

Ten-year Diabetes Risk Forecast in the Capital of Jordan

Arab Diabetes Risk Assessment Questionnaire Perspective—A Strobe-Complaint Article

Ahmad Alghadir, PhD, Alia A. Alghwiri, PhD, Hamzeh Awad, PhD, and Shahnawaz Anwer, MPT

Abstract: The prevalence of diabetes in Jordan has been increasing. The early diagnosis of diabetes is vital to slow its progression. The Arab Risk (ARABRISK) screening tool is a self-administered questionnaire used to determine people who are at high risk for developing diabetes. This study aimed to identify people at high risk for developing type 2 diabetes by using the ARABRISK in the capital of Jordan.

A cross-sectional study was conducted with a convenience sample of people in the capital of Jordan. The ARABRISK screening tool was administered to identify the participants' risk for developing diabetes. In addition to descriptive statistics, percentages of the ARABRISK categories were represented, and an independent samples *t* test was used to explore the differences between men and women. A total of 513 participants with a mean age of 51.94 (SD = 10.33) were recruited; 64.9% of the participants were men (n = 333).

The total ARABRISK score ranged from 0 to 25 with a mean score of 12.30 (SD = 4.76). Using the independent samples *t* test, women (mean = 13.25, SE = 0.10) had significantly higher ARABRISK total scores than men did (mean = 12.95, SE = 0.09), $t(141) = -2.23$, $P = 0.03$ in the "moderate risk" category. All of the items in the ARABRISK questionnaire were found to be good predictors of the ARABRISK total scores. Among them, age, body mass index (BMI), and high blood glucose (HBG) were the best predictors as indicated by the standardized regression coefficient (β). Older age, obesity, elevated weight circumference, absence of daily physical activity, daily consumption of fruits/vegetables, presence of high blood pressure (HBP), and HBG were significantly associated with increased odds of high ARABRISK total scores. Neither a history of gestational diabetes nor a positive family history was associated with an increased odds of high ARABRISK total scores.

By identifying risk factors in these participants, interventions and lifestyle changes can be suggested and implemented to reduce the risk and incidence of diabetes.

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Abbreviations: ARABRISK = Arab Diabetes Risk Assessment Questionnaire, BMI = body mass index, CANRISK = Canadian Diabetes Risk Assessment Questionnaire, FINDRISK = the Finnish Diabetes Risk Score, IFG = impaired fasting glucose, IGT = impaired glucose tolerance, T2D = type 2 diabetes.

INTRODUCTION

Diabetes mellitus is a chronic disease with debilitating complications that contribute to morbidity and mortality. The worldwide prevalence of diabetes has been increasing at a noteworthy rate. It has been estimated that the total number of people with diabetes would inflate from 171 million in 2000 to 366 million in 2030.¹ Healthcare costs from diabetes impose a global economic burden. The healthcare costs from diabetes alone were \$376 billion USD in 2010 and have been estimated to increase to \$490 billion USD in 2030.² Presently, the Middle East region is among the most impacted countries.¹

As noted in multiple research studies, the ability to recognize members of a population who are at risk for diabetes is critical for multiple reasons. Among these is that at the time of initial diagnosis, many patients are already demonstrating signs of small and large vessel complications, which indicate that diabetes may have gone undetected from 4 to 7 years before the patients' diagnoses.^{3,4} Additionally, patients who are found to have prediabetes, as indicated by impaired fasting glucose (IFG) and/or impaired glucose tolerance (IGT), demonstrate a 10 to 20 times greater risk of developing of type 2 diabetes (T2D) compared with people with normal glycemic levels.^{5,6} Presently, there is a notable lack of assessment tools available to identify persons of Middle-Eastern origin who are prediabetic or have undiagnosed diabetics, despite the high numbers of both types of patients in the population.

Hence, there is an urgent need to apply applicable screening tools to facilitate diabetes prediction and support the global prevention effort. Previous randomized experimental studies on the prevention of diabetes have reported the effectiveness of lifestyle intervention to reduce the incidence of diabetes among those with prediabetes.⁷

The use of risk-scoring questionnaires may be helpful to upgrade the individual risk assessments.

