

Utility Of Finnish Diabetes Risk Score In A Young Adult Population In An Urban Setting In Africa

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Abstract

Background The prevalence of type 2 diabetes mellitus (T2D) and other NCDs is on the rise globally, low-income countries like Tanzania are not spared. Affordable and effective screening tools are needed to combat these epidemics. This study aimed to evaluate the utility and applicability of the Finnish Diabetes Risk Score (FINDRISC) as one of the screening tools for T2D and its potential risk factors in population of young adults from an urban setting in Tanzania. **Methods** A community based cross-sectional study was conducted in urban setting Mwanza-Tanzania. Data was collected using FINDRISC questionnaire (assessing Age, BMI, waist circumference, physical activity participation, vegetable consumption, and history of high blood pressure, history of high blood sugar and family history of diabetes) and physical assessment of, blood pressure, waist circumference and hip circumference. Laboratory measurements for fasting blood glucose, oral glucose tolerance and lipid profile. Data was analyzed using STATA 13. Pearson's correlation was used to assess the associations between FINDRISC with clinical and biochemical parameters. Linear regression was used to assess the extent at which FINDRISC predicted various clinical and biochemical parameters. P-value was considered significant at $p \leq 0.05$. **Results** Of the 259 participants enrolled, 32.8% were in the FINDRISC categories of "at least slightly elevated risk" to "high risk" of developing T2D in 10 years' time. FINDRISC correlated with FBG ($r=0.12$, $p=0.05$), diastolic blood pressure ($r=0.19$, $p=0.02$), mean arterial blood pressure ($r=0.13$, $p=0.036$), low density lipoprotein cholesterol ($r=0.19$, $p=0.005$), and waist to hip ratio - WHR ($r=0.34$, $p=0.001$). Furthermore, FINDRISC explained 11% of the variation in WHR (Adjusted $r^2 = 0.11$, $p=0.001$), 3% of diastolic blood pressure (adjusted $r^2 = 0.03$, $p=0.02$), 3% of low density lipoprotein cholesterol (adjusted $r^2=0.03$, $p=0.005$), 1% of mean arterial pressure (adjusted $r^2=0.01$, $p=0.036$) and 1% of FBG ($r^2=0.01$, $p=0.05$). **Conclusion** This study provides novel insights on the potential utility of FINDRISC as a simple and non-invasive screening tool for metabolic syndrome-related ailments among young adults in Africa. Longitudinal studies, with context-specific modifications of FINDRISC, are suggested to ascertain its predictive value for future T2D in this population.

Background

Type 2 Diabetes Mellitus (T2D) is a chronic disease that is characterized by a long pre-diabetic state before development of full-blown disease. For individuals diagnosed early during pre-diabetes (1), it is possible to institute interventions that will prevent the development of full-blown T2D (2–4).. Standard diagnostic tools, Oral Glucose Tolerance Test (OGTT) and HbA1c, are expensive and difficult to scale up in a large population, especially in resource limited settings like Tanzania (5). Of late, cheaper and easy to use tools have been developed and tested in other countries and have shown to be cost effective in the diagnosis of pre-diabetes. The Finnish Diabetes Risk Score (FINDRISC) is one such affordable and easy to use screening tool (6–8).

The FINDRISC questionnaire, originally used a screening tool in the Finnish Diabetes Prevention Study, and was found to be an effective tool in identifying individuals at a high risk of developing T2D in 10-years' time. Since then, the tool has been validated in several other studies (7, 8), and is used in adult

populations for early diagnosis and prevention of overt T2D(8–10). In a study done in a Greek population, the sensitivity and specificity of FINDRISC in predicting unknown T2D were 81.9% and 59.7%, respectively, for scores of 15 or higher. Besides unknown diabetes, the tool also performed well in the cross-sectional detection of Impaired Fasting Glucose and Impaired Glucose Tolerance (6).

Little is known on the validation of FINDRISC as 10 years risk predictor in Africa, despite other conducted studies worldwide (7,10–13). In other studies it has been used to screen the undiagnosed T2D and it has been a validated in many countries, but still few if any in Africa (9)

With the rise of T2D and other NCDs, we real need simple risk identification and screening tools to combat the epidemics of NCDs such as FINDRISC is needed. It has however not known to be used in younger population in Africa. Reports from other studies indicated much higher age of 35-75 years of age (14–17).

