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Prevalence and predictors of diabetes mellitus among adult population in delta central senatorial district of Delta State, Nigeria

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Abstract

Context: Diabetes Mellitus (DM) is a growing global health priority with a rapidly increasing prevalence in sub-Saharan Africa.
Objective: This study evaluated the prevalence and predictors of DM among adults in the Delta Central Senatorial District of Delta State, Nigeria.
Materials and Methods: A community-based, descriptive cross-sectional study was conducted among 536 adults recruited via multistage sampling. Data on demographics and anthropometrics were collected using a structured proforma. Glycemic status was determined by measuring Random Blood Sugar (RBS) after an 8-hour fast using an ACCU-CHEK Advantage II glucometer, with classification (normoglycemic, pre-diabetes, and diabetes) based on WHO criteria. Data were analyzed using SPSS version 25. Linear regression analysis was used to determine predictors of DM, with significance set at $p<0.05$.
Results: The mean age of the participants was 37.93±13.81 years, with a female preponderance (58.8%). The Urhobo ethnic group constituted 41% of the cohort. More than half of the participants (56.2%) were overweight. The prevalence of pre-diabetes and diabetes was 26.4% and 24.2%, respectively. Strong positive predictors of DM included family history ($r=0.90$, R2=0.81, $p<0.05$), Body Mass Index ($r=0.89$, R2=0.80, $p<0.05$), and sleep patterns ($r=0.87$, R2=0.76, $p<0.05$). Cigarette smoking was identified as a moderate predictor ($r=0.77$, R2=0.59, $p<0.05$).
Conclusion: There is a high prevalence of diabetes and pre-diabetes among adults in Delta Central Senatorial District. Modifiable factors such as BMI and sleep patterns, alongside non-modifiable family history, are significant drivers of the disease. Targeted interventions, including routine screening and lifestyle modification programs, are essential to mitigate the region's growing diabetes burden.

Keywords: Diabetes Mellitus, Prevalence, Predictors, Delta State, Body Mass Index.

Introduction

Diabetes Mellitus (DM) represents one of the most significant clinical and public health challenges of the 21st century. Characterized by chronic hyperglycemia resulting from defects in insulin secretion, action, or both, DM serves as a primary driver of non-communicable disease morbidity globally.[2] The metabolic derangements associated with unchecked DM lead to progressive structural and functional damage to vital organs, manifesting as retinopathy, nephropathy, neuropathy, and cardiovascular disease.[3] Despite evidence that timely intervention can attenuate these complications, late detection remains a pervasive barrier to effective

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management.[1]

The global epidemiological profile of DM is alarming. Current estimates suggest a rising incidence projected to reach a prevalence of 9.9% by 2045. In 2017 alone, over 545 million individuals were living with the diagnosis.[4,5] Furthermore, the mortality burden is staggering; it is estimated that one person dies every seven seconds from diabetes-related causes, with approximately 50% of these deaths occurring in individuals under the age of 60.[2] By 2030, the World Health Organization (WHO) predicts DM will become the seventh leading cause of death globally.[6]

In Nigeria, the burden reflects these global trends but is exacerbated by rapid urbanization and lifestyle transitions. With a population exceeding 230 million, meta-analytical data suggests a pooled DM prevalence of 5.77%, implying that approximately 11.2 million Nigerians or 1 in 17 adults are affected.[7,8] Notably, significant sub-national variations exist; the South-South geopolitical zone consistently reports the highest prevalence rates, correlating with regional trends in obesity, a primary risk factor for Type 2 DM.[8,9]

Delta State, situated within the South-South zone, there is a worrying increase in patients presenting to healthcare facilities with previously unidentified hyperglycemia.[10] While clinical research confirms that the morbidity and mortality associated with DM are largely preventable through early diagnosis, many cases in this region remain undetected until complications arise.[10] Community-based screening remains a vital tool for identifying high-risk individuals and implementing early interventions. However, there is a dearth of recent, localized data specifically focusing on the Delta Central Senatorial District. Therefore, this study aimed to investigate the prevalence and predictors of diabetes mellitus among adults in this district to provide a baseline for targeted public health strategies.

Materials and Methods

Study Design and Setting

A community-based, descriptive cross-sectional study was conducted to evaluate the prevalence and predictors of Diabetes Mellitus (DM) among adults in the Delta Central Senatorial District of Delta State, Nigeria. The district comprises eight Local Government Areas (LGAs): Ethiope East, Ethiope West, Okpe, Sapele, Udu, Ughelli North, Ughelli South, and Uvwie, with a total estimated population of 1,575,738. Delta State is among the most populous states in the South-South geopolitical zone, with contemporary projections exceeding 6.3 million residents.[7]

Study Population and Selection Criteria

The study population consisted of adults aged 18 to 64 years residing within the senatorial district. Inclusion criteria were adults (≥18 years) currently living in Delta Central who provided informed consent. Exclusion criteria included individuals residing outside the state, those below the age of 18, and individuals who declined participation or were unable to provide consent.

