Risk Estimation of Type 2 Diabetes and Dietary Habits among Adult Saudi Non-diabetics in Central Saudi Arabia

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Received: February 9, 2011 Accepted: February 28, 2011 doi:10.5539/gjhs.v3n2p123

The research is financed by the Scientific Research Deanship at Qassim University, Saudi Arabia. No. SR-D-009-234

Abstract

Background: International Diabetes Federation ranked Saudi Arabia on third among the top 10 countries for prevalence of diabetes in 2010. Identifying people those are at increased risk for diabetes, followed by blood glucose testing to establish the diagnosis, and are considered to be an appropriate way of dealing with this problem. **Objectives and methods**: This cross-sectional study was conducted for the first time in Saudi Arabia to estimate the 10-years risk of developing type 2 diabetes using the Finnish Diabetes Risk Score and to investigate the dietary habits in such individuals among the Saudi non-diabetic population from July 2009 to March 2010. A total of 2007 Saudi citizens from all 11 provinces of Al-Qassim region were assessed using combined pre-piloted questionnaires. Statistical analysis was done utilizing SPSS version 13.0. **Results**: The gender ratio of the study participants was 1.6 male: 1.0 female. The mean (SD) age was 26.6 (10.2) years. The mean (SD) weight and height for males were 75.7 (19.6) kg and 169.4 (30.1) cm and for females were 64.4 (17.8) kg and 157.2 (10.4) respectively. Males had significantly higher body weight (kg), height (cm), and waist circumstance (cm) as compared to females (p <0.05). Our findings estimated that more than one-fourth of Saudi non-diabetics were found to be at moderate (one in six), high (one in three), and very high (one in two) risk to develop type 2 diabetes within 10 years. Majority of them were overweight and obese (36.8% and 60% respectively). More than ninety percent were found to have very limited physical activity with poor dietary habits. **Conclusion**: This study provides insight into progression and onset of type 2 diabetes in Saudi non-diabetic population within next 10 years using FINDRISC. The population at risk characterized by the sedentary activities, unhealthy dietary habits, obesity, and central obesity. Our findings suggest the need for urgent efforts to increase the level of physical activity, minimize sedentary lifestyle, and to improve the pattern of dietary habits especially among the population at risk in Saudi general population.

Keywords: Type 2 diabetes, FINDRISC, Risk factors, Unhealthy diets, Physical inactivity, Lifestyle, Saudi Arabia, Non-diabetic population

1. Introduction

Parallel with globalization, pronounced changes in the human environment and in human behavior and lifestyle have resulted in escalating rates of diabetes (Schwarz *et al*., 2007). The recent statistics released by the World Health Organization (WHO) and the International Diabetes Federation (IDF) are alarming (Boutayeb *et al*., 2005). The WHO estimated that more than 180 million people worldwide suffered from diabetes in 2008, a number which will be more than twice as high by 2030 (Pan *et al*., 2010). For Saudi Arabia, the prevalence of diabetes mellitus has been estimated by IDF for the year 2010 as 16.8% (third place on top 10) and expected to be 18.9% by 2030 (IDF Diabetes Atlas, 2009).

Recently it is reported that type 2 diabetes (T2D) is very common in younger people especially in the age group below 30 years old (Schwarz *et al*., 2009). Moreover, T2D can remain asymptomatic for up to 10 years, and at the time of diagnosis 20- 30% will have already developed complications (Wilson *et al*., 2010; Valdez 2009). This would place a significant burden on the family and society due to an earlier onset of complications, and subsequently, a longer and more intensive medical treatment (Si *et a*l., 2010).

Results from several large, long-term randomized controlled trials provide convincing evidence that changes made in physical activity levels and dietary habits are effective in delaying, and possibly preventing, progression from impaired glucose tolerance (IGT) to T2D (Harris *et al*., 2003). The earlier detection of individuals at high risk of T2D is a high priority for primary prevention (Xie *et al*., 2010). Research protocols for estimating a person's future risk for T2D have depended primarily on identifying IGT through a 2-hour oral glucose tolerance test (Kahn *et al*., 2009). However, mass population screening by such means is unlikely to be an acceptable and cost-effective way of identifying people who might benefit from health promotion interventions aimed at reducing the burden of disease associated with hyperglycemia (Rahman *et al*., 2008).

