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The Performance of the Finnish Diabetes Risk Score (FINDRISC) Questionaire for Screening Individuals with Undiagnosed Type 2 Diabetes and Dysglycaemia in Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Authors OAM and OR designed the study, collected the data, did the statistical analysis and involved in the final draft of the manuscript. Author IOS involved in the statistical analysis and the final draft of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: The Finnish Diabetes Risk Score (FINDRISC) questionnaire is a non-invasive, cheap, and easy to use screening tool to estimate future risk of diabetes development and detection of asymptomatic type 2 diabetes mellitus (T2DM) in other populations. This study aimed to evaluate usefulness of the FINDRISC to assessed future development of T2DM among a high-risk population.
Methods: 750 participants recruited from semi-urban communities aged 18 years and older participated in this cross-sectional study. Data on the FINDRISC and fasting plasma glucose

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variables were available for each participant. SPSS version 16 was used for analysis and p<0.05 was taken as statistically significant.
Results: The mean age of participants was 61.7±18.5years, 70.6% females and 8.8% were adjudged to have diabetes based on FPG. 103 (13.73%) participants had high-risk score of 15-20, which estimates that 1 in 3 participants would develop diabetes within 10 years. 4 of the participants had very high risk (>20) and all of them were adjudged to have diabetes. There was significant association between diabetes risk score and FPG (p=0.001), SBP (p=0.034) and age (p<0.001).
Conclusion: The FINDRISC seem a useful non-invasive, easy to use, self-administered and practical tool to screen for undetected diabetes and future development of diabetes among high-risk groups in this semi-urban community.

Keywords: Community; FINDRISC; Nigeria; risk assessment; screening; type 2 diabetes.

1. INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a global health problem in developed and developing countries whose prevalence is increasing rapidly [1]. The worldwide number of people with diabetes is estimated to rise from the current estimate of 382 million to 592 million in 2035 [2]. The rapid increase in the incidence of diabetes mellitus (DM) has led to heightened public concern over prevention and treatment [3]. Because of the chronic course of T2DM, and the significant morbidity and mortality associated with vascular complications of the disease, T2DM has become not only a serious public health threat but also a heavy economic burden on every health care system [4]. The risk factors for T2DM and stages of abnormal glucose tolerance (AGT) can be detected early before the clinical onset of T2DM [4]. Therefore, early detection of undiagnosed diabetes and identification of individuals at high risk are crucial steps in reducing the associated health care burden [5]. Because T2DM is usually asymptomatic in its earliest stages, many cases remain undiagnosed for a long time. 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 [6]. The absence of a diagnosis of diabetes may prevent patients from receiving early adequate intensified treatment in time so as to prevent development of diabetic complications [7]. It is clinically important to be able to identify individuals at risk for diabetes. First, undiagnosed diabetes often remains undetected for 4 to 7 years before clinical diagnosis, and many newly diagnosed patients already exhibit signs of microvascular and macrovascular complications [7,8]. Also, individuals with prediabetes (impaired fasting glucose {IFG} and/or impaired glucose tolerance {IGT}) have a high likelihood of developing T2DM -10 to 20 times that of normoglycemic persons [9,10]. As such, adults with prediabetes are the most likely to benefit from early diagnosis [9,10]. Identification of at risk individuals could be of particular importance because chronic complications are often diagnosed coincidentally with the diagnosis of T2DM [8].

Recommended methods for diabetes screening in the general population include plasma glucose (either fasting or 2 hours after an oral glucose tolerance test {OGTT}), and glycosylated haemoglobin (HbA1c) levels [9]. However, these are invasive methods, costly and time-consuming (especially OGTT), and thus not readily suitable for mass screening in the communities. The use of non-invasive risk scores is more likely to be cost-effective and feasible for large- scale screening than is use of invasive risk score [10,11]. Generally, the use of non-invasive risk score instruments has been widely incorporated into strategies for diabetes prevention [10,11]. The Finnish Type 2 Diabetes Risk Score (FINDRISC) questionnaire [12] is a simple, fast, non-invasive, cost-effective and practical screening tool to identify individuals at high risk of future development of T2DM which has been validated mostly in different Caucasian populations. As the effectiveness of the FINDRISC questionnaire has only been used in few studies in Nigeria [13,14], hence this study aimed to evaluate the performance to predict undetected T2DM, and pre-diabetes among adult (≥18years) semi-urban dwellers in South-western Nigeria.