Sample Size and Sampling Technique

The sample size was determined using Cochran's formula for cross-sectional studies.[11]

Where: n=(Z^2 Pq)/d^2

were, n= the desired sample size

Z = standard normal deviate, set at 1.96 corresponding to 95% level of significance

P = population in the target population estimated to have a particular characteristic. In a community-based study done in south-south and south east Nigeria, the prevalence of diabetes was 8.6%.[12] This was used to calculate the sample size.

q = 1-p

d = degree of accuracy, set at 5% (0.05).

Hence, n=((1.96)^2×(0.086)×(0.914)) / (0.05)^2)

n= approximately 121

To account for a 10% non-response or attrition rate, resulting in 134 subjects per LGA.[11]

Using a multistage sampling procedure, four LGAs with the highest populations (Ughelli North, Ethiope East, Ethiope West, and Ughelli South) were selected. Consequently, a total of 536 volunteers were recruited (134 per LGA). The study achieved a high return rate of 93.3%, which was considered representative of the target population.

Instrument for Data Collection

The primary tool was a structured Proforma adapted from the "Prevalence, Predictors, and Complications of Diabetes Mellitus" (PPCDM) instrument.[11] The Proforma was organized into three thematic sections: Section A: Demographic profile; Section B: Assessment of clinical and lifestyle predictors (e.g., sleep patterns, smoking); Section C: Anthropometric and biochemical parameters.

Clinical and Biochemical Measurements

Physical and biochemical assessments were conducted following World Health Organization (WHO) standards.[13] Participants were instructed to fast for at least 8 hours prior to the examination. Capillary whole blood samples were obtained via fingertip prick to determine glycemic status using the ACCU-CHEK Advantage II glucometer (Model 800-858-8072). Participants were categorized as normoglycemic, pre-diabetic, or diabetic based on WHO diagnostic thresholds.[4,11]

Anthropometric data were collected using standardized equipment:

Height: Measured to the nearest 0.1 cm using a SECA 217 stadiometer (Hamburg, Germany).

Weight: Measured using a calibrated weighing balance.

Body Mass Index (BMI): Calculated as weight in kilograms divided by the square of the height in meters (kg/m^2). BMI was categorized as underweight/normal <18.5 or 18.5–24.9 (underweight/normal), 25.0–29.9 (overweight), and ≥30.0 (obese).[14]

To ensure validity, the glucometer was calibrated weekly using manufacturer-provided control solutions and cross-referenced with plasma glucose estimations (glucose oxidase method) analyzed by a senior chemical pathologist at the Delta State University Teaching Hospital (DELSUTH). Aseptic conditions were maintained throughout the procedure

Data Analysis

Data were processed and analyzed using the Statistical Package for the Social Sciences (SPSS) version 25.0. Descriptive statistics summarized the demographic and clinical characteristics. Linear regression analysis was employed to test the hypotheses and identify significant predictors of DM. All tests were two-tailed, and the hypotheses at 0.05 alpha level.

Ethical Considerations

Ethical approval was granted by the Health Research Ethics Committee (HREC) of the Delta State University Teaching Hospital (Approval No: HREC/PAN/2023/069/0596). Written informed consent was obtained from all participants. Confidentiality was strictly maintained by using anonymized code numbers on all Proformas instead of personal identifiers.

Results

Demographic characteristics

Table 1: Socio-demographic parameters of Participants

	Variables	*Frequency (N)*	*Percentage (%)*
Age Group (years)	≤ 20years	77	15.4
	21-30years	93	18.6
	31-40years	117	23.4
	41-50years	128	25.6
	51-60years	61	12.2
	61years and above	24	4.8
	Mean ± SD	37.93 ± 13.81	
Sex	Male	206	41.2
	Female	294	58.8
Level of Education	No Formal Education	41	8.2
	Primary	99	19.8
	Secondary School	165	33.0
	Tertiary (HND/OND/BSc/)	132	26.4
	Postgraduate	63	12.6
Marital Status	Single	225	45.0
	Married	184	36.8
	Separated	62	12.4
	Divorced	18	3.6
	Widowed	11	2.2
Ethnic Group	Urhobo	205	41.0
	Itshekiri	44	8.8
	Yoruba	29	5.8
	Igbo	73	14.6
	Ijaw	88	17.6
	Benin	61	12.2
Income Level (₦)	< 50,000	45	9.0
	50000-150K	143	28.6
	150-250K	186	37.2
	ABOVE 250K	126	25.2

