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# Prevalence of dysglycemia in Calabar: a cross-sectional observational study among residents of Calabar, Nigeria

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## ABSTRACT

**Objective:** Population data on dysglycemia are scarce in West Africa. This study aimed to determine the pattern of dysglycemia in Calabar city in South East Nigeria.

**Design:** This was a cross-sectional observational study.

**Methods:** 1134 adults in Calabar were recruited. A multistage sampling method randomly selected 4 out of 22 wards, and 50 households from each ward. All adults within each household were recruited and an oral glucose tolerance test was performed. Dysglycemia was defined as any form of glucose intolerance, including: impaired fasting glucose (blood glucose level 110–125 mg/dL), impaired glucose tolerance (blood glucose level ≥140 mg/dL 2 h after consuming 75 g of glucose), or diabetes mellitus (DM), as defined by fasting glucose level ≥126 mg/dL, or a blood glucose level ≥200 mg/dL, 2 h after a 75 g glucose load.

**Results:** Mean values of fasting plasma glucose were 95 mg/dL (95% CI 92.1 to 97.5) for men and 96 mg/dL (95% CI 93.2 to 98.6) for women. The overall prevalence of dysglycemia was 24%. The prevalence of impaired fasting glucose was 9%, the prevalence of impaired glucose tolerance 20%, and the prevalence of undiagnosed DM 7%. All values were a few percentage points higher for men than women.

**Conclusions:** The prevalence of undiagnosed DM among residents of Calabar is similar to studies elsewhere in Nigeria but much higher than the previous national prevalence survey, with close to a quarter of the adults having dysglycemia and 7% having undiagnosed DM. This is a serious public health problem requiring a programme of mass education and case identification and management in all health facilities.

**Trial registration number:** CRS/MH/CR-HREC/020/Vol.8/43

## KEY MESSAGES

- Close to a quarter of the adults studied in Calabar have dysglycemia and 7% have undiagnosed diabetes mellitus.
- These alarming figures are much higher than the national prevalence estimates which appear to underestimate disease burden.
- Concerted public health efforts are urgently required to stem this tide of disease in our communities.

## INTRODUCTION

Diabetes mellitus (DM) is defined as "a metabolic disorder of multiple aetiologies, characterised by chronic hyperglycaemia with disturbances of carbohydrate, fat and protein metabolism, resulting from defects in insulin secretion, action or both."[1] The effects of DM include long-term damage, dysfunction, and failure of various organs.[1]

The global burden of diabetes among adults was estimated at 366 million in 2011, and this is projected to increase to 552 million by 2030.[2] The global prevalence of diabetes was 8.3% in 2011 and is predicted to be 9.9% by 2030, while the global prevalence of impaired glucose tolerance (IGT) was 6.4% in 2011 and is forecast to reach 7.1% by 2011.[2] The number of patients with type 2 diabetes is likely to be far higher than the current estimates because a substantial proportion of patients with type 2 diabetes go undetected.[3]

The available data suggest that diabetes is emerging as a major health problem in Africa, including Nigeria.[4] Developing countries, including sub-Saharan Africa, may experience the largest proportional increase in diabetes. This significant rise in diabetes cases is attributed to population growth, increasing life expectancy, urbanization, and the increasing prevalence of obesity and physical inactivity.[5] The greatest number of people with diabetes are between 40 and 59 years of age,[2] while greater numbers of people with diabetes live in urban areas compared with rural areas. Diabetes is said to have caused 4.6 million deaths in 2011,[2] and accounted for at least US$45 billion of healthcare expenditure in 2011, 11% of the

total adult (20–79 years) healthcare expenditure.[2]

The onset of type 2 diabetes may occur up to 7 years before clinical diagnosis[6] even in high-income settings such as the USA and the Netherlands. The prevalence of undiagnosed diabetes in adults is estimated to be approximately 3%,[7 8] with failure to detect diabetes typically rising with age.[7] There is some evidence that enhanced screening systems in some developed countries are decreasing the prevalence of undiagnosed diabetes,[9] but the percentage of undiagnosed diabetes is higher in developing countries, where it is not unusual for half[10] or three-quarters[11] of all cases of diabetes to remain undiagnosed.

