Community based diabetes risk assessment in Ogun state, Nigeria (World Diabetes Foundation project 08-321)

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ABSTRACT

Objective: The study assessed the risk of developing type 2 diabetes Mellitus in Ogun State, Nigeria. Materials and Methods: Finnish Medical Association diabetes risk score was administered across 25 communities facilitated by non-communicable disease clinics established under a World Diabetes Foundation project. Subjects in the high risk group had blood glucose estimated. Results: 58,567 respondents included 34,990 (59.6%) females and 23,667 (40.3%) males. Majority (61.2%) were between 25 years and 54 years. Considering waist circumference, 34,990 (38.1%) females and 23,667 (5.3%) males had values above 88 cm and 102 cm respectively. Overall, 11,266 (19.2%) were obese and 28.9% overweight using body mass index (BMI). More females had elevated BMI than males. Mean systolic blood pressure (SBP) and diastolic blood pressure (DBP) of all subjects were 129.54 mm Hg ± 23.5 mm Hg and 76.21 mm Hg ± 15.5 mm Hg respectively. Prevalence of hypertension (Joint National Committee VII classification) was 27.7%. More subjects had normal DBP than SBP (68.2% vs. 42.5% P < 0.05). Mean fasting blood glucose (FBG) of all subjects was 5.5 mmol/L ± 0.67 mmol/L. Using a casual blood glucose >11.1 mmol/L and/or FBG >7 mmol/L, the total yield of subjects adjudged as having diabetes was 2,956 (5.05%). Mean total risk score was 5.60 ± 3.90; this was significantly higher in females (6.34 ± 4.16 vs. 4.24 ± 3.71, P < 0.05). A total of 2,956 (5.05%) had high risk of developing DM within 10 years. Conclusion: The risk of developing DM is high in the community studied with females having a higher risk score. There is urgent need to implement diabetes prevention strategies.

Key words: Community, diabetes risk, Nigeria, survey

INTRODUCTION

Over time, diabetes mellitus (DM) has emerged as a global healthcare problem that has reached epidemic proportions. It is a major risk factor for cardiovascular disease, with a 2-4 fold increase risk compared with persons who do not have diabetes. DM is the leading cause of blindness, non-traumatic amputations, and end-stage renal disease.

The health systems in many countries are not equipped to meet the rising challenges of diabetes care and non-communicable diseases (NCD). Type 2 DM accounts for approximately 90-95% of all cases of diabetes worldwide and the current diabetes epidemic is attributable to rising cases of type 2 diabetes. A complex interplay of genetic susceptibility and environmental/lifestyle factors such as overweight/obesity, physical inactivity, and a high-fat/low-fiber diet is believed to be driving the global explosion in type 2 DM.
In some of the poorest regions in the world such as Africa, where infectious diseases have traditionally been the focus of healthcare systems, diabetes cases are expected to increase by 90% by 2030.[8] At least 78% of people in Africa are undiagnosed and do not know they are living with diabetes.[8] Recent figures released by the International Diabetes Federation (IDF) indicate that the number of people living with diabetes is expected to rise from 366 million in 2011 to 552 million by 2030, if no urgent action is taken.[9] This equates to approximately three new cases every 10 s or almost 10 million per year. The IDF recently estimated that as many as 183 million people are un-aware that they have diabetes. Presently, more than three-quarters of the estimated 179 million people with diabetes are in the 40-59 age range.[9]

In sub-Saharan Africa, the proportion of people with undiagnosed diabetes can reach up to 90% in some countries compared to about one-third undiagnosed people in high-income countries.[8]

Some of Africa's most populous countries also have the highest number of people with diabetes, with Nigeria having the largest number of people (3.0 million), followed by South Africa (1.9 million), Ethiopia (1.4 million), and Kenya (769,000).[8] The crude prevalence of DM in a national survey conducted in 1992 in males and females below the age of 45 years was 1.6% and 1.9%, respectively; with a 3-fold increase after the age of 45 years to 5.4% and 5.6% in males and females, respectively.[9] Urban communities had a higher overall prevalence of diabetes (3.3%) when compared with rural communities (2.6%).[9] The recent IDF data (2011) estimated the prevalence of diabetes in Nigeria to be 4.04%, compared to Reunion (highest in Africa [16.78%]), Benin (1.71%), Ghana (4.09%), Niger (4.36%), Cameroun (5.18%), and South Africa (6.46%).[9]

Globally, the diabetes pandemic is driven by an increase in the adult population, increased longevity, and changes in behavior associated with rapidly increasing urbanization and development. The key changes in behavior include reduced physical activity, a shift to highly energy dense calorie diets, with associated increase in obesity.