The result showed that 58.8% of our study participants were women. The mean age and standard deviation (SD) were 37.93 ± 13.81. Participants from the Urhobo ethnic group constituted about 41 % of the study subjects, and more (33%) had attended secondary school or above. A high proportion (45%) of the participants reported to be single and most (37.2%) had income between 150, 000-250,000 naira. About (56.2%) of them were overweight. The mean Waist circumference and standard deviation (SD) was 85.52 ± 7.27, while the mean Hip circumference and standard deviation (SD) was 94.39 ± 5.03 giving a Waist-Hip ratio of 0.91 ± 0.08.

Prevalence of diabetes mellitus among the study population

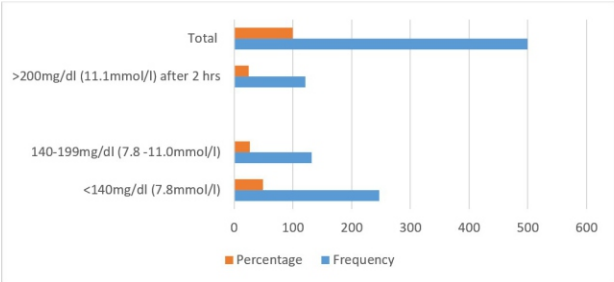

Figure 1: showing the prevalence of diabetes mellitus among the adult' populations in Delta Central Senatorial district
Guide: <10% is low; 10-24.9% is moderate, ≥25.0% high prevalence

The findings of the study indicated that 26.4% (247) were pre-diabetic while 24.2% (121) were diabetic Thus, the prevalence of diabetes among adult population in Delta State was high.

Table 2: Regression analysis showing predictors of diabetes mellitus among the adult populations in Delta central senatorial district, Delta State

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Decision
Age	0.86*	0.74	0.745	0.97	Very High relationship/ high predictor
Sex	0.85*	0.73	0.73	0.60	Very High relationship/ high predictor
Sleep pattern	0.87*	0.76	0.73	0.60	Very High relationship/ very high predictor
Family history	0.90*	0.81	0.81	0.83	Very High relationship/ very high predictor
BMI	0.89*	0.80	0.80	0.84	Very High relationship/ very high predictor
Physical activity	0.85*	0.72	0.72	1.01	Very High relationship/ high predictor
Cigarette smoking	0.77*	0.59	0.59	1.22	Very High relationship/ moderate predictor
Income level	0.86*	0.74	0.74	0.97	Very High relationship

Guide: 0.00-0.19 = very low, 0.20-0.39 = low, 0.40-0.59 = moderate, 0.60-0.79 = high and 0.80 above is very high relationship *= Significant p<0.05

Predictors of diabetes mellitus

The findings reveal that family history ($r = 0.90$, $R2 = 0.81$, $p < 0.05$), Body Mass Index ($r = 0.89$, $R2 = 0.80$, $p < 0.05$), and sleep pattern ($r = 0.87$, $R2 = 0.76$, $p < 0.05$) are all significant predictors of diabetes mellitus in the surveyed population. Cigarette smoking had moderate level of predictability ($r = 0.77$, $R2 = 0.59$, $p < 0.05$) as gleaned in table 2.

Discussion

This community-based study investigated the prevalence and predictors of Diabetes Mellitus (DM) and pre-diabetes among adults in the Delta Central Senatorial District. The findings reveal a unambiguous epidemiological reality: a DM prevalence of 24.2% (121 individuals) and a pre-diabetes prevalence of 26.4% (247 individuals). These figures are significantly higher than the national pooled prevalence of 5.77% reported in recent meta-analyses.[7] This disparity may be attributed to the specific socio-demographic and lifestyle profiles of the South-South region, which has been identified as a high-burden zone for non-communicable diseases.[8]

One of the most compelling findings of this study is the potent predictive power of sleep patterns on DM risk ($r=0.87$, $R2=0.76$, $p<0.05$). The data suggests that extreme variations in sleep duration both deprivation (<4 hours) and excessive sleep (>8 hours) account for approximately 76% of the variance in diabetes cases. In the Nigerian context, sleep restriction is increasingly driven by economic pressures and the ubiquitous use of digital devices late into the night. Physiologically, sleep deprivation disrupts metabolic homeostasis by increasing cortisol levels and oxidative stress, which directly heightens insulin resistance.[15] Furthermore, sleep restriction alters appetite-regulating hormones, elevating ghrelin while suppressing leptin, thereby inducing cravings for high-caloric, sugar-dense foods.[16] Conversely, excessive sleep is often associated with sedentary behavior and a reduction in postprandial metabolic rate, leading to increased adiposity.[16] These local findings resonate with international studies in China,[16] the Netherlands,[17] and the USA,[18] where short or irregular sleep duration was consistently linked to elevated fasting glucose and HbA1c levels.[19,20] Given the current climate of psychological stress in Nigeria, these results suggest that without targeted sleep hygiene campaigns, DM incidence will likely escalate

