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Emmanuel M. Akwuruoha *

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Research Article

Evaluation of Risk Factors of Gestational Diabetes among Pregnant Women in Abia State, Nigeria

Emmanuel M. Akwuruoha [1]* and Augustine I. Airaodion [2]

[1]Department of Obstetrics and Gynaecology, Abia State University Teaching Hospital, Aba, Nigeria.

[2]Department of Biochemistry, Lead City University, Ibadan, Oyo State, Nigeria.

***Corresponding Author:** Emmanuel M. Akwuruoha, Department of Obstetrics and Gynaecology, Abia State University Teaching Hospital, Aba, Nigeria.

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Abstract:

Background: Gestational diabetes mellitus (GDM) is an increasing public health concern associated with adverse maternal and neonatal outcomes. Limited data exist on its risk factors in southeastern Nigeria, particularly among antenatal clinic attendees in Abia State. This study evaluated the socio-demographic, obstetric, lifestyle, and clinical predictors of GDM.

Materials and Methods: A hospital-based cross-sectional study was conducted among 140 pregnant women attending the antenatal clinic of Abia State University Teaching Hospital, Aba. Participants were recruited using a systematic random sampling technique. Data were collected through structured interviewer-administered questionnaires, anthropometric measurements, and laboratory investigations, including a 75 g oral glucose tolerance test (OGTT) following WHO diagnostic criteria. Descriptive statistics summarized participant characteristics, while chi-square tests, Pearson's correlation, and logistic regression identified risk factors of GDM. Statistical significance was set at $p < 0.05$.

Results: The mean age of participants was 31.2 ± 5.6 years, with the majority being married (90.7%) and educated (80.7% with secondary/tertiary education) (Table 1). Significant risk factors associated with GDM included advanced maternal age ($p = 0.028$), higher body mass index ($p < 0.001$), elevated blood pressure ($p = 0.002$), family history of diabetes ($p < 0.001$), parity ($p = 0.044$), history of macrosomia ($p = 0.002$), and inadequate physical activity ($p = 0.024$) (Tables 5–6). Educational level ($p = 0.036$) and monthly income ($p = 0.006$) were also significant determinants. Lifestyle factors such as smoking and alcohol consumption showed no significant association with GDM.

Conclusion: GDM in this population was significantly associated with maternal age, obesity, family history of diabetes, parity, macrosomia, and low physical activity. Strengthening routine screening, promoting healthy lifestyles, and targeted interventions for high-risk groups are recommended to mitigate the burden of GDM in Abia State.

Keywords: gestational diabetes; pregnancy; risk factors; maternal health; obesity; antenatal care

Introduction

Gestational diabetes mellitus (GDM), glucose intolerance first diagnosed in pregnancy, is one of the commonest metabolic complications of pregnancy worldwide and represents an important and growing public-health problem because of its short- and long-term consequences for both mother and child [1]. GDM arises when the normal pregnancy-associated increase in insulin resistance (driven by placental hormones and maternal physiological changes) overwhelms pancreatic β-cell capacity, leading to hyperglycaemia during the second half of pregnancy and thereby increasing the risk of obstetric complications such as pre-eclampsia, induction of labour, caesarean delivery and macrosomia, as well as neonatal hypoglycaemia and longer-term cardiometabolic risks for the offspring. Large systematic reviews and guideline syntheses emphasize both the frequency of GDM (affecting an estimated one in seven pregnancies globally under contemporary diagnostic criteria) and its association with adverse perinatal and long-term outcomes for mother and child, underlining the value of early detection and management [2].

Prevalence estimates for GDM vary widely between regions and by diagnostic criteria, but within Nigeria studies show a particularly broad range (from under 1% to nearly 40%) with a pooled prevalence around the low double digits. A national systematic review and meta-analysis of Nigerian studies reported a pooled prevalence of approximately 11% and highlighted substantial heterogeneity across studies, reflecting differences in screening strategies, diagnostic cut-offs and study populations [3]. Given this heterogeneity, local, state-level data (such as for Abia State) are essential to plan screening, prevention and treatment strategies that match population needs. The Nigerian pooled evidence also identified a consistent set of determinants that recur in primary studies from the country, supporting the need to evaluate these risk factors in local contexts.