Many risk-scoring models for T2D need specific blood test outcomes that assume that a clinical examination or diagnostic assessment has effectively occurred.^{8–15} This limits the widespread use of these models in a public health system. The Finnish Diabetes Risk Score (FINDRISK), developed in Finland, is a participant-rated diabetes risk assessment that does not require any knowledge of particular laboratory test values.¹⁶ Based on the FINDRISK, Canadian researchers developed the Canadian Risk (CANRISK), which considers the variability of the ethnicity of the Canadian population as well as the subject's sex and

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From the Department of Rehabilitation Sciences (AA, HA, SA), College of Applied Medical Sciences, King Saud University, Riyadh, Kingdom of Saudi Arabia; Department of Physical Therapy (AAA), Faculty of Rehabilitation Sciences, The University of Jordan, Amman, Jordan; and Dr. D. Y. Patil College of Physiotherapy (SA), Dr. D. Y. Patil Vidyapeeth, Pune, India.

Correspondence: Shahnawaz Anwer, MPT, Department of Rehabilitation Sciences, College of Applied Medical Sciences, King Saud University, Riyadh, Saudi Arabia
(e-mail: anwer_shahnawazphysio@rediffmail.com).

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TABLE 1. Results of ARABRISK Specific Items and Total Score Between Males and Females

Q	ARABRISK Items	Males, n (%)	Females, n (%)	Total, n (%)
1	Age, y			
	40–44	97 (29)	59 (33)	156 (30)
	45–54	119 (36)	53 (29)	172 (34)
	55–64	65 (19)	33 (18)	98 (19)
	65–74	52 (16)	35 (20)	87 (17)
2	Sex	333 (100)	180 (100)	
3	BMI			
	<25	163 (49)	81 (45)	244 (48)
	25–29	86 (26)	44 (24)	130 (25)
	30–34	37 (11)	28 (16)	65 (13)
	≥35	47 (14)	27 (15)	74 (14)
4	Waist circumference			
	Male <94/female <80	119 (36)	36 (20)	155 (30)
	Male 94–102/female 80–88	49 (15)	25 (14)	74 (15)
	Male >102/female >88	165 (49)	119 (66)	284 (55)
5	Daily physical activity ≥30 minutes			
	Yes	214 (64)	95 (53)	309 (60)
	No	119 (36)	85 (47)	204 (40)
6	Daily consumption of fruits/vegetables			
	Every day	174 (52)	94 (52)	268 (52)
	Not every day	159 (48)	86 (48)	245 (48)
7	HBP			
	Yes	128 (38)	62 (34)	190 (37)
	No	205 (62)	118 (66)	323 (63)
8	HBG			
	Yes	94 (28)	52 (29)	146 (28)
	No	239 (72)	128 (71)	367 (72)
9	History of gestational diabetes			
	Yes	–	6 (3)	6 (1)
	No, do not know, or not applicable	333 (100)	174 (97)	507 (99)
10	Positive family history of diabetes (mother, father, siblings, children)			
	One of them	19 (6)	9 (5)	28 (5)
	Two of them	40 (12)	28 (16)	68 (13)
	Three of them	87 (26)	56 (31)	143 (28)
	All of them	173 (52)	81 (45)	254 (50)
	Others or no/do not know	14 (4)	6 (3)	20 (4)
11	Ethnicity of parents			
	Arab	333 (100)	180 (100)	513 (100)
12	Education			
	Some high school or less	105 (31)	60 (33)	165 (32)

Q	ARABRISK Items	Males, n (%)	Females, n (%)	Total, n (%)
	High school diploma	95 (29)	57 (32)	152 (30)
	College or university degree	133 (40)	63 (35)	196 (38)
	Total score points			
	Low risk (<21)	14 (4)	23 (13)	37 (7)
	Moderate risk (21–32)	97 (29)	69 (38)	166 (32)
	High risk (≥33)	222 (67)	88 (49)	310 (61)

BMI = body mass index, HBG = high blood glucose, HBP = high blood pressure.

educational level.¹⁷ Both tools were developed to identify people who are at high risk for developing diabetes. An Arabic version of the CANRISK was adapted and validated to enable use with Arab-speaking people in Jordan and Saudi Arabia.¹⁸ The Arab Diabetes Risk Assessment Questionnaire (ARABRISK) represents an Arabic questionnaire designed to screen a person's risk of developing T2D or prediabetes in an Arab population.

