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Risk-assessment score for screening diabetes mellitus among Omani adults

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Abstract

Purpose: The purpose of this study was to evaluate a self-administered risk-assessment scoring system for identifying Omani adults with type 2 diabetes mellitus (T2DM).

Methods: An exploratory cross-sectional design was used. Simple random sampling was used to select 93 adults in Muscat. Ethical approval was obtained from the College of Nursing Research and Ethics Committee. The Finnish Diabetes Risk Score (FINDRISC) was used to collect the data in 2009. Informed consent was obtained from the participants. Data were analysed with the Pearson chi-square test.

Results: A total of 9.7% of the adults had very high FINDRISC and 17.2% had slightly elevated risk of developing T2DM within 10 years. The risk assessment (family history, waist circumference, body mass index, physical activity, dietary intake, hypertension and high blood glucose) of T2DM was significant and positively related to the prediction of T2DM among Omani adults.

Keywords

Diabetes mellitus, diabetes nurse educator, risk assessment, risk score, screening, prediction, prevention

Introduction

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 lifestyle and cultural 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 diabetes mellitus (DM). DM is considered as one of the major health problems worldwide. The number of adults with DM is approximately 194–246 million in the world, and these numbers will rise to 333–380 million people by 2025.[1] An examination of preventable lifestyle-related risk factors of T2DM identified overweight, abdominal obesity and sedentary lifestyle with high saturated fat, refined carbohydrate, total energy and low dietary fibre intake.[2–6] In some countries of the Eastern Mediterranean and Middle East Region, the prevalence of DM is among the highest in the world (9.4 in 2007) like Kuwait (18.85%), Bahrain (18.33%), Qatar (17.56%), Lebanon (16.59%) and Egypt (15.26%), and some of them are among the top 10 countries in the world in terms of prevalence of DM.[1,7] There is an increase in prevalence of DM in Oman from 11.6% in 2000 (6.5% of males and 5.1% of females) to 15% in 2005 to 16.1% in 2008.[8–11]

Oman, a newly industrialized country, has experienced rapid socio-economic development over the past three decades, resulting in an increase in the prevalence of non-communicable diseases.[10,12] A total of 30% of the population is overweight, 20% are obese, 41% have high cholesterol and 21% have metabolic syndrome.[13] Type 2 diabetes mellitus (T2DM) is one of the most prevalent conditions (11.6% in 2000), and has become a health challenge in Oman.[13,14] This has triggered an increase in morbidity (DM, ischaemic heart disease, asthma, polyneuropathy, etc.).[15] It is predicted that the older adult population (currently 3.5% of the population) is expected to increase by 6-fold by 2030, which will also be a major contributing factor for the burden of T2DM.[9] Increasing number of diabetes cases were observed from 53,972 (2000), 61,583 (2005), 75,000 (2009), 1,45,600 (2012) to 1,70,000 (2013), and the number is predicted to rise to 2,17,000 (2025) and 3,26,400 (2030),[8,12,16,17] with exposure to abundance of fast and high calorie food and sedentary lifestyles leading to major risk factors like overweight and obesity.[8] It is predicted that there will be an increase in the number of diabetes cases by 124% in 2030 and 190% by 2050.[1] T2DM is recognized as one of the leading causes of financial

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burden, disability and death in Oman.[12,17] Identification of individuals at risk for T2DM can allow the risk factors, many of which are modifiable, to be addressed reducing the likelihood of developing T2DM.[18]

Significance

Major risk factors identified for DM can be used to guide screening strategies, preventive interventions and health policy development.[19] The benefits of early detection and intervention on improved health outcomes and reduced morbidity associated with T2DM are shown in many studies.[20–24] Studies also support the utilization of risk-assessment scoring systems in quantifying individual's risk for developing T2DM.[25–29]

Many of the contributing risk factors are potentially modifiable.[30,31] As the prevalence of DM among Omani adults rises despite measures to decrease morbidity, it is crucial for diabetes nurse educators (DNEs) to be able to identify high-risk populations. This prediction of new cases of T2DM in Oman, a largely preventable disorder, requires early identification and screening for mitigating early preventive and health promotion measures/actions for the local populations at high risk for developing T2DM. There is limited research examining the risk-assessment score of developing T2DM in Oman. This compels DNEs to empower the general public in identifying the risk factors and thus taking adequate preventive measures in combating DM. Thus, a self-administered risk-assessment scoring system for early screening of T2DM among Omani adults will be beneficial to identify high-risk adults.

Objective

The objective is to evaluate a risk-assessment scoring system for early screening among Omani adults for developing T2DM in a selected local community in Muscat.

Methodology

Design

An exploratory cross-sectional research design was used to evaluate the risk-assessment scoring system among adults in Muscat.

