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ORIGINAL ARTICLE

10-Year Risk of Developing Type 2 Diabetes Mellitus – A Survey of Rural Communities in Southern Nigeria

Risque à 10 Ans de Développer un Diabète Sucré de Type 2 – Enquête Sur Les Communautés Rurales du Sud du Nigéria

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ABSTRACT

BACKGROUND: The exponential rise in the prevalence of Type 2 Diabetes (T2DM) necessitates the introduction of strategies for early diagnosis to reduce the burden of the disease. This study assessed the prevalence of prediabetes and also determined the 10-year risk of developing T2DM in Southern Nigerian rural communities by adopting the validated Finnish Diabetes Risk Score (FINDRISC) tool.

METHODS: 273 participants from 3 Southern rural communities aged 18 years and older were recruited in this cross-sectional study. Data in the FINDRISC stratification tool and Random Blood Glucose (RBG) variables were obtained for the participants. IBM SPSS version 21 was used to analyze the data with a level of significance put at $p < 0.05$.

RESULTS: The participants' mean age was 54.20±16.61 years. The prevalence of prediabetes among the study participants based on RBG was 4.8% (3.8% of males and 6.6% of females, respectively). Most of the study participants (41%) had a low risk of developing T2DM which meant that 1 in 100 participants would become diabetic in a 10-year period, based on the FINDRISC scale. Amongst the male participants, the Total Diabetes Risk Score (TDRS) showed significant positive correlation with the RBG (r=0.315, p=0.001); similarly, a weak positive correlation between TDRS and RBG was noted among female participants.

CONCLUSION: The propensity of developing T2DM in 10 years was indisputably low amongst rural dwellers in the Southern Nigerian rural communities studied. Further studies to compare the risk of developing T2DM between rural and urban communities would be required. **WAJM 2022; 39(11): 1113–1118.**

Keywords: FINDRISC, Nigeria, TDRS, Type 2 Diabetes, Prediabetes, Rural Dwellers.

RÉSUMÉ

CONTEXTE: L'augmentation exponentielle de la prévalence du diabète de type 2 (DT2) nécessite l'introduction de stratégies de diagnostic précoce pour réduire le fardeau de la maladie. Cette étude évalue la prévalence du prédiabète et détermine également le risque sur 10 ans de développer un DT2 dans les communautés rurales du sud du Nigeria en adoptant l'outil validé FINDRISC (Finnish Diabetes Risk Score).

MÉTHODES: 273 participants de 3 communautés rurales du sud du pays âgés de 18 ans et plus ont été recrutés dans cette étude transversale. Les données de l'outil de stratification FINDRISC et les variables de la glycémie aléatoire (RBG) ont été obtenues pour les participants. IBM SPSS version 21 a été utilisé pour analyser les données avec un niveau de signification mis à $p < 0,05$.

RÉSULTATS: L'âge moyen des participants était de 54,20±16,61 ans. La prévalence du prédiabète parmi les participants à l'étude, basée sur le RBG, était de 4,8% (3,8% des hommes et 6,6% des femmes respectivement). La plupart des participants à l'étude (41 %) présentaient un faible risque de développer un DT2, ce qui signifie que 1 participant sur 100 deviendrait diabétique sur une période de 10 ans, selon l'échelle FINDRISC. Chez les hommes, le score total de risque de diabète (TDRS) a montré une corrélation positive significative avec le RBG (r=0,315, p=0,001) ; de même, une faible corrélation positive entre le TDRS et le RBG a été notée chez les femmes.

CONCLUSION: La propension à développer un DT2 en 10 ans est indiscutablement faible chez les habitants des communautés rurales du sud du Nigeria étudiées. D'autres études visant à comparer le risque de développer un DT2 entre les communautés rurales et urbaines seraient nécessaires. **WAJM 2022; 39(11): 1113–1118.**

Mots clés: FINDRISC, Nigeria, TDRS, Diabète de type 2, Prédiabète, Habitants ruraux.

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Abbreviations: FINDRISC, Finnish Diabetes Risk Score., TDRS, Total Diabetes Risk Score.