Methodology

Study Design, Population and Recruitment

This was a community based cross-sectional study conducted between May and August, 2018 in an urban setting in Mwanza city, Tanzania. Mwanza has 2 universities, hosting a mixture of national and international students. Most young adults who are not students are involved in small-scale agriculture, fishing, and retail businesses or are employed in office jobs. Based on FINDRISC sensitivity of 82% in predicting unknown diabetes in a study done in Greece (reference), the minimum required sample size, adjusted for 10% non-response rate, was 252 participants. We recruited young adults who met the inclusion criteria of being in the age range of 18-35 years, not known to have the clinical diagnosis of diabetes or hypertension. Multistage random sampling technique was utilized where two wards from three urban districts (Nyamagana, Ilemela and Magu) were chosen and finally we chose four streets from each ward where participants were recruited. All participants provided written informed consent.

Data Collection

i) Participants Interview

Participants' socio-demographic information were obtained using a structured questionnaire. Subsequently, the investigators also administered the FINDRISC questionnaire to all participants. The following parameters were recorded: age, level of physical activity, use of vegetables, history of high blood pressure, history of high blood glucose and family history of diabetes. The components of FINDRISC requiring measurements (body mass index and waist circumference) were evaluated as detailed in "clinical and anthropometric measurements" below. Each parameter was scored as per respective points assigned on the FINDRISC questionnaire. The individual scores were added to give a unit FINDRISC (Fin-score) for every participant. Risk categories were identified as per FINDRISC standard groups \of low risk, slightly elevated, moderate, high and very high risk.

ii) Clinical and Anthropometric Measurements

Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured two times at 5 minutes interval using a calibrated digital sphygmomanometer (*CH-432B, Citizen Systems Japan Co Ltd*). Mean Arterial Pressure (MAP) was calculated using the equation. Weight, height, hip and waist circumference were measured using a calibrated stadiometer and tape measure under WHO protocols. Body mass index (BMI) was calculated using the formula $\text{weight (kg)}/\text{Height}^2 \text{ (m}^2\text{)}$. BMI cut off for overweight and obesity were defined according to WHO standards.

iii) Biochemical Assessment

Upon completion of interviews, participants were instructed to fast overnight and were directed to report the next morning at nearby local government offices which were used as temporary research stations for assessment after an overnight fast (at least 8 hours). A capillary fingertip blood sample was obtained from each participant for fasting blood glucose using an ONCALL-PLUS device (*ACON Laboratories, Inc.*). Assessment of glucose tolerance by Oral Glucose Tolerance Test (OGTT) was done by measuring blood glucose levels after administering 75mg of oral glucose mixed with 200mls of water, taken in 5 minutes. Two-hour postprandial capillary blood glucose was assessed using ONCALL-PLUS. Five milliliters (5mL) of venous blood was collected from consenting participants, processed and analyzed for plasma lipids under standard operating procedure (SOP) for lipid profile tests using ERBA XL machine (*Erba Lachema s.r.o.*).

Definition of Clinical Parameters

Overweight was defined as BMI of $25\text{kg}/\text{m}^2$ - $30\text{kg}/\text{m}^2$; obesity as $\text{BMI} > 30\text{kg}/\text{m}^2$; high waist to hip ratio as above 0.9 in males and 0.8 in females; dyslipidemia was defined as the presence of either total cholesterol of more than 5.2mmol/L, low density lipoprotein of more than 3.3mmol/L, triglycerides of more than 1.7mmol/L or high density lipoprotein of less than 1.03mmol/L in males or less than 1.29mmol/L in females; impaired glucose tolerance as OGTT capillary blood glucose levels of 7.8mmol/l to 11mmol/l; isolated systolic hypertension as systolic blood pressure of more than 140mmHg with normal diastolic blood pressure, isolated diastolic hypertension as diastolic blood pressure of more than 90mmHg with normal systolic blood pressure.

Statistical Analysis

Continuous variables were summarized into frequency, mean, standard deviations, median and inter-quartile ranges. Categorical variables were presented in frequency and proportions. Association between continuous variables was done using Pearson's correlation. For clinical and biochemical parameters that are not featured in FINDRISC and which correlated significantly with FINDRISC, the predictive power of FINDRISC for these parameters was ascertained using linear regression. . Two-side P-values of equal or less than 0.05 were considered statistically significant. Data was analyzed using STATA IC 13 (64-bit; StataCorp LLC).

Ethical consideration.