2. METHODS

A total of 856 subjects aged 18 years and older with no known diabetes were recruited as a

convenient sample. All consented adults with no exclusion criteria (previously diagnosed with diabetes, individuals on steroids, pregnant women) were allowed to participate in this study. All individuals completed the FINDRISC questionnaire (which assesses diabetes risks) and had their fasting plasma glucose (FPG) checked after 8-12 hours of fasting. The study was conducted in a community outreach (held at town halls) at five semi-urban communities selected at Ekiti North Senatorial district of Ekiti State, between November 2012 and April 2013. The FINDRISC is a self-administered questionnaire to gather information about the diabetic risk factors, originally developed by Lindstrom and Tuomilehto [12]. It was validated from a multivariate logistic regression model based on an independent population survey completed in 1992, with a prospective follow-up 5 years later. The questionnaire comprises eight items: age, body mass index (BMI), waist circumference, physical inactivity, dietary consumption of fruits, vegetables or berries, use of antihypertensive medication, history of high blood glucose, and family history of diabetes. The total diabetes risk score (TDRS) for each study participant was the summation of all the scores. The total test score (maximum: 26) provides the measure of the possibility of developing T2DM, with a score of greater or equal to 15 being indicative of high probability (Fig. 1). The risk of developing T2DM within 10 years was classified as follows: low (<7), slightly elevated (7-11), moderately elevated (12-14), high (15-20) and very high (>20).

The following variables were also collected from each participant using administered questionnaire: age, gender, body weight (kg), height (m), waist and hip circumference (cm), systolic (SBP) and diastolic blood pressure (DBP). Fasting plasma glucose was determined using Accu-Chek glucometer that was earlier calibrated with laboratory measurement. Total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), and triglyceride (TG) levels were also measured from the Chemical Pathology laboratory of the Federal Medical Centre, Ido-Ekiti, using enzymatic assay. Low-density lipoprotein cholesterol (LDL-C) was calculated using the Friedeward formula [15]. Based on the result of FPG, participants were classified into the following: normal glucose tolerance (NGT), FPG <6.1 mmol/L; impaired fasting glucose (IFG), FPG 6.1-6.9 mmol/L; and diabetes, FPG ≥7.0 mmol/L. Ethical clearance was sought and obtained from the ethical committee of Federal medical centre, Ido Ekiti. Each participant gave informed consent.

