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Healthcare Studies 1(1) (2023): 30 –38

Research Article

Effect of Gravidity on Atherogenic Indices in Normotensive and Hypertensive 3rd Trimester Pregnant Women

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How to cite:
Oladapo-Akinfolarin et al. 2023. "Effect of Gravidity on Atherogenic Indices in Normotensive and Hypertensive 3rd Trimester Pregnant Women". *Healthcare Studies* 1(1): 30 – 38. https://doi.org/10.58612/hs114

Received: March 15, 2023
Accepted: May 20, 2023
Published: May 31, 2023

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Abstract: The nine-month period during which a woman bears her unborn child is known as the gestation period. It is common practice to divide the total number of weeks or months of pregnancy into three equal parts, or trimesters. Pregnant women who are at risk for cardiovascular disease may be at even greater risk for problems such as hypertension due to changes in several indices, including atherogenic markers. Since the changes in pregnancy rise with each child, it is vital to understand the effects of gravidity on atherogenic indicators in both hypertensive and normotensive women during their third trimester of pregnancy. The study's objective was to compare atherogenic indicators between pregnant women with normal and high blood pressure throughout the final trimester. Rivers State University Teaching Hospital conducted a cross-sectional study with 100 female participants. Women who met the inclusion criteria and gave informed consent were randomly assigned to one of two groups: 50 normotensive pregnant women in their third trimester and 50 hypertensive pregnant women in their third trimester (HPW3T). The women were assigned to each group based on number of child birth; primigravid (first-time mother), multigravid (mother of two or more children), or grand multigravid (mother of more than five children). Participants' blood was drawn via venipuncture while they fasted for fasting lipid profile. We performed quantitative analyses of the atherogenic indices AIP, CR-I, CR-II, AC, and APoB/APoA1. Using an alpha level of 0.05, analysis of variance followed by Tukey's test for multiple comparisons was performed on the collected data. For the normotensive group, there was a significant difference in AIP among the gravidity groups (p0.05). The hypertensive population showed no statistically significant variation. Although most pregnant women are able to keep their blood pressure within normal range throughout their pregnancies, this work showed that the atherogenic index of plasma (AIP) was significantly altered by gravidity in the third trimester.

Keywords: atherogenic indices, pregnancy, trimester, normotensive, hypertensive.

1. Introduction

The nine-month period during which a woman bears her unborn child is known as the gestation period. The duration of a pregnancy is classified into three stages according

to the gestational age (in weeks and months). The first three months following fertilization are referred to as the "first trimester" of a pregnancy (2 months and 3 weeks). During a typical pregnancy, the second trimester (weeks 13-27) lasts for around three to six months and two weeks. A study by Huda et al. (2009) supports this. Gravidity is an indicator of a woman's past reproductive success. According to the 2014 Global Burden of Disease report, the number of maternal fatalities has decreased from 377,000 in 1990 to 293,000 in 2013. Maternal sepsis, obstructed labour, maternal haemorrhage, maternal blood pressure during pregnancy, and maternal sepsis are among the primary causes of these deaths. Endothelial dysfunction and other blood flow abnormalities during pregnancy are risk factors for cardiovascular disease later in life. This is due to the physiological processes at work during pregnancy. In this case, pregnancy is seen as a separate risk factor from the others already listed. This is still a source of worry (Harvey et al., 2015). Around 7% of pregnancies are affected by pregnancy-induced hypertension and preeclampsia, with severe preeclampsia being a major contributor to catastrophic maternal morbidity, such as stroke and liver rupture (Seegers et al., 2010). Chronic or gestational hypertension and proteinuria are hallmarks of preeclampsia, which typically present itself after the 20th week of pregnancy due to an abnormal placentation that result in inadequate uteroplacental blood perfusion and ischaemia (Hromadnikova, 2015). Scientists have found that (Khan et al., 2006). While implantation abnormalities have been linked to preeclampsia, the exact aetiology of the condition remains unknown. Pregnancy is complicated for 9–25% of women with hypertensive disorders, a major contributor to the development of cardiovascular disease in females (Cunningham et al., 2010). Pre-eclampsia (PE) is responsible for one in three obstetric morbidities, a fivefold increase in perinatal death, and at least 76 000 maternal deaths annually throughout the world (Global Burden, 2013). Post-20 week pregnancy arterial hypertension (systolic arterial pressure 140/diastolic arterial pressure 90 mm Hg) is the most common risk factor for pre-eclampsia-related damage. Some of the additional symptoms include lung and brain edoema, visual problems, proteinuria, thrombocytopenia, renal failure, and liver function disorders (Association obstetrics & Gynaecology, 2013). Remember that this problem doubles or quadruples the risk of developing cardiovascular disease in the future (Chen et al., 2014). Since 2011, when the American Cardiological Association first recommended treating pre-eclampsia as a separate risk factor for both sexes, this practice has become widespread (Mosca et al., 2011). It is a current focus of scientific interest to identify its first warning indications because doing so may lead to the development of novel preventative and treatment strategies (Mutsalhanova, 2015). The malfunctioning of endothelial cells is a key factor in the onset of multisystem disease in preclinical models. Mechanisms underlying defective endothelial cells are still poorly understood (Miko et al., 2013). It has been demonstrated that the atherogenic indices are more precise than the earlier approaches. One such measure To assess a person's risk of developing cardiovascular disease (CVD), the "Cardiac Risk Ratio," or simply the ratio of total cholesterol to High Density Lipoprotein (HDL) cholesterol, is utilised (Bafna et al., 2012).

