross-sectional study was conducted among pregnant and non-pregnant women at the University of Gondar Hospital, from February to April, 2015. Fasting blood sample was collected from 139 pregnant and 139 age matched non-pregnant women using systematic random sampling technique. Interviewer-administered questionnaire was used to collect socio-demographic and clinical data. Fasting blood glucose and lipid profile were measured by A25 Biosytemchemistry analyzer using enzymatic calorimetric methods. Data analysis was done using SPSS version 20. Level of significance between groups was analyzed using independent student t-test and Mann-Whitney U test. A p-value of <0.05 was considered as statistically significant.***

RESULT: ***Pregnant women as compared to non-pregnant had significantly increased glucose (96.35±14.45 and 81.12±9.86 mg/dl), total cholesterol (211.9±40.88 and 172.40±29.64 mg/dl) [p<0.05], respectively. It had also significantly high triglycerides (190.81±81.04 and 107.43±45.80 mg/dl) and low-density lipoprotein cholesterol (116.03±37.26 and 86.12±27.29mg/dl) [p<05] in pregnant as compared to non-pregnant women. The level of high-density lipoprotein cholesterol was significantly lower in pregnant women (59.58±14.26) than control (63.63±11.4, P <0.05).***

CONCLUSION: ***There were statistically significant increment in glucose, total cholesterol, triglycerides, low-density lipoprotein cholesterol and decrement in high-density lipoprote in cholesterol levels among pregnant women compared with non-pregnant women. Therefore, pregnant women have to be monitored closely for their biochemical profiles to avoid adverse pregnancy outcomes.***

KEYWORDS: ***Pregnancy, biochemical profiles, Gondar, Ethiopia***

INTRODUCTION

Pregnancy is a period from fertilization to development of one or more offspring, known as a fetus or embryo, in a woman's uterus (1). It is a natural physiological statement that is accompanied with hormonal and metabolic alterations (2). During pregnancy, the body undergoes physiologic changes in the cardiovascular, metabolic, renal, respiratory and gastrointestinal systems. Pregnancy is known to change metabolic processes involved in lipid and lipoprotein metabolism among others. These metabolic alterations are likely evolved to meet the metabolic demands of the growing fetus (3).The body may not be able to balance the changes, and biochemical profiles can become significantly distorted from the values normally noted during pregnancy (4-6).

The body must alter its physiological and homeostatic mechanisms to ensure the development and survival of the fetus. Levels of progesterone and estrogens increase constantly throughout pregnancy to suppress the hypothalamic axis and subsequently the menstrual cycle (7). Biochemical profile levels reflect this adaptive alteration in most organ systems and are visibly different from the non-pregnant state. The woman's renal function,carbohydrate, lipid, and protein metabolism and mainly the hormonal pattern are affected. Adaptations of maternal lipid metabolism taking place throughout gestation have major consequences for fetal growth. It is known that deviations in maternal hyperlipidemia, such as those caused by hypercholesterolemia, even when temporary and limited to pregnancy, trigger pathogenic events in the fetal aorta and may lead to atherosclerosis later in life. In addition, the most common biochemical metabolic disorder in pregnancy is gestational diabetes mellitus (GDM) (8). Currently, 2-10% of pregnancies are complicated with GDM (9). Therefore, it is vital to understand both normal and abnormal changes during pregnancy because biochemical profile determination can help to manage both the mother and the infant (10).

According to WHO, pregnancy related complications kill more than 20 million women around the world each year. In addition, the lives of 8 million women are threatened and more than 500,000 women are expected to have died in 1995 as a result of causes related to pregnancy and childbirth (11). In Gaza Strip, the mortality rate in pregnancy and 6 weeks after delivery was expected to be 23.4 %, and the child mortality rate was 1023 per 100,000 populations (12). A diabetic pregnant women and her unborn infant are at increased risk of pregnancy complications such as pre-eclampsia, preterm births, stillbirths, infections, obstructed labour, postpartum hemorrhage, fetal obesity, miscarriage, intrauterine growth retardation, congenital anomalies, birth injuries and death in worst case scenarios (13,14).