Ethical clearance was sought from research and publication committee of MUHAS. Permission to conduct this study was obtained from Mwanza City director through regional medical officer. Each participant signed an informed consent before participation.

Results

Socio-demographic Characteristics, Prevalence of Hypertension, Dysglycemia, Dyslipidemia and Risk of T2D

A total of 259 participants were enrolled in this study, with median (interquartile) age of 21(19-27) years. 60.2% of the participants were females. Majority of the study participants were university students (66.8%) (Table 1). High prevalence of hypertension, impaired glucose tolerance and dyslipidemia was observed (Table 1). The Mean FINDRISC for risk of T2D in 10 years was 5.2, with minimum score of 0 and maximum score of 22. Overall, 32.8% of the participants fell in the categories of slightly elevated to very high risk of T2D (Figure 1).

Correlation of FINDRISC with Age, Clinical and Biochemical Parameters

FINDRISC was positively and significantly correlated with WHR ($r=0.34$; $p<0.001$), DBP ($r=0.19$, $p=0.002$), LDL ($r=0.18$, $p=0.005$), MAP ($r=0.13$, $p=0.036$), as well as FBG ($r=0.12$, $p=0.05$). No significant association was observed between FINDRISC and OGTT, SBP, hypertension, triglyceride, total cholesterol and HDL (Table 2).

FINDRISC as a Predictor of Clinical and Biochemical Parameters

To further investigate the predictive power of FINDRISC on clinical and biochemical parameters that showed significant correlation with FINDRISC, we performed Linear Regression and Analysis of Variance between FINDRISC and WHR, FBG, DBP, MAP and LDL. The results showed that a unit increase of FINDRISC was accompanied by a significant increase of FBG by 0.029mmol/L, low density lipoprotein by 0.039mmol/L, mean arterial pressure by 0.34 mmHg, and diastolic blood pressure by 0.49 mmHg. Furthermore, FINDRISC significantly accounted for 1% to 11% of the variation in WHR, FBG, DBP, MAP and LDL (Figure 2).

Discussion

We found high prevalence of T2D, dyslipidemia, overweight and hypertension among young adults. FINDRISC has shown potential utility in predicting occurrence of this metabolic alignments among importance. Young adults and we propose its utility in the efforts of combating them in resource limited settings like Tanzania.

High prevalence of diabetes in this age group is alarming. Despite younger ages, the prevalence is more or less the same as that of world adult population (18), this goes in hand with high rates of overweight, dyslipidemia and hypertension that have been observed in this study. Frequent health checking habit is uncommon in this age group as well as life style modification. These alarming findings should awake the community on the intervention in early ages. Intensified exercise programs in schools and a review on food types and food preparation in universities are of high importance

We found significant association between FINDRISC with WHR, DBP, LDL, MAP and FBG. This goes in hand with other studies where FINDRISC was validated as a screening tool to detect occurrence of metabolic syndrome in high risk population (17). In this study FINDRISC has shown to significantly predict the current status of these factors, and so opening up its potential use as a cheap and noninvasive screening tool for overweight, dyslipidemia, hypertension as well as dysglycemia in young adults.

Despite its utility, FINDRISC was developed in a developed setting with a purpose of predicting 10 years risk for developing T2D (10). Its structure is however unfavorable for the young adult population, since anyone who is below 45 years of age will have 0 points and so it doesn't make any difference in difference age groups of adults below 45. Vegetable, fruits or berries consumption is also ambiguous in African setting where this stuffs are not taken as main dishes and so quantifying is necessary in assessing its effects in development of dyslipidemia, dysglycemia and hypertension. Family history of diabetes is another part which can easily bring bias because, in African setting most of people with diabetes remain undiagnosed and might die without knowing, or present late with complications and die before relatives are aware of the presence of the disease in their family (19–23)

Modifying this question will bring reality in this questionnaire in African context. And validation studies of a modified FINDRISC paramount. Many validation studies has been done and the results are promising too, (24)(14), although in some setting the tool proved not to be useful like in Botswana, (9) validated tools will bring more useful findings.

In this study FINDRISC has demonstrated novel utility in predicting current dysglycemia, dyslipidemia, overweight and hypertension among young adults in urban settings in Africa. This is supported by other studies that FINDRISC has been used to predict current and future risk of T2D and other co-morbidities such as metabolic syndrome with great success (10-13)(23).

