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**Original Research Article**

# The effect of gestational periods on fasting lipid profile, plasma glucose and chromium levels of apparently healthy pregnant women in Port-Harcourt, Nigeria

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## ABSTRACT

**Background:** Pregnancy is a physiological condition in which the uterus of a woman carries at least one embryo for about 38 weeks, from conception to delivery; during this period, several physiological changes in biochemical and haematological functions occur. Knowledge of these changes however, may be helpful in providing effective care for pregnant women; hence this study was aimed at evaluating the effect of gestational periods on lipid profile, plasma glucose and chromium levels of apparently healthy pregnant women in Port-Harcourt, Nigeria.

**Methods:** A total of 200 apparently healthy women were used for the study; 150 of them were pregnant (50 in the first trimester, 50 in the second trimester, and 50 in the third trimester), and the remaining 50 women were not pregnant. They were divided into four (4) groups; group I (control group) consists of 50 non-pregnant women, group II consists of 50 pregnant women in their first trimester, group III consists of 50 pregnant women in their second trimester, while group IV consists of 50 pregnant women in their third trimester. About 8 ml of fasting venous blood was collected from the antecubital fossa of each subject; 3 ml was dispensed into a fluoride oxalate anticoagulant bottle for the determination of plasma glucose concentration. The remaining 5 ml was dispensed into a lithium heparin-anticoagulant bottle for the determination of chromium and lipid profile. The data were analyzed using the one-way analysis of variance (ANOVA) and Tukey multiple comparison test.

**Results:** The results showed a significant decrease ($p<0.05$) in glucose levels in the third trimester (group IV) of pregnancy compared to the non-pregnant group (control/group I), and a significant increase in chromium levels in the third trimester (group IV) compared to the non-pregnant group (control/group I), first trimester (group II) and second trimester (group III). Also, plasma triglyceride levels were significantly elevated in the second and third trimesters compared to the non-pregnant group and first trimester. Similarly, low-density lipoprotein (LDL) levels were significantly elevated in the second trimester compared to the non-pregnant group and first trimester, and in the third trimester compared to the non-pregnant group. Contrarily however, high-density lipoprotein (HDL) levels significantly decreased in the second and third trimesters compared to the non-pregnant group and first trimester, but no significant difference in total cholesterol when all the groups were compared.

**Conclusions:** These findings revealed increased levels of chromium, which may be responsible for the decreased glucose levels in the third trimester. Also, this study revealed that pregnancy had no effect on the total cholesterol levels. However, an upsurge in triglyceride and LDL levels was noted in pregnancy, specifically in the second and third trimesters, whereas a down surge in HDL was noted in the second and third trimesters. The results show good glucose control, but with dyslipidaemia which is a risk factor for cardiovascular diseases especially arteriosclerosis.

**Keywords:** Pregnancy, Trimester, Gestational period, Dyslipidaemia, Apparently healthy

## INTRODUCTION

Within every 28 days, in the middle of a woman's menstrual cycle, an ovum is released from one of the ovaries, and is drawn into one of two fallopian tubes that lead to the uterus. While the ovum travels, the corpus luteum secretes hormones that prepare the lining of the uterus to receive a fertilized ovum. If there is no fertilized ovum, the corpus luteum shrinks, and the lining of the uterus is discarded two weeks later with menstruation.[1] However, if there is a fertilized ovum, it gets implanted on the endometrial lining of the uterus, resulting in pregnancy. Therefore, pregnancy is a physiological condition in which the uterus of a woman carries an embryo (which later develops into a fetus) for about 38 weeks, from conception to delivery.[1]

After sexual intercourse, sperms are transported upward from the vagina and through the uterus and fallopian tube, where fertilization usually takes place. One spermatozoon out of hundreds of millions ejaculated by the man may penetrate the outside layer of the ovum and fertilize it. Through fertilization, the egg is activated to begin its developmental process, and the haploid nuclei of the two gametes come together to form the genome of a new diploid organism. The fertilized egg, known as a zygote, then moves toward the uterus, and gets implanted.[2]