2.1 Statistical Analysis

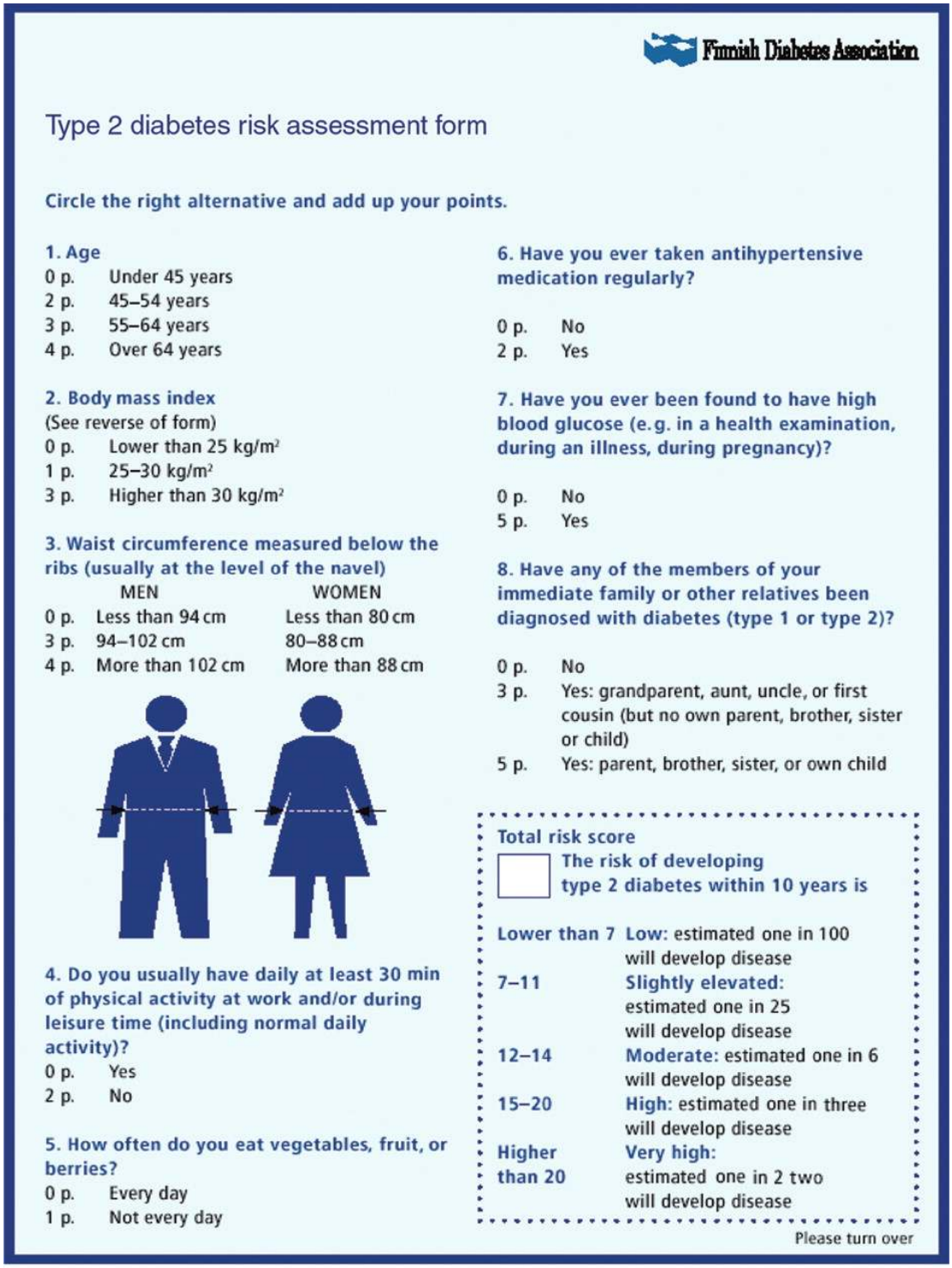
Data were analysed using Statistical Package for Social Sciences version 16.0 software (SPSS Inc, Chicago, IL, USA). Continuous variables were presented as means ± standard deviation. Comparisons between normally distributed continuous variables were performed using Student's t-test. Associations between categorical variables were done with Chi-Square test. Patient's characteristics according to their FINDRISC scores were compared by One-way analysis of variance (ANOVA) for continuous variables. A p-value <0.05 was considered statistically significant.

3. RESULTS

A total of 856 participants were initially enrolled but some declined to give a blood sample. Others were discarded because of incomplete data and/or information. The screening tool excludes known diabetics. The age of the participants ranged from 18 to 83 years with a mean age of 61.7±18.2 years. There were 529 (70.9%) females, with a male to female of 1:2.4. The sociodemographic, clinical and biochemical characteristics of the study population are as shown in Table 1.

The mean TDRS was 13.32±2.48. The TDRS was similar in males and in the females (12.90±2.58 vs. 12.86±2.32, p=0.860). One hundred and three (103 (13.73%)) had high risk (which estimated that 1 in 2 of the participants will develop diabetes within 10 years), compared to 539 (71.86%) with elevated and moderate elevated risk (estimate 1 in 6 – 25 chance of developing diabetes within 10 years), Table 2. Mean FINDRISC values showed a progressive and significant increase (p<0.001) as the glucose categories worsened (normal, pre-diabetes, diabetes), with use of FPG. The prevalence of those adjudged to have diabetes in this study was 8.8%, and this prevalence increased with increase in FINDRISC values. The prevalence of T2DM was 4.8%, 8.2%, 14.6% and 100% for low, moderately elevated, high and very high risk respectively, Table 3. Also individuals with higher scores had higher values for age, BMI, WC, and systolic (SBP) and diastolic blood pressure (DBP), Table 4. Of the subgroup of participants as being high or very high, i.e. TDRS >14 by the FINDRISC (sensitivity=72.6% and specificity=64.8%), FPG indicated 17.0% as

having diabetes. Meanwhile, this finding for diabetes in the individuals identified by the FINDRISC as having low, slightly high or moderate high is 7.5%.



Finnish Diabetes Association

Type 2 diabetes risk assessment form

Circle the right alternative and add up your points.