Conclusion

This study is the first to evaluate utility and applicability of FINDRISC as a screening tool for T2D and metabolic syndrome in a population of young adults. Furthermore, FINDRISC showed novel utility in predicting occurrence overweight, dyslipidemia, dysglycemia and hypertension among young adults in urban setting in Africa. . These findings highlight the need for concerted efforts in combating rising levels of these diseases, and provides avenue for further research to optimize and modify FINDRISC as a cheap

and non-invasive tool for screening and prediction of hypertension, diabetes and dyslipidemia among the youths in urban settings in Tanzania.

Limitations

The population was more of college students, than merely community population, and it had small sample size compared to similar studies. We could not differentiate T2D from other forms of diabetes due to unavailability of specific biochemical tests in this setting.

Abbreviations

DBP- Diastolic Blood Pressure

FBG- Fasting Blood Glucose

FINDRISC- Finnish Diabetes Risk Score

HDL- High Density Lipoprotein cholesterol

LDL- Low Density Lipoprotein cholesterol

MAP- Mean Arterial Pressure

NCDs- Non Communicable Diseases

OGTT- Oral Glucose Tolerance Test

SBP- Systolic Blood Pressure

T2D- Type two Diabetes Mellitus

WHR- Waist to Hip Ratio

Declarations

Ethical Approval and Consent to Participate

Ethical clearance was sought from research and publication committee of Muhimbili University of Health and Allied Sciences (MUHAS) with a Ref No DA_287/298/01.A/. Permission to conduct this study in Mwanza city was obtained from City Director through Regional Medical Officer. A verbal and written informed consent was request from each participant signed an informed consent before participation and after explaining the purpose of the study. Laboratory results were communicated to the patients and their attending physicians for further management. Furthermore to ensure confidentiality numbers and codes were during data analysis and interpretations.

Authors' Contributions

EM participated in conception, research design, data collection, data analysis and interpretation and drafting of the manuscript. EB, MN and FM contributed in research design, data analysis and interpretation, and revising the manuscripts. All authors read and approved the final version of this manuscript.

Conflict of Interest

Authors declare that there is no competing interest

Consent to Publish

Not Applicable

Availability of data

Data generated and used in analysis are available from the corresponding author on reasonable request.

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Tables

Table 1: Socio-Demographic and Clinical Characteristics of the Study Participants

Characteristics	Median (IQR) / n (%)
Number of subject enrolled, N	259
Age in years, Median (IQR)	21(19 -27)
Sex, N (%)	
Female	156(60.2)
Male	103(39.8)
Education level, N (%)	
None	1(0.4)
Primary	33(12.7)
Secondary	29(11.2)
College and higher	196(75.7)
Occupation, n (%)	
Employed	38(14.7)
Not employed	9(3.5)
Self employed	39(15.0)
Students	173(66.8)
BMI categories, n (%)	
Lower than 17.99kg/m	24 (9.3)
18-24.99kg/m	170 (65.6)
25-30kg/m	44 (17)
Higher than 30kg/m	21 (8.1)
Waist hip ratio, n (%)	
Normal	215 (83)
Overweight	44 (17)
Physically active? N (%)	
Yes	65 (25.1)
No	194 (74.9)
Eating vegetables daily, n (%)	
Yes	72 (27.8)
No	187 (72.2)
Personal history of hypertension, n (%)	
Yes	12 (4.6)
No	247 (95.4)
Personal history of hyperglycemia, n (%)	
Yes	10 (3.9)
No	249 (96.1)
Family history of diabetes, n (%)	
No	188 (72.5)
Yes, first degree relative	22 (8.6)
Yes, second degree relative	49 (18.9)
Systolic blood pressure, mean (range)	129.14 (97-200)
Diastolic blood pressure, mean(range)	86 (53-133)
Mean arterial blood pressure, mean (SD)	100.3 (9.7)

IQR=Interquartile Range

Table 2: Correlation of FINDRISC with Age, Clinical and Biochemical Parameters

Variables	Correlation Coefficient (r)	P value
FINDRISC	1.00	
Age	0.35	<0.001
Body Mass index	0.64	<0.001
Waist Hip Ratio	0.34	<0.001
Hypertension	0.09	0.1685
Systolic Blood Pressure	0.02	0.8063
Diastolic Blood Pressure	0.19	0.0020
Fasting Blood Glucose	0.12	0.0496
Oral Glucose Tolerance	0.002	0.966
Cholesterol	0.09	0.173
High Density Lipoprotein	-0.04	0.543
Low Density Lipoprotein	0.18	0.005
Triglyceride	0.06	0.352
Mean Arterial Pressure	0.13	0.036