Pregnancy has three trimesters, each of which is marked by specific fetal developments; it is often defined as beginning once the developing embryo becomes implanted in the uterus. The first 12 weeks of pregnancy are considered to make up the first trimester, the beginning of weeks 13 to 28 of pregnancy is regarded as the second trimester weight, while weeks 29 to 40 of the pregnancy are the third trimester.[3]

During pregnancy, some physiological changes take place, which are necessary to better accommodate the embryo or fetus; these include changes in cardiovascular, haematologic, metabolic, renal or respiratory functions. However, these changes may be attributed to the effect of progesterone and oestrogen produced in the first trimester; for example, pregnancy is associated with a state of physiological and temporary insulin resistance in humans, and this condition is driven by high concentrations of steroid hormones such as progesterone, estrogens, prolactin, cortisol and placenta-derived human placental lactogen, and can lead to decreased sensitivity of insulin receptors.[3,4] This study was aimed at evaluating the effect of gestational periods on lipid profile, plasma glucose and chromium levels of normal pregnant women in Port-Harcourt, Nigeria.

## METHODS

### *Experimental design*

This is a cross-sectional study conducted at the Rivers State University Teaching Hospital (RSUTH) from November 2021 to August 2022. The study consisted of 200 apparently healthy female subjects, out of which 150 subjects were pregnant women (50 women in the first trimester, 50 women in the second trimester, and 50 women in the third trimester), and 50 subjects were non-pregnant women. These subjects were divided into four (4) groups; group I (also the control group) consists of 50 non-pregnant women, group II consists of 50 pregnant women who are in their first trimester, group III consists of 50 pregnant women who are in their second trimester, while group IV consists of 50 pregnant women in their third trimester. The subjects were intimated on the nature of the study, and those who showed interest, were recruited in the study.

### *Blood sample collection*

With the aid of sterile syringes and needles, 8 ml of fasting venous blood was collected from the antecubital fossa of each subject; 3 ml was dispensed into a fluoride oxalate anticoagulant bottle, and used for the determination of plasma glucose concentration. The remaining 5 ml was dispensed into a lithium heparin-anticoagulant bottle, which was spun to obtain the plasma as described by Ibama et al, and used for the determination of chromium and lipid profile.[5]

### *Sample analysis*

The plasma glucose concentration was analyzed with the glucose oxidase method, the lipid profile parameters such as the total cholesterol, triglycerides, and high-density lipoprotein (HDL) were analyzed using the enzymatic methods, while low-density lipoprotein (LDL) was calculated using the Friedewald's equation as described by Ibama et al.[6] Also, plasma chromium was analyzed using the atomic absorption spectrophotometer as described by Ibama and Amadi.[7]

### *Statistical analysis*

The generated data were analyzed using statistical package for the social sciences (SPSS) version 23, and the results were expressed as mean±standard deviation. The results were compared using the one-way analysis of variance (ANOVA), and significant differences among groups were further checked using Tukey test. Results were considered statistically significant at 95% confidence interval ($p<0.05$).

## RESULTS

### *Comparison between the mean levels of plasma glucose and chromium of non-pregnant women (control), pregnant women in first trimester (group II), pregnant women in second trimester (group III), and pregnant women in third trimester (group IV)*

Details of this are shown in Table 1. It shows a significant decrease ($p<0.05$) in plasma glucose in group IV compared

to group I, but no significant difference (p>0.05) when other groups were compared. For plasma chromium, there was a significant decrease in group III compared to group II, and a significant decrease in group IV compared to the other groups.

***Comparison between the lipid profile of non-pregnant women (control), pregnant women in first trimester (group II), pregnant women in second trimester (group III), and pregnant women in third trimester (group IV)***

Details of this are shown in Table 2. It shows no significant difference (p>0.05) in total cholesterol levels when all the groups were compared. HDL levels significantly decreased in group III and group IV compared to group I (control) and group II. Meanwhile, triglyceride levels significantly increased in group III compared to group I (control) and group II, and significantly increased in group IV compared to other groups. Similarly, LDL levels significantly increased in group III compared to group I (control) and group II, and significantly decreased in group IV compared to group I (control).

