IBOM MEDICAL JOURNAL
Vol.19 No.3 | July - September 2026 | Pages 582-591
www.ibommedicaljournal.org

Predictors of Gestational Diabetes Mellitus Among Antenatal Population in a Tertiary Hospital: Role of Biomarkers of Insulin Resistance

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Abstract

Context: Gestational Diabetes Mellitus (GDM) is any degree of impaired glucose tolerance with onset or first recognition during pregnancy. This condition affects many pregnancies and has its varied complications for both mother and child. This study aims to analyse the role of biomarkers of insulin resistance in GDM among women attending antenatal care (ANC) clinic at the University of Calabar Teaching Hospital (UCTH), Calabar.

Materials and Methods: A total of 180 pregnant women between 24 and 28 weeks of gestation attending ANC at UCTH Calabar were enrolled for the study. After obtaining ethical approval and informing the women, participants who consented had OGTT done by administration of 75g of glucose after a 12-hour overnight fast.Samples were collected and assayed for fasting plasma insulin, fasting plasma glucose, triglycerides, total cholesterol, HOMA-IR, and HOMA-β. A well-structured questionnaire containing information on demographic characteristics, socioeconomic status, and obstetric and gynaecological characteristics were obtained and assessed for association with biochemical findingsA p-value of less than 0.05 was considered significant .

Results: Out of the 180 women enrolled in the study, most were either overweight (38.3%) or obese (38.9%). Most of the women with GDM were primigravida (40%) and para 1 (37.3%), had previous caesarean section (52.8%), previous preterm delivery (95.4%), and previous stillbirth (45.8%). Based on risk factor assessment, ironically, 45.6% (majority) of women with GDM were of low risk, 29.5% of average risk, and 13.2% of high risk. Elevated fasting plasma glucose (FPG) was found in 30.6%, fasting plasma insulin (FPI) in 41.1%, triglycerides (TG) in 11.1%, total cholesterol (TC) in 51.1%, and insulin resistance index (HOMA-IR) in 67.8%. Of these biomarkers, FPG ($p = 0.000$) and HOMA-IR ($p = 0.004$) were found to be significantly associated with the development of GDM

Conclusion: Insulin resistance index (HOMA-IR) and fasting plasma glucose (FPG) were significantly related to the development of GDM.

Keywords: Gestational Diabetes Mellitus, Insulin Resistance, Predictors, Prevalence, Biomarkers, HOMA-IR, HOMA-β

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DOI: 10.61386/imj.v19i3.1182

Introduction

Gestational Diabetes Mellitus (GDM) is any degree of impaired glucose tolerance with onset or first recognition during pregnancy[1-3]. The World Health Organization (WHO) defines it as carbohydrate intolerance resulting in varying degrees of hyperglycemia, with onset or first detection during

pregnancy[2,4,5]. In normal pregnancy, insulin resistance increases in the late second trimester to levels that would approximate what is obtainable in type 2 diabetes mellitus. Most women remain normoglycemic as a result of adequate beta-cell compensation with increased insulin secretion. However, GDM develops if the beta-cell compensation is inadequate for the degree of insulin resistance and hepatic glucose production[6,7]. Based on the demographic projections made by the United Nations Population Division for 2015, the WHO issued estimates of adults with diabetes mellitus in all countries and reported that there will be more affected women than men, and a significant increase in the burden of GDM, especially in the low-resource countries of the world[2]. Regarding the estimated number of cases of hyperglycemia in pregnancy, Africa is second to South-East Asia, and more than 90% of cases are estimated to occur in low- and middle-income countries[8,9,10].

