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BIOCHEMICAL CHANGES IN LIPID PROFILE AND ANTIOXIDANT STATUS IN PREGNANCY

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ABSTRACT

Pregnancy is a complex physiological process shaped by a range of interconnected factors. The reasons behind abortion or disruptions in pregnancy are varied, including genetic, hormonal, environmental, and immunological influences. The development of the fetus during pregnancy, along with the effects of childbirth, is closely linked to the mother's lipid profile and antioxidant levels. Understanding the factors that induce pregnancy loss is essential for improving health outcomes for both mothers and their babies. This study was initiated in response to the rising rates of pregnancy loss, pregnancy-induced hypertension, preeclampsia, and other issues, particularly among women in their second and third trimesters. 50 women were recruited from two Primary Healthcare facilities, consisting of 25 pregnant participants and 25 non-pregnant controls of reproductive age. The lipid profile, antioxidant status, and lipid peroxidation were assessed using analytical test kits on blood samples from the participants. The results showed a statistically significant increase ($p < 0.05$) in lipid parameters among the subjects in comparison to control group. Moreover, Glutathione peroxidase and Malondialdehyde activity were also significantly higher ($p < 0.05$) in the subjects than in the controls. There was a significant elevation ($p < 0.05$) in fasting blood sugar (FBS) levels in non-pregnant control group in comparison to pregnant subjects. This study highlights the importance of evaluating lipid profiles and antioxidant levels in pregnant women to improve pregnancy outcomes and reduce the incidence of pregnancy loss.

Key words: - Lipoproteins, Glutathione, Malondialdehyde, miscarriage, abortion

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INTRODUCTION

Pregnancy is a physiological phase that begins with the implantation of the products of conception, which normally occurs in the uterus [1]. The journey can end through spontaneous or elective abortion, or through delivery. As conception unfolds, the mother undergoes a series of physiological changes that impact all organ systems, ensuring the developing fetus gets the support it needs [2]. This experience is a complex physiological phenomenon that hinges on the intricate interplay of various factors. Typically, the duration of pregnancy is counted from the first day of the last menstrual period, averaging around 280 days [2]. Throughout pregnancy, the mother's body undergoes significant transformations alongside the growth of the fetus, which are closely tied to the maternal lipid profile and antioxidant levels [3]. Specifically, total cholesterol can rise by about 50%, LDL cholesterol by 30-40%, HDL cholesterol by 25%, and triglycerides can increase two- to threefold. These lipid changes are normal adaptations that help meet the increased energy and nutritional needs of the growing fetus and prepare the body for lactation after delivery [4]

The changes in lipid levels during pregnancy can vary in individuals, this variability is influenced by several factors, including the prenatal lipid levels, how much weight she gains during pregnancy, and which stage of pregnancy an individual is in [5]. Additionally, pregnancy can trigger oxidative stress, mainly due to a typical systemic inflammatory response, which can result in increased levels of circulating reactive oxygen species (ROS) [3]. Oxidative stress occurs when there is an imbalance between the production and buildup of these reactive oxygen species in cells and tissues and the body's ability to detoxify them [6]. Given that indicators of oxidative stress are known to be elevated during a typical pregnancy, it is anticipated that pregnancy may exacerbate oxidative stress, potentially resulting in increased oxidant levels and a corresponding decrease in total antioxidant capacity (TAC).

Dyslipidemia and the abnormal generation of reactive oxygen species (ROS) during pregnancy can significantly impact both maternal and

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fetal health. The potential consequences of these conditions include developmental delays, preterm birth, low birth weight, respiratory complications, compromised maternal and placental functions, gestational diabetes mellitus, and even miscarriage [7 & 8]. This study aims to fill crucial gaps about the interplay between lipid metabolism and oxidative stress during pregnancy by comparing pregnant individuals with non-pregnant controls, the research will examine the biochemical changes that occurs and how they impact both maternal and fetal health. The insights gained could inform clinical monitoring practices and improve pregnancy outcomes through more focused interventions.