Identifying people at increased risk for undiagnosed diabetes, followed by blood glucose testing to establish the diagnosis, and are considered to be an appropriate way of dealing with this problem. The American Diabetes Association (ADA) recommends screening for T2D by using a verbal or written questionnaire to select high-risk individuals to increase the cost-effectiveness of testing undiagnosed individuals (Baan *et al*., 1999). A number of diabetes risk scores have been developed to detect those who should be screened for diabetes (Balkau *et al*., 2008; Valdez 2009). The Finnish Diabetes Risk Score (FINDRISC) is a validated well established method implemented as a practical screening tool to estimate the individual 10-years risk of T2D and to detect undiagnosed T2D (Wang *et al*., 2010). It is simple to understand and does not require laboratory measurements (Schwarz *et al*., 2009).

The present cross-sectional study aimed to estimate the 10-years risk of developing T2D using FINDRISC test and to investigate the dietary habits in such individuals among Saudi non-diabetic population. The results of this study can be used to increase the willingness and motivation of Saudi general population (who at risk) to change their lifestyle by adding insight into the influence of unhealthy dietary habits and exercise for developing T2D. This may also be useful in future programmes to prevent the increasing rate of developing T2D among the Saudi citizens.

2. Material and methods

2.1 Study design and population

A total of 2007 male and female non-diabetic Saudi citizens from the 11 provinces (Buraida, Onaiza, Al-Rass, Al-muthnab, Al-Bekaria, Al-Al-Badaei, Al-Asyah, Al-Nabhania, Oyon Jawa, Riad Khobara, and Al-Shamasia) of Al-Qassim region participated in this study. Al-Qassim region lies approximately at the centre of the Arabian Peninsula. The subjects selected randomly and potentially eligible for this study, if they were Saudi citizen aged above 15 years, understood the questionnaire; neither having been diagnosed as diabetes nor using any hypoglycemic medication.

A multi-stage random cluster technique was employed for the sampling. In the first stage of sampling each province in the Al-Qassim region was considered as a cluster. The study samples were collected from each cluster, size of which depended upon the population structure of each province as per the 2004 census, Department of statistics, KSA. Samples from both genders were taken in the study, keeping the prevalence of diabetes in KSA among males and females as to estimate the risk in both genders.

2.2 Data collection

The data was collected from July 2009 to March 2010 using combined pre-piloted questionnaires during the visits to homes and public places, i.e. Estarahes (party lounges), markets. The questionnaire included questions concerned with FINDRISC and questions concerned with dietary habits. Prior to filling out the questionnaire, the

participants were informed about the objectives of this study and were requested to fill out the questionnaire.

2.2.1 The FINDRISC test

The part of FINDRISC test in the questionnaire included a total of eight questions regarding age, body mass index (BMI), waist circumference, physical activity, daily consumption of fruits & vegetables, use of antihypertensive medication, history of high blood glucose, and family history of diabetes. The Maximum total score of FINDRISC questions was 26 points. The risk of developing T2D within 10 years is categorized as low, slightly elevated, moderate, high, and very high as per instructions (see appendix).

2.2.2 The dietary habits questions

In addition, participants were being asked about their dietary habits by seven questions regarding the frequency of taking: rice, fried food, fruit juice, red meat, dates, chocolate, and candy. The frequency of dietary intake was estimated by providing the options: never, occasionally, regularly, and daily.

2.3 Measurement of BMI and waist circumference

Body weight, height, and waist circumference were measured by trained research assistants. Weight was measured using calibrated electronic weighing scales (Proton Digital Scale, Model PHC 309 MD) and height was measured using a Portable Height Scale (Mentone Educational, Model PE087, Australia). Waist circumference was measured using an anthropometric tape at a level midway between the lower rib margin and iliac crest with the tape all around the body in a horizontal position.

