Original Article

Prediction of the risk of developing diabetes mellitus among Bangladeshi adults by using risk assessment score

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Abstract

Background: *Diabetes mellitus (DM) is considered as one of the major health problems worldwide. The rising prevalence of type 2 diabetes mellitus (T2DM) in Bangladesh is primarily attributed to rapid urbanization and associated changes in lifestyle, such as sedentary lifestyle, higher calorie food intake and stressful life. Studies support the utilization of risk-assessment scoring systems in quantifying individual's risk for developing T2DM. Thus, a simple risk-assessment scoring system for early screening of T2DM among Bangladeshi adults will be beneficial to identify the high-risk adults and thus taking adequate preventive measures in combating DM.The purpose of the study was to calculate the risk assessment score of developing T2DM within 10 years among Bangladeshi adults.*

Methods: *The cross-sectional observational study was carried out in the outpatient department (OPD) of Medicine, MARKS Medical College & Hospital, a tertiary care hospital in Dhaka, Bangladesh from February 2018 to July 2018 among randomly sampled 205 adult subjects. Subjects undiagnosed with diabetes mellitus and had previous history of high blood glucose during pregnancy or other health examination (i.e. impaired fasting glucose, impaired glucose tolerance or gestational diabetes mellitus) were included. From a review of literature regarding risk factors of developing DM in Bangladesh, the Finnish Diabetes Risk Score (FINDRISC) system was found to be more useful for the Bangladeshi adults. The Finnish Diabetes Risk Score (FINDRISC) questionnaire was used to collect the data including demographic characteristics and different risk factors and to calculate total risk score for predicting the risk of developing T2DM within 10 years.*

Results: *Among 205 subjects, male and female were 57.1% and 42.9% respectively. The Mean (±SD) age of the study subjects was 37.64±1.07 years. In this study, both non-modifiable and modifiable risk factors showed statistically significant association with the FINDRISC among Bangladeshi adults ($p<0.05$). There was a significant association among FINDRISC with history of previous high blood glucose, and treated hypertensive Bangladeshi adults.33.65% of the Bangladeshi adults had slightly elevated diabetes risk score (DRS). This study predicts that 17.55% of the Bangladeshi adults may have moderate to high risk to develop T2DM within the consecutive 10 years.*

Conclusion: *This study provides a simple, feasible, non-invasive and convenient screening FINDRISC tool that identifies individuals at risk of having T2DM. People with high risk of DM should be referred for early intervention and changes to a healthy lifestyle and primary prevention to prevent or delay the onset of T2DM.*

Keywords: *FINDRISC, Risk Assessment Score, Type 2 Diabetes Mellitus.*

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Introduction

Diabetes is now recognized as a major chronic public health problem throughout the world and affecting a large number of people in a wide range of ethnic and economic levels in both developed and developing countries. However, it is estimated that the developing countries will bear the brunt of this epidemic in the 21st century, with 80% of all new cases of diabetes are expected to appear in the developing countries by 2025[1] including South Asian countries like Bangladesh.[2] The International Diabetes Federation (IDF) estimates, Bangladesh has nearly 8.4 million of diabetic patients which is expected to reach to 16.8 million by 2030.[3] In Bangladesh most of the patients are type 2 diabetics and the risk of developing type 2 diabetes mellitus

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(T2DM) is determined by some modifiable factors related to rapid urban growth and changing lifestyle (i.e. obesity, sedentary lifestyle, diet, smoking, physical and emotional stress) and non-modifiable factors (i.e. family history of diabetes, age, race/ethnicity).[4,5] The rising prevalence of T2DM in Bangladesh is primarily attributed to rapid urbanization and associated changes in lifestyle, such as sedentary lifestyle, higher calorie food intake and stressful life.[5-7]Prevention of diabetes is important because it is costly both in human and monetary matters.[8] Awareness of risk factors is a prerequisite to prevent diabetes among general population and also in high-risk groups, such as impaired fasting glucose (IFG) and impaired glucose tolerance (IGT).[9-11]The benefits of early detection and intervention on improved health outcomes and reduced morbidity associated with T2DM are shown in many studies.[13, 14]

As the prevalence of DM among Bangladeshi adults rises prediction of new cases of T2DM in Bangladesh requires early identification and screening.Studies also support the utilization of risk-assessment scoring systems in quantifying individual's risk for developing T2DM.[15]Thus, using a simple risk-assessment scoring system for early screening of T2DM among Bangladeshi adults will be beneficial to identify the high-risk adults and thus taking adequate preventive measures in combating diabetes. The purpose of the study was to calculate the risk assessment score of developing T2DM within 10 years among Bangladeshi adults.