1. Age
0 p. Under 45 years
2 p. 45–54 years
3 p. 55–64 years
4 p. Over 64 years

2. Body mass index
(See reverse of form)
0 p. Lower than 25 kg/m²
1 p. 25–30 kg/m²
3 p. Higher than 30 kg/m²

3. Waist circumference measured below the ribs (usually at the level of the navel)

	MEN	WOMEN
0 p.	Less than 94 cm	Less than 80 cm
3 p.	94–102 cm	80–88 cm
4 p.	More than 102 cm	More than 88 cm

4. Do you usually have daily at least 30 min of physical activity at work and/or during leisure time (including normal daily activity)?
0 p. Yes
2 p. No

5. How often do you eat vegetables, fruit, or berries?
0 p. Every day
1 p. Not every day

6. Have you ever taken antihypertensive medication regularly?
0 p. No
2 p. Yes

7. Have you ever been found to have high blood glucose (e.g. in a health examination, during an illness, during pregnancy)?
0 p. No
5 p. Yes

8. Have any of the members of your immediate family or other relatives been diagnosed with diabetes (type 1 or type 2)?
0 p. No
3 p. Yes: grandparent, aunt, uncle, or first cousin (but no own parent, brother, sister or child)
5 p. Yes: parent, brother, sister, or own child

Total risk score
The risk of developing type 2 diabetes within 10 years is

Lower than 7	**Low:** estimated one in 100 will develop disease
7–11	**Slightly elevated:** estimated one in 25 will develop disease
12–14	**Moderate:** estimated one in 6 will develop disease
15–20	**High:** estimated one in three will develop disease
Higher than 20	**Very high:** estimated one in 2 two will develop disease

Please turn over

Test designed by Professor Jaakko Tuomilehto, Department of Public Health, University of Helsinki, and Jaana Lindström, MFS, National Public Health Institute.

Fig. 1. The FINDRISC form

Table 1. Clinical and biochemical profile of the study population (±Standard Deviation)

Variable	Men	Women	Total	P-value
Age (years)	59.96(20.01)	64.42(17.28)	61.7(18.50)	0.090
Weight (Kg)	60.96(12.97)	57.77(13.54)	58.71(13.44)	0.003
Height (m)	1.64(0.12)	1.56(0.09)	1.58(0.11)	<0.001
BMI (Kg/m^2)	22.61(5.52)	23.68(5.50)	23.36(5.53)	0.013
Waist circumference (cm)	83.31(9.61)	86.69(12.66)	85.69(11.94)	<0.001
Hip circumference (cm)	89.42(7.51)	94.63(10.99)	93.09(10.35)	<0.001
Waist-hip ratio	0.93(0.06)	0.93(0.43)	0.93(0.26)	0.104
Systolic blood pressure (mmHg)	142.32(28.71)	142.39(28.54)	142.37(28.57)	0.976
Diastolic blood pressure (mmHg)	81.07(14.97)	81.77(13.82)	81.57(14.16)	0.530
Total cholesterol (mmol/L)	3.01(0.97)	3.21(1.13)	3.16(1.20)	0.020
HDL-C (mmol/L)	1.12(0.54)	1.02(0.46)	1.05(0.49)	0.014
TG-C (mmol/L)	0.74(0.34)	0.82(0.53)	0.79(0.48)	0.035
LDL-C (mmol/L)	1.69(1.08)	1.82(0.95)	1.78(0.95)	0.040
TC/HDL	3.44(2.60)	3.80(2.50)	3.69(2.55)	0.070

Body mass index (BMI), Total cholesterol (TC), Low density lipoprotein cholesterol (LDL-C), High density lipoprotein cholesterol (HDL-C), Triglycerides (TG-C)

Table 2. Stratification of participants according to the diabetes risk scores

Grade	Total	Male	Female	X^2	P value
Low	105(14.00)	37(35.24)	68(64.76)		
Elevated	295(39.33)	101(34.24)	194(65.76)		
Moderate elevated	244(32.53)	56(22.95)	188(77.05)	10.803	0.029
High	103(13.73)	26(25.24)	77(74.76)		
Very high	3(0.40)	1(33.33)	2(66.67)		

Table 3. Prevalence of diagnosed diabetes mellitus among stratification groups

Variable	Low (%)	Elevated (%)	Moderately elevated (%)	High (%)	Very high (%)	X^2	*p*–value
FBS							
Normal	100(95.2)	275(93.2)	224(91.8)	88(85.4)	0(0.0)		
DM	5(4.8)	20(6.8)	20(8.2)	15(14.6)	3(100)	40.625	<0.001
Total	105(100)	295(100)	244(100)	103(100)	3(100)		

4. DISCUSSION

The increasing prevalence of type 2 diabetes requires the development and introduction of better prevention strategies to reduce the incidence and prevalence of the disease [14,16]. Although the development of specific preventive measures for diabetes diagnosis targeting the entire population is not practically feasible, cost effective nor as appropriate strategy; it is therefore essential to identify subjects at increased risk of developing diabetes. Hence, a simple, inexpensive, non-invasive and valid tool focused on classic and valuable risk factors is needed [10].