**Table 1: Mean levels of plasma glucose and chromium of control and different gestational periods compared.**

| Parameters | Glucose (mmol/l) | Chromium (µg/l) |
|---|---|---|
| **Group I (control)** | 93.78±13.54$^{d}$ | 0.07±0.02$^{d}$ |
| **Group II (1st trimester)** | 87.62±23.20 | 0.07±0.01$^{cd}$ |
| **Group III (2nd trimester)** | 78.84±10.93 | 0.09±0.02$^{bd}$ |
| **Group IV (3rd trimester)** | 71.10±9.42$^{a}$ | 0.13±0.02$^{abc}$ |
| **F value** | 4.251 | 23.664 |
| **P value** | 0.011 | 0.000 |

$^{a}$significantly different from group; $^{b}$significantly different from group II; $^{c}$significantly different from group III; $^{d}$significantly different from group IV

**Table 2: Lipid profile of control and different gestational periods compared.**

| Variables | T. chol (mmol/l) | Triglyceride (mmol/l) | HDL (mmol/l) | LDL (mmol/l) |
|---|---|---|---|---|
| **Group I (control)** | 5.08±0.15 | 0.89±0.15$^{cd}$ | 1.45±0.28$^{cd}$ | 2.88±0.35$^{cd}$ |
| **Group II (1st trimester)** | 4.89±0.34 | 0.85±0.14$^{cd}$ | 1.18±0.45$^{cd}$ | 3.17±0.44$^{c}$ |
| **Group III (2nd trimester)** | 5.03±0.13 | 1.76±0.48$^{abd}$ | 0.65±0.15$^{ab}$ | 3.65±0.24$^{ab}$ |
| **Group IV (3rd trimester)** | 4.94±0.12 | 2.12±0.14$^{abc}$ | 0.65±0.12$^{ab}$ | 3.42±0.17$^{a}$ |
| **F value** | 1.756 | 55.42 | 20.075 | 10.662 |
| **P value** | 0.173 | 0.000 | 0.000 | 0.000 |

$^{a}$significantly different from group I, $^{b}$significantly different from group II, $^{c}$significantly different from group III, $^{d}$significantly different from group IV, T. chol=total cholesterol, HDL=high density lipoprotein, LDL=low density lipoprotein

## DISCUSSION

Results from this study reveal that the plasma glucose concentration of the pregnant women who were in their third trimester decreased significantly compared to that of the non-pregnant women (control); however, no significant difference was recorded in the first and second trimesters. This result may be attributed to the fact that there might have been a good blood glucose control in the healthy pregnant women compared to non-pregnant women; gestational periods void of the insulin-inhibitory effects of placental hormones. This report agrees with that of Nigam et al which revealed a significant decrease in blood glucose levels in women who were in their second and third trimesters of pregnancy compared to that of the non-pregnant women; this may be so because the dynamics of glucose during pregnancy is altered and physiologic adaptation occurs throughout gestation to ensure adequate transfer of glucose to the fetus for proper development.[8] However, the report obtained from this study disagrees with that of Nwaoguikpe and Uwakwe which stated a rise in plasma glucose concentration as the gestational period increased, and this may be attributed to the presence of gestational diabetes (induced by some placental hormones) in the pregnant women they used in their study.[9]

Also, the results reveal that the plasma chromium concentration increased significantly in the third trimester of the pregnancy. Chromium is an essential element in human nutrition.[7] A diet lacking in chromium may result in the development of diabetes mellitus.[10] From this study, the increase in chromium levels (which of course is within the reference range) in the third trimester may be attributed to dietary chromium, and this may have been the reason for the decreased glucose concentration recorded in the third trimester; chromium is believed to be an insulin-sensitizing agent and may facilitate insulin attachment to the insulin receptor (tyrosine kinase), thereby stimulating a decrease in blood glucose concentration.[11]

The total cholesterol levels in the different trimesters of pregnancy had some fluctuations; however, they were not significantly different from one another, and from that in non-pregnant women. This report disagrees with that of Blessing et al and with reports from several other studies which recorded a significantly high total cholesterol level in all trimesters, particularly in the second and third trimesters of pregnancy compared to the non-pregnant (control) group; their report may be due to the fact that pregnancy is accompanied by significant variations in maternal lipid metabolism.[12-14] Butte reported that the hypercholesterolemia during pregnancy is attributed to

changes in sex steroid hormones, hepatic and adipose metabolism.[15] From this present study however, hypercholestrolaemia was not recorded in the different gestational periods, and this may be attributed to the presence of the various steroid hormones not sufficient enough to induce hypercholestrolaemia.