Another metric for cardiovascular risk assessment is log (tryglyceride (TG)/high density lipoprotein(HDL)-cholesterol). It has recently been recommended as a marker

of plasma atherogenecity due to its inverse connection with Low Density Lipoprotein particle size and greater prevalence in those at high risk for coronary heart disease. As both TGs and HDL-C are simple to test, this ratio is often taken as an indicator of the balance between these two risk and protective lipoprotein components (Dobiasova et al., 2011). An additional metric, the atherogenic coefficient, is derived by dividing the amount of non-HDL cholesterol by the amount of HDL cholesterol (AC). Non-HDL-c levels can be determined without the patient fasting. The apo B level is more indicative of health than the LDL cholesterol content (Deric et al., 2008). Epidemiologic and experimental studies show that children born to women with preeclampsia have an elevated risk of cardiovascular disease later in life (Davis, 2012). Consequently, evaluating the impact of pregnancy on atherogenic indices All during the third trimester of pregnancy, in both normotensive and hypertensive women, is critical.

2. Materials And Method

Design of Study

The cross-sectional study comprised one hundred women, half of whom were pregnant and the other half who were not. According to the patient charts, 50% of the participants had healthy blood pressure and 50% had excessive blood pressure. Women with hypertension or normal blood pressure were further classified into three groups based on their gravidity (the number of pregnancies they have had): primigravida (those who have only had one), multigravida (those who have had two or more), and grand multigravida (those who have had more than five) (five or more). There were 15 normotensive primigravida, 27 normotensive multigravida, and 8 normotensive grand multigravidas. There were 25 hypertensive subjects in the multigravida, 25 in the primigravida, and 4 in the grand multigravida.

Location of Study

The study was conducted at the Braithwaite Memorial Specialist Hospital, now known as the Rivers State University Teaching Hospital (RSUTH). RSUTH is located in Port Harcourt, the capital of Rivers State, Nigeria.

Ethical Clearance and Consent

Permission to conduct the study in the hospital was obtained following the issuance of ethical clearance from the RSUTH Ethics Committee. Before they could eligible participants were required to complete a written informed consent form in order to participate in the study.

Eligibility criteria

Women with and without hypertension who were pregnant and visiting the prenatal clinic were included in this study. Among the grounds for exclusion were the inability to give informed consent and a recent history of surgery or blood transfusion.

Method of Selection

As proposed by multiple researchers in a study on expectant women, participants who met the inclusion criteria and gave their Those who agreed to take part in the study were selected at random. approach (Oladapo- Akinfolarin et al., 2022).

Sample Collection method

The method of venipuncture as described by Oladapo- Akinfolarin et al. (2022) in similar study was applied in the collection of blood samples from the subjects for laboratory assessment of lipid parameters.

Laboratory Methods

Total Serum Cholesterol Determination

Total cholesterol was measured using an enzymatic method. (Oladapo- Akinfolarin et al., 2018).

High-Density Lipoprotein (HDL) Cholesterol in Serum Analysis

HDL-C was quantified using an enzymatic technique (Oladapo- Akinfolarin et al., 2018).

Serum Triglycerides Determination

Triglycerides are measured using an enzymatic method (Oladapo- Akinfolarin et al., 2018).

Low-Density Cholesterol Measurement (LDL-C)

The Friedewald equation was used to calculate LDL cholesterol (Oladapo-Akinfolarin et al., 2017; Oladapo- Akinfolarin et al., 2018).