Knowledge of diabetes care by healthcare workers in many Nigerian health establishments is generally poor. This has resulted in inadequate care for many persons with diabetes in Nigeria. Earlier studies showed that a large number of healthcare workers in Southwest Nigeria, in the absence of a Nigerian National guideline, were unfamiliar with the current practice guidelines of the American Diabetes Association for the management of diabetes.[10-12]

The main objective of the study was to assess the risk of developing type 2 diabetes over 10 years in communities across Ogun State, Nigeria as part of the World Diabetes Foundation (WDF) sponsored Project 08-321 (strategies for improving diabetes care in Nigeria [SIDCAIN]).

**MATERIALS AND METHODS**

The study was part of the WDF sponsored WDF 08-321 Project in Ogun State, Nigeria. This is a diabetes education program aimed at preventing and improving overall diabetes care in Nigeria and thus preventing/delaying the onset of complications.

Ethical clearance was obtained from the Health Research and Ethical Committee of the Olabisi Onabanjo University Teaching Hospital, Sagamu, and the procedures followed were in accordance with the ethical standards of this institutional committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 2000. Written approval for the project was also obtained from the Ogun State Health authorities.

**Study design**

This was an observational research study. The study involved all the 20 local government areas of Ogun State. One healthcare institution was randomly selected from each local government area of the State. Healthcare workers including two medical officers, three nurses, and a laboratory scientist were randomly selected from health institutions from each of these 20 local government areas, and given an intensive training over a 3-week period. Six resource staff served as trainers for the program. Relevant additional and locally available and willing resource personnel were sourced when required, from the nearest tertiary health institutions. Baseline knowledge of diabetes and hypertension care among healthcare workers at the primary and secondary healthcare levels within the selected local government areas was assessed through a structured questionnaire. The healthcare workers within the selected local government areas in the state were re-trained using the IDF training module for Africa.[13] Each training program was completed within 3 weeks. The training program was stratified into two: all willing healthcare workers were accommodated within the 1st week of the training program. The remaining 2 weeks were concentrated on the participating and willing middle cadre healthcare providers. Pre- and Post-training tests were administered.

**Selection and description of participants**

Diabetes risk assessment was carried out with the use of the Finnish Medical Association [Table 1].[14] The questionnaire consists of eight items, some of which are questions while others are patient's biodata. The total risk
score (TRS) for each study participant was the summation of all the scores.

NCD clinics were established and incorporated into the existing infrastructure of the selected health institutions in all the 20 local governments. The selected trained healthcare workers formed the core staff of the established NCDs clinics. The NCD clinics were provided with NCD registers for documenting patients’ biodata, key clinical and laboratory data, and diabetes care records. Each NCD Clinic was also provided with a “NCD Clinic Pack” that includes a sphygmomanometer, stadiometer, two glucometers, test strips, and a stethoscope. The NCD clinics were operated on a revolving account basis so as to ensure regular supply of test strips.

The NCD clinics were involved in diagnosis, assessment and treatment of persons with diabetes, health education, maintenance and regular review of metabolic control, continuing health education, and appropriate timing of referral to secondary and tertiary healthcare levels when indicated. Continuous (in-service) diabetes education was organized for the healthcare givers in the established clinics. Recruited program facilitators reviewed the activities of the NCD Clinics at the end of every month including the NCD register using a protocol and data collection form.