Pre-eclampsia and eclampsia are the most frequently encountered medical complications of pregnancy (15). It affects both the mother and the unborn infant. Itoccurs in approximately 4-8% of all pregnancies and it also leads to death up to 17% of pregnant women (16). During pregnancy, changes occur and alter any manifestations by impairing maternal fat depot accumulation, such as hypothyroidism or overt diabetes during the first half of gestation, greatly affects fetal growth at late gestation, even if they are compensated for by appropriate hormonal treatment during the second half of gestation. The association of lipid and glucose levels with gestational hypertension and DM, has suggestive role for biochemical profile alteration and it may be used as a diagnostic and prognostic marker for adverse pregnancy outcomes (17). Thus, successful outcomes of pregnancy require frequent monitoring of biochemical profiles to avoid complications throughout the trimesters of pregnancy. Therefore, the main purpose of this study was to assess the serum level of biochemical profiles of pregnant women attending at the University of Gondar Hospital, Northwest Ethiopia.

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MATERIALS AND METHODS

A comparative cross-sectional study was conducted from February to April, 2015 at the Antenatal Care (ANC) Clinic of the University of Gondar Hospital which is found in Gondar Town of Amhara National Regional State, Ethiopia. Gondar is located 742 km far from Addis Ababa, the capital city of Ethiopia, to the northwest. All pregnant and apparently healthy non-pregnant women who had access to service at the University of Gondar Hospital were used as a source population. Pregnant and apparently healthy non-pregnant (control) women age matched, who had no past history of chronic disease and present history of any disease sign and symptoms were included in the study. Individuals with previous history of DM, hypertension, other chronic diseases and taking medications (for any reason) that affect biochemical profile levels were excluded. In addition, study participants who were smokers, drinkers and chewers of chat were also excluded from the study.

Sample size and sampling technique: The sample size was calculated using Open Epi info 2.3 by comparing mean difference of two groups and by considering the following assumptions: 95% two sided confidence level, 80% power, 1:1 pregnant women: non-pregnant women ratio, and mean ±SD of total cholesterol, which is 170.10 ±26.23 and 159±38.63 for pregnant and non-pregnant women, respectively (18). The final sample size was 278 (139 pregnant and 139 non-pregnant women. All study participants attending at the institution were selected using systematic random sampling technique. Control groups were recruited from non-remunerated blood donors at Gondar Blood Bank Center and non-pregnant women attending at ANC clinic for other purposes.

Data collection and laboratory methods: Socio-demographic and clinical characteristics data were collected using semi-structured interviewer administered questionnaire after pre-test in 5% of the participants at Dabat Health Center after verbal and written consent by trained data collectors. Body Mass Index (BMI, kg/m^2) was calculated by dividing the study subjects' weight (kg) and height square (m2). Blood pressure (BP) was measured by qualified personnel with automated Mercury Sphygmomanometer. Overnight (8-12 hours) fasting venous blood sample of 4 ml was collected in sterile plain vacutainer tube. Then, the sample was allowed to clot for 30 minutes and centrifuged at 3000 rpm for 5 minutes to obtain the serum. The serum was separated into sterile tubes and used for lipid profiles and glucose determination. Biochemical profiles were measured by A25 Biosytemchemistry analyzer using enzymatic calorimetric methods. Low density lipoprotein cholesterol (LDL-c) was calculated byFriedwaldequation (LDL-c = Total cholesterol – [HDL-C + (TG/5)]) (19).

Data management and quality assurance: The questionnaire was prepared in English and translated into Amharic and well trained counselor midwives carried out the interview. The biochemical profiles were measured based on laboratory manuals and standard operational procedures (SOPs). Fasting blood sample was collected in ANC clinic following aseptic procedures. Then, the sample was transported to clinical chemistry laboratory using standard transportation equipment. Quality control samples were done daily in order to check the optimal reactivity of the reagent and the proper functionality of the analyzer.