Quantifying the prevalence of diabetes and the number of people affected by diabetes, now and in the future, is important to allow rational planning and allocation of resources.[12] This study aimed to determine the prevalence of dysglycemia among residents of Calabar.

IGT and impaired fasting glucose (IFG) form an intermediate state in the natural history of DM.[13] These terms have replaced previous terms such as 'borderline' or 'chemical' diabetes. IGT is defined as a blood glucose level (BGL) between 140 and 200 mg/dL (7.8–11 mmol/L) 2 h after consuming 75 g of oral glucose. IFG is defined as a BGL between 110 and 125 mg/dL (6.1–6.9 mmol/L) in fasting patients. These glucose levels are above normal but below the levels that are diagnostic of diabetes.[14] Patients with IGT and IFG have a significant risk of developing DM and thus are an important target group for primary prevention.

## METHODS

### Study area

The research was carried out within Calabar South and Calabar Municipal Council, the two local government areas that make up Calabar metropolis. Calabar is the capital of Cross River State of Nigeria, which is located in South East Nigeria. Calabar city lies to the south of Cross River State, and it has a population of 371 022, according to the 2006 national population census.[15]

### Study design

The research was a cross-sectional observational study that recruited participants aged between 15 and 79 years who had resided in Calabar, Cross River State, for at least 2 years prior to the date of the survey. The following were excluded from this study: pregnant or breast-feeding women and acutely unwell individuals as overnight fasts would be inappropriate in these groups. Other groups excluded were persons taking steroids (as this could impair glucose metabolism) and persons previously diagnosed with DM.

### Ethical considerations

Informed written consent was obtained from all the participants in the study. Informed written consent was obtained from next of kin, caretakers, or guardians on behalf of the minors (<15 years) involved in this study. Participation was voluntary and the information provided was kept confidential. Permission was sought and obtained from the local government area (LGA) Chairmen through the LGA health units before the start of the study.

### Sampling

A multistage sampling method was applied to select the participants for the study. The sampling frame consisted of all the 22 wards of Calabar metropolis, made up of 12 wards in Calabar South Council and 10 wards in Calabar Municipal Council. Four wards were then randomly selected from the 22 wards within the two local government areas. Using the census enumeration list from the 2006 national population census, 50 households from each of the four wards were selected using the table of random numbers.

From each of the 200 households selected, eligible individuals aged between 15 and 79 years were selected and administered questionnaires. The invitation to participate in the study was either in person or by typed invitation slips. Participants were requested to come to designated health centers within their vicinity, where the study took place on particular dates, between 7:30 and 11:00. The primary health centers (PHCs) at Anantigha, Ekpo Abasi, and Ewa Ekeng were selected for Calabar South while those at Eyo Edem, Okon Enoch, and Ikot Ansa were recruited for Calabar Municipal. The procedure sequence is shown in the flow diagram in figure 1.

Of the 1350 participants invited for the study, 1134 participants, comprising 645 men and 489 women, completed the study, thus giving a response rate of 87.2%. There was no significant difference between the proportions of men and women that responded ($p>0.05$).

The performance of the plasma glucose assay using the intra-assay and interassay coefficients of variation of the tests is shown in table 1.

### Study procedure

Trained assistants made up of medical doctors and medical students who spoke English and Efik languages (common languages spoken in Calabar) were involved in data collection. Permission and cooperation for the study was obtained from the community and ward heads. The research procedure was based on a modification of the WHO STEPS instrument.[16] Consenting participants for the study were invited to the nearest PHCs in their vicinity. For Calabar South Council, the designated PHCs were Anantigha, Ewa Ekeng, and Ekpo Abasi, while for Calabar Municipal the PHCs were Eyo Edem, Okon Enoch, and Ikot Ansa.