BMI was calculated as weight (in kilograms) divided by height (in metres) squared. Participants with BMI between 25-30 kg/m^2 or greater than 30.0 kg/m^2 were defined as overweight or obese respectively. For males, waist circumference of less than 94 cm was considered low, while 94–102 cm was high and more than102 cm was very high. For females, waist circumference of less than 80 cm was considered low, 80–88 cm was high and more than 88 cm was very high.

2.4 Ethical consideration

Ethical approval was obtained from the Ethics and Research Committee at Qassim University. The recruitment of the potential participants was accomplished after explaining the objectives of the study by trained field research assistants. Participation was voluntary and verbal consent was acquired from each participant. Confidentiality of all participants was maintained as no names were requested in the questionnaires.

2.5 Statistical analysis

Statistical Packages for the Social Sciences (SPSS) version 13.0 was utilized for data analysis. The demographic variables (age, weight, height, BMI, waist circumstance) were expressed as mean ± standard deviation. The frequencies of risk factors of T2D as well as dietary habits were expressed as number (%). Statistical differences between males and females were estimated using the Chi-squared (for categorical variables) and Student's t-test (for continuous variable) according to the statistical distribution of data. Differences were considered statistically significant at p value < 0.05.

3. Results

3.1 Demographic characteristics of participants

As shown in table 1, the gender ratio of the study participants was 1.6 male: 1.0 female, while the mean (SD) age was 26.6 (10.2). The overall mean (SD) BMI (Kg/m^2) of participants was 26.6 (10.4). The mean (SD) weight and height for males were 75.7 (19.6) kg and 169.4 (30.1) cm and for females were 64.4 (17.8) kg and 157.2 (10.4) respectively. Males had significantly higher body weight (kg), height (cm), waist circumstance (cm) as compared to females (p <0.05).

3.2 Estimation of the 10-years risk of T2D in adults

As shown in Table 2; out of the two –thousands and seven participants, our findings estimated that 29.4% of Saudi non-diabetics were found to be at moderate/high/very high risk to develop T2D within 10 years i.e., at least one in 6 will develop the disease within 10 years. Of these 59.3% were males and 40.7% were females. In addition to this 29.4%, around 38.1% of the participants had a slightly elevated score to develop the disease (i.e., one in 25 will develop the disease). This may let to conclude that as a whole, approximately more than two-third (67.5%) of Saudi non-diabetics was found to be at risk to develop T2D within 10 years. It seemed that males were found to be significantly more prone to develop T2D as compared to females (p=0.019).

Of the 29.4% (n=590) participants, who were found to be at moderate/high/very high to develop T2D, data showed that 80.2% of the targeted participants aged between 15 and 44 years, the majority of them were

overweight and obese (36.8% and 60% respectively). Approximately, half of males (49.1%) had waist circumstance greater than 102cm, while in females, again half of them (56.5%) had waist circumstance greater than 88 cm. More than ninety percent (91.1%) were found to have very limited physical activity i.e., had not daily at least 30 minutes of physical activity at work and/or during leisure time. Surprisingly, 85.6% of participants who were found to be at moderate/high/very high risk to develop T2D reported that they had never diagnosed with high blood glucose while 78.3% of them informed that their first-degree relatives were diabetic patients. Overall males were found to be significantly more overweight, obese, physically inactive, and had high waist circumstance as compared to females. The prevalence diabetes risk factors assessed in FINDRISC test among this group of participants were illustrated in table 3.

3.3 Estimation of dietary habits among individuals with moderate/high/very high risk developing T2D.

As shown in table 4; the frequencies of selected items of food/drink were also analyzed among the group of participants (29.15%) who were found to be at moderate/high/very high risk to develop T2D. Our data showed that the dietary habits among this group were poor. On daily/regular basis, the percentages of targeted participants accustomed to eat fried food, red meat, chocolate, rice or dates were 35.8%, 48.8%, 43.8%, 81.1%, 76.3% respectively. Moreover, the percentages of targeted participants reported that they used to drink soft drinks or fruit juice on daily/regular basis were 48.3% and 39.5% respectively. Males were found to be more accustomed to unhealthy diets as compared to females. These differences were statistically significant between males and females ($p < 0.05$).