Methods

The cross-sectional observational study was carried out in the outpatient department (OPD) of Medicine, MARKS Medical College & Hospital, a tertiary care hospital in Dhaka, Bangladesh from February 2018 to July 2018 among randomly sampled 205 adult Bangladeshi male and female subjects. Subjects undiagnosed with diabetes mellitus and had previous history of high blood glucose during pregnancy or other health examination (i.e. impaired fasting glucose, impaired glucose tolerance or gestational diabetes mellitus) were included. Individuals with a apparent communicative, cognitive impairment or physical disability were excluded from the study.With written informed consent, the Finnish Diabetes Risk Score (FINDRISC) questionnaire was used to collect the data including demographic characteristics and different risk factors and to calculate total risk score for predictors the risk of developing T2DM within 10 years.

Methods of calculation of FINDRISC

Various risk factors of T2DM were reviewed from the literature like sex, age at diagnosis of diabetes, ethnicity, family history of diabetes, diet and exercise, smoking and alcohol usage, hypertension, hyperlipidaemia, body mass index (BMI), weight, waist circumference (WC), gestational diabetes, macrosomia and polycystic ovarian syndrome.[17] Various risk-assessment scoring systems were reviewed like American Diabetes Association,[19] Rotterdam,[16] Cambridge,[14] Finnish,[20] Danish,[21] Indian,[22] Thai,[23] Omani,[24] Kuwaiti,[12] Australian T2DM risk-assessment tool and Trinidad Risk Assessment Questionnaire-5 (TRAQ-5).[25] The Finnish Diabetes Risk Score (FINDRISC) developed in 2001 and tested for validity and reliability on Finnish population and in different countries.[20,26-30]In Bangladesh, still we do not have any diabetes risk assessment scoring system. After review of literature regarding risk factors of developing diabetesin Bangladesh, we also reviewed some other well validated risk assessment scoring systems for diabetes of different countries. We found the risk assessment tools of the Finnish Diabetes Risk Score (FINDRISC) [20] to calculate risk score was more useful for the Bangladeshi adults. The FINDRISC had 8 risk factors correlating with the risk of developing T2DM and was used as a prognostic screening tool to detect a diabetes risk in a 10-year period based on age, family history, WC, BMI, physical activity, vegetable/fruit diet, past history of hypertension and blood glucose. It demonstrates the probability of developing T2DM within 10 years and the risk score is categorized as <7: low (estimated 1 in 100 will develop DM), 7–11: slightly elevated (estimated 1 in 25 will develop DM), 12–14: moderate (estimated 1 in 6 will develop DM), 15– 20: high (estimated 1 in 3 will develop DM) and >20: very high (estimated 1 in 2 will develop DM). Hence, the FINDRISC tool was found to be appropriate for the purpose of this study.

Component of FINDRISC tool

Anthropometric measurements of height and weight were measured by a reliable height scale and weighing scale, respectively. Random blood glucose was measured using laboratory blood glucose test.[21,31] BMI

(weight in kilograms/square of height in meters (kg/m^2) was categorized as underweight (<18.5 kg/ m^2), normal (BMI: 18–25 kg/m^2), overweight (BMI: 25–30 kg/m^2) and obese (BMI: ≥30 kg/m^2). Hypertension was defined as a systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg, or in case of use of anti-hypertensive medications[19] was measured by a manual sphygmomanometer in standard conditions (measured 2 times after a 5-min rest between each measurement).[32] WC ≥ 90 cm for males and ≥80 cm (35 inches) for females was considered as a risk factor for DM,[33] and it was measured in a horizontal plane, midway between the inferior margin of the ribs and the superior border of the iliac crest using a reliable measuring inch tape.

Statistical analysis

Data were analyzed with Statistical Package for Social Science (SPSS) software version 16. The means and standard deviations were used to describe continuous data. For categorical data, frequencies and percentages were estimated. Among the basic characteristics of the study subjects, the continuous variables were compared with each other using the Student's t-test. Categorical variables were compared with each other using the chi-square test. P value <0.05 was considered as significant.