METHODOLOGY

In this study, a total of fifty healthy women were recruited. Out of these, twenty-five were pregnant, selected from antenatal clinics at primary health centers, forming our case (test) group. The other twenty-five participants were non-pregnant women of reproductive age, making up the control group.

Inclusion criteria:

1. Pregnant women in their second or third trimester attending antenatal clinic.
2. Pregnant women taking only routine medications provided by the antenatal clinic.

Exclusion criteria:

1. Pregnant women with a history or current issues related to substance abuse (drugs).
2. Pregnant women diagnosed with or undergoing treatment for specific conditions such as diabetes, HIV/AIDS, hypertension, etc.
3. Women with a history of miscarriage.

Collection of data:

Questionnaire was designed to collect data, it included demographic details, anthropometric measurements, medical history, as well as insights into dietary habits and physical activity levels. Consent was sought from all participants, the study was also granted ethical approval: NHREC/TR/UNIMED-HREC-Ondo st/22/06/21.

Biochemical Analysis

Collection of fasting blood samples was done through venipuncture. Biochemical parameters were evaluated

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in both the case and control subjects. To determine the lipid profile parameters, Randox test kits were used, carefully following the manufacturer's instructions.

1. Total Serum Cholesterol (using the CHOD-PAP Method) [9].
2. Serum Triglycerides (measured by the GPO-Trinder Method) [10].
3. Serum High-Density Lipoproteins (HDL) (determined via the Phosphotungstic Acid Method) [11].
4. Serum Low-Density Lipoproteins (LDL) (calculated using the Friedwald equation) [12].
5. Serum Very low- density lipoproteins (VLDL) (Freidwald equation) [12].
6. Antioxidant activity: Glutathione peroxidase [13]
7. Lipid peroxidation: Malondialdehyde (MDA) [14]
8. Fasting blood sugar**:** Using FBS test strips

Statistical evaluation

Statistical evaluation was done on the data collected, using the unpaired t-test with GraphPad Prism version 8.0.0. The results were presented as mean ± standard error of the mean (SEM). To identify differences between the means of the pregnant participants and the non-pregnant subjects, a significance level of $p < 0.05$ at a 95% confidence interval was set.

RESULTS

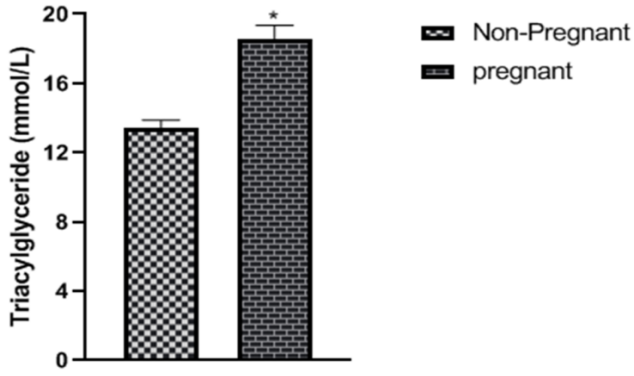

Figure I: The levels of triglycerides in pregnant women (PP) and non-pregnant women (NPP) exhibit a statistically significant difference, with ($P < 0.05$)

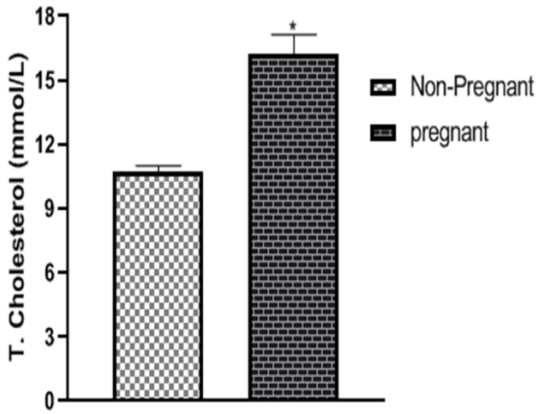

Figure II: The total cholesterol levels in pregnant women (PP) and non-

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pregnant women (NPP) exhibit a significant difference, with ($P < 0.05$)