The World Health Organization (WHO) has noted the threat of an increased prevalence of overweight and obesity as a detriment to the health of the worldwide population.¹⁹ Presently, the trend of sedentary work has increased²⁰; thus, the risk of obesity has been increased because of long sedentary working hours.²¹ More recently, Leischik et al²² reported a high risk of cardiovascular disease, high prevalence of metabolic disease, increased waist circumference, and higher carotid intima media thickness in sedentary clerks compared with firefighters. Furthermore, Leischik et al²³ reported an association of sedentary occupations with obesity and metabolic syndrome in middle-aged men. Therefore, the workplace is a good setting for the implementation of health programs.²⁴ Ramli et al²⁵ reported a significant improvement in physical fitness and body fat percentage following the implementation of health programs at a worksite. The prevalence of diabetes is the highest in Jordan among the world, which makes it an alarming public health burden.²⁶ The prevalence of diabetes increased from 6.3% in 2002 to 7.4% in 2004 in Jordan's population.²⁷ A study published in 2008 revealed a 31.5% increase in the prevalence of diabetes in Jordanians aged 25 years or older compared with a similar survey conducted in 1994.²⁸ A previous study suggested that at the end of 2050, approximately 1 to 3 million people in Jordan will have diabetes, hypertension, or increased blood cholesterol based on the changes in disease prevalence and the growth of the popu-

TABLE 2. Mean and SD of ARABRISK Total Score Between Males and Females

Total Score Categories	Males (Mean ± SD)	Females (Mean ± SD)	P*
Low risk (<21)	18.64 ± 1.50	16.43 ± 2.95	0.01
Moderate risk (21–32)	38.93 ± 12.13	34.42 ± 12.55	0.01
High risk (≥33)	45.22 ± 9.66	44.83 ± 8.66	0.74

SD = standard deviation.

* t test for independent samples is significant at P < 0.05.

TABLE 3. Mean and SD With 95% CI of the Mean ARABRISK Total Score for Each Item Category

Q	ARABRISK Items	Total ARABRISK Score (Mean ± SD)	95% CI
1	Age, y		
	40–44	27.97 ± 9.30	26.50–19.45
	45–54	36.24 ± 9.82	34.76–37.72
	55–64	44.44 ± 10.58	42.32–46.56
	65–74	48.37 ± 10.41	46.15–50.59
2	Sex		
	Male	38.93 ± 12.13	37.63–40.24
	Female	34.42 ± 12.55	32.57–36.26
3	BMI		
	<25	32.95 ± 10.10	31.68–34.22
	25–29	34.35 ± 10.05	32.61–36.10
	30–34	42.65 ± 11.59	39.77–45.52
4	Waist circumference		
	Male <94/female <80	30.81 ± 10.82	29.10–32.53
	Male 94–102/female 80–88	36.74 ± 11.19	34.15–39.34
	Male >102/female >88	41.07 ± 12.14	39.66–42.49
5	Daily physical activity ≥30 minutes		
	Yes	36.25 ± 11.89	34.92–37.58
	No	39.02 ± 13.13	37.21–40.83
6	Daily consumption of fruits/vegetables		
	Every day	35.82 ± 11.22	34.47–37.17
	Not every day	39.02 ± 13.51	37.32–40.72
7	HBP		
	Yes	43.10 ± 12.59	41.30–44.90
	No	33.97 ± 11.08	32.75–35.18
8	HBG		
	Yes	47.49 ± 11.91	45.54–49.43
	No	33.32 ± 10.18	32.27–34.36
9	History of gestational diabetes		
	Yes	43.17 ± 9.93	32.75–53.59
	No, do not know, or not applicable	37.28 ± 12.48	36.19–38.37
10	Positive family history of diabetes (mother, father, siblings, children)		
	One of them	32.71 ± 8.06	29.59–35.84
	Two of them	37.44 ± 14.08	34.03–40.85
	Three of them	35.95 ± 11.43	34.06–37.84
	All of them	38.21 ± 12.67	36.64–39.77
	Others or no/do not know	42.60 ± 13.78	36.15–49.05
11	Ethnicity of parents		
Arab	37.35 ± 12.46	36.27–38.43	

Q	ARABRISK Items	Total ARABRISK Score (Mean ± SD)	95% CI
12	Education		
	Some high school or less	43.02 ± 11.93	41.19–44.68
	High school diploma	34.57 ± 11.67	32.70–36.44
	College or university degree	34.73 ± 11.93	33.05–36.41

SD = standard deviation, BMI = body mass index, HBG = high blood glucose, HBP = high blood pressure.

lation.²⁹ In developing countries, for example, Palestine, the prevalence of diabetes is projected to be 20.8% in 2020 and 23.4% in 2030, as estimated by model forecasts.³⁰