INTRODUCTION

Diabetes Mellitus remains high on the list of illnesses of global public health concern.[1] Once thought to be a disease of affluence, it now plagues low-income countries including their rural communities, causing a high number of deaths and long-term morbidity.[2] Type 2 Diabetes Mellitus (T2DM) originally presumed rare in children is now a frequent finding due to rise in the prevalence and magnitude of obesity in children and adolescents.[3] An estimate of 537 million people suffered from diabetes worldwide as at 2021; this figure is predicted to rise to 643 and 783 million by 2030 and 2045, respectively.[4] In addition to deaths from cardiovascular complications, persons with diabetes are at risk of untimely mortality from cancers, infectious diseases and degenerative disorders.[5]

Interventions to quell this epidemic-scale disease are geared towards prevention, as well as early diagnosis and treatment of those suffering from it, as early disease is often minimally symptomatic, if at all.[4] The determinant factors that influence the development of T2DM and grades of dysglycaemia can be identified prior to the diagnosis of T2DM.[6] Hence, prompt diagnosis of diabetes and detection of high-risk individuals are crucial steps in mitigating complications and negative impacts on health care.[7] Prediabetes, a transitional state between normoglycaemia and overt diabetes includes states of glucose intolerance and elevated glycated haemoglobin ($HBA1_C$) levels with RBG and $HBA1_C$ values of 140–199mg/dl and 5.7–6.5%, respectively.[8]

Inability to diagnose diabetes early may preclude patients from getting appropriate treatment and life-threatening complications may ensue. Therefore, it is expedient to recognize individuals with high risk of developing diabetes.

Preventing diabetes involves paying close attention to the modifiable risk factors such as obesity, diet, sedentary lifestyle, smoking, alcohol consumption and psychosocial factors such as stress, depression and anxiety.[9] Effective strategies include weight loss, reduction in total intake of fats (including saturated fats), increasing dietary fiber intake and physical activity.[10]

The World Health Organization (WHO) recommends that a combination of tests (including risk assessment questionnaire, plasma glucose and glycated haemoglobin levels) can be used in population screening to improve the performance of the screening exercise.[11] Several tools have been developed over time to assess the risk of having T2DM including the Finnish Diabetes Risk Assessment Score (FINDRISC).[12] The FINDRISC questionnaire is an easy, fast, non-invasive, economical and practical screening tool to identify individuals at risk of later development of T2DM. The well validated FINDRISC tool takes into account the age, body mass index (BMI), waist circumference (WC), physical activity, daily consumption of fruits and fibers, use of blood pressure-lowering drugs, history of hyperglycemia and family history of diabetes. This tool not only aids in the detection of undiagnosed diabetes, but also predicts the likelihood of developing T2DM within a 10-year period.[13] Studies have shown up to 100% sensitivity in detecting previously undiagnosed dysglycaemia, compared to a sensitivity of 72-88% using other risk assessment tools.[12]

A previous study reported prevalence of 9.2% and 15.8% for impaired fasting glucose and impaired glucose tolerance among inhabitants of rural dwellers, respectively.[14] It is known that the diet of the rural Nigerian communities consists of high carbohydrate and potentially diabetogenic foods such as cassava and yam-based meals.[15] There are few population-based studies on the risk assessment for T2DM among rural dwellers across Nigeria, and even fewer researchers have examined the performance of a diabetes screening tool such as the FINDRISC on rural populations in Nigeria. It was imperative that this study was undertaken to fill a gap in knowledge as to the current rate of prediabetes/diabetes in rural Southern Nigeria, as well as the lifestyle patterns of the population in question. It will provide many who lack the wherewithal or access to health care facilities, the opportunity to be screened en-masse and also ensure early detection of undiagnosed disease.

The primary aim of the study was to determine the risk of developing T2DM over a 10-year period among rural dwellers in Southern Nigeria.

METHODS

This study was centered on a screening program established to cater for selected rural communities in Southern Nigeria. It was conducted in two rural communities in the Southwestern region – Ilishan–Remo and Odogbolu, Ogun State, and one rural community in the Southeastern region – Uburu, Ebonyi State.

Study Period

The study was carried out between March and June 2019.