Results

Demographic and clinical characteristics

A total of 205 subjects were included. Among them male and female were 57.1% and 42.9% respectively. The mean (±SD) age of the study subjects was 37.64±1.07 years. Maximum age was 71 years and minimum was 21 years. The mean (±SD) age of the male and female were 39.82 ± 1.16 and 34.73 ± 8.68 years respectively (p<0.05).The mean (±SD) height(meter)and weight (kg) were higher in male subjects than female (1.65± 6.11 vs. 1.57± 1.28 and 68.45±1.10 vs. 59.07±1.09 respectively); (p<0.05). Average BMI (kg/m^2) was 24.75 ± 3.59 in male subjects and 24.37 ± 4.15 (Mean ±SD) in female subjects; (p=0.48). And average Waist Circumference (cm) was 90.75±8.68 in male and 84.61±12.17(Mean ±SD) in female (p<0.05) The Mean (±SD) Blood Pressure(mm of Hg) of the study subjects were SBP: 116.32 ±1.22 vs. 111.48 ±9.77 and DBP: 78.75 ±8.98 vs. 73.75 ± 8.34 in male and female respectively. Random blood sugar (mmol/L) was 6.17±1.91 in male and 5.80±1.77 in female (Mean ±SD). (Table I)

Table I Comparison of demographic, clinical, biochemical & FINDRISC of developing type 2 diabetes between male & female subjects (n=205).

Variables	Male	Female	p
	Mean ±SD	Mean ±SD	value
Age(Yrs)	39.82±1.16	34.73±8.68	0.001
Height(m)	1.65±6.11	1.57±1.28	<0.001
Weight(kg)	68.45±1.10	59.07±1.09	<0.001
BMI (kg/m^2)	24.75±3.59	24.37±4.15	0.488
WC (cm)	90.75±8.68	84.61±12.17	<0.001
SBP (mm of Hg)	116.32 ±1.22	111.48±9.77	0.003
DBP (mm of Hg)	78.75±8.98	73.75±8.34	0.016
RBS (mmol/L)	6.17±1.91	5.80±1.77	0.162
FINDRISC(10-year Risk Scores)	6.92±4.48	7.40±5.25	0.476

BMI: Body mass index; WC: Waist circumference;SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure;RBS: Random Blood Sugar; FINDRISC: Finnish Diabetes Risk Score.

Some of the adults had a family history (parents, grandparents, aunts, uncles; 52.7 %) of DM ($p<0.05$). A total of 42.49% of the adults had no daily physical activity and low intake of vegetables, fruits or berries (38.0%); ($p<0.05$). Some of the adults had high BMI (34.1% were overweight and 8.8% were obese); ($p<0.05$) and high WC (22.4% in male and 30.3% in female); ($p<0.05$). A total of 10.2 % of the adults had hypertension and were on anti-hypertensive medications, and 12.2% had previous history of high blood glucose during pregnancy or during other health examination (i.e. impaired fasting glucose, impaired glucose tolerance or gestational diabetes mellitus) ($p<0.05$) [Table II & Table III].

Risk assessment score (FINDRISC) among Bangladeshi adults

The FINDRISC predicted 10-year risk of developing T2DM was more in female subjects than male ($p= 0.47$)). Among subjects, the mean (Mean ±SD) FINDRISC were 7.40±5.25 vs. 6.92 ± 4.48 (female vs. male). (Table 1)

A total of 33.65% of the Bangladeshi adults had slightly elevated dia-betes risk score (DRS). Among them, 62.31% were male and 37.68% were female. No one had very high risk score. While 10.73% had moderate DRS (Male vs. Female were 45.45% vs. 54.54%) and 6.82% had high DRS (among them 50% were male & 50% were female); ($p=0.51$).This predicts that 17.55% of the Bangladeshi adults may have moderate to high risk to develop T2DM within the consecutive 10 years, if no primary preventive measures are taken to curb it (Figure 1 & Figure2).

Table II Prevalence of risk assessment factors for prediction of FINDRISC of developing type 2 diabetes among Bangladeshi subjects (n=205).