International evidence identifies a set of well-established maternal risk factors that increase the likelihood of GDM and that have been repeatedly confirmed by contemporary reviews and meta-analyses [4]. These include advanced maternal age, maternal overweight and obesity, a prior history of GDM or of delivering a macrosomic infant, family history of type 2 diabetes, polycystic ovary syndrome (PCOS), and certain patterns of parity and obstetric history. Lifestyle and sociodemographic drivers, for example urbanization, dietary changes, physical inactivity and rising obesity prevalence, are also important contributors to the rising burden of GDM in low- and middle-income countries. More recent work has broadened the risk-factor lens further to include environmental exposures (air pollution, certain endocrine-disrupting chemicals and trace element disturbances), maternal sleep and psychosocial stressors, and gene-environment interactions that may modify individual susceptibility [5]. These varied determinants point to the multifactorial nature of GDM and to the need for locally-tailored risk assessment that integrates clinical, behavioural and environmental information.

The public-health importance of identifying risk factors at the state or facility level is twofold. First, women with GDM are at markedly higher risk of developing type 2 diabetes and cardiovascular disease after pregnancy, and their children have higher lifetime risk of obesity and metabolic disease; hence, detection of GDM creates an opportunity for early preventive interventions that benefit two generations [1]. Second, local evidence on risk factor distributions (for example, the prevalence of obesity, maternal age profile, parity patterns, or exposure to environmental pollutants) informs which screening approaches and prevention programmes will be most efficient and equitable. Studies and guideline reviews repeatedly call for improved postpartum follow-up, standardized screening (including timing and test selection) and culturally-appropriate lifestyle interventions, but also note significant evidence gaps around optimal screening algorithms and feasible, high-impact prevention strategies in resource-constrained settings [2]. These gaps strengthen the justification for state-level research in Abia State that links clinical risk profiles to pragmatic screening and referral pathways.

Despite national meta-analytic estimates and global reviews [4,5], there remains limited, granular evidence from many Nigerian states including Abia State about which risk factors are most prevalent and most predictive of GDM locally. Abia State, like many parts of south-east Nigeria is experiencing shifts in lifestyle and urbanization that plausibly increase GDM risk (for example rising overweight/obesity, changes in diet and physical activity, and variable access to antenatal screening). A focused evaluation of GDM risk factors among pregnant women in Abia State will therefore produce actionable data for local health authorities: it will quantify the local distribution of modifiable and non-modifiable risks, allow prioritization of prevention strategies (such as targeting pre-pregnancy weight and physical activity interventions), and inform pragmatic screening policies (who to screen early vs. universally, which tests to use). In addition, the study can contribute to the national evidence base, helping reconcile regional heterogeneity and guiding standardized clinical pathways across Nigeria. This study evaluated the socio-demographic, obstetric, lifestyle, and clinical predictors of GDM.

Materials And Methods

Study Design

This study employed a hospital-based cross-sectional design to evaluate the risk factors associated with gestational diabetes mellitus (GDM) among pregnant women in Abia State, Nigeria. The design was considered appropriate as it allows the simultaneous assessment of socio-demographic, obstetric, lifestyle, and clinical risk factors in relation to GDM status at a single point in time.

Study Area

The study was conducted at the Antenatal Clinic (ANC) of Abia State University Teaching Hospital (ABSUTH), Aba, Abia State, Nigeria. The hospital is a major tertiary health institution in the southeast geopolitical zone of Nigeria, providing specialist healthcare services, including obstetric and gynaecological care, to a diverse population within Abia State and neighboring states. The ANC operates on weekdays and records a high patient turnover, with an average of 50–70 pregnant women attending each clinic day. The patient population is heterogeneous, comprising individuals from various socio-economic and educational backgrounds.