Study Design

A cross-sectional design was employed in this study. All recruited participants were screened for diabetes mellitus by checking their RBG using capillary blood with the Accu-Chek® Active Glucometer. Values obtained were express in milligrams per deciliter (mg/dl). Anthropometric indices, i.e. weight and height were obtained using a standard weighing scale and stadiometer, and the body mass index (BMI) was generated from the aforementioned.

Half-way between the lowest rib and the anterior superior iliac spine was used as the landmark for waist circumference (WC). The validated FINDRISC questionnaire was administered on each study participant.

Study Instrument

The FINDRISC is an instrument which uses the following variables to generate a score for each participant: Age, BMI, WC, everyday exercise not less than 30 minutes, daily consumption of fruits and fibers, use of blood pressure-lowering drugs, previous identification of high blood glucose and family history of diabetes mellitus. The maximum value for the FINDRISC score is 26. A score less than 7 signifies a very low probability of developing diabetes within a 10-year period, 7–11 indicates a slightly elevated risk, 12–14 indicates moderate risk, 15–20 shows a high risk and a score more than 20 designates a very high risk.

Exclusion Criteria

Participants were excluded from the study on the basis of any of the following: A previous history of diabetes mellitus (Type 1 or Type 2), any participant with RBG in the diabetic range, steroid use or other diabetogenic medications, acute illnesses, pregnancy as well as refusal of consent.

Sample Siz

The sample size was determined using the Kish formula.[16]

$$N = \frac{Z^2P(1-P)}{d^2}$$

Where,

N = is the minimum sample size

Z = Standard normal deviation at 95% confidence interval (1.96)

P = is the proportion of those with pre-diabetes in a rural area in Nigeria from a previous study[17] (21.5%).

d = is the absolute precision (5% or 0.05).

Therefore,

$$\frac{3.84 \times 0.215 \times (1-0.215)}{0.05^2} = 259$$

A minimum sample size of 259 participants was obtained for the study. However, in order to make adequate provisions for errors in filling questionnaires due to inconsistency and possible missing data, a total sample size of 273 was adopted.

Sampling Technique

All eligible individuals were recruited into the study. Convenience sampling technique was employed, as the screening exercise was made open to all members of the communities and awareness was created with the help of the traditional rulers, the community elders and religious leaders.

Data Collection

Data were collected on the days assigned for the community screening programme. The questionnaire was interviewer-administered to aid comprehension.

Statistical Analysis

Data obtained were entered into IBM SPSS version 21 for analysis. Descriptive statistics were expressed as means with standard deviation for continuous variables and proportions for categorical variables. Gender difference between continuous variables was compared using Student's t-test, and Chi-square test was used for categorical variables. All statistical tests were two-tailed, and a p-value less than 0.05 was statistically significant.

Ethical Considerations

Study approval was obtained from the Babcock University Health Research Ethics Committee, Ilishan-Remo, Ogun State (BUHREC 517/19). All relevant standards of Revised Declaration of Helsinki were followed.

Definition of Study Criteria

Normoglycaemia:

- RBG less than 140mg/dl.
  Dysglycaemia/prediabetes
- RBG of 140-199mg/dl.
  Overt diabetes
- RBG of 200mg/dl OR higher with classic symptoms of diabetes.

RESULTS

The socio-demographic and clinical parameters of the study population are depicted in Table 1.

A total of 273 participants were screened in the three rural communities in Southern Nigeria where the study was carried out.

