

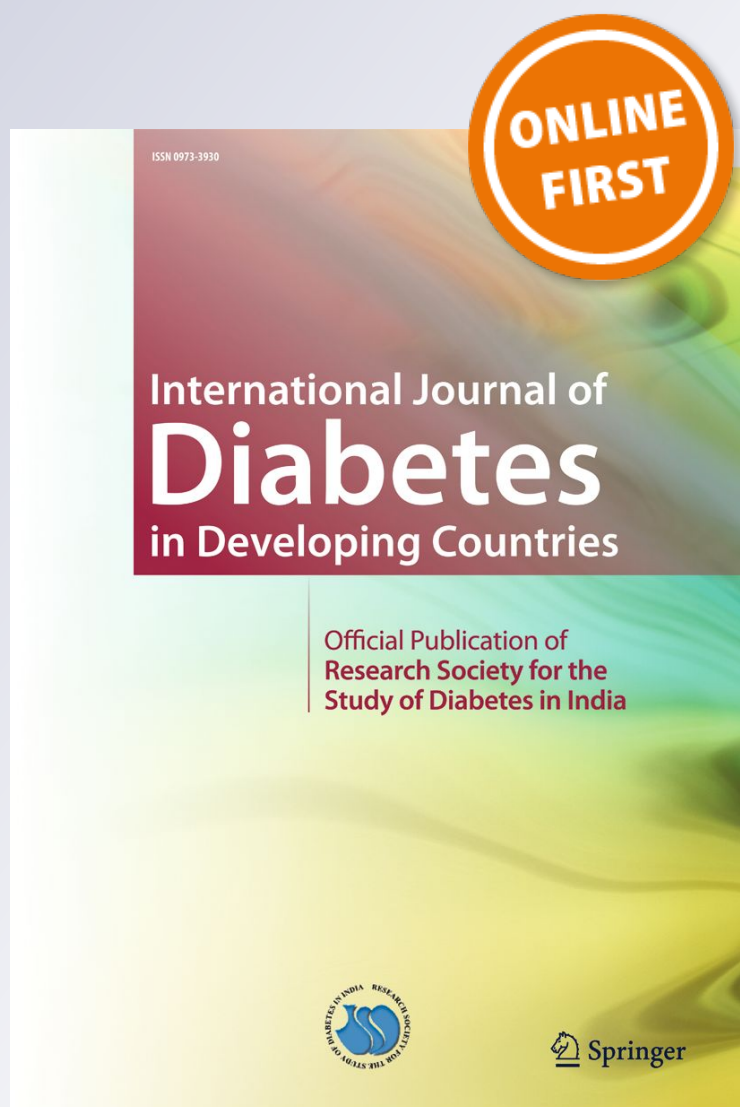
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# Prevalence of type 2 diabetes mellitus in Southern Cross River: a cross-sectional observational survey

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## Abstract

The International Diabetes Federation estimates that 1.6 million (1 in 53) Nigerian adults have diabetes mellitus while 60.7% (949,900) of Nigerian adults with diabetes are undiagnosed. In spite of these worrying projections, current nationwide data on diabetes prevalence to aid policy formulation in Nigeria is non-existent. This was a cross-sectional observational study that recruited 1200 adults residing in the Southern Cross River State. Glucometers were used to measure the fasting capillary glucose of participants, and those with readings  $\geq 7$  mmol/l were asked to come back the following day for another fasting blood glucose check for confirmation. Those who had two fasting blood glucose readings consistently  $\geq 7$  mmol/l were classed as having diabetes mellitus and referred to the nearest hospital for further evaluation and management. Blood pressure and waist circumference were also measured. There were 683 (56.9%) females and the mean age of the participants was  $41.3 \pm 15.3$ . Using body mass index (BMI), 159 (13.3%) participants were found to be obese. The prevalence of diabetes mellitus among the tested participants was 6.9%. Univariate analysis was carried out to identify associations with diabetes among the participants. Statistically significant associations were identified between blood pressure  $> 140/90$  mmHg ( $p = 0.013$ ), local government area ( $p = 0.001$ ), level of education ( $p = 0.002$ ), and diabetes. The diabetes mellitus prevalence of 6.9% in this community is much higher than internationally reported estimates for Nigeria and makes a compelling case for further epidemiological studies on diabetes in Nigeria and prioritisation of this disease by health policy makers.