Following either a written invitation, or an invitation in person, all households within the sampled population were visited. Residents were informed about the survey and permission was sought for an interviewer to visit to conduct a household interview. A detailed description of the study objectives, the interview and examination

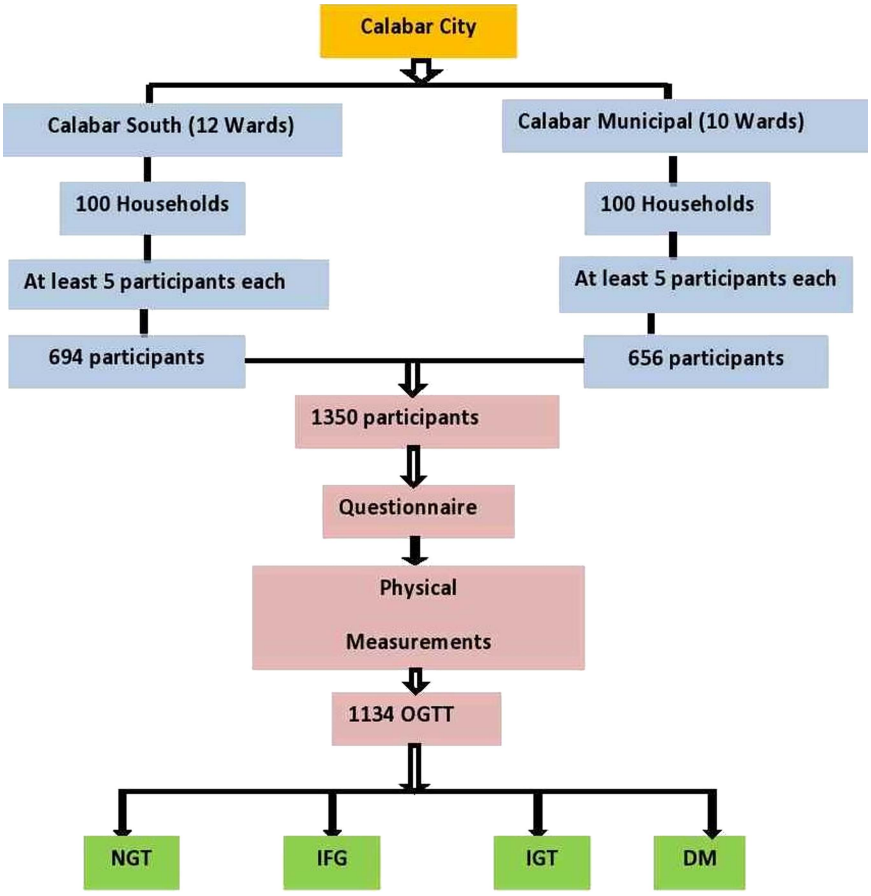


**Figure 1** Flow diagram of sampling: showing sampling circuitry for dysglycemia. DM, diabetes mellitus; IFG, impaired fasting glucose; IGT, impaired glucose tolerance; NGT, normal glucose tolerance; OGTT, oral glucose tolerance test.

process, and study confidentiality was supplied in the initial household interview. This description was provided in writing and, where necessary, translated orally in Efik or Pidgin English for ease of understanding. If the interviewer was unable to make contact with the household members, a message was left suggesting an alternative interview time. The interviewers made two to five visits before a household was classified as a non-contact.

Where possible, at each participating household, a personal interview was conducted with members aged 15 years and over, who met the eligibility requirements. Selected participants were requested to fast from 22:00 the night before their appointment at the designated health facility for biochemical and physical measurements. They were also asked not to smoke or engage in strenuous activity before their appointment, though they were permitted to drink water. The interview ascertained sociodemographic, lifestyle, and physical activity details. In some instances, household members who were unable to answer for themselves because of old age, intellectual disability, or difficulty with the English language were interviewed with the help of a responsible 'proxy'. In order to obtain a personal interview with all eligible household members, interviewers made appointments to visit as often as was necessary. In a small number of cases, interviews were conducted at the nearest health center and transport was provided where there were challenges.

At the completion of the interview, all household members aged 15 years or older were invited to the nearest health center where arrangements had been made for trained assistants to carry out relevant biomedical tests. A thorough explanation was given to participants, addressing the procedure for physical measurements and biomedical assessment.

Step 1 involved the completion of a modified WHO questionnaire under the supervision of trained research assistants. The biochemical measurements were conducted at the participant's closest health center every

**Table 1** Performance of plasma glucose assay

| Assay | Number of samples | Mean | SD | CV% |
|---|---|---|---|---|
| *Plasma glucose level (mg/dL)* | | | | |
| Intra-assay | | | | |
| Low | 10 | 63.28 | 1.26 | 1.9 |
| High | 10 | 248.49 | 5.40 | 2.2 |
| Interassay | | | | |
| Low | 20 | 62.88 | 2.24 | 3.5 |
| High | 20 | 232.86 | 6.10 | 2.6 |

Both assays yielded low CV% of less than 5%, which was within acceptable limits of variation.