4. Discussion

In this study we have chosen FINDRISC (as a tool to estimate the 10-years risk of T2D among the Saudi non-diabetic population) for several reasons. First, it is recommended by several authorities (such as the European Association for the Study of Diabetes, the European Society of Cardiology, and the International Diabetes Federation Consensus Group) to be used for risk stratification purposes in the European population (Schwarz P. E. H., *et al*., 2009); second, FINDRISC is a well validated established method implemented as a practical screening tool to estimate the individual 10-years risk of T2D and to detect undiagnosed T2D (Wang J., *et al*., 2010); third, it is widely applicable since it focuses on general risk factors for T2D, which are globally prevalent (Schwarz P. E. H., *et al*., 2009); lastly, to the best of our knowledge, only one study (Abduelkarem A. R., *et al*., 2009) applied FINDRISC on a sample of the Arab population of the Middle East.

As it is accepted fact that the number of diabetic patients in Saudi Arabia is high and it is also increasing very rapidly due to the urbanization process and lifestyle changes. In the FINDRISC, most of the variables used to predict risk of T2D within 10 years are related to lifestyle. Therefore, it would be appropriate to apply FINDRISC in spite of race/ethnicity or cultural differences.

The data from this study indicated that more than one-fourth (29.4%) of Saudi non-diabetics were found to be at moderate (one in six), high (one in three), and very high (one in two) risk to develop T2D within 10 years. Of these 59.3% were males and 40.7% were females. It is likely that males are more susceptible to develop T2D as compared to females. This is in agreement with the report from a national survey conducted in 2004 that estimated the prevalence of T2D in Saudi adults was 23.7% and the prevalence in males as compared to females were 26.2% and 21.5% ($p<0.00001$). Moreover the authors in this survey reported that a large number of diabetics (27.9%) were found to be unaware of having diabetes mellitus (Al-Nozha M. M., *et al*., 2004). The age of 80.2% participants from this 29.4% Saudi non-diabetics who were found to be at moderate/high/very high risk to develop T2D within 10 years was between 15 and 44years. This indicates that young Saudi citizens, who represented an overwhelming majority of the Saudi population, were found to be at risk to develop T2D (Saudi Arabia. Encyclopedia of the Nations). This may further increase the economic burden of the disease in the country.

It is generally agreed that T2D is a poly etiological disorder. The genetic background, environmental factors, and the interaction between these all influence the development of the disease. More than three-quarter (78.3%) of the targeted group reported that their first-degree relatives were diabetic patients. This implies that majority of them had a genetic predisposition to develop T2D, in addition to the high consanguinity rate among Saudi citizens (Elhadd T.A., *et al*., 2007).

However, diabetes still has modifiable risk factors that if they well be controlled may reduce the earlier onset of the disease. Therefore, WHO developed Global Strategy on Diet, Physical Activity and Health. WHO stated that unhealthy diets and physical inactivity are among the leading causes of the major noncommunicable diseases, including cardiovascular disease, type 2 diabetes and certain types of cancer, and contribute substantially to the global burden of disease, death and disability (Global strategy on diet, physical activity and health, 2004).

Regardless of this alarm from WHO since 2004, more than ninety percent (91.1%) of Saudi non-diabetics who were found to be at moderate/high/very high risk to develop T2D reported that they did not accustom to have at least 30 minutes of physical activity at work and/or during leisure time. Males were statistically physical inactive as compared to females (p=0.054). Knowler et al. (2002) in a clinical trial cohort study reported that the incidence of diabetes was reduced by 58 percent in the group of participants who at least 150 minutes of physical activity per week as compared with placebo.