**Keywords** Diabetes mellitus · Cross River · Nigeria · Fasting glucose

## Introduction

Diabetes mellitus is a chronic debilitating disease characterised by hyperglycemia that accounts for significant morbidity and mortality the world over. The International Federation for Diabetes (IDF) estimates that globally, 415 million adults are suffering from diabetes (one in 11 adults) and this figure is

projected to rise to around 642 million by 2040 [1]. Between 1980 and 2016, the World Health Organization reports that the global rates of adults living with diabetes have almost quadrupled [2]. This rise in cases of diabetes has been attributed to population growth, increasing life expectancy, urbanisation, and the increasing prevalence of obesity and physical inactivity [3]. The African region appears to be worse hit with an estimated 14.2 million adults aged 20–79 suffering from diabetes [1]. It is particularly concerning that over two thirds (66.7%) of people with diabetes in Africa are unaware they have the disease [1].

Nigeria reportedly has Africa's highest burden of diabetes [4]. The IDF estimates that 1.6 million (1 in 53) Nigerian adults have diabetes while 60.7% (949,900) of Nigerian adults with diabetes are undiagnosed [1]. Diabetes is also estimated to account for 3.5–15% of medical admissions in most hospitals in Nigeria [5]. In spite of these worrying projections, information on diabetes for policy formulation in Nigeria can be described as fragmentary at best [6]. The last nationwide epidemiological survey on diabetes in Nigeria in 1997 reported a diabetes prevalence of 2.2% [7]. However, in the face of the epidemiological transition, this is

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likely to represent a gross underestimate of current disease burden. A recent systematic review of 20 population-based Nigerian studies reports a wide variation in diabetes prevalence ranging from 0.8 to 11% involving both urban and rural populations [6]. This review did not include data from Cross River State as the literature search ended in 2013. In 2014, Enang and colleagues reported a prevalence of undiagnosed diabetes among residents of Calabar of 7% but this was limited to just one town in Cross River State [8]. The paucity of data on the prevalence of diabetes in Cross River State exists in a setting where cultural beliefs and practices which predispose persons to developing diabetes abound. These practices include the socially acceptable act of deliberately fattening young brides prior to marriage [9] and widespread consumption of refined sugars [10]. There is an urgent need for more epidemiological surveys to accurately describe the current burden of diabetes in Cross River State. This precise assessment of the scale of diabetes is the vital first step towards establishing a robust public health strategy against diabetes at both state and national levels.

This study aimed to assess the prevalence of diabetes in Southern District of Cross River State, Nigeria.

Operational definition of terms is as follows:

- (1). Diabetes mellitus: two fasting capillary glucose levels  $\geq$  7.0 mmol/l
- (2). Fasting blood sugar (FBS): the normal range used in this study was 3.5–5.5 mmol/l

## Methodology

### Study setting

Cross River State is a coastal state in South Eastern Nigeria, named after the Cross River which flows through the state. Located in the Niger Delta, Cross River State occupies 20,156 km<sup>2</sup>. According to the 2006 national census figures, Cross River State has a total population of 2,888,966 with 1,492,465 males and 1,396,501 females [11]. The state is divided into three districts, namely Southern, Central, and Northern districts. The Southern District comprises six local government areas (LGAs), namely Calabar Municipality, Calabar South, Akampka, Akpabuyo, Bakassi, and Biase. The state is basically an agrarian society with the civil service being the other major employer of labour.

### Study design

The research was a cross-sectional observational study.

### Sampling technique

A multistage sampling method was employed to select the 1200 participants for the study. In stage 1, four LGAs were randomly selected, namely Akampka, Akpabuyo, Biase, and Calabar Municipality from the six LGAs in the Southern District of Cross River State.

In stage 2, in each selected LGA, two wards were selected randomly from the full list of all wards by balloting.

In stage 3, a range of 228–420 participants were recruited from each ward.

An advocacy visit to community leaders was carried out to introduce the research group. Prospective participants were then advised to fast from 22:00 before presenting at a designated health centre the next morning for screening. They were permitted to drink water freely.

### Study participants

These were consecutive volunteers aged  $\geq$  30 years of age residing in the Southern District of Cross River State.