Saturday over a 4-week period, in each of the sampled areas. Activities at the testing site started at 7:30 and typically finished at 11:00. On average, approximately 30 participants attended daily. The biochemical protocol followed the WHO modified STEPS questionnaire for diabetes and other non-communicable disease field survey.[16] Following the initial collection of the fasting blood sample, an oral glucose tolerance test (OGTT) was performed on all participants according to WHO specifications.[1] After the ingestion of glucose, the participants were requested to wait in the sitting area of the health facility until they were due for the 2 h post glucose load (2 HPG) check. Participants moved through the biochemical assessment procedures in a circuit-like manner that took approximately 2–3 h to complete. All data from the participants' record forms were entered manually onto data sheets and later transferred to an electronic version.

Biochemical measurements were taken according to the WHO STEP guideline, and consisted of an OGTT in the fasting state.

The participants were required to fast for 8–14 h prior to testing. Two and a half (2.5) millilitres of venous blood was collected from a forearm vein into a fluoride oxalate bottle for fasting blood glucose estimation. Then 75 g of anhydrous glucose, dissolved in 250 mL of water, was administered orally to participants. Venous blood sampling was repeated 2 h later to determine the blood sugar level 2 HPG. The plasma glucose assay was performed using Trinder's analytic method. Two milliliters of glucose oxidase containing solution was placed inside a test tube, into which 0.2 mL of plasma was added. The mixture was incubated at 37°C for 15 min. After cooling, there was a color change from a colorless to a pink solution. The absorbance of the pink solution was read off using a spectrophotometer.

### Statistical analyses

The analysis of data was carried out using the statistical package for social sciences (SSPS) V.20.0 for windows (SPSS Inc, Chicago, Illinois, USA). A comparison of means between the two groups was done using the Student t test. The $\chi^2$ test was used to find an association between categorical variables and to test for differences in proportions, and the level of significance was taken as $p<0.05$.

### Definition of terms and criteria

A. *Normal glucose tolerance*: Fasting plasma glucose <6.1 mmol/L (110 mg/dL) or BGL 2 HPG <7.8 mmol/L (140 mg/dL).[1]
B. *Glucose intolerance*: Denotes impaired fasting glucose, IGT, or DM.[1]
C. *Dysglycemia*: In this study, dysglycemia refers to impaired fasting glucose, IGT, or type 2 DM.
D. *Prediabetes*: Signifies impaired fasting glucose and/or IGT.[1]
E. *Impaired fasting glucose*: Fasting plasma glucose levels between 6.1 (110 mg/dL) and 6.9 mmol/L (125 mg/dL).[1]
F. *IGT*: Fasting plasma glucose <7 mmol/L (126 mg/dL) and BGL 2 HPG ≥7.8 (140 mg/dL) and <11.1 mmol/L (200 mg/dL).[1]
G. *DM*: Either fasting plasma glucose ≥7 mmol/L (126 mg/dL) or BGL 2 HPG ≥11.1 mmol/L (200 mg/dL).

## RESULTS

### Sociodemographic characteristics of participants

A total of 645 (56.5%) men and 489 (43.1%) women participated in the study. The majority of participants were in their third and fourth decades of life. Table 2 shows the distribution of the study participants by age and sex. There were more women among the elderly and the young age group, and more men than women in the middle age group. The mean (SD) age of the participants was 38.9 (11.1) years, with a range of 15–73 years. The mean (SD) ages of the men and women were 39.7 (10.2) and 37.7 (12.2) years, respectively ($p<0.001$).

The ethnic representations were as follows: 33% Efik, 25.6% Ekoi, and 41.1% other ethnicities, as shown in table 3. About one-third of the participants were single and about two-thirds were married. Male civil servants made up 32% of the study population and female civil servants accounted for 21% of the study population. Fourteen percent of the study population were students while the unemployment rate was 12.4% (men 6.4%; women 6%). There was a preponderance of women with no formal education compared with men, but 35% of the study population had at least post secondary education and more than half the participants had at least a tertiary education as shown in table 3.