Study Population

The study population comprised pregnant women attending the antenatal clinic at ABSUTH during the study period, regardless of their gestational age, parity, or previous pregnancy outcomes.

Inclusion Criteria

1. Pregnant women registered and attending ANC at ABSUTH during the study period.
2. Women who gave informed consent to participate in the study.
3. Women aged 18 years and above.

Exclusion Criteria

1. Pregnant women who were critically ill at the time of the study.
2. Those who declined participation.
3. Women with cognitive or communication impairments that could hinder effective response to the questionnaire.

Sample Size Determination

The sample size was determined using Cochran's formula for estimating population proportions, as outlined by Ezebuiro et al. [6]:

$$n = \frac{Z^2(Pq)}{e^2}$$

The formula components are defined as follows:

1. n represents the minimum required sample size.
2. Z is set at 1.96, corresponding to a 95% confidence level.
3. P denotes the established prevalence of contraceptive use among women in Nigeria.
4. e signifies the allowable margin of error, fixed at 5% (0.05).

q = 1 - p

A recent study conducted by Ajiboye et al. [7] reported the prevalence of GDM in Nigeria as 9%

P = 9% = 0.09

q = 1 – 0.09

= 0.91

$$n = \frac{(1.96)^2(0.09 \times 0.91)}{(0.05)^2}$$

$$n = \frac{3.8416 \times (0.0819)}{0.0025}$$

$$n = \frac{0.3146}{0.0025} = 125.85$$

The minimum sample size was 126, but it was adjusted to 140 to account for a 10% non-response rate.

Sampling Technique

A systematic random sampling technique was used. Using the ANC attendance register, the sampling interval was determined by dividing the estimated number of eligible pregnant women attending ANC during the study period by the required sample size [8]. The first participant was selected randomly, and every 5th eligible woman was subsequently recruited until the sample size was attained.

Data Collection Instruments

A structured interviewer-administered questionnaire was used to collect data. The instrument consisted of five sections:

1. **Socio-demographic characteristics** – age, marital status, education, occupation, and income.
2. **Obstetric and reproductive history** – parity, gravidity, family history of diabetes, history of macrosomia, stillbirths, or GDM in previous pregnancies.
3. **Lifestyle factors** – dietary habits, physical activity, alcohol consumption, and smoking.
4. **Anthropometric measurements** – pre-pregnancy weight, current weight, height, and BMI.
5. **Laboratory investigations** – Oral Glucose Tolerance Test (OGTT) results.

The questionnaire was pre-tested at Rhema University Teaching Hospital, Aba to ensure clarity, reliability, and validity.

Anthropometric and Clinical Measurements

1. Weight was measured using a calibrated digital weighing scale, with participants wearing light clothing and no shoes.
2. Height was measured with a stadiometer, ensuring participants stood erect with heels together.
3. BMI was calculated as weight (kg) divided by height squared (m^2).
4. Blood Pressure was measured using a mercury sphygmomanometer after participants had rested for at least 5 minutes.

Laboratory Investigations

Screening and diagnosis of GDM were carried out following World Health Organization (WHO, 2013) criteria [9]:

1. 75 g Oral Glucose Tolerance Test (OGTT):
- Participants fasted overnight (8–10 hours).
- Fasting venous plasma glucose was measured.
- Participants ingested 75 g of anhydrous glucose dissolved in 250–300 ml of water.
- Plasma glucose was measured at 1 hour and 2 hours post-ingestion.

2. Diagnostic Criteria for GDM:
- Fasting plasma glucose ≥ 5.1 mmol/L (92 mg/dl)
- 1-hour plasma glucose ≥ 10.0 mmol/L (180 mg/dl)
- 2-hour plasma glucose ≥ 8.5 mmol/L (153 mg/dl)
- GDM was diagnosed if any of the above thresholds were met.

Blood samples were analyzed using standard enzymatic methods at the hospital laboratory. Internal quality control procedures were followed to ensure accuracy.