In this study, the prevalence of total diabetes as detected by FPG was 8.8%. This value is higher than National prevalence of 2.2% [17], also higher than the recent estimate (4.99%) for this country by the International Diabetes Federation (IDF) [2], and 5.05% as detected by Alebiosu et al. [14] in a similar community-based screening using FINDRISC. This higher prevalence in this study (6.8% vs. 5.05%) may be due to older participants, and higher prevalence of detected hypertension (47.5% vs. 27%), both of which are known risk factors for the development of type 2 diabetes [18,19]. It was observed that male gender, older age group, increased blood pressure were more in the high risk group. These are in keeping with known risk factors for developments of T2DM. The screening for type 2 diabetes is recommended by the American Diabetes Association (ADA) at 3-year intervals, beginning at age 45 years, especially in those with risk factors, especially those with family history of diabetes and those with a BMI greater

Table 4. Comparison of clinical and sociodemographic data between high risk subjects and low risk subjects

Parameter	High risk (>14) n=106	Low risk (0-14) n= 644	P value
Mean age	68.61±11.54	60.56±18.79	<0.001
Sex			0.330
Male	27(25.5)	194(30.1)	
Female	79(74.5)	450(69.9)	
Occupation			0.207
Petty trading	12(11.3)	73(11.3)	
Unemployed	55(51.9)	254(39.4)	
Farmer	23(21.7)	188(29.2)	
Unskilled labour	3(2.8)	49(7.6)	
Clerk	0	1(0.2)	
Professional	6(5.7)	34(5.3)	
Other	7(6.6)	45(7.0)	
Exercise –yes %	1(0.9)	51(7.9)	<0.001
Vegetables –yes %	1(0.9)	135(21.0)	<0.001
HTN-yes	56(52.8)	31(49.8)	0.569
DM-yes	18(17.0)	48(7.5)	0.001
Mean BMI	29.64±7.65	22.33±4.29	<0.001
BMI Male	28.82±11.64	21.74±3.21	0.004
BMI Female	29.92±5.77	22.58±4.67	<0.001
Waist circumference	98.92±8.80	83.51±10.95	<0.001
Male waist circumference	93.33±8.55	81.91±8.91	<0.001
Female waist circumference	100.83±8.09	84.20±11.66	<0.001
Family history of diabetes			<0.001
None	99(93.4)	640(99.4)	
Parent	5(4.7)	3(0.5)	
Other relatives	2(1.9)	1(0.2)	
Mean FBS	107.39±66.96	84.39±31.78	0.001
Mean SBP	144.52±28.51	142.01±31.78	0.044
Mean DBP	84.14±12.79	81.14±14.32	0.031
Mean TDRS male	16.52±2.01	9.53±3.18	<0.001
Mean TDRS female	15.96±1.72	10.51±2.91	<0.001
MEAN TDRS	16.10±1.81	10.24±3.04	<0.001

or equal to 25 kg/m^2 [20]. The U.S. Preventive Services Task Force (USPSTF) recommends screening only persons with a blood pressure greater than 135/80 mmHg [21]. However, these recommendations are not widely followed, as indicated by the fact that one-third of those who have diabetes go undiagnosed even in high-income countries [6], as the main reason for this problem is the cost and inconvenience of diabetes testing [22]. The ADA approach lacks specificity because it recommends screening all adults older than 45 years, whereas USPSTF lacks sensitivity because it would only screen patients with hypertension. The use of simple, independent risk-assessment tools is an alternative, with the potential to be more specific while missing relatively few individuals with undiagnosed diabetes.

The high possibility of developing type 2 diabetes among the screened participants in this South western Nigeria study corroborates with the projected epidemics of diabetes especially the type 2 diabetes.

5. CONCLUSION

Computation of diabetes risk score may be useful in the context of targeting prevention interventions to high risk groups. The finding in this study suggests that the diabetes risk factor (FINDRISC) perform comparatively well to enable accurate estimation of absolute risk for detecting undiagnosed T2DM. Thus, risk score which are non-invasive, cheap and easy to use should be used for routine clinical evaluation to identify individuals or population subgroups that

might benefit from more comprehensive risk assessment for development of T2DM. This is more important for resource-poor setting like Nigeria where there is high poverty, poor health culture and inadequate health resources.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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