Table 4 shows the frequency and sex distribution of the various forms of dysglycemia. The prevalence of dysglycemia was 23.6% (24.2% in men; 22.9% in women). The prevalence of IFG was 8.8% (men 9.3%; women 8.2%). IGT was more common in men than in women, with a 19.6% overall prevalence. The overall prevalence of isolated impaired fasting glucose (I-IFG) was 19% and the female participants had a higher prevalence than

**Table 2** Distribution of participants by age and sex

| Age group (years) | Male, n (%) | Female, n (%) | p Value |
|---|---|---|---|
| 15–24 | 21 (26.9) | 57 (73.1) | <0.001 |
| 25–34 | 153 (50.0) | 153 (50.0) | 0.99 |
| 35–44 | 297 (65.6) | 156 (34.4) | <0.001 |
| 45–54 | 117 (60.0) | 78 (40.0) | 0.001 |
| 55–64 | 42 (60.9) | 27 (39.1) | 0.63 |
| 65 and above | 15 (45.5) | 18 (54.6) | 0.46 |
| Total | 645 (56.9) | 489 (43.1) | |

Table 3 Distribution of study participants by other demographic characteristics and sex

| Variables | N (%) Male | Female | Row total |
|---|---|---|---|
| Ethnic group | | | |
| Efik | 161 (14.2) | 220 (19.4) | 381 (33.6) |
| Quas | 30 (2.6) | 42 (3.7) | 72 (6.3) |
| Ejagham | 69 (6.1) | 36 (3.2) | 105 (9.3) |
| Ekoi | 178 (15.7) | 112 (9.9) | 290 (25.6) |
| Ibibio | 99 (8.7) | 36 (3.2) | 135 (11.9) |
| Other | 108 (9.5) | 43 (3.8) | 151 (13.3) |
| Column total | 645 (56.9) | 489 (43.1) | 1134 (100) |
| Marital status | | | |
| Single | 207 (18.3) | 168 (19.4) | 375 (33.1) |
| Married | 405 (35.7) | 300 (26.5) | 705 (62.2) |
| Widowed | 9 (0.8) | 12 (1.1) | 21 (1.9) |
| Separated | 9 (0.8) | 9 (0.8) | 18 (1.6) |
| Divorced | 15 (1.3) | 0 (0) | 15 (1.3) |
| Column total | 645 (56.9) | 489 (43.1) | 1134 (100) |
| Occupation | | | |
| Civil servant | 366 (32.3) | 243 (21.4) | 609 (53.7) |
| Business | 111 (9.8) | 42 (3.7) | 153 (13.5) |
| Student | 72 (11.2) | 87 (17.8) | 159 (14.0) |
| Trading | 15 (1.3) | 39 (2.5) | 54 (4.8) |
| Farming | 9 (0.8) | 9 (0.8) | 18 (1.6) |
| Unemployed | 72 (6.4) | 69 (6.0) | 141 (12.4) |
| Column total | 645 (56.9) | 489 (43.1) | 1134 (100) |
| Education | | | |
| None | 6 (0.5) | 15 (1.4) | 21 (1.9) |
| Primary | 15 (1.3) | 66 (5.8) | 81 (7.1) |
| Secondary | 90 (7.9) | 114 (10.1) | 204 (18.0) |
| Postsecondary | 84 (7.4) | 111 (10.2) | 195 (17.2) |
| Tertiary | 450 (39.7) | 183 (16.1) | 633 (55.8) |
| Column total | 645 (56.9) | 489 (43.1) | 1134 (100) |

15–39=young age, 40–59=middle age, 60–79=elderly age.

male participants (21.5% vs 17.2%; p=0.07). The overall prevalence of isolated IGT (I-IG) was higher in men (9.8%) than in women (6.7%), but the difference was not statistically significant. About 4.5% of all the participants had combined IFG/IGT (C-IFG/IGT), affecting more women (4.9%) than men (4.2%). The prevalence of undiagnosed DM was 6.5% and the prevalence in men and women was 7.9% and 4.7%, respectively (p<0.05).