Risk Assessment Factors of FINDRISC		Frequency	Percentage
Age (years)	< 45 Years	149	72.7
	45-54 Years	44	21.5
	55-64 Years	10	4.9
	> 64 Years	2	1.0
Family history of diabetes mellitus	No	97	47.3
	Grand Parent, aunt, uncle, or first cousin	32	15.6
	Parent, sibling , children	76	37.1
BMI(kg/m^2)	Normal: Lower than 25kg/m^2	117	57.1
	Over weight: 25-30 kg/m^2	70	34.1
	Obese: Higher than 30 kg/m^2	18	8.8
Waist circumference (cm) Male	Less than 94 cm	69	33.7
	94-102 cm	43	21.0
	More than 102 cm	5	2.4
Female	Less than 80 cm	26	12.7
	80-88 cm	26	12.7
	More than 88 cm	36	17.6
Physical activity daily 30 min	Yes	118	57.6
	No	87	42.4
Vegetables, fruit or berry consumption	Every day	127	62.0
	Not every day	78	38.0
History of hypertension with or without anti-hypertensive	No	184	89.8
	Yes	21	10.2
History of previous high blood glucose (i.e. IFG, IGT, GDM)	No	180	87.8
	Yes	25	12.2
Gender	Male	117	57.1
	Female	88	42.9

BMI: body Mass Index; IFG: Impaired Fasting Glucose; IGT: Impaired Glucose Tolerance; GDM: Gestational Diabetes Mellitus; FINDRISC: Finnish Diabetes Risk Score.

Table III Association of risk factors of Finish Diabetes Risk Score among Bangladeshi adults. (N = 205)

Risk Assessment Factors ofFINDRISC			λ value	df	p
Age (years)		< 45 Years 45-54 Years 55-64 Years > 64 Years	37.768	9	<0.001
Family history of Diabetes Mellitus		No Grand Parent, aunt, uncle, or first cousin Parent, sibling, children	63.489	6	<0.001
BMI (kg/m^2)		Normal: Lower than 25kg/m^2 Over weight: 25-30 kg/m^2 Obese: Higher than 30 kg/m^2	33.818	6	<0.001
Waist circumference(cm)	Male	Less than 94 cm 94-102 cm More than 102 cm	22.861	9	0.007
	Female	Less than 80 cm 80-88 cm More than 88 cm	19.66	9	0.020
Physical activity daily 30 min	Yes No	21.935	3	<0.001	
Vegetables, fruit or berry consumption		Every day Not every day	10.597	3	0.014
History of hypertensive with or without anti-hypertensive		No Yes	41.502	3	<0.001
History of previous high blood glucose (i.e. IFG, IGT, GDM)		No Yes	1.073	3	<0.001

BMI: Body mass index; FBG: fasting blood glucose; IFG: Impaired Fasting Glucose; IGT: Impaired Glucose; FINDRISC: Finish Diabetes Risk Score. Tolerance; GDM: Gestational Diabetes Mellitus; Pearson chi-square = ë value; df: degree of freedom; p<0.05=significant.

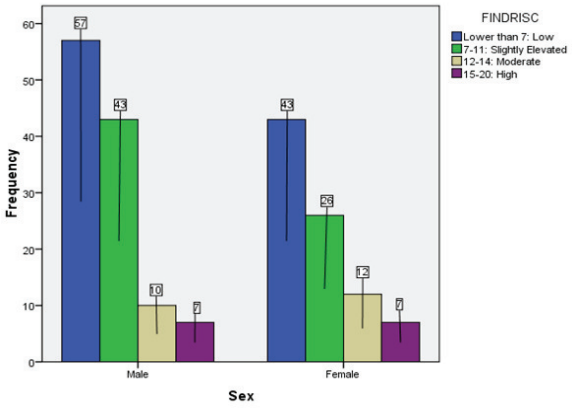

Figure 1 Risk assessment scoring system (FINDRISE) among Bangladeshi adult (n=205)

NB: FINDRISC: Finnish Diabetes Risk Score.