Besides the lack of physical activity, our findings indicated that obesity and central obesity were prevalent among the targeted group. The data revealed that 36.8% of them were overweight and 60% were obese. Males had more weight as compared to females. The difference between males and females was statistically significant (p=0.0437). Moreover, since the central obesity defined as the waist circumference >102 cm for males and >88 cm for females; our data revealed that approximately half of males and females suffered from central obesity (49.1% vs. 56.5%). Again difference between males as compared to females in waist circumstance was statistically significant (p=0.00004). Evidence is now emerging that obesity-driven type 2 diabetes might become the most common form of diabetes in adolescents within the next ten years (Rees A., *et al*., 2009).

Food intake has been associated with obesity not only in terms of the volume of food ingested but also in terms of the composition and quality of diet (Amin T. T., *et al*., 2008). The adoption of a dietary pattern characterized by a high intake of red meat, besides other components, including sweets and fried foods, is believed to contribute to the increased the risk of insulin resistance and T2D (Panagiotakos D. B., *et al*., 2005; Vang A., *et al*., 2008; Villegas R., *et al*., 2006). In contrast, it is documented the inverse association between quintiles of vegetable intake and T2D. Fruit and vegetable consumption may play a protective role in the development of T2D, as they are rich in nutrients and other components that are believed to be protective against diabetes, such as antioxidants and fiber. Fruits and vegetables also contain numerous other beneficial phytochemicals, many of which are not documented in nutrient databases (Villegas R., *et al*., 2008). Our data showed that the dietary habits of the targeted group who at moderate/high/very high risk developing T2D were poor. Although the daily intake of vegetables was reported by only 22.9% of targeted participants, red meat and fried food intake on daily/regular basis were reported by 48.8% and 35.5% of targeted participants respectively. Males were significantly seemed to be more consumers of red meat and fried food as compared to females (p=0.008 and p=0.002 respectively). Moreover, rice represented the major food of the targeted group whom 53.6% of them informed that they eat rice daily. The percent of males to females in daily rice consumption were statistically significant (p=0.0000). Recently Nanri *et al*. (2010) reported that elevated intake of white rice is associated with an increased risk of T2D in Japanese women study.

Approximately half (48.0%) of targeted group reported that they accustomed to drink soft drinks daily/regularly. Recent evidence suggests an association between the intake of sugar sweetened soft drinks and the risk of obesity and diabetes resulting from large amounts of high fructose corn syrup used in their manufacture, which raises blood glucose similar to sucrose (Nseir W., *et al.* 2010). In addition, diet soft drinks contain aspartame sweetener and caramel coloring, which are rich in advanced glycation end products that potentially increase insulin resistance and inflammation (Assy N., *et al.* 2008).

Such bad dietary patterns in addition to the sedentary lifestyle among the majority of the targeted group who were found to be at moderate/high/very high risk to develop T2D may even accelerate the onset of the disease among such a group who already were genetically predisposed to diabetes. This demands urgent needs for changing lifestyle among general population and to increase the awareness of healthy diet.

5. Strengths and limitation of the study

Strengths of this study include: in addition to the large sample size (n=2007), we succeeded to estimate the people who have an increased risk of developing T2D based on FINFRISC and also illustrated their dietary habits in terms of frequencies. Furthermore, the results of this study highlighted the importance of using diabetes risk screening questionnaires/scores (such as FINDRISC) among the general population as an initial step for detection of undiagnosed diabetes or prediabetes.

Our study has limitations in the accuracy of answers of participants regarding the frequency of their dietary habits as it is a self-reported survey. Moreover, in this study we couldn't quantify the consumed dietary food which would be more significant than estimation the frequency of consumption. Also, as there is no blood glucose tests have been done, there is some possibility that the study population included some undiagnosed T2D; possibly this may increase the percentage of the very high risk category.