Statistics
Data so obtained were entered into a computerized database located at the Program Coordinators Office. Data were analyzed using the Statistical Package for Social Sciences (SPSS) for Windows, version 11 software (SPSS Inc., Chicago, IL). A $P < 0.05$ was considered statistically significant. The data were expressed as mean ± SD.

In addition to providing regular diabetes care, the NCD clinics facilitated events to increase the awareness of diabetes in the surrounding communities. The risk of developing type 2 diabetes within 10 years was stratified into: Low (<7), slightly elevated (7-11), moderately elevated (12-14), high (15-20), and very high (>20).

Inclusion and exclusion criteria
The inclusion criterion is any consenting non-diabetic adults attending the free screening camps organized by any of the established NCD clinics. Subjects with normal blood pressure but on anti-hypertensives were included. The exclusion criterion is an established diagnosis of DM.

Table 1: Type 2 diabetes risk assessment questionnaire
Circle the Appropriate Scores (On Left) for Yourself and Sum up the Total Points

| Age                  | 0<45 years | 45-54 years | 55-64 years | 65 years |
|----------------------|------------|-------------|-------------|----------|
| Body mass index (kg/m²) | 0<25.0 | 1 25.0-29.9 | 3>30.0 |
| Waist circumference measured below the ribs | Men: 0 < 95 cm Women: 0 < 80 cm | 395-102 cm 380-88 cm | 4 >102 cm 4 >88 cm |
| Do you usually have daily exercise (at least 30 min of physical activity) at work or during leisure time (including normal daily activity)? | 0 Yes | 2 No |
| How often do you eat vegetables or fruits? | 0 Every day | 1 Not every day |
| Have you ever taken antihypertensive drugs on a regular basis? | 0 No | 2 Yes |
| Have you ever been found to have a high blood glucose (e.g., in a health examination, during an illness or during pregnancy for women)? | 0 No | 2 Yes |
| Do you have a family history of diabetes? | 0 No | 3 Yes: Grandparent, aunt, uncle, or first cousin | 5 Yes: Parent, brother, sister, or own child |
| Total risk score: Risk of developing type 2 diabetes within 10 years | Risk score stratification: | <7 Low | 7-11 Slightly elevated | 12-14 Moderate | 15-20 High | >20 Very high |
| Mean age (years) | 40.69±16.27 |
| Female | 34,990 (59.6%) |
| Occupation | Trading | 22759 (38.8) |
| Student | 10793 (18.4) |
| Teaching | 5983 (10.2) |
| Civil servants | 4223 (7.2) |
| Health care giver | 1408 (2.4) |
| Artisans/unemployed | 19327 (33.0) |
| Exercise-Yes | 40825 (69.6%) |
| Eats vegetable frequently-Yes | 16307 (27.8%) |
| Hypertensive?-Yes | 7567 (12.9%) |
| Diabetes? 0020-Yes | 3461 (5.9%) |
| Family history of DM? | None | 52500 (89.5%) |
| 1st degree FH | 3694 (6.7%) |
| Other relatives | 2216 (3.8%) |
| Mean BMI (kg/m²) | 25.8±5.62 |
| Mean waist circumference | 83.4±14.3 cm |
| Mean FBG (mmol/L) | 5.5±0.67 mmol/L |
| Mean SBP | 129.5±23.5 (mmHg) |
| Mean DBP | 76.2±15.5 (mmHg) |
| Mean total risk score | 5.6±3.90 |

DM: Diabetes mellitus, BMI: Body mass index, FBG: Fasting blood glucose, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, FH: Family history

Table 2: Demographic, anthropometric and clinical data of the study population (n=58,657)
Blood pressure was measured by trained research assistants in accordance with standard procedure. Blood glucose was determined using glucometers that were previously calibrated with laboratory measurements. Only subjects in the high-risk group had their blood glucose estimated with a glucometer. Diabetes was diagnosed using a Random Blood Glucose ≥11.1 mmol/L and/or Fasting Blood Glucose ≥7 mmol/L.

**RESULTS**

**Demographic data**
Out of a total of 58,657 subjects screened by the NCD clinics, no known diabetic patients were included. The screening tool excludes known diabetics. The number comprises of 34,990 (59.6%) females. Table 2 shows the demographic data of all the study subjects. The mean age of all subjects was 40.69 years ±16.27 years.