Gestational diabetes mellitus is the commonest cause of hyperglycaemia in pregnancy, accounting for about 90% of all diabetes during pregnancy.5 Gestational diabetes mellitus (GDM) is one of the most common metabolic disorders complicating pregnancy and constitutes a growing public health challenge worldwide. In Nigeria, the prevalence of GDM varies considerably depending on the population studied, screening strategy, and diagnostic criteria employed. A recent systematic review and meta-analysis reported a high prevalence of GDM among Nigerian pregnant women, highlighting the increasing burden of the disease and the need for effective screening and preventive strategies.[8]

In Calabar, South-South Nigeria, a recent study conducted among pregnant women attending antenatal care at the University of Calabar Teaching Hospital reported a GDM prevalence of 37.7%, indicating a substantial burden of disease in the locality. The study further identified advanced maternal age, overweight/obesity, previous adverse obstetric outcomes, and insulin resistance as important associated factors.[11] The consequences of GDM are significant for both the mother and the fetus. Maternal complications include pre-eclampsia, pregnancy-induced hypertension, increased rates of operative delivery and Caesarean section, and an elevated risk of developing type 2 diabetes mellitus later in life. Fetal and neonatal complications include macrosomia, birth trauma, neonatal hypoglycaemia, respiratory distress syndrome, hyperbilirubinaemia, preterm delivery, and increased perinatal mortality. Furthermore, offspring exposed to intrauterine hyperglycaemia are at increased risk of obesity, glucose intolerance, and type 2 diabetes later in life.Given the substantial prevalence of GDM in Nigeria and particularly in Calabar, together with its associated maternal and fetal complications, early identification and appropriate management are essential to improve pregnancy outcomes and reduce long-term metabolic risks in both mother and child.

Generally, GDM has few symptoms and is most commonly diagnosed by screening during pregnancy. It is a public health concern that currently affects a large proportion of the female population, with both short and long-term consequences for the fetus/neonate and the mother[12]. Depending on the ethnic population studied and the diagnostic criteria used, it has been reported that GDM complicates 1%-14% of all pregnancies worldwide, and its incidence has been on a dramatic increase[12-14]. This is due to the increasing pre-pregnancy weight and other risk factors associated with diabetes mellitus. Many biomarkers affect key pathways for insulin sensitivity and secretion; however, this study observed and analyzed the changes and relationship of some of the biomarkers that may have a direct role in insulin resistance during pregnancy and the pathogenesis of GDM. Fasting biochemical markers, e.g., glucose, insulin, lipid metabolism/profile markers, as well as insulin resistance index (HOMA-IR) and beta-cell function index (HOMA-β), were all observed in patients with GDM, and their usefulness in predicting the development of GDM and ultimately its diagnosis.[15]

Several different criteria are used to diagnose GDM. These are based on maternal history and clinical risks. The heterogeneity in the diagnostic criteria has not only made optimal management of the condition difficult, but it has also made the accurate determination of the true prevalence and the establishment of the risk of progression to type 2 DM postpartum problematic. This has also made it difficult to evaluate possible variations among ethnic groups and to compare published studies. All

these have led to confusion as to the management of patients with GDM, and this involves the health system at every level, leading to poor guidelines and policies concerning the condition, especially in the developing countries of the world. This study may help to examine the potential values of the biomarkers in improving the performance of screening for GDM by maternal risk factors, characteristics, and medical history. In Calabar and even in Nigeria, aside from risk factors evaluation and subsequent screening at 24-28 weeks of gestation using OGTT, there are no clear diagnostic tools reflecting insulin resistance established for GDM, despite it being one of the most common metabolic medical disorders in pregnancy. With the paucity of local content on the diagnostic utility of biomarkers of insulin resistance in GDM, the findings from this study will guide further studies on the subject in this environment and enrich the local content of the literature.

Materials and Methods

Study Design

The study was a descriptive cross-sectional study as it established the role of biomarkers of insulin resistance in the prediction of GDM among the antenatal population at UCTH, Calabar. The study was carried out over ten months.

Study Area

This study was carried out at the antenatal clinic of the University of Calabar Teaching Hospital (UCTH), Calabar, Cross River State, in the South-south geopolitical area of Nigeria. Cross River State has a population of about 2.8 million people. Calabar is the capital city of Cross River state and has a population of 371,022, and the occupation of people is predominantly civil service, trading, and farming16. University of Calabar Teaching Hospital is a tertiary healthcare facility located in Calabar Municipality of Cross River State.