Family history emerged as the strongest predictor in this study ($r=0.90$, $R2=0.81$, $p<0.05$), accounting for 81.5% of the DM cases. The probability of developing the disease was particularly high (0.82) among participants with first-degree relatives diagnosed with DM. This underscores the hereditary nature of the disease, which appears to operate independently of ethnic or racial nuances within the adult population.

Our findings align with studies conducted in Uganda,[21] Ethiopia,[22] and Southern Nigeria,[23] reinforcing the global consensus on the genetic transmission of DM risk. However, this study contradicts a hospital-based report from Imo State by Agbaka,[11] which found no significant association with family history. This discrepancy is likely methodological; hospital-based studies often suffer from selection bias as they focus on a clinical population already undergoing treatment, whereas community-based designs provide a more accurate cross-section of genetic risk distribution in the general population.

Body Mass Index (BMI) was a significant predictor of DM (r=0.89, R2=0.80, p<0.05), with obesity accounting for over 80% of the cases observed. This is particularly concerning given that 56.2% of our participants were overweight. In many Nigerian cultures, a larger body size is traditionally perceived as a sign of affluence, a misconception that hinders the adoption of weight management behaviors. Furthermore, the nutrition transition in Nigeria characterized by a shift toward cheap, carbohydrate-heavy processed foods exacerbates obesity rates. The global consistency of the BMI-DM link is well-documented, with similar findings reported in India,[24] Saudi Arabia,[25] and South Africa.[26] Notably, our findings contrast with Cookey et al.,[12] who reported no significant association between BMI and DM in South-South/South-East Nigeria. However, the strength of our correlation suggests that adiposity, measured through BMI and Waist-Hip Ratio (0.91±0.08), remains a primary driver of the DM epidemic in Delta State.

Complementing the BMI data, physical inactivity predicted 72.6% of DM cases (r=0.85, R2=0.72, p<0.05). The transition to sedentary occupations and motorized transport in urbanizing areas of Delta State has reduced daily energy expenditure. Promoting moderate-intensity activity, such as 150 minutes of brisk walking per week, is therefore essential for primary prevention. These results are corroborated by studies in Florida,[27] and Ethiopia,[22] suggesting that the metabolic benefits of physical activity are a universal biological constant.

Cigarette smoking showed a moderate but significant predictability (r=0.77, R2=0.59, p<0.05), accounting for 59% of the risk in the study area. The toxic components of tobacco smoke induce systemic inflammation and oxidative stress, which impair the signaling pathways of insulin-responsive cells. In Delta State, smoking is often viewed as a recreational activity among young adults, compounded by societal stressors. Our findings mirror studies in Florida,[27] and rural Southern Nigeria,[28] which identify smoking as a significant, yet preventable, contributor to the DM burden. The contradiction with the Imo State study,[11] which found no link again highlights the difference between clinical populations who may have already ceased smoking post-diagnosis and community members with ongoing habits.

The high prevalence of pre-diabetes (26.4%) identified in this study represents a critical window for intervention. If these individuals are not targeted with lifestyle modification programs, they will likely transition to overt DM within five to ten years. Public health strategies in Delta State must shift from reactive hospital-based care to proactive community-based screening.

It should therefore focus on educating the public on the metabolic consequences of sleep deprivation, counteracting cultural myths regarding body size and promoting fiber-rich, low-glycemic diets, and encouraging individuals with a positive family history to undergo annual glycemic checks.

Conclusion

This study confirms that Delta Central Senatorial District is a high-prevalence area for Diabetes Mellitus and pre-diabetes. The disease is driven by a complex interplay of non-modifiable genetic factors and modifiable lifestyle behaviors, specifically BMI, sleep patterns, physical inactivity, and smoking. These findings provide a robust empirical basis for the Delta State Ministry of Health to implement targeted screening and lifestyle intervention programs. Addressing these predictors holistically offers the best chance at mitigating the burgeoning DM epidemic in the region.

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Conflict of interest
The authors have no competing interests to declare that are relevant to the content of this article.

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