6. Conclusion

This study provides insight into the progression and onset of T2D among Saudi non-diabetic population within next 10 years using FINDRISC. More than one-fourth of Saudi non-diabetics were found to be at moderate (one in six), high (one in three), and very high (one in two) risk to develop T2D within 10 years. The age of 80.2% of them was between 15 and 44years. Males were more susceptible to develop T2D as compared to females. The majority of the targeted group characterized by sedentary activities, unhealthy dietary habits, obesity, and central obesity. Our findings suggest the need for urgent efforts to encourage Saudi general population to increase the level of their physical activity, minimize their sedentary activity, and to improve the quality of their diet. As in this Era, the prevalent diseases are due to lifestyle changes, rather than due to agent or vector born communicable diseases.

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Table 1. Characteristics of the study participants (n= 2007)

Variable	Total (n=2007)	Males (n=1241)	Females (n=766)	p-value
	mean±SD	mean±SD	mean±SD	mean±SD
Age (yr)	026.6±10.2	026.4±10.0	026.9±10.5	0.265
Body weight (kg)	071.4±19.7	075.7±19.6	064.4±17.8	0.000*
Body height (cm)	164.8±25.2	169.4±30.1	157.2±10.4	0.000*
BMI	026.6±10.4	026.8±09.2	026.1±12.1	0.118
Waist circumstances (cm)	081.9±24.9	086.8±18.9	074.0±30.7	0.000*

Data presented as mean±standard deviation.* p< 0.05 significant difference between males and females.
Abbreviations: SD = standard deviation, yr = years, Kg = kilograms, cm = centimeters, BMI = body mass index

Table 2. The risk of developing type 2 diabetes within 10 years between males and females (n=2007)

Category	Total n (%)	Males n (%)	Females n (%)	χ^2 test p-value
Low (estimated one in 100 will develop disease)	652(32.5)	425(21.2)	227(11.3)	0.019*
slightly elevated (estimated one in 25 will develop disease)	765(38.1)	497(24.7)	268(13.4)	
Moderate (estimated one in 6 will develop disease)	375(18.7)	236(11.8)	139(06.9)	
High (estimated one in three will develop disease)	197(09.8)	105(05.2)	92(04.6)	
very high (estimated one in two will develop disease)	18(00.9)	09(00.4)	09(00.4)	

Data presented as frequency (n) and percent (%) of the total number in each category.* Chi-square p<0.05 significant difference between males and females

ISSN 1916-9736 E-ISSN 1916-9744

Table 3. Prevalence of diabetes risk factors used in FINDRISC test among the group of participants who were found to be at moderate/high /very high risk to develop diabetes (n=590)

variable	Total n=590	Males (n=350)		Females (n=240)		χ^2 test p-value
Age (years)						
15-44	473(80.2)	289(82.6)		184(76.7)		0.3391
45-54	89(15.1)	47(13.4)		42(17.5)		
55-64	19(3.2)	10(2.9)		09(3.8)		
> 64	09(1.5)	04(1.1)		05(2.0)		
BMI (kg/m^2)						
Underweight/ normal (<25)	19(3.2)	07(2.0)		12(5.0)		0.0437*
Overweight (25-30)	217(36.8)	122(34.9)		95(39.6)		
Obese (>30)	354(60.0)	221(63.1)		133(55.4)		
Physical activity						
active ≥ 30 min/day	53(8.9)	38(10.9)		15(6.3)		0.0545*
non-active < 30 min/day	537(91.1)	312(89.1)		225(93.7)		
Waist circumstances (cm)						
		≤ 94	14(4.0)	< 80	05(2.1)	0.00004*
		94-102	164(46.9)	80-88	74(30.8)	
		> 102	172(49.1)	> 88	161(56.5)	
Eat vegetables, fruit, or berries						
Every day	135(22.9)	82(23.4)		53(22.1)		0.7023
Not every day	455(77.1)	268(76.6)		187(77.9)		
Take anti-hypertensive medication regularly						
No	509(86.3)	305(87.1)		204(85.0)		0.4575
Yes	81(13.7)	45(12.9)		36(15.0)		
Have high blood glucose						
No	505(85.6)	300(85.7)		205(85.4)		0.9194
Yes	85(14.4)	50(14.3)		35(14.6)		
Family history						
No	20(3.4)	09(2.6)		11(4.6)		0.0784
Yes, second relatives	108(18.30	73(20.9)		35(14.6)		
Yes, first relatives	462(78.3)	268(76.5)		194(80.8)		