### Study procedure

Participants who provided written informed consent were interviewed using a structured proforma. Roche Accucheck glucometers were used to measure the FBS of respondents. A finger of each participant was cleaned with alcohol and then allowed to dry. The finger was then pricked using a lancet and the first drop of blood was wiped away and testing was carried out on the second drop of blood to reduce contamination. The result was measured in millimoles per litre (mmol/l). Participants with fasting blood glucose of  $\geq$  7 mmol/l were asked to come back the following day for another fasting blood glucose check for confirmation. Those who had two fasting blood glucose reading consistently  $\geq$  7 mmol/l were referred to the nearest general hospital for further evaluation and management. Rigorous quality control exercises were carried out on these glucometers at regular intervals using control solution and a reference laboratory.

The blood pressure of all participants was measured using a mercury sphygmomanometer. The waist circumference was measured with the cut-off for truncal obesity being 88 cm for females and 102 cm for males. The body mass index (BMI) was also calculated with normal values

being 18.5 to 24.9 kg/m<sup>2</sup> and obesity being identified as BMI ≥ 25.

All data was collected manually using data sheets and later transferred to electronic databases.

### Data analysis

Data generated from the study was entered into and analysed using the IBM® SPSS® statistical package V.23.0 for windows. All categorical variables were represented as percentages. The chi-squared test was used to test the significance of associations between the categorical variables and diabetes. A *p* value of <0.05 was regarded as being statistically significant.

## Results

### Socio-demographic data

There were 683 (56.9%) females and males were 517 (43.1%). The mean age of the participants was 41.3 years with a standard deviation of ± 15.3. The most common occupation among the participants was farming (399; 33.3%) followed by civil service (269; 22.4%) as shown in Table 1.

Most (420; 35%) of the participants were drawn from Akpabuyo LGA while Calabar Municipality, Biase, and Akampka accounted for 288 (24%), 264 (22%), and 228 (19%) of the participants, respectively. With respect to their educational level, most (451;37.6%) had received education up to secondary level. This was followed by those with just primary education (371;30.9%), those with tertiary education (251; 20.9%), and those with no formal education (127; 10.6%).

Using BMI, 159 (13.3%) participants were found to be obese while 1041 were not. A total of 193(16.1%) of the participants had truncal obesity.

**Table 1** Occupation of the participants

Occupation	Frequency	Percent
Civil servant	269	22.4
Farming	399	33.3
Fishing	41	3.4
Self employed	302	25.2
Unemployed	127	10.6
Retiree	62	5.2
Total	1200	100.0

### Prevalence of diabetes mellitus among participants

Out of the 1200 participants in this study, 83 (6.9%) of them had two fasting plasma glucose levels ≥ 7.0 mmol/l. Thus, the prevalence of diabetes among the tested participants was 6.9%. The mean age of these 83 participants was 43.

### Univariate analysis

Univariate analysis was carried out to identify associations with diabetes among the participants. Statistically significant associations were identified between blood pressure > 140/90 mmHg (*p* = 0.013), LGA (*p* = 0.001), level of education (*p* = 0.002), and diabetes (Table 2).

**Table 2** Variables vs diabetes mellitus

Risk factor	Diabetes mellitus ( <i>n</i> = 83)	<i>p</i> value
Smoking		
Yes	11	0.420
No	73	
Alcohol consumption		
Yes	37	0.837
No	46	
Blood pressure > 140/90		
Yes	39	0.013
No	44	
Truncal obesity (WC)		
Yes	11	0.467
No	72	
Obesity using BMI		
Yes	16	0.093
No	67	
Sex		
Male	31	0.274
Female	52	
LGA		
Akampka	28	0.001
Akpabuyo	24	
Biase	23	
Calabar Municipality	8	
Level of education		
No formal education	19	0.002
Primary	23	
Secondary	25	
Tertiary	16	
Family history of diabetes		
Yes	10	0.181
No	73	