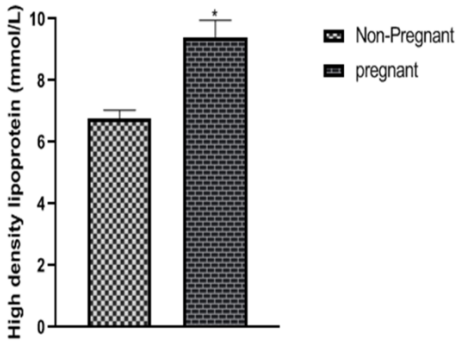

Figure III: The concentration of high-density lipoprotein (HDL) in pregnant women (PP) is significantly different from that in non-pregnant women (NPP) with ($P < 0.05$)

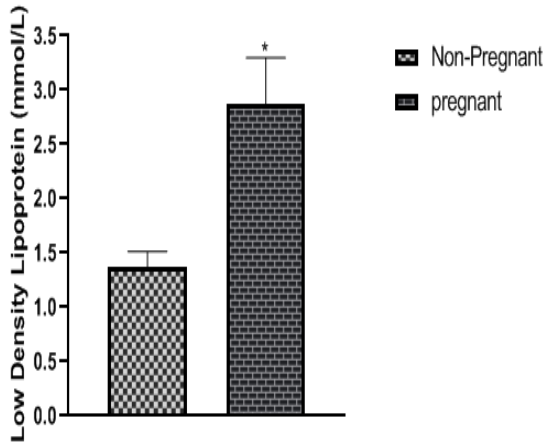

Figure IV: The levels of low-density lipoprotein in pregnant women (PP) and non-pregnant women (NPP) exhibit a statistically significant difference, with ($P < 0.05$)

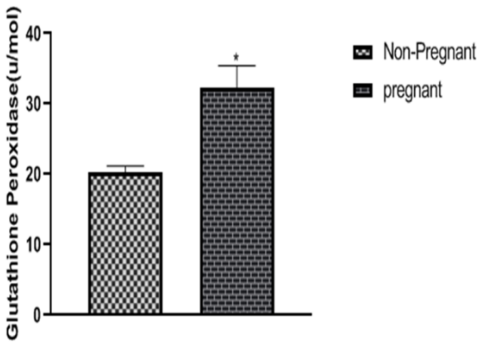

Figure V: The levels of glutathione peroxidase in pregnant women (PP) and non-pregnant women (NPP) were found to be significantly different, with a statistical significance of ($P < 0.05$)

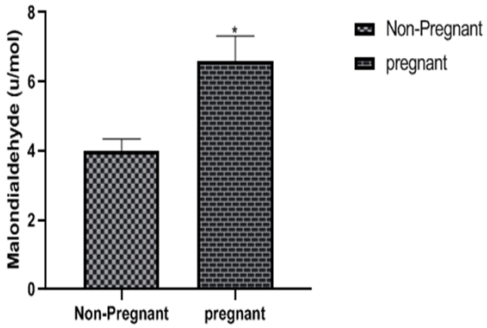

Figure VI: The levels of Malondialdehyde in pregnant women (PP) and non-pregnant women (NPP) exhibit a statistically significant difference, with ($P < 0.05$)

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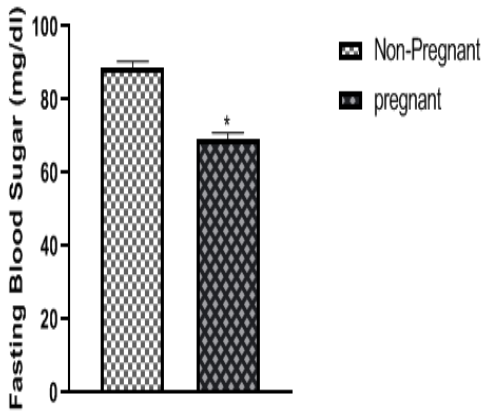