The triglyceride levels increased as the gestational period increases, with the increase noted in the second and third trimesters of the pregnancy. This report agrees with that of Blessing et al which noted an increase in triglyceride levels in the second and third trimesters of pregnancy.[12] Also, the report from this study is in agreement with that of Kumari et al.[16] This elevated plasma triglyceride level during pregnancy is necessary as an energy store to take care of the metabolic needs of the mother and fetus particularly towards late gestation, and functions as a source of milk formation prior to parturition.[17] At the later stage of pregnancy, fat depots are rapidly broken down, which is essential in developing the fetus. Maternal hypertriglyceridaemia is a characteristic feature during pregnancy and corresponds to the accumulation of triglycerides in low (LDL-C) and high-density lipoprotein (HDL-C).[18] Additionally during pregnancy, hepatic lipase activity increases, which in turn, causes surges of triglyceride synthesis in the liver; this may have also contributed to the increased triglyceride level obtained from this study.[15]

The HDL levels decreased as the gestational period increases, with the decrease noted in the second and third trimesters of the pregnancy. This report is similar with that of Pusukuru et al where they studied the baseline lipid parameters in the second and third trimesters among pregnant women in India, and reported a decrease in HDL in the third trimester when compared to the second trimester.[19] However, the report obtained from this study disagrees with that of Kumari et al which stated an HDL increase in the first trimester, a decrease in the second trimester, and then an increase in the third trimester.[16] Kumari et al stated that the initial increase in HDL in the first trimester is estrogen-dependent, while decreasing HDL in the second trimester correlate with rising levels of human placental lactogen, insulin and insulin resistance.[16]

LDL levels increased as the gestational period increases; the LDL level in the second trimester was higher than that in the first trimester and control, whereas the LDL level in the third trimester was only higher than that of the control. This report is in concordance with those of Blessing et al and Kumari et al which stated an increase in LDL as the gestational period increases.[12,16] Similarly, Pusukuru et al carried out a study which evaluated lipid profile in the second and third trimesters of pregnancy, which a report of a significant decrease in LDL in the second trimester, which later became increased in the third trimester of pregnancy.[19] Additionally, it has been noted by Fahraeus et al and Jimenez et al that the levels of LDL in normal pregnancy increased with increasing gestational period.[20,21] The increase in LDL obtained from this study may be attributed to the elevated maternal oestrogen and progesterone concentration which usually in pregnancy; in return, circulating LDL cholesterol is the chief substrate for placental progesterone synthesis.[22,23] However, the LDL found in maternal serum during pregnancy is atherogenic, small and dense.[22]

## CONCLUSION

This study evaluated the plasma fasting lipid profile, glucose and chromium levels in the different gestational periods in pregnant women, and in non-pregnant women in Port-Harcourt, Nigeria. It revealed a decrease in glucose levels, and an increase in chromium levels in the third trimester; the decreased glucose level may however be attributed to the increased chromium levels. Chromium is known to increase insulin-specific receptors thereby increasing insulin-binding, and thus resulting in a decreased glucose concentration in the circulation. This study also revealed that pregnancy had no effect on the total cholesterol levels. However, an upsurge or increase in triglyceride and LDL levels was noted in pregnancy, specifically in the second and third trimesters, whereas a down surge or decrease in HDL was noted in the second and third trimesters. Maternal physiology is highly influenced by the placental hormones particularly in the third trimester of the pregnancy. The variation in hormonal levels generally affects the glucose and lipid metabolism and such variations take place in order to make sure that the fetus receives an ample supply of nutrients for its development.

The results obtained from this study shows good glucose control, but with dyslipidaemia which is a risk factor for cardiovascular diseases especially arteriosclerosis. Although, there has been an assumption for several decades that hyperlipidaemia or dyslipidaemia in pregnancy is physiological and not atherogenic. However, hyperlipidaemia or dyslipidaemia during pregnancy is now linked with increased risks of preterm delivery, gestational diabetes and preeclampsia, as well as the later development of atherosclerosis in the offspring. It is therefore very necessary to monitor the lipid profile as a routine test during pregnancy.

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