Data Analysis

Data collected were entered into Statistical Package for Social Sciences (SPSS) version 26.0 for analysis. Descriptive statistics: Mean, standard deviation, frequencies, and percentages were computed for continuous and categorical variables. Bivariate analysis: Chi-square test was used to assess associations between GDM and categorical risk factors, while an independent t-test compared continuous variables. Multivariate analysis: Binary logistic regression was performed to identify independent predictors of GDM. Adjusted Odds Ratios (AORs) with 95% Confidence Intervals (CIs) were reported. Level of significance: A p-value < 0.05 was considered statistically significant.

Ethical Considerations

This study was approved by the Abia State University Teaching Hospital Research Ethics Committee with reference number ABSUTH/MAC/117//VOL.II/78. Written informed consent was obtained from all participants after explaining the objectives, procedures, potential risks, and benefits of the study. Confidentiality and anonymity were assured by coding data and restricting access to only the research team. Participation was voluntary, and respondents could withdraw at any stage without consequences.

Results

The study involved 140 participants whose sociodemographic characteristics showed that the majority were between 30–34 years (26.4%) and 35–39 years (22.1%), with most being married (90.7%). A substantial proportion had tertiary education (43.6%) and secondary education (37.1%). In terms of occupation, traders (33.6%) and civil servants (27.9%) were the most represented (Table 1).

Regarding obstetric and medical history, most participants had 3–4 pregnancies (44.3%), while 26.4% were nulliparous and 14.3% were grand multiparous. Notably, 13.6% reported a history of macrosomia, 10.7% had a history of preeclampsia, and 18.6% had a family history of diabetes mellitus. A family history of hypertension was observed in 29.3% of participants (Table 2).

Lifestyle analysis revealed that while 42.9% agreed or strongly agreed to engaging in regular physical activity, 50.7% admitted consuming a high-carbohydrate diet, and 57.9% frequently consumed fruits and vegetables. Tobacco use (4.3%) and alcohol consumption during pregnancy (7.1%) were relatively uncommon (Table 3).

Anthropometric and clinical characteristics indicated an average BMI of 28.1 ± 3.9 kg/m^2, with mean systolic and diastolic blood pressures of 122.6 ± 11.5 mmHg and 77.4 ± 8.7 mmHg, respectively. Mean fasting plasma glucose was 4.9 ± 0.8 mmol/L, while 1-hour and 2-hour plasma glucose levels were 8.6 ± 1.5 mmol/L and 7.7 ± 1.3 mmol/L, respectively (Table 4).

Correlation analysis demonstrated significant positive associations between GDM and age ($r = 0.291$, $p = 0.001$), BMI ($r = 0.354$, $p < 0.001$), systolic BP ($r = 0.276$, $p = 0.002$), and diastolic BP ($r = 0.248$, $p = 0.004$). Additionally, BMI correlated significantly with fasting plasma glucose ($r = 0.318$, $p <$

0.001), while age showed a weaker but significant correlation with 2-hour plasma glucose ($r = 0.187$, $p = 0.027$) (Table 5).

Chi-square analysis further revealed significant associations between GDM and several risk factors, including age group ($p = 0.028$), educational level ($p = 0.036$), monthly income ($p = 0.006$), family history of diabetes ($p < 0.001$), history of macrosomia ($p = 0.002$), parity ($p = 0.044$), and physical activity ($p = 0.024$). However, marital status ($p = 0.411$) and alcohol consumption ($p = 0.518$) were not significantly associated with GDM (Table 6).