## DISCUSSION

The overall prevalence of dysglycemia in this study was 23.6% and undiagnosed DM was present in 6.5% of the study population. The prevalence estimates of DM, IFG, and IGT in this study were made according to current WHO criteria, based on OGTT. The 6.5% prevalence of undiagnosed type 2 DM found in this study (7.9% in men and 4.7% in women) is analogous to the prevalence rates reported in Ghana[2] and Croatia[17] (6.3% and 6.1%, respectively). However, it is much higher than the existing Nigerian national prevalence of 2.2%[18] and several other studies from Nigeria.[19–21] The prevalence of type 2 DM in a survey of the Lagos metropolis by Ohwovoriole *et al*[22] was 1.5% in men and 1.9% in women. Leslie *et al*[23] demonstrated prevalence rates of 4.6% in men and 2.3% in women in Pima Indians and Sabir[19] in North West Nigeria, and a study by Puepet[24] in urban Jos (Nigeria) obtained prevalence rates of 3.1%. However, recent data from North West Nigeria[19] and North East Nigeria[20] suggest higher prevalence rates of 4.6% and 7%, respectively. The highest prevalence rates in an urban community were found in Port Harcourt (7.9%)[21] and Lagos Mainland, Nigeria (7.2%).[18]

The increased prevalence demonstrated in our study population, compared with many other Nigerian studies, may be attributable to modernization and the adoption of a western lifestyle, as observed in other studies.[25] The increased prevalence compared with that in North West Nigeria may also be due to reasons of ethnicity. A study by Nyenwe *et al*[21] in Port Harcourt reported a higher prevalence of diabetes among the Ibibio who are of South East extraction like the Efiks, Quas, Ekois, and Ejaghams in Calabar. The prevalence of undiagnosed type 2 DM is, however, lower than that reported in Port Harcourt by Nyenwe *et al*.[21] Though Calabar and Port Harcourt are within the Niger Delta region of Nigeria, Port Harcourt is more industrialized with a heavy presence of oil and gas workers compared with the predominantly civil servant population in Calabar. Civil servants are not as affluent as oil and gas workers and are less likely to afford meals with a high content of refined carbohydrate and fat.

In the present study, the highest prevalence of DM was in the middle age category (40–59 years), which is comparable with reports from other studies carried out in low-income and middle-income countries.[12] The International Diabetes Federation (IDF) reports that the 40–59 age category currently has the greatest number of people living with diabetes, with some 132 million individuals in 2010, more than 75% of whom live in low-income and middle-income countries.[11] In contrast, the majority of people with diabetes in high-income countries are >64 years of age.[11]

The prevalence of IFG in this study was 8.8%, which is lower than the overall prevalence of 11.3% (with a male preponderance) found in Croatia. It is also three times lower than the 25.3% prevalence reported by Thorpe *et al*[26] in New York and significantly lower than the 20.4% prevalence found in the Seychelles.[27] Much lower figures of IFG have been reported in African settings such as North East Nigeria (14.5%)[20] and Ghana (6.1%),[2] which are in accordance with our results.[2] The IGT prevalence of 19.6% found in this study is higher than that found in many other studies. Prevalence rates of 12.2%, 10.6%, and 10.2% were reported in North West Nigeria,[19] Ghana,[2] and the Seychelles, respectively.[27] Williams *et al*[28] found a 16.7% prevalence of IGT in the UK while Omar *et al*[29] reported a much lower prevalence in South Africa of 7.6%. In keeping with our findings for IFG, IGT was most common in the middle age group, with a prevalence of 22.6%.

The overall prevalence of I-IFG was 19% (17.2% in men and 21.5% in women). These values are unlike