Figures

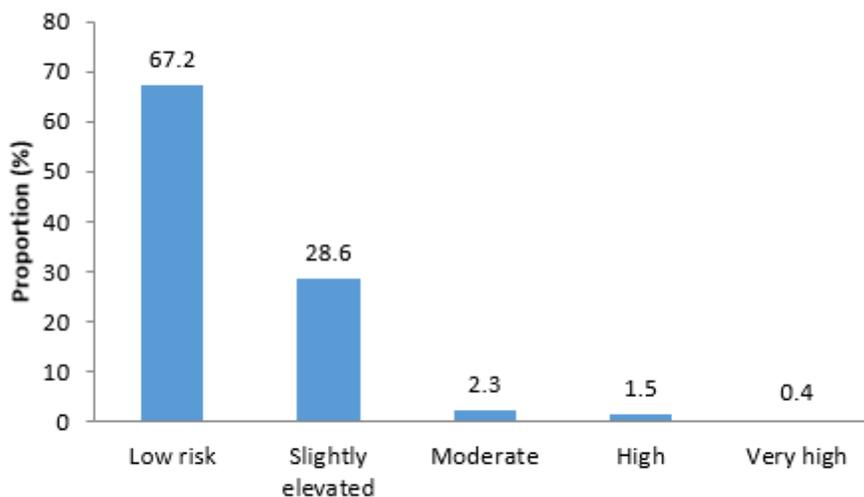


Figure 1

Percentage Distribution of 10 Years Risk of T2D as categorized by FINDRISC

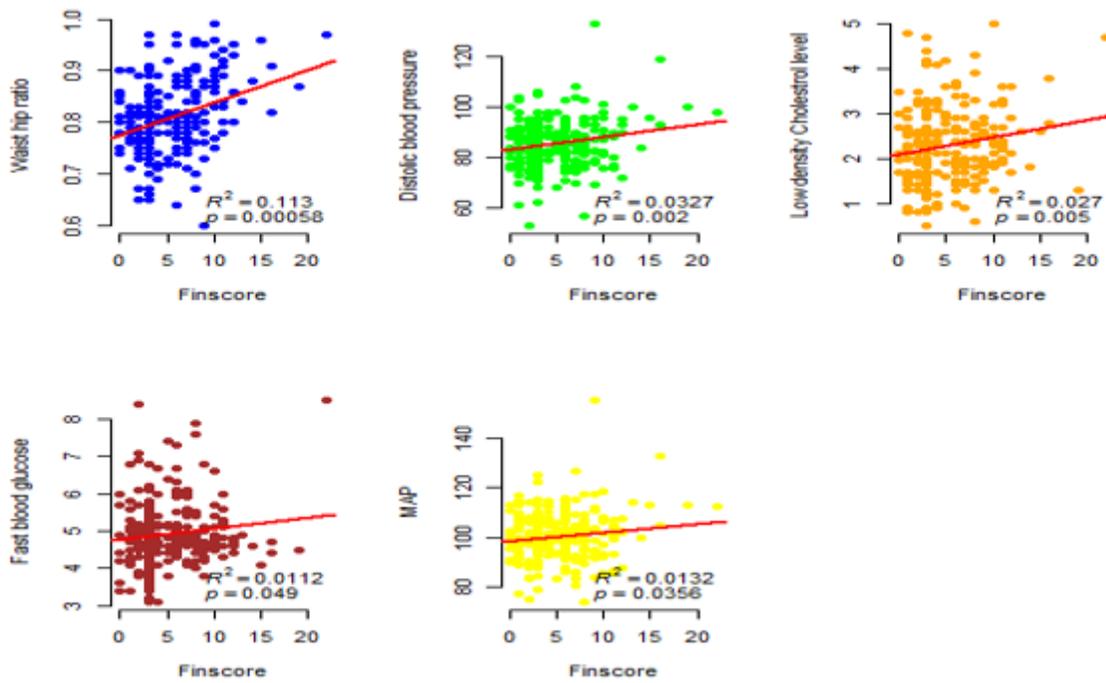


Figure 2

Linear Regression on Predictive Potential of FINDRISC on WHR, FBG, DBP, MAP and LDL as Response Variables

Supplementary Files

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