In Jordan, the self-reported diagnosed prevalence of obesity, high blood pressure, high blood cholesterol, and asthma in adults aged 18 years or older was 12.8%, 22.2%, 20.9%, and 5.1%, respectively.³¹ In a previous study, the presence of obesity compared with normal weight was significantly associated with diabetes (odds ratio [OR] 3.27), high blood pressure (OR 3.69), high cholesterol (OR 3.45), and asthma (OR 5.12) in the Jordanian population.³² According to the behavioral risk factor survey conducted in the Jordanian population, approximately 50% of the surveyed individuals were not participating in any physical activity.³³ Obesity is a worldwide epidemic, particularly in the Middle East, where the rate of obesity is high (38%–44%) compared with Canada (23%) and the United States (21%).³⁴ Another study reported that the prevalence of obesity would be 21.1% and 40.5% in men and women, respectively, in the year 2027.³⁵ Furthermore, in a previous report, it was found that obese men who had a moderate to high fitness level had less than half the risk of death compared to normal weight men who had a poor fitness level.³⁶ Recently, Al-Nsour et al³⁷ reported a high prevalence of diabetes, hypertension, overweight, and obesity in the Jordanian male and female population. Therefore, the present study utilized the ARABRISK to identify and discuss the risk of diabetes among participants in the capital of Jordan (Amman).

METHODS

A cross-sectional questionnaire (ARABRISK)-based survey was used to identify the risk of developing type 2 diabetes (T2D) in a convenience sample of healthy participants in Amman, the capital of Jordan.

Procedures

After obtaining ethical approval from the ethical committee, the faculty of Rehabilitation Sciences in the University of Jordan and the participants gave informed consent. The ARABRISK was completed by healthy participants between June and September 2014. Participants for this study were recruited from public gathering areas such as malls and parks in Amman, Jordan. Both men and women subjects between the ages of 40 and 74 years of age were included in the study. Participants with a known diagnosis of diabetes were excluded.

Statistical Analysis

Descriptive statistics, including measures of central tendency and variability, were calculated to describe

participants' characteristics. Percentages of the ARABRISK categories were represented and compared between sexes. The independent samples *t* test was also performed between males and females to explore significant differences between sexes on the ARABRISK total score among categories. Stepwise multiple regression analysis was done to identify the best predictors for the outcome. In addition, a multivariate logistic regression analysis was done to determine the OR with the corresponding 95% confidence intervals (95% CI) for all risk factors. All of the statistics were significant when $P < 0.05$. Statistical analysis was conducted using SPSS statistics for Windows version 21 (SPSS Inc, Chicago, IL).

RESULTS

Five hundred thirteen participants were recruited from public areas of Amman, Jordan. The total ARABRISK score ranged from 8 to 76 with a mean total score of 37.35 (SD = 12.46). Sixty-one percent of the participants had a high risk for developing diabetes (Table 1). The comparison between males and females demonstrated that the male participants had significantly higher ARABRISK total scores than did women in both the low- and moderate-risk categories (Table 2), signifying that male participants had a higher risk of developing T2D than did females.

The age of participants ranged from 40 to 74 years, with a mean age of 51.94 (SD = 10.33). The study included 65% males ($n = 333$) and 35% females ($n = 180$). The mean BMI score was 27.85 (SD = 7.02), with a low of 17 and a high of 53. The mean waist circumference was 58.93 cm (SD = 22.77). In addition to these characteristics, both the maternal and paternal ethnicity for all participants was Middle Eastern descent (Arab). Only 3% of the women who had given birth to a large baby weighing at least 9 pounds had developed gestational diabetes.

Table 3 details the mean, SD, and 95% CI of the mean ARABRISK total score for the categories of each item. The older participants scored higher in ARABRISK total score

compared with younger age groups. Greater BMI and waist circumference values were associated with a higher ARABRISK total score. Physically active participants and who consumed vegetables or fruits daily had a lower ARABRISK total score. In addition, a history of high blood pressure, high blood sugar, and gestational diabetes resulted in a higher ARABRISK total score compared with no such history. Similarly, a high educational status was associated with a lower ARABRISK total score compared with low educational status. There was no association between number of relatives with T2D and ARABRISK total score. Participants who had direct relatives (mother, father, sibling, child) with T2D were not associated with a higher ARABRISK total score compared to having 1, 2, or 3 of them with T2D.

Table 4 details the best model of regression analysis. The value of R^2 in this model was 0.99 or 99% of the variance in ARABRISK total scores. All of the items on the ARABRISK questionnaire were found to be good predictors of the ARABRISK total scores. Among them, age, body mass index (BMI), and high blood glucose (HBG) were the best predictors, as indicated by the standardized regression coefficients values (β). These predictors were positively associated with the ARABRISK total scores. The shared and unique contributions of the predictors age, BMI, and HBG predictors were 99% (each) and 19.8%, 14.4%, 21.9%, respectively, as indicated by the partial correlations in Table 4. The regression plot of standardized residuals versus standardized predicted values indicates that the points are randomly and evenly dispersed throughout the plot, as shown in Figure 1.