Setting, sample size and inclusion criteria

The target population consisted of adults undiagnosed with any endocrine illness, type 1 diabetes mellitus (T1DM) or T2DM, visiting the local primary health centre (PHC) in a local community and able to comprehend and communicate in Arabic or English language.[32,33] Individuals with a diagnosis of endocrine illness, metabolic syndrome, pre-diabetes, T1DM, T2DM, apparent communicative, cognitive impairment or physical disability were excluded from the study. All potentially eligible individuals of the target population in a local PHC in Muscat were identified and assigned an identifier. Random tables were used to randomly select the individuals for the study in 2009.

The sample size was determined using 95% confidence interval,[34] with a margin of error of 10% and 30% of the Omani population being overweight.[13,35] The computed sample size was 103.

Measurements

Various risk factors of T2DM were reviewed from the literature like sex, age at diagnosis, 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.[36–38] Various risk-assessment scoring systems were reviewed like American Diabetes Association,[27] Rotterdam,[29] Cambridge,[20] Finnish,[22] Danish,[26] Indian,[39] Thai,[40] Omani,[41] Kuwaiti,[18] Australian T2DM risk-assessment tool[42] and Trinidad Risk Assessment Questionnaire-5 (TRAQ-5).[43] From a review of literature regarding risk factors of developing DM in Oman, the Finnish Diabetes Risk Score (FINDRISC) developed in 2001 and tested on Finnish population and in different countries[22,44–48] was found to be useful for the Omani 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.

Anthropometric measurements of height and weight were measured by a reliable height scale and weighing scale, respectively. Fasting blood glucose (FBG) ≥126 mg/dL (7 mmol/L) was diagnosed using laboratory blood glucose test.[26,32,49] BMI (weight in kilograms/square of height in metres (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 antihypertensive medications[27] was measured by a manual sphygmomanometer in standard conditions (measured 3 times after a 5-min rest between each measurement).[50] WC ≥94 cm (39 inches) for males and ≥80 cm (35 inches) for females was considered as a risk factor for DM,[51] 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.

Validity and reliability test

The FINDRISC tool was validated among three medical doctors (medicine, gastroenterologist and endocrinologist) in the local PHC and was found to be valid. The FINDRISC was administered to 30 selected Omani adults undiagnosed with T1DM or T2DM. The Cronbach's alpha reliability of the tool was 0.84 and was found to be reliable for the study.

Ethical considerations and data collection

A total of 103 individuals were recruited in the study using simple random sampling. Three participants were excluded from the study because they did not meet eligibility criteria, three declined to participate in the study and four participants withdrew their participation after the informed consent citing personal reasons. Hence, 93 participants were recruited in the study.

Ethical approval was provided by the Ethics and Research Committee, College of Nursing and Sultan Qaboos University (SQU) Hospital, SQU in 2009. Written informed consent was obtained from each participant, before providing an informed document on the purposes of the study, the risks and benefits of participation, instructions and study questionnaire. Participants were assured of anonymity, voluntary participation and free will to withdraw from the study at any time without any consequences. All informed consents were stored and locked separately from data files in cabinets. Confidentiality was maintained by assigning code numbers to the data files.

Data analysis

Data were entered into Statistical Packages for Social Sciences (SPSS) version 18 for comparing, analysis and auditing for accuracy. Data were screened for missing values, logical inconsistencies and extreme values. There was no missing data. A probability of <0.05 was considered statistically significant for all tests. Descriptive summary and Pearson chi-square test were used to analyse the data.

Results

Demographic and clinical characteristics

Majority of the adults were below 45 years (90.3%) and men (87.1%; Table 1). Some of the adults were married (49.5%) and had a family history (parents, grandparents, aunts, uncles; 31.2%) of DM. A total of 55.9% of the adults had no daily physical activity (55.9%) and low intake of vegetables, fruits or berries (44.1%). Some of the adults had high BMI (26.9% are overweight and 18.3% are obese) and high WC (45.2%). A total of 35.5% of the adults had past hypertension and were on anti-hypertensive medications, and 26.9% had high blood glucose in the past. Those adults who reported past blood glucose (high) also had high FBG confirmed with the blood glucose test (26.9%).

Risk-assessment scoring system (FINDRISC) among Omani adults

A total of 28% of the Omani adults had slightly elevated diabetes risk score (DRS), while 17.2% had moderate DRS and 9.7% had very high DRS. This predicts that 26.9% of the Omani adults may develop T2DM within the consecutive 10 years, if no primary preventive measures are taken to curb it (Table 2).