LDL cholesterol = Total Cholesterol - (TG/2.2) – HDL

The following standard formulas were used to determine the atherogenic indices andlipid ratios:

AIP = Log (TG/ HDL-C): Reference Range = Low risk (-0.3 – 0.1), Moderate risk(0.1 – 0.24), High risk (>0.24)

CRI-1 = TC/HDL-C: Reference Range = Low risk (< 1-3), Moderate risk (3-5), Highrisk (>5)

CRI-II = LDL-C /HDL-C: Reference Range =Low risk (< 1-3), Moderate risk (3-5),High risk (> 5)

AC = TC – HDL-C/ HDL-C: (Reference >3.0)

Apo B/ Apo A1: Reference range = (low risk 0.30, moderate risk 0.6 and high risk0.8)

Statistical Analysis

The research data were analysed using GraphPad Prism, version 8.0.2.263. The data were described using the mean and standard deviation. To compare the mean levels

between the groups, a one-way analysis of variance was conducted, then a Tukey comparison test. Level of significance was set at 0.05.

3. Results

Impact of Gravidity on Atherogenic Markers in the Third Trimester of Normotensive Women

Table 1 shows the comparison of atherogenic markers in third trimesters of normotensive pregnant women. The results show that only AIP levels were significantly different (p-value<0.05) among the groups (primigravida, multigravida and grand multigravida).

Table 1. Comparing atherogenic parameters among primigravida, multigravida and grand multigravida groups

Parameters	**Normotensive Women**			***P*-value**	**F-value**
	Primigravida (1)n = 21 (42%)	Multigravida(>1)n = 22 (44%)	Grand Multigravida (≥ 5) n = 7 (14%)		
AIP	0.20 ± 0.07	0.16 ± 0.06	0.21 ± 0.04	0.0416	3.4050
CRI 1	5.46 ± 1.30	4.86 ± 0.53	5.63 ± 0.41	0.0573	3.0400
CRI 2	3.78 ± 1.25	3.22 ± 0.49*	3.93 ± 0.51	0.0727	2.7730
AC	4.46 ± 1.30	3.86 ± 0.53	4.63 ± 0.41	0.0573	3.3400
APoB/APoA1	0.41 ± 0.07	0.44 ± 0.05	0.46 ± 0.11	0.1752	1.8080

Table 2. Post-Hoc Comparison Test for the Impact of Gravity on Atherogenic Indices (Normotensive 3rd Trimester)

Parameters	Primagravida Vs. Multigravida	Primagravida Vs. Grand multigravida	Multigravida Vs. Grand Multigravida
AIP	0.0722	0.9087	0.1219
CRI 1	0.0984	0.9012	0.1438
CRI 2	0.1154	0.9226	0.1760
AC	0.0984	0.9012	0.1438
APoB/APoA1	0.3490	0.2151	0.7486

Effect of Gravidity on Atherogenic Indices in Hypertensive 3rd Trimester

Tables 3 and 4, respectively, indicate the effect of gravidity on the atherogenic indices (AIP, CRI1, CRI2, AC, and ApoB/ApoA1) in pregnant hypertensive women. The third trimester in hypertensive pregnant women showed no discernible effects of gravidity on any of the atherogenic indices (p>0.05).

Table 3. Gravity's impact on atherogenic indicators in pregnant women with high blood pressure

Parameters	Hypertensive Women			*P*-value	F-value
	Primigravida (1) n = 20 (40%)	Multigravida(>1) n = 16 (32%)	Grand Multigravida (≥ 5) n = 14 (28%)		
AIP	0.22 ± 0.07	0.18 ± 0.05	0.22 ± 0.07	0.2304	0.5150
CRI 1	5.79 ± 2.13	5.25 ± 0.57	5.03 ± 0.72	0.2850	1.2890
CRI 2	4.06 ± 2.05	3.54 ± 0.58	3.29 ± 0.68	0.2624	1.3770
AC	5.79 ± 2.13	4.25 ± 0.57	4.03 ± 0.72	0.2850	1.2890
APoB/APoA1	0.37 ± 0.03	0.36 ± 0.02	0.36 ± 0.03	0.6790	0.3903

Table 4. The Turkish Multiple Comparison Test for the ANOVA Post-Hoc Results for the Impact of Gravity on Atherogenic Indices (Hypertensive 3rd Trimester)

Parameters	Primagravida Vs. Multigravida	Primagravida Vs. Grand multigravida	Multigravida Vs. Grand Multigravida
AIP	0.2473	0.9924	0.3633
CRI 1	0.5089	0.2905	0.9054
CRI 2	0.5092	0.2610	0.8770
AC	0.5089	0.2905	0.9054
APoB/APoA1	0.6758	0.8268	0.9746