Variable	Frequency (n = 140)	Percentage (%)
Age group (years)		
18–24	22	15.71
25–29	28	20.00
30–34	37	26.43
35–39	31	22.14
40–45	22	15.71
Marital status		
Married	127	90.71
Single	9	6.43
Divorced/Separated	4	2.86
Educational level		
No formal education	8	5.71
Primary	19	13.57
Secondary	52	37.14
Tertiary	61	43.57
Occupation		
Unemployed	23	16.43
Trader	47	33.57
Civil servant	39	27.86
Artisan	18	12.86
Professional	13	9.29

Table 1: Sociodemographic Characteristics of Participants

Variable	Frequency (n = 140)	Percentage (%)
Gravidity		
1–2	54	38.57
3–4	62	44.29
≥5	24	17.14
Parity		
Nulliparous	37	26.43
Multiparous (1–4)	83	59.29
Grand multiparous (≥5)	20	14.29
History of macrosomia	19	13.57
History of stillbirth	12	8.57
History of preeclampsia	15	10.71
Family history of DM	26	18.57
Family history of HTN	41	29.29

Table 2: Obstetric and Medical History of Participants

Variable	Strongly Disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Strongly Agree n (%)
I engage in regular physical activity	27 (19.29)	31 (22.14)	22 (15.71)	39 (27.86)	21 (15.00)
I consume a high-carbohydrate diet	11 (7.86)	18 (12.86)	26 (18.57)	53 (37.86)	32 (22.86)
I frequently consume fruits and vegetables	9 (6.43)	22 (15.71)	28 (20.00)	55 (39.29)	26 (18.57)
I smoke cigarettes or use tobacco	119 (85.00)	10 (7.14)	5 (3.57)	4 (2.86)	2 (1.43)
I consume alcohol during pregnancy	107 (76.43)	17 (12.14)	6 (4.29)	7 (5.00)	3 (2.14)

Table 3: Lifestyle Characteristics

Variable	Mean ± SD
Pre-pregnancy Weight (kg)	67.8 ± 9.4
Current Weight (kg)	75.3 ± 10.8
Height (m)	1.64 ± 0.06
BMI (kg/m²)	28.1 ± 3.9
Systolic BP (mmHg)	122.6 ± 11.5
Diastolic BP (mmHg)	77.4 ± 8.7
Fasting Plasma Glucose (mmol/L)	4.9 ± 0.8
1-hour Plasma Glucose (mmol/L)	8.6 ± 1.5
2-hour Plasma Glucose (mmol/L)	7.7 ± 1.3

Table 4: Anthropometric and Clinical Characteristics+

Variables	Pearson's r	p-value
Age (years) vs. GDM	0.291	0.001*
BMI vs. GDM	0.354	<0.001*
Systolic BP vs. GDM	0.276	0.002*
Diastolic BP vs. GDM	0.248	0.004*
Fasting Plasma Glucose vs. BMI	0.318	<0.001*
2-hour Plasma Glucose vs. Age	0.187	0.027*

Table 5: Correlation Analysis between Continuous Variables and GDM Status

*Significant at p < 0.05

Variable	χ² value	df	p-value	Remark
Age Group	10.841	4	0.028*	Significant
Marital Status	1.783	2	0.411	Not Significant
Educational Level	8.524	3	0.036*	Significant
Monthly Income	12.639	3	0.006*	Significant
Family History of Diabetes	16.711	1	<0.001*	Significant
History of Macrosomia	9.482	1	0.002*	Significant
Parity	6.229	2	0.044*	Significant
Physical Activity	11.208	4	0.024*	Significant
Alcohol Consumption	3.241	4	0.518	Not Significant

Table 6: Chi-Square Test of Association between Risk Factors and GDM

*Significant at p < 0.05

Discussion

In this study on pregnant women in Abia State, Nigeria, a substantial proportion of participants were aged 30–34 years (26.4%) and 35–39 years (22.1%), reflecting a tendency towards advanced maternal age. Age emerged as a significant correlate of gestational diabetes mellitus (GDM), with both Pearson's correlation ($r = 0.291$, $p = 0.001$) and chi-square analysis across age groups ($\chi^2 = 10.841$, $p = 0.028$) showing strong associations. Our finding aligns with several Nigerian and African studies indicating that advanced maternal age, a known non-modifiable risk factor, predisposes women to GDM (e.g., age ≥ 30 years) [3,10]. The systematic review and meta-analysis on GDM in Nigeria also listed advanced maternal age among the most commonly reported determinants [3].