Figure VII: The levels of fasting blood glucose in pregnant women (PP) and non-pregnant women (NPP) exhibit a significant difference, with ($P < 0.05$)

DISCUSSION

Pregnancy is a complex physiological state, marked by hormonal and metabolic changes that support fetal growth and survival [1]. However, any disruptions in these biochemical profiles can lead to unintended miscarriages and various complications during pregnancy. In this study, pregnant participants had significantly lower ($p < 0.05$) fasting blood glucose levels in comparison to control subjects. This finding is consistent with the research by [15], who reported a decrease in fasting glucose levels among pregnant women compared to their non-pregnant peers. In contrast, a study by [16] found no notable difference in fasting blood glucose levels in pregnant and non-pregnant women. The observed reduction could be linked to metabolic factors, especially the increased demand for glucose from the developing fetus. A mother's metabolism undergoes significant shifts, largely due to rising levels of estrogen and progesterone. These hormones induce pancreatic beta-cell hyperplasia, which increases insulin production which leads to a drop in fasting blood glucose levels [17].

A significantly higher ($p < 0.05$) levels of total cholesterol, triglycerides, and low-density lipoprotein were observed in the test group compared to control. This finding is backed up by studies from [18, 19 & 20] all of which reported marked increases in total cholesterol, LDL, and triglyceride levels. The rise in triglycerides during pregnancy can largely be traced back to reduced lipoprotein lipase activity in adipose tissue, a result of insulin resistance [21]. Additionally, prenatal insulin resistance, which tends to peak in the third trimester, boosts hormone-sensitive lipase activity in maternal

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adipocytes, leading to the breakdown of triglycerides.

A significant increase ($p < 0.05$) in HDL-C levels among pregnant women was also recorded in this study. This aligns with studies by [22 & 23] which noted that pregnant women tend to have higher HDL levels than those who are not pregnant. The boost in HDL cholesterol during pregnancy is largely due to rising estrogen and progesterone levels, with estrogen playing a key role in regulating HDL concentrations [24 &25]

Moreover, this study observed significantly higher ($p < 0.05$) MDA level test group compared to control. This finding is consistent with a study by [26], which also reported increased MDA levels in pregnant women. MDA is a known marker of lipid peroxidation, and the consistently elevated levels in pregnant women can be linked to the unique physiological demands of pregnancy. Factors such as heightened metabolic needs, hormonal changes, and placental growth all contribute to increased oxidative stress during this time [27]. The elevated MDA levels seen in pregnancy are likely a result of the physiological adjustments and metabolic needs that come with this condition.

Additionally, glutathione peroxidase (GPx) activity showed a significant elevation ($p < 0.05$) in test group compared to control. This observation is consistent with studies by [28 & 29], which also reported a marked increase in superoxide dismutase (SOD) and GPx levels in pregnant women versus their non-pregnant peers. The increased activity ($p < 0.05$) of antioxidant enzymes may be typically associated with the presence of oxidative stress. While oxidative stress is an inherent aspect of pregnancy, excessive levels of reactive species may lead to adverse conditions such as preeclampsia, premature birth, and spontaneous abortion [28 & 30].

Recommendation

Lipid profile parameters and antioxidant levels during pregnancy are important for the well-being of both the mother and the fetus. This proactive approach helps reduce the chances of complications and can even prevent unexpected pregnancy loss. These parameters are key indicators that help

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us understand how oxidative stress, dyslipidemia, and lipid peroxidation might impact maternal and fetal health. When interpreting these results, it's essential to consider factors related to pregnancy loss and definitely look into strategies to lower oxidative stress, such as incorporating antioxidant supplements and making some lifestyle changes.

Declaration by Author

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