**Blood glucose distribution**
The mean fasting blood glucose (FBG) was 5.5 mmol/L ± 0.67 mmol/L. The total yield of subjects adjudged as having diabetes was 2,956 (5.05%).

**Blood pressure distribution**
Mean systolic blood pressure (SBP) and diastolic blood pressure (DBP) of all the subjects were 129.54 mmHg ± 23.5 mmHg and 76.21 mmHg ± 15.5 mmHg, respectively [Table 3]. There was no significant difference in the SBP and DBP of the male and female subjects at 130.28 mmHg ± 22.04 mmHg versus 129.11 mmHg ± 25.24 mmHg and 76.43 mmHg ± 15.6 mmHg versus 76.05 mmHg ± 15.86 mmHg, respectively (P > 0.05). The prevalence of hypertension using the JNC VII classification in the subjects was 27.7%.

**Body mass index**
A total of 13,091 (22.3%) females had waist circumference (WC) greater than 88 cm, whereas 1,161 (2.0%) males had WC greater than 102 cm [Table 4]. Mean body mass index (BMI) for all subjects was 25.18 kg/m² ± 5.62 kg/m². The mean male BMI of 25.3 ± 4.35 was similar to that of females (26.12 ± 6.22, P > 0.05). About half (54.2%) of females had BMI >24.9 Kg/m² compared with 47.1% of males, P > 0.05; however, significantly more females were obese (BMI >30) (24.8% vs. 10.8%, P < 0.05).

**Total risk score**
Using the Finnish diabetes risk scoring, less than one-tenth (8.6%) of all the subjects were in the high and very high-risk groups, majority were in the low-risk group (<7). Tables 5 and 6 show the pattern of risk stratification of the study population.
risk for type 2 diabetes. The Finnish diabetes risk score has been previously validated among Nigerians.

Globally, a changing disease pattern tilting toward NCD preponderance has been documented in epidemiological predictions and observational data. Till date, this is perhaps one of the largest community-based studies on NCD in Nigeria. This is the strength of this study. The National Population Study on NCDs conducted by the Federal Ministry of Health in Nigeria which covered all the states of the Federation remains the only nation-wide data available till date.

Our data showed that only 1/5 (21%) of the subjects were older than 55 years. Hypertension and type 2 diabetes which tend to increase with age might have been under-represented in this cohort which comprised essentially young-and middle-aged subjects.

The mean FBG was 5.5 mmol/L ± 0.67 mmol/L. Using a casual blood glucose >11.1 mmol/L and/or FBG >7 mmol/L, the total yield of subjects adjudged as having diabetes was 2,956 (5.05%).

This is higher than the National average of 2.2% (1992) but a little higher than the recent estimate for the country released by the IDF (4.04%). This figure may even be on the low side because of the age range of participants. The mean FBG of 5.5 mmol/L ± 0.67 mmol/L is also rather high for a community screening and should be a source of concern and a call for urgent action!

Prevalence of hypertension using the JNC VII in the study subjects was 27.7%. This is slightly higher than the National average of 20%. About two-thirds of our hypertensives had stage 1 hypertension which is in consonance with the National consensus. There was no difference in the number of male and female hypertensives. More subjects had normal DBP than SBP (68.2 vs. 42.5, P < 0.05), underscoring a trend toward systolic hypertension.

The prevalence of central obesity is low among the male subjects as compared with the female where more than one-third had abnormal WC. The difference between the sexes was significant (38.1% female >88 cm vs. 5.3% male >102 cm, P < 0.05).