Table 1: Demographic and Clinical Data of Study Population

Variables	Malen=182 (66.7%)	Femalen= 91 (33.3%)	Total	Statistic Test Value	P value
Mean age±SD (years)	53.54 ± 17.35	55.53 ± 15.03	54.20 ± 16.61	t= –0.932	0.352
Mean Wgt±SD (kg)	64.38 ± 14.98	65.90 ± 18.51	64.89 ± 16.22	t= –0.727	0.468
Mean Hgt±SD (m)	1.60 ± 0.89	1.56 ± 0.67	1.59 ± 0.85	t= 3.837	0.001*
Mean BMI±SD (kg/m^2)	25.42 ± 5.85	26.86 ± 6.97	25.90 ± 6.27	t= –1.804	0.072
Mean WC±SD (cm)	91.28 ± 11.29	80.68 ± 10.86	87.75 ± 12.21	t= 7.401	0.001*
Mean RBG±SD (mg/dl)	102.10 ± 44.82	117.84 ± 57.26	107.35 ± 49.77	t= –2.485	0.014*
Eat Veg Frequently (%)					
Everyday	115(63.2)	63(69.2)	178(65.2)	χ^2= 0.977	0.323
Not everyday	67(36.8)	28(30.8)	95(34.8)		
Taken BP drugs (%)					
Yes	56(30.8)	23(25.3)	79(28.9)	χ^2= 0.891	0.345
No	126(69.2)	68(74.7)	194(71.1)		
Exercise (%)					
Yes	103(56.6)	68(74.7)	171(62.6)	χ^2= 8.522	0.004*
No	79(43.4)	23(25.3)	102(37.4)		
Fmly hx of DM (%)					
None	154(84.6)	80(87.9)	234(85.7)	χ^2= 1.282	0.527
First Degree	6(3.3)	1(1.1)	7(2.6)		
Other relatives	22(12.1)	10(11.0)	32(11.7)		
Mean total risk score±SD	6.90±5.19	7.09±5.55	6.96±5.30	t= –0.274	0.784

**Wgt – Weight, Hgt – Height, BMI – Body Mass Index, WC – Waist Circumference, RBG – Random Blood Glucose, BP – Blood Pressure, Eat veg frequently – Eat vegetables frequently, Fmly hx of DM – Family history of diabetes mellitus, p* - p value is Significant.*

The age of the participants ranged from 18 to 90 years with a mean age of 50.20±16.61 years. Among the study participants, males made up 66.7% (182) while females constituted 33.3% (91) with a male-to-female ratio of 2:1. The mean waist circumference of the male and female participants were 91.28±11.29 and 80.68±10.86, respectively. This differed significantly between the two study groups ($p<0.05$). The female participants had statistically significant higher mean value of RBG compared to the male participants (117.84±57.26 vs 102.10±44.82). Majority of the study participants 62.6 % (171) routinely engaged in at least 30 minutes of daily physical activity while 65.2% (178) of them had vegetables, fruits or berries as part of their daily diet.

The prevalence of prediabetes and diabetes amongst the study participants is illustrated in table 2. One hundred and sixty-six (91.2%) of the male participants had normal RBG while 80(87.9%) of the female participants had normal RBG. Prediabetes was found among 7(3.8%) and 6(6.6%) of the male and female participants, respectively. The total yield of individuals with RBG in the diabetic range was 14(5.1%).

Table 3 shows the pattern of risk stratification of the study population using the FINDRISC score distribution. The mean total diabetes risk score (TDRS) was 6.96±5.30. The TDRS was similar in the male and female participants (6.90±5.19 vs 7.09±5.55, p=0.784). A large proportion of study participants represented as 68 (37.4%) males and 44(48.4%) females had a low risk (FINDRISC <7) of developing T2DM within 10 years. Moderate risk (FINDRISC 12–14) was found in 35 (19.2%) males and 16(17.2%) females; however, only 1(0.5%) male and 2(2.2%) females had a very high risk (FINDRISC >20) of developing T2DM within 10 years.

The correlation of TDRS with the RBG in both sexes is depicted in Table 4. Among the male participants, there was a significant positive correlation between TDRS and RBG (r=0.315, p=0.001), whereas there was a weak but positive correlation between TDRS and RBG amongst the female study participants, though the correlation was not statistically significant (r=0.182, p=0.084).

Table 2: Prevalence of Diabetes in the study participants

Variables	Male (%) n=182	Female (%)n= 91	Total (%)	Statistic Test value	P value
Blood Sugar					
Normal	166(91.2)	80(87.9)	246(90.1)	1.070	0.586
Prediabetes	7(3.8)	6(6.6)	13(4.8)		
Overt Diabetes	9(4.9)	5(5.5)	14(5.1)		