Data analysis and interpretation: The data were cleaned, edited and checked for completeness before data entry. After overall data arrangement, analysis was carried out by using SPSS version 20 statistical software. Assessment of normality was performed using Kolmogorov–Smirnov test. Data were described as percentages and mean± SD (standard deviation) for parametric and interquartile range for non-parametric variables. Level of significance between pregnant and non-pregnant women was analyzed using independent t-test and Mann–Whitney U test for parametric and non-parametric variables, respectively. Pearson correlation coefficient was used to determine the relationship between anthropometric measurement and biochemical

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profiles of the study participants. A p-value of <0.05 was considered as statistically significant.

Ethical considerations: Ethical clearance was obtained from theResearch and Ethical Review Committee of the School of Biomedical and Laboratory Sciences, College of Medicine and Health Sciences, University of Gondar. Permission letter was obtained from the University of Gondar Hospital director and head of the ANC clinic. Written and verbal informed consent was also obtained from each study subject before actual data collection and all data obtained were kept confidentially by using codes instead of any personal identifier.

RESULTS

Socio-demographic, clinical and anthropometric characteristics: In this study, 139 pregnant women with mean age of 26.24± 4.29 years and 139 apparently healthy non-pregnant women with mean age of 26.91± 4.82 were recruited. About 48(34.5%) pregnant and 46(33.1%) non-pregnant women were between 22-25 and 26-29 years of age, respectively. Most 53(38.1%) pregnant women had attended primary school. On the other hand, the majority, 69(49.6%), of the non-pregnant women were University/College graduates. The majority of the pregnant woman, 130(93.5%), and non-pregnant women, 132(95%), were Orthodox Christians. The majority of the pregnant women were also at the second trimester, 57(41%) (Table 1). The BMIs of majority of the study participants were normal: 82(59%) for pregnant and 111(79.9%) for non-pregnant women (Figure1).