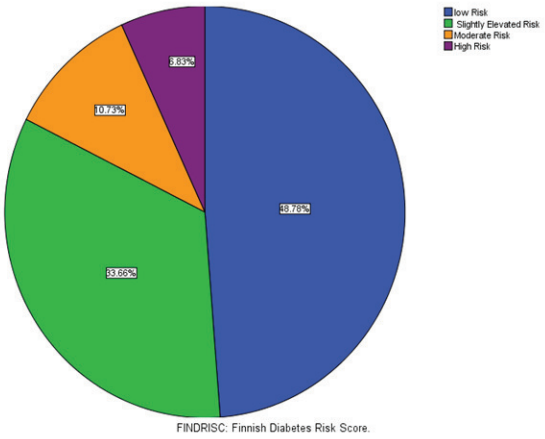

Figure 2 Percentage of total risk score (findrisc) among Bangladeshi adult (n=205)

Discussion

With the rapid transition in economic development, industrialization and globalization have lead to lifestyle changes and increase in life expectancy in most areas of the world. This increase in cultural and lifestyle changes, including unhealthy dietary habits and decrease in physical activity, has been accompanied by an increase in the prevalence of non-communicable (chronic) diseases, including DM.[34]The preventable lifestyle-related risk factors of T2DM are overweight, abdominal obesity and sedentary life style with high saturated fat, refined carbohydrate, total energy and low dietary fiber intake.[35]The increasing prevalence of diabetes and its complications in Bangladesh would pose a real threat to existing health services. Assessment of the risk score of diabetes can assist in its early detection, prevention and reduce its incidence.

FINDRISC is a useful tool for identifying people with asymptomatic DM who might not seek early or regular evaluation, thus facilitating intervention early in the disease course. Early detection leads to a better quality of life, reduced morbidity, premature mortality and ultimately a reduction in associated health care and wider economic costs. Adults with slightly elevated high-risk assessment score, regardless of their blood glucose status, are suitable candidates for lifestyle modification. The health care professionals can empower the patients in the moderate-high-risk group to be self-motivated with life style modifications like increasing physical activity, maintaining ideal body weight and periodic health checks, including blood glucose and blood pressure. This should prompt high-risk adults with knowledge acquisition on prevention, early detection, treatment and disability limitation in prevention of DM leading to quality care.[36,37]A high dietary fiber and increase in vegetable consumption, low-moderate total calorie, reduced fat, low glycaemic index foods and low polyunsaturated fat will reduce the susceptibility to DM.[38] At least 30 min of moderate physical activity with variable emphasis on high-intensity and resistance training exercise (e.g. brisk walking, swimming, cycling, dancing) on all or most days of the week are recommended. Regular walking for at least 30 min per day reduces diabetes risk by 35%”40% .[39] This has been proven to effectively prevent and delay the development of DM among young adults.[40]

In this study, the non-modifiable risk factors i.e. age, positive family history of diabetes, history of hypertension or blood glucose were the sig-nificant independent risk factors for predicting T2DM. However, BMI, WC, physical activity and dietary intake were the significant modifiable risk factors. Both non-modifiable and modifiable risk factors were statistically significant with the FINDRISC among Bangladeshi adults ($p<0.05$). Hypertension is a major risk factor for atherosclerosis and diabetes.[41]An increase in blood pressure is significantly associated with diabetes, particularly among urban-dwellers than rural areas.[42]There was a significant association of FINDRISC with history of hypertension and previous history of high blood glucose among the Bangladeshi adults.

In Bangladesh, prevalence of diabetes in adults is 6.9%[43], with significant predictors like age, hypertension, obesity /WC/BMI and family history.[12] In this study among subjects, 33.65% of the Bangladeshi adults had slightly elevated diabetes risk score (DRS). 17.55% had high or moderately elevated FINDRISC. This predicts that 33.65% of the Bangladeshi adults have slightly elevated risk and 17.55% of the adults have moderate to high risk to develop T2DM within the consecutive 10 years, if no primary preventive measures are taken to curb it. This assessment will help to increase awareness and motivate the public about the importance of modifiable anthropometric risk factors regarding T2DM.[44]

Conclusion

This study provides a simple, feasible, non-invasive and convenient screening FINDRISC tool that identifies individuals at risk of having T2DM. People with high risk of DM should be referred for early intervention and changes to a healthy lifestyle and primary prevention to prevent or delay the onset of T2DM. From public health perspective, there is a critical need for innovative target oriented prevention programs for people who are high-risk individuals to adopt a healthy lifestyle, undergo routine medical check-ups and be an active player in the prevention of diabetes.

Limitations

This study is limited by the cross-sectional design and is not causal or effect study or measure of temporal changes. Validation of the risk assessment with a large sample size in different populations would have enhanced the generalizability of the results.

Conflict of interest: Nothing to declare.

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