## Discussion

The prevalence of diabetes among this cohort of adult males and females in the southern region of Cross River State was found to be 6.9%. This is an alarmingly high prevalence rate which buttresses the fact that diabetes is emerging as a major public health problem in Africa, including Nigeria [12]. A cursory look at prevalence rates for diabetes from various parts of Nigeria corroborates the high prevalence rate found in this study. From the South-South Zone of Nigeria, researchers have reported type 2 diabetes prevalence rates of 7.45% from Port Harcourt [13], 10.5% from Uyo [14], 5.1% from Ndokwa West [15], and 7% from Calabar [8]. From the South-East Zone of Nigeria, high diabetes prevalence rates of 5.3% in Nkanu-East [16] and 4.9% in Umudike have been reported [17]. From the North-East zone, diabetes prevalence rates of 7.0% have been reported in Maiduguri [18]. A diabetes prevalence rate of 5.1% was reported in Gindiri [19] which is in the North-Central zone. From the South-West zone, equally high diabetes prevalence rates of 6.8% in Ido-Ekiti [20], 6.4% in Egbeda [21], and 5.15 in Ogun have been reported [22]. A comparison of the diabetes prevalence figures from actual surveys across Nigeria with the estimated diabetes prevalence rate for adult Nigerians of 4.6% from IDF suggests a gross underestimation of the burden of this disease in Nigeria.

Traditionally, infectious diseases were thought to be the major cause of morbidity and mortality in tropical and sub-Saharan climates like Nigeria. However, the epidemiologic transition appears to be a reality in Nigeria with non-communicable diseases such as diabetes gaining prominence [23]. However, it would seem that national priorities still favour the control of communicable diseases such as malaria, tuberculosis, and human immunodeficiency virus (HIV). This appears to be driven by donor-determined and donor-funded priorities. With rising industrialisation and globalisation in Nigeria, there appears to have been a shift from the traditional foods which are low in calorie-dense materials to the “fast foods” which are quick to prepare and readily available [24]. These “fast foods” are typically high in saturated fats and refined sugars and low in fibres. These quick meals are potentially diabetogenic and tend to deviate from the current general recommendation that carbohydrates should provide between 45–65% of the daily caloric intake while fat and protein should constitute 25–35 and 15–20% respectively of the total daily calories [25]. Consumption of these calorie-dense foods is probably contributing to the rising prevalence of diabetes in Nigerian communities. Interestingly, these poor dietary choices are not limited to the urban rich as the poor within urban areas are also opting for unhealthy meals. This may be related to our finding that diabetes was associated with LGA of residence as higher rates of diabetes were identified in the more rural settings such as Akampka, Akpabuyo, and Biase.

With increasing urbanisation of the Nigerian populace, there has been a concomitant reduction in physical activity. This is in addition to the lack of an exercise culture and dearth of facilities such as sports centres and recreational parks which typically promote increased physical activity. This has probably contributed to obesity rates which are reported by the World Health Organization (WHO) to have increased by 47% in men and 39% in women, between 2002 and 2010, in Nigeria [26]. In Cross River State, there is a cultural practice of deliberately fattening young ladies just before marriage to make them more desirable to their betrothed [27, 28]. Despite the fact that this age-long tradition is gradually falling out of favour, it is very possible that this could have contributed to the high obesity rate of 13.3% we found.

The link between traditional risk factors and diabetes is not in doubt. Research has shown that the risk of diabetes is almost doubled by physical inactivity and consumption of energy-dense foods [29]. Obesity has been shown to be a key risk factor for developing diabetes as it promotes insulin resistance [29]. Tackling the lifestyle-related risk factors for diabetes such as obesity, physical inactivity, and consumption of low-fibre, high fat, and energy-dense diets is crucial to the success of any diabetes control strategy [30].

There was an association between persons with blood pressure > 140/90 mmHg and persons with diabetes. As this association was lacking with obesity, we are unable to define the extent of the metabolic syndrome in our patient population.

The present study recorded a high prevalence of diabetes of 6.9% among participants from a region in Nigeria where a paucity of baseline data on diabetes exists. The results of this study are strikingly different from the accepted national diabetes prevalence figures and projections from IDF for Nigeria. There is an urgent need for nationwide epidemiological studies on diabetes to accurately map out the burden of disease. Greater prioritisation of diabetes among policy makers and health managers in Nigeria remains a desirable target.

## Limitations of this study

The blood glucose measurement was achieved using capillary blood samples and this varies from glucose measurement in plasma and whole blood. However, the validity of the use of capillary glucose for diabetes screening has been demonstrated in previous studies.

## Conclusion

This community-based survey highlights the prevalence of diabetes among 1200 participants drawn from the Southern District in Cross River State, Nigeria. The prevalence of 6.9% is higher than internationally reported estimates and

corroborates the finding of a prevalence of undiagnosed diabetes of 7% among predominantly Calabar residents of Cross River. This study makes a compelling case for further epidemiological studies on diabetes in Nigeria and prioritisation of this non-communicable disease by health policy makers.

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