High BMI was another prominent risk factor in our cohort, with mean BMI of 28.1 kg/m² indicating overweight status. This variable displayed a stronger correlation with GDM ($r = 0.354$, $p < 0.001$) than age, and obesity is well-established in the literature as a major modifiable risk factor. Indeed, obesity frequently appears among the top determinants of GDM in systematic reviews across Nigeria and broader sub-Saharan Africa [3,11]. Local research, including the Ibadan Pregnancy Cohort Study, confirmed that maternal obesity significantly increases the risk of GDM, macrosomia, and other adverse perinatal outcomes, with poor lifestyle and cultural dietary practices playing a contributory role [12].

Our data also showed that family history of diabetes was significantly associated with GDM ($\chi^2 = 16.711$, $p < 0.001$), consistent with global and regional findings, which consistently identify a familial predisposition, especially first-degree relatives, as an important risk factor [3,13].

Similarly, a history of macrosomia among participants' prior pregnancies was significantly linked to GDM ($\chi^2 = 9.482$, $p = 0.002$). This finding is in line with Nigerian meta-analyses that frequently point to previous macrosomic births as a strong predictor of GDM [3,14]. It's noteworthy that macrosomia is both an outcome of GDM and a predictor for recurrent GDM, due to shared pathophysiological mechanisms like insulin resistance [15].

Parity also emerged as significant ($\chi^2 = 6.229$, $p = 0.044$), mirroring broader epidemiological observations suggesting that higher parity can be linked to increased GDM risk [10]. However, the relationship may be multifactorial, related to cumulative weight gain, age, and metabolic changes.

Educational level ($\chi^2 = 8.524$, $p = 0.036$) and monthly income ($\chi^2 = 12.639$, $p = 0.006$) also showed significant associations with GDM. While socioeconomic determinants are less commonly isolated in GDM research, they likely shape access to health information, nutrition, and antenatal care, indirectly influencing risk profiles. Elevated education often correlates with healthier lifestyles, but it may also correspond to more sedentary occupations, urban living, and dietary transition, which can elevate GDM risk. Unfortunately, many studies do not directly examine these variables.

Physical activity was a significant protective factor ($\chi^2 = 11.208$, $p = 0.024$). Only 42.9% of our participants indicated regular exercise (Agree or Strongly Agree), while the rest were inactive. This echoes global findings: low physical activity is associated with increased GDM risk, and interventions promoting regular moderate activity reduce risk [16]. In Nigeria, although empirical GDM-specific data on physical activity are limited, the connection between sedentary behaviors, obesity, and GDM is well-documented [12].

In contrast, tobacco smoking and alcohol consumption during pregnancy were not significantly associated with GDM in our analysis ($p > 0.05$). This aligns with the understanding that while smoking may modestly elevate GDM risk in some populations [15], the behaviors are generally uncommon among pregnant women in Nigeria, reducing statistical power. Similarly, alcohol use during pregnancy may contribute to other adverse outcomes but is not a well-established GDM risk factor.

Blood pressure also correlated with GDM (systolic $r = 0.276$, $p = 0.002$; diastolic $r = 0.248$, $p = 0.004$), consistent with the clustering of hypertensive disorders and GDM in metabolic syndrome frameworks [17]. We also noted that Fasting Plasma Glucose positively correlated with BMI ($r = 0.318$, $p < 0.001$), reinforcing the interdependence of adiposity and glucose metabolism.

Conclusion

Our findings validate several well-established risk factors for GDM in the Nigerian context, advanced maternal age, elevated BMI, family history of diabetes, and history of macrosomia. Additionally, lifestyle factors such as physical inactivity significantly contribute. These insights reinforce the importance of targeted interventions promoting healthy weight, physical activity, early screening, particularly among older, multiparous, or metabolically predisposed women, and optimizing socioeconomic supports to reduce GDM burden.

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