Pearson’s correlation showed that exercising did correlate with abdominal obesity. In all the subjects, the TRS correlated positively with FBG (r = 0.324, P = 0.000). This holds true when male and female subjects were separately

| Parameters | High risk (>13) (n=2,954) | Low risk (0-13) (n=55,701) | P value |
|------------|-----------------------------|-----------------------------|---------|
| Mean age (years) | 57.3±12.3 | 40.4±16.0 | <0.05 |
| Male (%) | 728 (24.6) | 22,939 (41.2) | <0.05 |
| Female (%) | 2,228 (75.4) | 32,762 (58.8) | <0.05 |
| Occupation | | | |
| Trading (%) | 1,817 (61.5) | 25,326 (45.5) | <0.05 |
| Student (%) | 34 (1.2) | 9,465 (17.0) | <0.05 |
| Teaching (%) | 291 (9.7) | 5,361 (9.6) | >0.05 |
| Civil servants (%) | 135 (4.6) | 3,800 (6.8) | >0.05 |
| Health care giver (%) | 30 (1.0) | 765 (1.4) | >0.05 |
| Artisans/unemployed (%) | 649 (22.0) | 10,984 (19.7) | >0.05 |
| Exercise-yes (%) | 1,355 (45.8) | 38,985 (70.0) | <0.05 |
| Eats vegetable frequently-yes (%) | 661 (22.4) | 15,785 (28.3) | >0.05 |
| Hypertensive?-yes (%) | 1,920 (65.0) | 6,213 (11.2) | <0.05 |
| Living with diabetes?-yes (%) | 1,244 (42.1) | 2,640 (4.7) | <0.05 |
| Family history of diabetes? | | | |
| None (%) | 967 (32.7) | 51,533 (92.5) | <0.05 |
| 1° degree family history (%) | 1,404 (47.5) | 2,537 (4.6) | >0.05 |
| Other relatives (%) | 585 (19.8) | 1,631 (2.9) | <0.05 |
| Mean BMI (kg/m²) | 30.9±6.4 | 25.0±5.5 | >0.05 |
| Men | 28.5±5.21 | 23.7±4.21 | <0.05 |
| Women | 31.7±6.56 | 25.8±6.06 | >0.05 |
| Mean waist circumference (cm) | 97.8±13.6 | 82.6±14.2 | >0.05 |
| Men | 94.8±14.19 | 81.8±12.02 | >0.05 |
| Women | 98.8±13.27 | 83.2±15.45 | <0.05 |
| Mean fasting blood glucose (mmol/L) | 7.28±4.14 | 5.04±4.03 | <0.05 |
| Mean SBP (mmHg) | 145.8±27.0 | 128.4±23.1 | <0.05 |
| Mean DBP (mmHg) | 83.3±15.1 | 75.5±15.4 | <0.05 |
| Mean total risk score Living with diabetes (Not living with diabetes) | | | |
| BMI: Body mass index, SBP: Systolic blood pressure, DBP: Diastolic blood pressure |
considered. The TRS was significantly higher in female subjects than males (6.34 ± 4.16 vs. 4.24 ± 3.71, P < 0.05).

It was observed that males and the older age group were more in the high-risk population. Students were more in the low-risk group, whereas traders were more in the high-risk group. This may be because of the younger age of students as well as likely increased activity, whereas trading as an occupation predisposes to sedentary lifestyle and subsequently overweight/obesity. However, student as a profession would have age as a confounding factor. It is interesting that the consumption of vegetables did not significantly differ between the low- and the high-risk groups.

One limitation of our study is the use of glucometer to determine blood glucose in the subjects. Although a calibrated equipment is allowed in field study, there could have been an over- or under-representation of diabetes prevalence. This is because a number of factors can affect the accuracy of glucose meter results, including operator technique, environmental exposure, and patient physiological and medication effects.[17]

The high risk of developing type 2 diabetes among indigenes of Ogun State, Nigeria corroborates the current global diabetes epidemic. The higher risk scores observed in females reflect the female preponderance of overweight and obesity in our communities.

**Conclusion**

The risk of developing type 2 diabetes within 10 years is unarguably high among the study participants. There is thus an urgent need to implement diabetes prevention strategies that include health education policies geared toward adoption of healthy lifestyle measures that prevent or delay the onset of type 2 diabetes.

Future research directions: In view of the global projections of diabetes epidemic and the outcome findings of this study, there is a need for a national research on diabetes in Nigeria. This must be a prospective study coordinated by the Federal Ministry of Health.

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