Study population

The target population was pregnant women between 24-28 weeks of gestation being cared for at the antenatal clinic of the facility (UCTH Calabar).

Sample size determination

The Leshie-Kish formula 17 illustrated below, was used to determine the sample size.

$n = Z^2pq/d^2$

Where:

n = desired sample size

Z = standard normal deviation at the 95% confidence interval (1.96)

P = estimated prevalence of GDM in similar studies8 (14%) = 0.14

$q = 1 - p$

To account for possible loss to follow-up, incomplete data, or participant withdrawal, an attrition rate of 10% was added to the calculated minimum sample size. Consequently, the final sample size was increased to 180 participants.

Inclusion criteria

1. All pregnant women at gestational ages between 24-28 weeks.
2. Consenting participants

Exclusion criteria

1. Known diabetic pregnant women.
2. Pregnant women on medications likely to alter glucose metabolism, e.g., steroids, sulfonylureas, protease inhibitors, and beta agonists.
3. Very ill patients
4. Women who had eaten before coming to the clinic

Sampling technique

Consecutive sampling was employed for this study. All eligible pregnant women between 24 and 28 weeks of gestation attending the antenatal clinic of the University of Calabar Teaching Hospital during the study period were approached consecutively and invited to participate until the desired sample size of 180 participants was achieved. Eligibility was assessed using the predefined inclusion and exclusion criteria, and only consenting participants were enrolled.

Ethical consideration and approval

Ethical approval for the study was obtained from the ethical and research committee of the University of Calabar Teaching Hospital before the study was undertaken. Informed consent was duly sought from participants of the study. The objectives, significance, and benefits of the study were

explained to the respondents, and participation in the study was strictly voluntary. The research participants were assured of anonymity and confidentiality of information. Informed consents were obtained using the informed consent form (Appendix A). Participation was voluntary and free, and the participants had the right to end their participation at any stage of the study. Continuing in the study or refusal did not change the standard recommended care protocol of the hospital.

Blood Sample Collection

After obtaining consent and ascertaining the overnight fast, blood samples were collected using an aseptic technique. This involved swabbing the located venous site (commonly at the cubital fossa). Using a 10ml syringe, a 5ml blood sample was collected by backflow pressure. A total of 3mls was put into a plain sample bottle (all pre-numbered) for fasting insulin and lipids analysis, while 2mls was put into a sample bottle containing fluoride oxalate for fasting glucose analysis. This was subsequently followed by the 75g oral glucose dissolved in 250 mL of water. Thereafter, the 1-hour and 2-hour blood sample collections (2mls each) were respectively carried out and put in sample bottles containing fluoride oxalate for the 1-hour and 2-hour glucose analysis. The collected sample was analyzed at the Chemical Pathology laboratory.

Assay Method

At the laboratory, the collected samples were centrifuged at 12,000 rpm at room temperature for 10 minutes. This separated the blood cells from the plasma.Glucose was assayed using the glucose oxidase method. The solid phase ELISA was used to assay for insulin levels. The homeostatic model assessment for insulin resistance (HOMA-IR) is a measure of insulin resistance and is calculated thus:

HOMA-IR = {Fasting glucose (mmol/L)} X {Fasting insulin (mIu/L)} / 22.5

OR

{Fasting glucose (mg/dL)} X {Fasting insulin (mIu/L)} / 405

Biochemical Measurements: The body mass index was calculated from the equation: BMI = Weight (kg) / Height (m^2). The determination of fasting plasma glucose concentration, fasting insulin level, Total Cholesterol (TC), Triglyceride (TG) concentration, and Determination of Homeostatic Model Assessment for insulin resistance (HOMA-IR) was calculated from this equation: HOMA-IR (Fasting Glucose x Fasting Insulin) / 22.5(Glucose in mmol/L). Determination of Beta-cell Function (HOMA-β) was calculated from this equation: HOMA-β = (20 x Fasting Insulin) / (Fasting Glucose - 3.5) (% β-cell function).