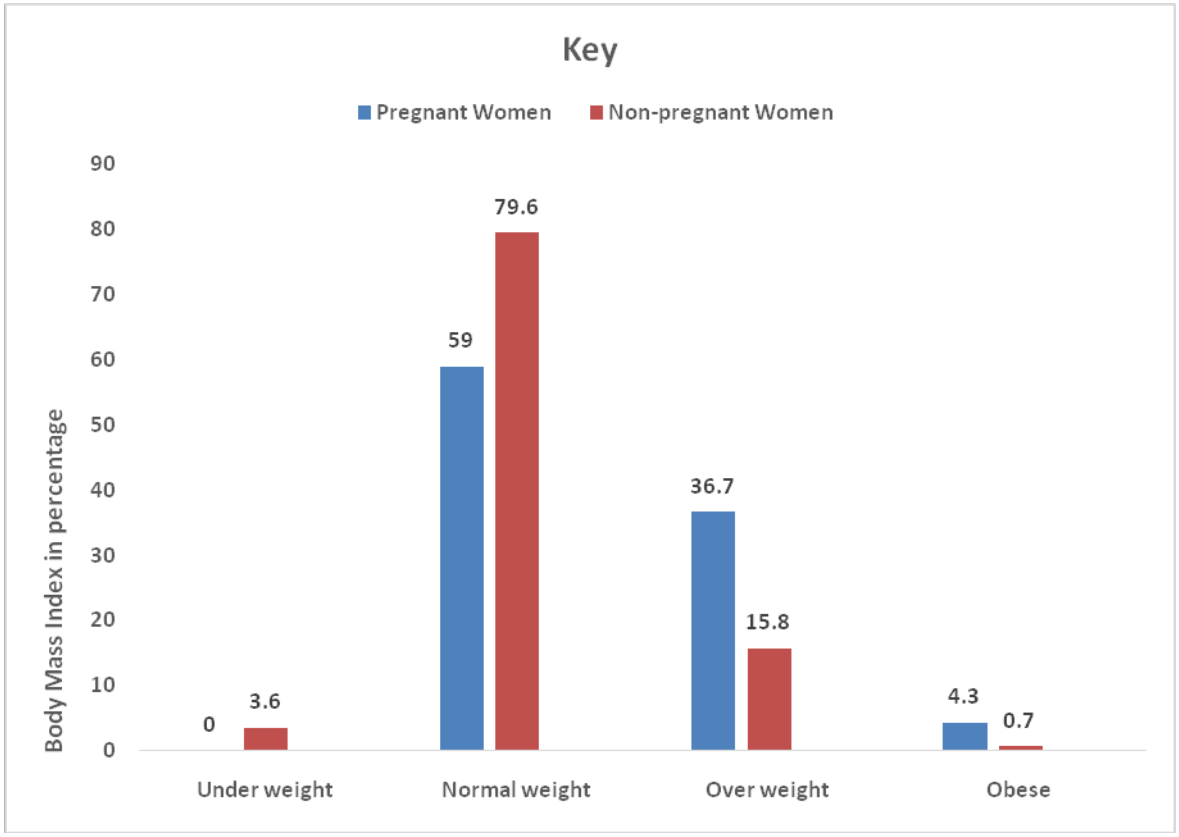

***Figure 1**: Distribution of body mass index among pregnant and non-pregnant women attending at University of Gondar Hospital, Northwest Ethiopia, 2015.*

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Table 1: Socio-demographic and clinical characteristics of pregnant and non-pregnant women at University of Gondar Hospital, Northwest Ethiopia, n=278

Variables	Pregnant Number (%)	Non-pregnant Number (%)	Total Number (%)
Age in year			
18-21	19(13.7)	14(10.1)	29(10.4)
22-25	48(34.5)	43(30.9)	91(32.7)
26-29	41(29.5)	46(33.1)	87(31.3)
30-33	20(14.4)	24(17.3)	44(15.8)
34-37	9(6.5)	8(5.8)	17(6.1)
≥38	2(1.4)	4(2.9)	6(2.2)
Residence			
Urban	113(81.3)	131(94.2)	244 (87.8)
Rural	26(18.7)	8(5.8)	34(12.2)
Educational status			
Non educated	28(20.1)	12(8.6)	40(14.4)
Primary school	53(38.1)	37(26.6)	90(32.4)
Secondary school	17(12.2)	21(15.1)	38(13.7)
University/Collage	41(29.5)	69(49.6)	110(39.6)
Occupation			
Government employee	44(31.7)	63(45.3)	107(38.5)
Private employee	8(5.8)	4(10.1)	22(7.9)
Student	5(3.6)	15(10.8)	20(7.2)
Housewife	71(51.1)	33(23.7)	104(37.4)
Merchant	11(7.9)	14(10.1)	25(9.0)
Religion			
Orthodox	130(93.5)	132(95)	262(94.2)
Muslim	9(6.5)	7(5)	16(5.8)
Marital status			
Single	9(6.5)	31(22.3)	40(14.4)
Married	130(93.5)	102(73.4)	232(83.5)
Widowed	0(0)	1(0.7)	1(0.4)
Divorced	0(0)	5(3.6)	5(1.8)
Average monthly income			
<1600 ETB	31(22.3)	40(28.8)	71(25.5)
1600-2600ETB	37(26.6)	34(24.5)	71(25.5)
2601-3600 ETB	28(20.1)	19(13.7)	47(16.9)
>3600 ETB	43(30.9)	46(33.1)	89(32)
Trimesters			
First	29(20.9)	—	—
Second	57(41)	—	—
Third	53(38.1)	—	—

Comparison of anthropometric measurements and biochemical profiles: Pregnant women had significantly higher BMI (24.83±2.09), and systolic (110(90-140) and diastolic (70 (60-90)) BP values than non-pregnant women [22.21±2.54, 105(90-130) and 70(60-90), respectively, p=0.000]. The levels of serum glucose, total cholesterol (Tc), triglycerides (Tgs) and low density lipoprotein cholesterol (LDL-c) significantly increased in pregnant women (96.35±14.45, 211.90±40.88, 190.81± 81.04 and 116.03±37.26) compared with non-pregnant women (81.12±9.86, 172.40±29.64, 107.43±45.80 and 86.12±27.29), respectively (p= 0.000). However, high density lipoprotein cholesterol (HDL-c) level was significantly decreased in

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pregnant women (59.58±14.26) than non-pregnant women (63.63±11.4, p= 0.009) (Table 2).