4. Discussion

This study analyzed ApoB/A1 as well as Atherogenic Coefficient (AC), Atherogenic Index of Plasma (AIP), Castelli Risk Indices (CRI 1) and (CRI 2), and Atherogenic Coefficient (AC). In this group of preeclamptic women, these characteristics are indicative of long-term cardiometabolic illness (PE). As a result, both normotensive and hypertensive pregnant women can use AIP (also known as the "zone of arterial risk") to forecast cardiovascular risks and choose the proper pharmacological therapy during the third trimester of pregnancy. Female participants were chosen from among hospital patients who participated in the study.

According to this study, grand multigravida had a third trimester AIP that was considerably higher than that of primigravida and multigravida in normotensive pregnant women (p=0.0416). This shows that the AIP value, which rises with each pregnancy, is the gravidity-sensitive measure for cardiovascular risk in pregnant women. These findings also show that pregnancy had no impact on the CR1, CR2, AC, and ApoB/ApoA1 artherogenic indices. The results did demonstrate an increase in APoB/APoA1 values from primigravida to multigravida and Grand multigravida, despite the fact that they were not statistically significant. According to this information, in third-trimester pregnant women with normal blood pressure, the APoB/APoA1 ratio rises with gestational age. However, after more investigation, post-hoc analysis of the various gravidity ages failed to demonstrate any statistical

significance at the 0.05 level. In third-trimester hypertensive pregnant women, there was no statistically significant difference between gravidity and atherogenic indices ($p>0.05$). The values of CRI 1, CRI 2, AC, and ApoB/ApoA1 did, however, gradually decrease from primigravida to multigravida and Grand multigravida, even though this was not statistically significant, according to the data. The number of pregnancies a woman had no affects on her third-trimester CRI 1, CRI 2, AC, and ApoB/A1 readings are, according to the study. The findings revealed that when the various numbers of pregnancies—from primigravida through multigravida and grand multigravida— were compared among themselves at p0.05, gravidity had no discernible impact on the artherogenic indices in pregnant hypertensive women.

The impact of gravidity on the atherogenic indices of second-trimester pregnant women is still being studied. Despite the fact that many studies have shown that pregnancy is a risk factor for metabolic disorders.

Given that it is widely established that hormonal changes during pregnancy have an impact on the mother's metabolism, hyperlipidemia is regarded as typical during this time. Pre-eclampsia is characterised by anomalies in lipid metabolism, which result in endothelial dysfunction. These abnormalities include decreased vasodilation and anticoagulant properties, increased expression of adhesion molecules, cytokine release, and reactive oxygen species. Preeclampsia is a significant cause of illness and mortality in both mothers and their babies. Its susceptibility has been linked to endothelial dysfunction brought on by lipid peroxidation, aberrant lipid metabolism, and altered lipid profiles. The simultaneous rise of the indices CHOL HDL-C and TG HDL-C, which Jia et al. (2006) claim may be used to accurately characterise the distribution of HDL-C subclasses, demonstrated the subclasses' shift towards smaller particles and the inadequacy of the reverse cholesterol transport. The fact that AIP increases during a typical pregnancy suggests that there may be a shift in the LDL particle distribution away from high, LDL particles and towards smaller, denser ones (Kaneva et al., 2015). The current investigation did not identify any correlation between in the current investigation, there was no discernible increase in the ratio of ApoB to ApoA1, in contrast to the findings of a study by Serrano and Casas (2018), and a higher risk of pre- eclampsia. This gap may be explained by the fact that this study focused on pregnant women in their third trimester while many other studies have mainly looked at pregnant women in their first and second trimesters. The results of the current investigation did not reveal a statistically significant (p0.05) difference between the atherogenic indices (AIP, CRI, and AC) in the case group and the control group, in contrast to those of Meenakshi et al. (2015) who discovered one. Keeping an eye on atherogenic indices during pregnancy may help prevent cardiovascular issues in the future because the significance level was established at p 0.0001. This research conflicts in line with a study by Aksonova et al (2016). That discovered elevated AIP and CRI indices in pregnant women with PE in the second trimester of pregnancy. On atherogenic indices Pregnancy's third trimester is when is sadly little information.

5. Conclusion

This research work has revealed that number of pregnancies do not cause any meaningful changes in the levels of atherogenic markers in normotensive and

hypertensive pregnant women in their 3rd trimester except in AIP parameter which was only reported in normotensive pregnant women.

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