Table 3: Risk of Developing Type 2 Diabetes among Study Participants

Total Risk Score	Male n=182 (66.7%)	Female n= 91 (33.3%)	Total (%)	Statistic Test Value	P value
L Risk (<7)	68(37.4)	44(48.4)	112(41.0)	6.847	0.144
S Elevated Risk (7–11)	61(33.5)	19(20.9)	80(29.3)		
M risk (12–14)	35(19.2)	16(17.6)	51(18.7)		
H risk (15–20)	17(9.3)	10(11.0)	27(9.9)		
VH risk (>20)	1(0.5)	2(2.2)	3(1.1)		

**L risk – Low risk, S elevated risk – Slightly Elevated risk, M risk – Moderate risk, H risk – High risk, VH risk – Very High risk*

Table 4: Correlation of Total Risk Score with RBG among the Study Participants

Variables	Male Mean±SD	Female r	p	Mean±SD	R	p
Total Risk Score	6.90±5.19	0.315	0.001	7.09±5.55	0.182	0.084
RBG (mg/dl)	102.10±44.83			117.84±57.26		

**RBG – Random Blood Glucose.*

DISCUSSION

The exponential rate at which the prevalence of T2DM is increasing necessitates the development and introduction of greater prevention strategies to reduce the incidence and prevalence of the disease. It is therefore very relevant to identify individuals at increased risk of developing the disease. The motive of community screening of T2DM is to make a clear distinction between asymptomatic individuals at high risk from individuals at low risk. [13] Screening for diabetes can detect subjects at an early disease stage and those amenable to early interventions.

The FINDRISC is a well-validated, cheap and reliable instrument for a large population T_2DM screening. It has been previously validated among Nigerians.[17]

Waist circumference is one of the elements of the National Cholesterol Education Programme-Adult Treatment Panel III (NCEP-ATP III) that is a major determinant of metabolic syndrome. This study reported lower mean values of WC for both males and females (91.28±11.29 vs 80.68±1086) compared to the set cut off of values for WC across gender ($\leq$102cm for males and $\leq$88cm for females. Reduction in central obesity (i.e. a lower waist circumference and particularly a lower waist-to-hip ratio) is more strongly associated with lower risk of development of T2DM.[25]

In this study, the prevalence of prediabetes identified by RBG was 4.8%. This is lower than the observed prevalence of 10.3% in a previous study done in an urban setting in Northern Nigeria.[18] In our study, the prevalence of T2DM was 5.1%. This is lower than the national prevalence of 5.7% reported by a recent study;[19] also lower than an earlier report of 8.8% from a group of semi-urban communities' screening using the

FINDRISC tool.[20] The difference in the prevalence of prediabetes and diabetes in our study compared to earlier studies can be attributed to dietary modifications, lifestyle patterns, and low incidence of co-morbid conditions like hypertension and family history of diabetes in the rural communities where this study was carried out. A higher intake of fruits and fibers as seen among rural dwellers in this study is likely linked with the perceived lower risk of T2DM.[21] This can be responsible for the low risk of developing T_2DM in a 10-year period seen in the majority 112(41.0%) of this study participants.

Also a large proportion of participants in this study (62.6%; 171) engaged in not less than 30 minutes of everyday exercise, which improves blood glucose, ameliorates cardiovascular risk factors, contributes to weight reduction and improves overall wellbeing. Regular exercise as seen among our study participants may thwart the risk of disease development.[22]

In the present study, a large percentage of the participants (41%; 112) had low risk of developing T2DM; this agrees with findings from previous community-based studies.[23,24]

In all our study participants, the TDRS correlated positively with RBG; this held true when male and female participants were separately considered.

Study Limitation

One limitation of this study was the use of glucometer to determine blood glucose of participants. In some cases, a well calibrated device can be used during a large community-based screening. In addition, the RBG was used as the sole determinant of glycaemia. This was as a result of logistic constraints, and the inability to control the arrival of participants. Participants with hyperglycemia would require further evaluation to ascertain their diabetic status.

CONCLUSION

The risk of developing T2DM within 10 years is undeniably low among the rural dwellers in the communities assessed. Dietary modifications, lifestyle interventions, low incidence of co-morbid conditions and low family history of diabetes are thought to be responsible for this finding. Further studies with large sample sizes will be required to compare the risk of developing diabetes between rural and urban communities.

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Competing Interests

Authors have declared that no competing interests exist.

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