Table 2: Comparison of anthropometric measurements and biochemical profiles of the pregnant and non-pregnant women at University of Gondar Hospital, Northwest Ethiopia, n=278

Parameters	Pregnant women (Mean± SD)	Non-pregnant women (Mean± SD)	P-value
BMI (kg/m2)	24.83 ± 2.09Ψ	22.21± 2.54	0.00
Systolic BP (mmHg)	110(90-140) Ψ	105(90-130) ©	0.00
Diastolic BP (mmHg)	70(60-90) Ψ	70(60-90) ©	0.00
Glucose(mg/dl)	96.35± 14.45Ψ	81.12 ± 9.86	0.00
Tc (mg/dl)	211.9± 40.88Ψ	172.40 ± 29.64	0.00
Tg(mg/dl)	190.81± 81.04Ψ	107.43 ± 45.80	0.00
HDL-c(mg/dl)	59.58± 14.26Ψ	63.63 ± 11.4	0.009
LDL-c(mg/dl)	116.03±37.26Ψ	86.12 ± 27.29	0.00

Ψand Ψ statistically significant association; ©: Data described as interquartile range; BMI: Body Mass Index; BP: Blood Pressure; HDL-c: High Density Lipoprotein Cholesterol; LDL-c: Low Density Lipoprotein Cholesterol; Tc: Total Cholesterol; Tg: Triglycerides

Pearson's correlations between gestational age, anthropometric measurements and the other biochemical profiles: BMI was positively correlated with Tg in the pregnant women (r(p)=0.144(0.02). In addition, it was positively correlated with Tc and LDL-c levels in non-pregnant women (r(p)=0.219(0.009) and 0.302(0.00), respectively). Gestational age was positively correlated with Tc, Tg and LDL-c (r(p)=0.318(0.000), 0.498(.000) and 0.217(.010) and negatively correlated with glucoseand HDL-c levels in the pregnant women (r(p)= -0.267(0.002) and -0.284(0.001), respectively (Table 3).

Table 3: Pearson's correlation between gestational age, anthropometric measurement with biochemical profiles among the study participants at the University of Gondar Hospital, Northwest Ethiopia, n=278

Parameters	Pregnant women				Non Pregnant women		
	SBP r(p)	**DBP** r(p)	**BMI** r(p)	**Trimester** r(p)	**SBP** r(p)	**DBP** r(p)	**BMI** r(p)
Glucose	-0.044	-0.063	-0.028	-0.267*	0.057	0.071	0.12
Total cholesterol	0.013	-0.033	0.094	0.318 *	-0.031	0.071	0.219
Triglycerides	0.118	0.018	\\0.263	0.498*	0.073	0.076	0.131
HDL-c	0.143	0.157	-0.103	-0.284*	0.054	0.024	0.012
LDL-c	-0.83	-0.074	0.059	0.217*	-0.026	0.15	0.302

*Significant correlation in correlation analysis; BP: Blood Pressure; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; HDL-**c**: High Density Lipoproteincholesterol; LDL-**c**: Low Density LipoproteinCholesterol

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DISCUSSION

This study showed that serum glucose level was significantly higher among pregnant women than among non-pregnant women (p=000), which agrees with findings in Benin City, Nigeria (20). As pregnancy progresses, a well-integrated metabolic shift occurs for adequate supply of nutrients to a constantly feeding fetus from an intermittently fasting and feeding mother is the reason for higher serum glucose level in pregnant women. Besides, pregnancy is also associated with an insulin-resistant situation, similar to that of type 2 DM. Early in pregnancy, increasing estrogen and progesterone levels, which guide to pancreatic cell hypertrophy and insulin excretion, alter maternal carbohydrate metabolism. Secretion of other hormones like human placental lactogen, prolactin, cortisol, estrogen and progesterone induce insulin resistance. These hormones are found to be in considerably greater levels in pregnant women (2,21,22).