Association between risk factors and FBG

FBG (≤ 7 and >7 mmol/L) was used to find association with the risk factors of T2DM. Family history of DM and marital status was significant with FBG (Table 3). Physical activity and dietary pattern were significant ($p < 0.001$) with FBG. BMI and WC were significantly associated with FBG ($p < 0.001$). Past history of hypertension/use of medications and high blood glucose were significant with FBG.

Discussion

In this study, among the non-modifiable risk factors, past history of hypertension or blood glucose were the most significant independent risk factors for predicting T2DM. However, BMI, WC, physical activity and dietary intake were the most significant risk factors. Increasing migration of Omanis to the cities were associated with major changes in lifestyles like escalation in car ownership, consumption of high fat caloric dense food, refined sugar and salt, less physical activity, overweight and the smoking habits.[8,13] Behaviours and beliefs among Omani people with regard to health, nutrition, rituals, family structure, food habits (e.g. dates served with coffee), social and geographical elements mutually influence culture and vice versa.[52] Individual differences in age, gender, education, experience, occupation and socio-economic factors also affect their beliefs and behaviours.[52,53]

Family history of DM, high BMI and WC, low physical activity and dietary intake of vegetables/fruits, history of hypertension and blood glucose were statistically significant with the FINDRISC among Omani adults.

Increase in WC and high BMI among Omani adults were related to poor lifestyle, physical activity (poor insulin sensitivity, hyperinsulinaemia, dyslipidaemia) and low consumption of vegetables and fruits among the Omani adults. One-fifth of the adult Omani population was overweight particularly visceral or abdominal, with increasing trend.[2,54,55]

Table 1. Demographic and clinical characteristics among Omani adults, N = 93.

Demographic and clinical and characteristics		Frequency	Percentage
Age (years)	<45	84	90.3
	45–54	8	8.6
	Above 55	1	1.1
Family history of diabetes mellitus	No	64	68.8
	Grandparents, aunt, uncle and cousin	18	19.4
	Parent, sibling and children	11	11.8
(BMI)	Normal: lower than 25 kg/m^2	51	54.8
	Overweight: 25–30 kg/m^2	25	26.9
	Obese: higher than 30 kg/m^2	17	18.3
Waist circumference	Men: <94 cm and women: <80 cm	51	54.8
	Men: 94–102 cm and women: 80–88 cm	37	39.8
	Men: >102 cm and women: >88 cm	5	5.4
Physical activity daily 30 min	Yes	41	44.1
	No	52	55.9
Vegetables, fruit or berry consumption	Every day	52	55.9
	Not every day	41	44.1
History of hypertensive and/or anti-hypertensives	No	60	64.5
	Yes	33	35.5
History of high blood glucose	No	68	73.1
	Yes	25	26.9
Fasting blood glucose	<7 mmol/L	68	73.1
	>7 mmol/L	25	26.9
Blood pressure	<140/90 mmHg	60	64.5
	>140/90 mmHg	33	35.5
Gender	Male	81	87.1
	Female	12	12.9
Marital status	Single	47	50.5
	Married	46	49.5

BMI: body mass index.

Table 2. Risk assessment scoring system (FINDRISC) among Omani adults, N = 93.

	Total risk score	Frequency	Percentage
1	Low risk <7	42	45.2
2	Slightly elevated 7–11	26	28.0
3	Moderate 12–14	16	17.2
4	Very high 15–20	9	9.7
	Total	93	100.0

FINDRISC: Finnish Diabetes Risk Score.

Obesity was associated with 36.8% of diabetics.[8,13,56] Hence, WC and BMI are better risk indicators of DM associated with increase in insulin resistance, hyperglycaemia and dyslipidaemia.[57] WC (odds ratio (OR): 6.89, 95% confidence interval (CI): 1.95, 24.3), use of blood pressure medication (OR 2.66, 95% CI: 1.00, 7.05) and family history of a sibling with diabetes (OR: 2.66, 95% CI: 1.08, 6.54) were significant predictors of DM.[18]

There was a direct proportionate of FINDRISC with history of hypertension, anti-hypertensive medications or high blood glucose among the Omani adults. Hypertension is a major risk factor for atherosclerosis and diabetes.[56] An increase in blood pressure is significantly associated with diabetes, particularly among urban-dwellers than rural areas.[19,58,59] Also fasting plasma glucose and post challenge glucose concentrations are predictors of risk of DM.[60] Using BMI, family history, history of high blood glucose or blood pressure was significantly a more predictive strategy for identifying risk for the development of DM due to interaction of race and diet.[18,61]

A quarter percentages of the Omani adults had very high or moderate elevated FINDRISC. The crude prevalence of total diabetes in Middle East was high (21.4%), with significant predictors like age, hypertension, obesity/WC/BMI and family history.[18] This study consists of several known diabetes risk factors using a self-administered tool for identifying individuals with undiagnosed T2DM, which is 66% of all prevalent cases of T2DM in Omani adults.[8] This assessment

Table 3. Association between risk factors and FBG among Omani adults, N = 93.