Homeostatic Model Assessment of B-Cell Function (HOMA-β)

The homeostatic model assessment of beta-cell function (HOMA-β) is a measure of pancreatic β-cell function (insulin sensitivity) and is calculated thus:

HOMA-β = (20 x Fasting Insulin) / (Fasting Glucose - 3.5) HOMA-β (% β-cell function)

HOMA-β= (360 × Fasting Insulin) / (Fasting Glucose - 63) (% β-cell function)

Low HOMA-IR values indicate high insulin sensitivity, whereas high HOMA-IR values indicate low insulin sensitivity (insulin resistance).

Data analysis

Data obtained were entered into an Excel spreadsheet and imported into Statistical Package for Social Sciences (SPSS) version 23.0 for data cleaning and analysis. Univariate analysis was done to describe the data and presented in frequencies, percentages, and mean ± standard deviation. Bivariate analysis of biomarkers of insulin resistance was carried out using the chi-square test statistics (or Fisher's Exact Test where appropriate) for categorical variables, and the students' t-test for continuous variables to assess their relationships with GDM. The level of significance was set at p-value < 0.05.

Results

Socio-demographic characteristics of the study participants are presented in Table 1.

The respondents had a mean age of 29.7 ± 5.1 years, with the majority (34.4%) aged 25–29 years. Most participants were married (93.9%). Regarding educational attainment, two-thirds (66.7%) had tertiary education, while 32.8% had secondary education. In terms of occupation, 45.6% were self-employed, 25.0% were formally employed, and

26.7% were unemployed. The majority of the participants (72.2%) resided in urban areas.

Table 1: Socio-demographic characteristics of Study Participants

Demographic characteristics	Frequency(n=180)	Percentage (%)
Age group/years		
≤25	37	20.6
>25	143	79.4
Mean age ± SD	29.7 ± 5.1	
Marital status		
Single	11	6.1
Married	169	93.9
Educational level		
Primary	1	0.6
Secondary	59	32.8
Tertiary	120	66.7
Employment status		
Self-employed	82	45.6
Formal employment	45	25.0
Unemployed	48	26.7
Student	5	2.8
Husband's profession		
Civil servant	84	46.7
Business man	61	33.9
Petty trader	1	0.6
Labourer	3	1.7
Others	21	11.7
No response	10	5.6
Current residence		
Rural	50	27.8
Urban	130	72.2

BMI and blood pressure of study participants

Table 2 below shows BMI and blood pressure of study participants

The result shows that 39 (21.7%) had normal BMI, while a higher proportion were overweight, 69(38.3%), and yet a further higher proportion were obese, 70(38.9%). Mean BMI was 28.6/4.8 Kg/m2 and fell within the range of overweight. More respondents had normal systolic and normal diastolic blood pressure values.

Table 2: BMI and blood pressure of study participants

Variable	Frequency (n=180)	Percentage
BMI category (Kg/m^2)		
Underweight	2	1.1
Normal weight	39	21.7
Overweight	69	38.3
Obese	70	38.9
Mean BMI/SD	28.6 ± 4.8	
Systolic BP (mmHg)		
Normal	148	82.2
Abnormal	32	17.8
Mean SBP/SD	114 ± 14.5	
Diastolic BP (mmHg)		
Normal	141	78.3
Abnormal	39	21.7
Mean DBP/SD	67.8 ± 10.4	

Relationship Between Biomarkers Of Insulin Resistance And GDM

Table 3 represents the relationship between biomarkers of insulin resistance and GDM.

Mean fasting plasma glucose was higher among women with GDM compared with women who did not have GDM (5.8/1.4 versus 4.2/0.7), and the difference was statistically significant (p=0.000). Similarly, the mean insulin resistance index was higher among women with GDM compared with those without GDM 5.7/2.7 versus 4.1/4.0), the difference was also statistically significant (p=0.004). Again, women who are GDM-positive, in comparison with their GDM-negative counterparts, had higher mean fasting plasma insulin (23.0/10.8 versus 20.2/11.5), slightly higher mean total cholesterol (6.4/1.4 versus 6.4/1.2) and higher triglycerides (1.7/0.8 versus 1.5/0.6), although these differences were not statistically significant (p>0.05). Conversely, women who are GDM-negative, in comparison with their GDM-positive counterparts, had higher mean beta-cell function index (HOMA-β) (576.3/60.5 versus 466.9/126.9), but the difference was not statistically significant (p=0.437).