Table 4 Prevalence of dysglycemia

| Variable | Frequency | | | $\chi^2$ | p Value |
|---|---|---|---|---|---|
| | Male (n=645) | Female (n=489) | Both (n=1134) | | |
| IFG | | | | | |
| Yes | 60 (9.3) | 40 (8.2) | 100 (8.8) | 0.31 | 0.58 |
| No | 585 (90.7) | 449 (91.8) | 1034 (1.2) | | |
| IGT | | | | | |
| Yes | 136 (21.1) | 86 (17.6) | 222 (19.6) | 1.95 | 0.16 |
| No | 509 (78.9) | 403 (82.4) | 912 (80.4) | | |
| Isolated IFG | | | | | |
| Yes | 111 (17.2) | 105 (21.5) | 216 (19.0) | 3.27 | 0.07 |
| No | 534 (82.8) | 384(78.5) | 918 (81.0) | | |
| Isolated IGT | | | | | |
| Yes | 63 (9.8) | 33 (6.7) | 96 (8.5) | 3.27 | 0.07 |
| No | 582 (90.2) | 456 (93.3) | 1038 (91.5) | | |
| Combined IFG/IGT | | | | | |
| Yes | 27 (4.2) | 24 (4.9) | 51 (4.5) | 0.33 | 0.5 |
| No | 618 (95.8) | 465 (95.1) | 1083 (95.5) | | |
| Diabetes mellitus | | | | | |
| Yes | 51 (7.9) | 23 (4.7) | 74 (6.5) | 4.17 | <0.05 |
| No | 594 (92.1) | 466 (95.3) | 1060 (3.5) | | |
| Glucose tolerance status | | | | | |
| Normal | 486 (75.3) | 384 (78.5) | 870 (76.7) | 1.40 | 0.24 |
| Abnormal | 159 (24.7) | 105 (21.5) | 264 (23.3) | | |
| Dysglycemia | | | | | |
| Yes | 156 (24.2) | 112 (22.9) | 268 (23.6) | 0.19 | 0.67 |
| No | 489 (75.8) | 377 (77.1) | 866 (76.4) | | |

Dysglycemia means the presence of at least one of IFG, IGT, and diabetes mellitus.
IFG, impaired fasting glucose; IGT, impaired glucose tolerance.

those found in studies in Mauritius[30] and the National Health and Nutrition Examination Survey (NHANES)[8] but are akin to values from another study in Australia.[31] These differences may be due to divergent sociodemographic attributes among these populations.

The overall prevalence of I-IGT was 8.5% (9.8% in men and 6.7% in women) in the present study. These results are inconsistent with some studies[15 23] but parallel to findings from an Australian study.[31] I-IFG in the present study was more common than I-IGT. I-IGT identifies those with a higher risk for diabetes.[32] Although I-IFG and I-IGT are insulin-resistant states, they differ in their site of insulin resistance.[33 34] In persons with I-IFG, the predominant abnormality is hepatic insulin resistance as the muscle insulin sensitivity is normal. On the other hand, persons with I-IGT have normal to slightly reduced hepatic insulin sensitivity and moderate-to-severe muscle insulin resistance, while individuals with IFG and IGT have been found to have muscle and hepatic insulin resistance.[35]

It has been suggested in some studies that the prevalence of I-IGT is higher in women than in men due to the smaller build of women and therefore proportionally larger effect of the same glucose load. However, in this study, I-IGT was higher in men. This may be due to the prevalence of other determinants of I-IGT among men, but this was not explored in this study.

The risks of developing diabetes and cardiovascular disease are not homogeneous within the categories of IFG or IGT, but are heavily influenced by the presence or absence of other risk factors.[36] For example, individuals with IFG and IGT are at a much higher risk of developing diabetes than individuals with either condition alone.[36] The overall prevalence of combined IFG/IGT was 4.5% (4.2% in men and 4.9% in women). Individuals with combined IGT and IFG tend to be at a much higher risk of diabetes than individuals with IGT alone, but those with IGT alone account for a greater proportion of those who eventually develop diabetes.[36]

The rates of IFG and IGT found in our study are of major significance as they represent intermediate states of abnormal glucose regulation that exist between normal glucose homeostasis and diabetes. These findings underscore the need for tested preventive strategies such as lifestyle modification or pharmacological therapy in preventing or delaying the onset of diabetes in our communities.

In conclusion, there is an alarmingly high prevalence of dysglycemia in Calabar, which portrays a more serious situation than the existing national prevalence figures for DM (2.2%) suggest. This pioneer study has highlighted a serious public health problem in a setting where survey data on non-communicable diseases are grossly lacking. It makes a strong case for revision of existing health policies to reflect this epidemiological transition. Thus, intensified programmes of mass education and case identification and management of DM are imperative to stem this tide of disability and death in our society.

## Limitations

This study focused on people between the ages of 15 and 79 years and may have missed out on dysglycemia presenting outside of this age range.

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