Risk factors and FBG		λ value	df	p
Age (years)	<45 45–54 Above 55	1.781	6	.939ns
Family history	No Grandparents, aunt, uncle and cousin Parent, sibling and children	26.545	6	.000*
BMI	Normal: Lower than 25 kg/m^2 Overweight: 25–30 kg/m^2 Obese: Higher than 30 kg/m^2	67.821	6	.000*
Waist circumference	Men: <94 cm and women <80 cm Men: 94–102 cm and women: 80–88 cm Men: >102 cm and women >88 cm	69.995	6	.000*
Physical activity daily 30 min	Yes No	55.754	3	.000*
Vegetables, fruit or berry consumption	Every day Not every day	28.009	3	.000*
History of hypertension	No Yes	50.245	3	.000*
History of high blood glucose	No Yes	8.588	3	.035*
Blood pressure	<140/90 mmHg >140/90 mmHg	50.245	3	.000*
Gender	Male Female	1.267	3	.737ns
Marital status	Single Married	10.967	3	.012*

BMI: body mass index; ns: not significant; BMI: body mass index; FBG: fasting blood glucose; ns: not significant.
Pearson chi-square = λ value.
*$p < 0.001$ = significant.

will help to increase awareness and motivate the public about the importance of modifiable anthropometric risk factors regarding T2DM.[13,62]

Conclusion

Among the modifiable risk factors that played a substantial role are BMI, WC, physical activity and dietary pattern. If modifiable risk factors are altered, the risk-assessment score can be considerably reduced. 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. This article builds on the extant literature on risk factors for screening DM that can serve as a foundation for a concise and easy-to-administer self-report measure for identifying T2DM and prevention development of DM among Omani adults. This study provides a simple, feasible, non-invasive and convenient screening FINDRISC tool that identifies individuals at risk of having T2DM.

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. FINDRISC may also be predictive of metabolic syndrome and cardiovascular disease as age, physical activity, dietary vegetables/fruits, WC, history of blood pressure or blood glucose are risk factors for both metabolic syndrome and cardiovascular disease. Adults with high-risk assessment, regardless of their blood glucose status, are suitable candidates for lifestyle modification, as these are risk factors for not only diabetes but also for metabolic syndrome and cardiovascular disease.

The health-care professionals and DNE can empower the patients in the high-risk group to be self-motivated with lifestyle 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.[63,64] Risk assessment for DM has the potential to allow DNE to be more responsive to the needs of their patients and to develop new approaches to improve different aspects of lifestyle. A high dietary fibre 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.[65,66] 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 is recommended. Regular walking for at least 30 min per day reduces diabetes risk by 35%–40%.[67,68] Knowledge of risk of T2DM can enhance Omani adults' awareness, leading to lifestyle modification.[69] This has been proven to effectively prevent and delay the development of DM among young adults.

Implications for DNEs

Prevention of T2DM among young adults at increased risk includes a simple three-step plan for identification of those who may be at higher risk, measurement of risk and the intervention to prevent the development of T2DM.[66,70,71] DNE should use the risk-assessment system, identify adults in high-risk group and empower them with lifestyle modification to delay the early onset of DM. This will result in decrease in incidence and prevalence of DM, and a decrease in burden on the health-care system.[64,72] Innovative methods should be integrated with focus on primary prevention of diabetes, early screening and detection of pre-diabetes population. DNE should be educated towards empowering self-management individualized tailored programme to deliver important information (diet, exercise, foot care, medications, blood glucose, stress management, prevention of risk factors and early detection of complications).

Psychosocial factors also provide an important foundation to establish goals and maintain the motivation to adhere the strategies that prevent DM.[65,73] Knowledge of determinants influencing early glycaemic control can be used by DNE to provide targeted interventions to those at greatest risk of short- or long-term complications. These have direct impact on the economic state of patients and families. These results can be utilized by DNE to emphasize management, motivation and reinforcement in adhering to self-care activities and efficacy in self-management of diabetes. The role of the DNE in ongoing assessment, continuous monitoring, close supervision, reinforcement of education and prevention of T2DM is important.

Limitations

This study is limited by the cross-sectional design and is not causal or effect study or measure of temporal changes. Some factors that can influence blood glucose levels (e.g. co-morbid conditions, genetically inherited haemoglobinopathies) have not been studied. Validation of the risk assessment with a large sample size in different populations would have enhanced the generalizability of the results.

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Declaration of conflicting interests

There are no organizations or communities with conflict of interest or coveting interests related to the study. The co-authors declare that they have no competing interests.

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