Table 3: Relationship between biomarkers of insulin resistance and GDM

Biomarkers of Insulin Resistance	GDM Present n=68	GDM Absent n=112	T-test N=180	P-value
Fasting plasma glucose	5.8 ± 1.4	4.2 ± 0.7	8.185	0.000*
Fasting plasma insulin	23.0± 10.8	20.3 ± 11.5	1.560	0.120
Total cholesterol	6.4 ± 1.4	6.4± 1.3	0.271	0.787
Triglycerides	1.7 ± 10.8	1.5± 0.6	1.881	0.062
Insulin resistance index (HOMA-IR)	5.7 ± 2.7	4.1 ± 4.0	2.943	0.004*
Beta-cell function index (HOMA-β)	466.9 ± 126.9	576.3 ± 60.5	0.779	0.437

Discussion

Most of the women enrolled in this study had various age ranges, with a mean age of 29.7 ± 5.1 years. Most of them (93.9%) were married, and two-thirds (66.7%) attained a tertiary level of education, while 32.8% attained a maximum of secondary education. While 45.6% of the respondents were self-employed, 25.0% had formal employment, and

26.7% were unemployed. Most were urban dwellers (85%). The socio-demographic characteristics of the respondents in this study are similar to those of the women studied at Owerri Municipal Council by Nwaokoro et al[18], where 92.0% of the pregnant women were married, and the majority had tertiary (63.0%) and secondary levels of education (27.0%). These trends were also consistent with the study by Chukwunyere et al in Abeokuta, Southwestern Nigeria.[2] However, the findings deviated from the findings by Rajput R et al[14] in an Indian study where the majority (58.2%) of the women were between the ages of 21-25 years with a mean age of 23.6 ± 3.4 years. The majority of the respondents in the Indian study were unemployed and in a lower socioeconomic class. In terms of the socio-demographic features as predictors for developing GDM, the study showed that the risk of GDM increases with women's age. This finding is consistent with earlier studies[11,12,14,18], notably those by Ewenighi CO et al[18], in Abakiliki, South-Eastern Nigeria, and Nguyen CL et al[9] in Eastern and Southeastern Asia. The study also reveals that most women with GDM were urban dwellers (P value =0.036). This is similar to results from India, where higher prevalence proportions in the urban compared to rural populations were reported[11]. It can be speculated that the difference in lifestyle factors (e.g, diet and physical activity) may explain the variation. On the other hand, in the study by Ewenighi et al[18], the prevalence proportions between the rural and urban populations were similar. Another reason could be the selection of study participants, where some studies involved women attending an antenatal clinic in an urban setting, as was the case in this study, while others were community-based studies involving all pregnant women in a particular community. Generally, there are limited community studies available in sub-Saharan Africa.[11]

There was no significant association between gestational diabetes mellitus (GDM) and the socio-economic status of the participants in this study. This finding is consistent with those reported by Innes KE et al.[20] and Yang et al.[21] among Chinese pregnant women, both of whom found no significant relationship between socio-economic status and the occurrence of GDM. However, this finding contrasts with that of Rajput et al.[14] who reported a significant association between GDM and socio-economic status among pregnant women in India. The observed association in the Indian study was attributed to factors commonly associated with higher socio-economic status, including advanced maternal age, increased pre-pregnancy body weight, higher body mass index (BMI), and a more sedentary lifestyle. Variations in socio-cultural characteristics, lifestyle practices, and population demographics may account for the differences observed between studies.

Higher parities are associated with a higher prevalence of GDM in a few studies[11,13,14,18,22]. This could be due to the low numbers of the study for those particular variables, and hence the result. This finding is contrary to studies by Rajesh et al[13] and Nwaokoro et al[18], who found that pregnancy-related complications/outcomes were common in GDM compared to non-GDM cases.