Data presented as frequency (n) and percent (%) of the total number in each category* Chi-square $p<0.05$ significant difference between males and females

Table 4. Dietary habits of the group of participants (29.4%) who were found to be at moderate, high or very high risk to develop diabetes (n=590)

Food group	Total (n=590)	Males (n=350)	Females (n=240)	χ^2 test p-value
Rice				
Never	3 (0.5)	2(0.6)	1(0.4)	0.00009*
Daily	316(53.6)	211(60.3)	105(43.8)	
Regular	162(27.5)	91(26)	71(29.6)	
occasionally	109(18.5)	46(13.1)	63(26.3)	
Fried				
Never	21(3.6)	12(3.4)	09(3.8)	0.00202*
Daily	37(6.3)	21(6.0)	16(6.7)	
Regular	174(29.5)	124(35.4)	50(20.8)	
occasionally	358(60.7)	193(55.1)	165(68.8)	
Fruit juice				
Never	30(5.1)	14(4.0)	16(06.7)	0.3185
Daily	55(9.3)	31(8.8)	24(10.0)	
Regular	178(30.2)	113(32.3)	65(27.1)	
occasionally	327(55.4)	192(54.9)	135(56.3)	
Soft drinks				
Never	66(11.2)	35(10.0)	31(12.9)	0.09203
Daily	152(25.8)	103(29.4)	49(20.4)	
Regular	133(22.5)	75(21.4)	58(24.2)	
occasionally	239(40.5)	137(39.1)	102(42.5)	
Red meat				
Never	18 (3.1)	05(1.4)	13(5.4)	0.00833*
Daily	74(12.5)	38(10.9)	36(15.0)	
Regular	214(36.3)	138(39.4)	76(31.7)	
occasionally	284(48.1)	169(48.3)	115(49.9)	
Dates				
Never	11(1.9)	04(1.1)	07(2.9)	0.24945
Daily	285(48.3)	176(50.3)	109(45.4)	
Regular	165(28.0)	99(28.3)	66(27.5)	
occasionally	129(21.9)	71(20.3)	58(24.2)	
Chocolate				
Never	67(11.4)	38(10.9)	29(12.1)	0.00000*
Daily	93(15.8)	37(10.6)	56(23.3)	
Regular	165(28.0)	84(24.0)	81(33.8)	
occasionally	265(44.9)	191(54.6)	74(30.8)	

Data presented as frequency (n) and percent (%) of the total in each category* Chi-square $p<0.05$ significant difference between males and females

 ISSN 1916-9736 E-ISSN 1916-9744

Appendix. The Finnish Diabetes Risk Score (FINDRISC) which we applied to estimate type 2 diabetes among adult Saudi non-diabetics in central Saudi Arabia

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

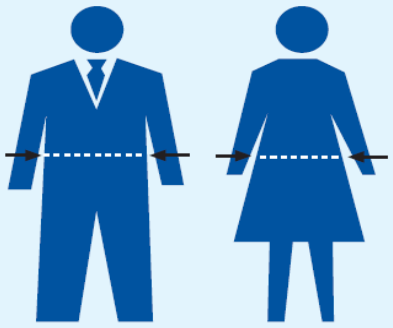
2. Body-mass index

(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 minutes 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 medication for high blood pressure on regular basis?

0 p. No
2 p. Yes

7. Have you ever been found to have high blood glucose (eg 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 1 in 100 will develop disease
7–11	**Slightly elevated:** estimated 1 in 25 will develop disease
12–14	**Moderate:** estimated 1 in 6 will develop disease
15–20	**High:** estimated 1 in 3 will develop disease
Higher than 20	**Very high:** estimated 1 in 2 will develop disease

Please turn over