This study demonstrated significantly higher serum Tc, Tg and LDL-c levels in pregnant women compared with non-pregnant women. This result is similar with the findings of different studies (20,23,24). In addition, another study reported a similar result but serum Tc and Tg levels were similar between groups (18). In this study, pregnant women had significantly lower serum HDL-c level than non-pregnant women, which is in line with other studies in Nigeria and Sudan (18, 20) but contradicts to other findings (23,24). Some studies showed that the serum levels of lipid profiles increased significantly during pregnancy (25).The increase in Tg, Tc and LDL-c serum levels observed in pregnant women may be explained by the fact that lipid metabolism changes during pregnancy due to an increase in hepatic lipase (HL) activity, a decrease in lipoprotein lipase (LPL) activity, delayed uptake of the remnant chylomicrons and hormonal changes (16,26,27).

On the other hand, an increment of Tg plays a part in decreasing the HDL-c level. In addition, impaired transport of cholesterol from peripheral tissues to the target area of utilization may decrease HDL-c in serum. This result is supported by the previous study which reported positive correlation between adipose tissue LPL activity and plasma HDL-c level (28). This direct correlation may be responsible for low levels of HDL-c. Besides, serum Tc level increment in pregnancy may be due to high concentration of many steroids that occurs as normal pregnancy advances. Cholesterol is the source of most of the steroids found in increased amounts in the circulation of pregnant women, which has a significant role of lipid metabolism in pregnancy. The lipid change during pregnancy may be due to formation of zygote in the uterine wall in the first trimester in response to the maternal switch from carbohydrate to fat metabolism, which is an alternative pathway for energy generation due to high energy demand in second trimester and development of fetal organ in the third trimester (29).

This study also showed that BMI was positively correlated with Tg level of pregnant women and Tc and LDL-c levels of non-pregnant women, which is similar with another study in India (3031). Similar with our study, BMI was positively correlated with Tg level in other studies(32, 33). In this study, levels of BMI and systolic and diastolic BP were significantly higher in pregnant women compared to non-pregnant women. Similar findings were also reported from Nigeria (23,20). The correlation of BMI with lipid profiles may be explained by the fact that excessive weight gain during pregnancy has been linked to several metabolic and hemodynamic abnormalities, including dyslipidemia, elevated BP, impaired glucose tolerance, insulin resistance and clustering of cardiovascular disease risk factors (34).

This study found that trimester of pregnancy was significantly and positively correlated with Tc, Tgand LDL-c levels but negatively correlated with glucose and HDL-c levels in pregnant women. This finding contradicts another study which showed that glucose level increased with trimesters and Tg level decreased with trimesters (20). In addition, this study showed that trimester of regnancy was significantly and positively correlated with Tc, Tg, and LDL-c but negatively

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correlated with HDL-c. Similar observations were reported in other studies although HDL-c dropped a little in the 2nd trimester (18,24). All lipid fractions increase in parallel to increasing pregnancy age. It was also reported that high lipid level maybe secondary to the increment in estrogen and progesterone levels during gestation.

The variations in some biochemical profiles in this study compared to other studies might be due to difference in race, gestational age, environmental, socio-cultural and socio-economic factors between the study populations.

In conclusion, there were significantly increased serum levels of glucose, Tc, Tg, LDL-c and decreased level of HDL-c in pregnant women compared with non-pregnant women. BMI was positively correlated with Tg level of pregnant women. Trimesters of pregnancy were positively correlated withTc, Tg and LDL-c while negatively correlated with glucose and HDL-c levels in pregnant women.This study showed that changes in the biochemical profiles during pregnancy might adversely affect the pregnancy outcomes. Therefore, pregnant women have to monitor their biochemical profiles to avoid adverse pregnancy outcomes.

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