In terms of BMI, this current study revealed that a majority of the women were either overweight (38.3%) or obese (38.9%) using the WHO classification system of obesity. In some of the participants, BMI was based on recall data, where several respondents were not completely certain of their pre-pregnancy weight. So, booking weights were employed. Hence, the interpretation of the rate of overweight and obesity needs to be done carefully. In a systematic review of GDM in Africa by Macaulay et al[9] it was found that women with BMI >30kg/m^2 versus <20kg/m^2 had a three times greater risk of developing GDM. Contrary to this, a study in Thailand by Anussara K et al[23] did not find any association between obesity and GDM. It has been shown that gestational weight gain during pregnancy is associated with adverse outcomes such as GDM and preeclampsia. In a Thai study, it was found that hypertension was significantly higher in obese Thai women. This corroborates data from other studies[24,25,26]. In this current study, the majority of the women had normal systolic and diastolic blood pressures. However, we did not control for the risk factors of gestational hypertension. Hence, it may be difficult to interpret the results.

The summary and recommendations of the Fifth International Workshop-Conference on Gestational Diabetes Mellitus held in Chicago in November 2005 endorsed the classification criteria and strategies for the detection and diagnosis of GDM

that were recommended at the Fourth Workshop-Conference. Women were classified into low risk, average risk, and high risk for GDM. However, the relationships were not statistically significant. This is in tandem with some studies that showed groups of women with GDM who had no antecedent risk factors. Risk prediction in GDM is primarily based on maternal history and clinical risk factors, with sensitivities and specificities reported to be around 40-50%.[6] Thus, about half of the women with GDM do not have specific risk factors, and about half of those found not to have GDM do have historic risk factors for GDM[28]. With the absence of any antecedent pregnancy and the fact that about 40-50% of affected women do not have any identifiable risk factor, use of the risk factor analysis might be limited with a low sensitivity for diagnosis of GDM. With no reliable method of identifying subjects at increased risk of GDM, it is suggested that all pregnant women be screened for GDM (universal screening)[6,22,29].

The majority of the women in the present study (67.8%) had a significant insulin resistance index (HOMA-IR). Amit DS et al[30] showed a significant rise in HOMA-IR in women at the 2nd and 3rd trimesters of pregnancy. In a recent cross-sectional study carried out in the Arusha region, Tanzania, by Msollo SS et al[29], a lower prevalence of 21% was observed among 230 randomly selected pregnant women who were not known to have diabetes before pregnancy. Insulin resistance is the condition in which there is a decrease in the action of insulin on body tissues at a normal concentration of plasma insulin. This can be a result of a number of factors, such as defective molecular structure of insulin, defective receptor functioning, or defective signal transduction pathway. Women with increased HOMA-IR are prone to develop pre-eclampsia and GDM. These conditions are both associated with an increase in expression of TNF-α and other inflammatory markers, which causes insulin resistance[30].

About half of the women in this study (51.1%) had high total cholesterol, and only 11.1% were found to have high triglycerides. In a Turkish study by Korkmazer et al[31], it was shown that pregnancy is a hyperlipidaemic state as defined by the National Cholesterol Education Program (NCEP) Adult Treatment Panel III Criteria, even though hyperlipidaemia criteria need adaptation for pregnancy due to the special physiology of pregnancy[31].

In analyzing the relationship between the biomarkers of insulin resistance and the development of GDM among the participants of this present study, the results indicated some significant correlations. The mean fasting plasma glucose and insulin resistance index (HOMA-IR) were significantly higher among the participants with GDM (p-value 0.000 and 0.004, respectively). This is corroborated by a Polish study by Alina Sokup et al[15], which showed that HOMA-IR, fasting plasma glucose, fasting plasma insulin, as well as the insulin dose required per day, increased in GDM. Georgiou HM et al[32] demonstrated a significantly higher concentration of fasting plasma glucose ($p < 0.001$) and HOMA-IR ($p < 0.004$) in women with GDM. These results are consistent with the general opinion that chronic insulin resistance lies at the core of the development of the most common form of β-cell dysfunction present in GDM[15]. This provides a unique opportunity to study the early pathogenesis of the condition and develop interventions to prevent the disease[29].

Though the present study revealed higher fasting plasma insulin levels among women with GDM, there is no significant correlation ($p > 0.05$). Sumaiya A et al in a South African study showed that insulin sensitivity markers are promising tools to identify women at risk of GDM[33].They found a significant correlation between fasting plasma insulin and the development of GDM ($p < 0.001$) out of the 262 pregnant women in the study. The findings were also in tandem with another study of 250 pregnant women in East Melbourne, Australia, by Georgiou HM et al[32], who found that women with GDM, compared to controls, exhibited significant elevation of plasma levels of insulin at 28 weeks of gestation. A decreased insulin response was also demonstrated by Xiang et al in women with GDM in late gestation[34]. The pathophysiology of GDM involves abnormalities of insulin-sensitive tissues. Beta-cells' sensing of glucose is abnormal and is manifested as an inadequate insulin response for a given degree of glycaemia[30].

The present study demonstrated slightly higher mean total cholesterol and triglycerides among the women with GDM, but the differences were not

statistically significant. Contrary to this, in a case-control study involving 116 pregnant women between 24 and 28 weeks of gestation, Korkmazer et al demonstrated that pregnancy is a hyperlipidaemic pattern[31]. However, they established that only serum triglyceride levels and atherogenic indices of the plasma measured at 24-28 weeks of gestation were significantly higher in the GDM group. A study by Guanghi Li et al[35] found higher degrees of dyslipidaemia from the fasting plasma lipid profiles of women who developed GDM among 2488 healthy pregnant women. They substantiated a significant correlation between GDM and increases in triglycerides, total cholesterol, and LDL/HDL ratio. With regards to each lipid marker, some studies from case-control studies[31,36] or prospective studies[35,37,39] suggested associations between higher triglyceride concentrations and increased risk of developing GDM, but other studies had different findings. Rizzo M et al[39] did not find any differences in the concentration of any of the plasma lipids between GDM women and controls. Lipidemic pattern in GDM is still controversial[30], The role of altered lipid metabolism in early pregnancy for the prediction of GDM independent of BMI and insulin resistance phenotypes is unproven and requires more longitudinal research[6].

The current study posits that women without GDM had higher β-cell function indices (HOMA-β) when compared with those who developed GDM, though the difference was not statistically significant (p = 0.437). This is contrary to the study by Kenna et al, who demonstrated that pancreatic β-cell death was rather reduced in women with GDM[40]. The insulin production capacity of pancreatic β-cells is not infinite. A gradual decline in β-cell function results in a reduction in insulin production, and the condition progresses to glucose intolerance and subsequently to GDM[40]. Xiang AH et al showed that impaired regulation of glucose clearance, glucose production, and reduced β-cell function are all found in late-stage GDM[34]. Recent studies examining β-cell function in Asian women provided additional support to the notion that β-cell function and glucose tolerance are decreased in GDM when compared with normal pregnancy[41] Saisho Y et al demonstrated a significant correlation between β-cell dysfunction and the development of GDM in Japanese women, irrespective of obesity[41].

Conflicts in some of the findings among studies mentioned earlier may be due to a variety of reasons, ranging from study design, sample size, confounders, variations in population characteristics/ethnicity, and diagnostic criteria of GDM employed.

Conclusion

This study demonstrated that fasting plasma glucose and insulin resistance index (HOMA-IR) were significantly associated with gestational diabetes mellitus among pregnant women attending antenatal care at the University of Calabar Teaching Hospital. These findings suggest that biomarkers of insulin resistance may have potential utility in identifying women at increased risk of GDM. However, further prospective studies with larger sample sizes and predictive performance analyses are required before these biomarkers can be incorporated into routine screening algorithms. Early recognition of insulin resistance remains important for improving maternal and fetal outcomes associated with gestational diabetes mellitus. Insulin resistance increases in pregnancy and is associated with the development of GDM.

Conflict of interest: The authors declare no conflict of interest.

Funding: None received

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