Table 5 details the results of the multivariate logistic regression analyses for the risk factors for the ARABRISK total scores. Older males were significantly associated with increased odds of higher ARABRISK total scores. Being obese and having an elevated weight circumference were significantly associated with increased odds of higher ARABRISK total scores. Additionally, absence of daily physical activity, daily consumption of fruits/vegetables, presence of HBP, and HBG

TABLE 4. Stepwise Multiple Regression Analysis for Risk Factors Predicting ARABRISK Total Scores in Study Participants

Predictors	Stepwise Regression ($R^2 = 0.99$, $F = 38740.2$ on 10 and 502 df, $P < 0.001$)				Correlations	
	B (95% CI)	SE B	β (95% CI)	P	Partial*	Part†
Constant	3.293 (3.11 to 3.47)	0.091		0.001		
Age	1.001 (0.993 to 1.008)	0.004	0.458 (0.28 to 0.63)	0.001	0.996	0.445
BMI	1.007 (0.998 to 1.016)	0.004	0.406 (0.23 to 0.58)	0.001	0.995	0.379
HBG	0.991 (0.984 to 0.998)	0.004	0.503 (0.33 to 0.68)	0.001	0.997	0.469
Waist circumference	1.005 (0.988 to 1.021)	0.009	0.214 (0.04 to 0.39)	0.001	0.982	0.198
Sex	0.976 (0.961 to 0.991)	0.007	0.225 (0.05 to 0.40)	0.001	0.986	0.221
Education	1.028 (1.008 to 1.047)	0.010	0.179 (0.02 to 0.35)	0.001	0.978	0.176
Positive family history of diabetes	0.999 (0.979 to 1.019)	0.010	0.174 (−0.02 to 0.35)	0.001	0.974	0.164
HBP	1.034 (1.012 to 1.056)	0.011	0.161 (−0.02 to 0.34)	0.001	0.971	0.156
Daily consumption of fruits/vegetables	1.099 (1.056 to 1.141)	0.022	0.088 (−0.09 to 0.26)	0.001	0.915	0.086
Daily physical activity ≥ 30 minutes	0.994 (0.606 to 1.382)	0.198	0.039 (−0.33 to −0.41)	0.001	0.219	0.037

β = standardized regression coefficients, B = unstandardized regression coefficients, BMI = body mass index, CI = confidence interval, HBG = high blood glucose, HBP = high blood pressure, SE = standard error.

* Shared contributions of the predictors.

† Unique contributions of the predictors.

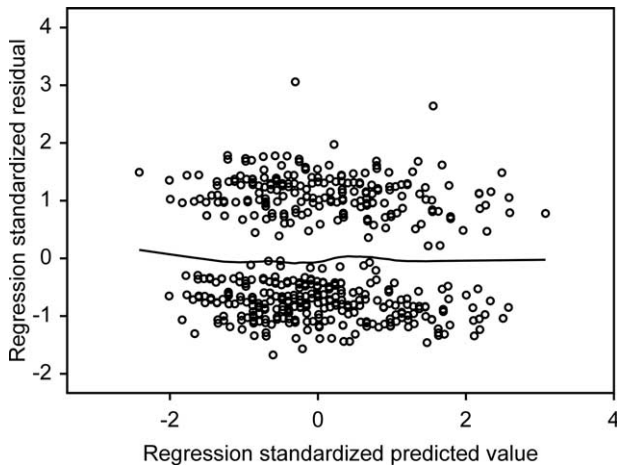


FIGURE 1. Regression plot of standardized residuals vs standardized predicted values (dependent variable, ARABRISK total score).

were significantly associated with increased odds of high ARABRISK total scores. Neither a history of gestational diabetes nor a positive family history was associated with increased odds of high ARABRISK total scores. Positive family history was not associated with increased odds of high ARABRISK total scores. In addition, a high school education or less was associated with increased odds of high ARABRISK total scores.

DISCUSSION

The results of the ARABRISK questionnaire-based survey were helpful in identifying the risk of diabetes in residents of Amman, Jordan. This study investigated the presence of high-risk factors and the degree to which modifiable risk factors affect the present results. Previous studies have reported relationships between various risk factors and the risk of developing T2D. BMI, hypertension, smoking, lipids, physical inactivity, low education, dietary patterns, family history, and specific genes are also reported as risk factors for T2D.³⁸⁻⁴²

In the present study, age and sex were associated with the ARABRISK total scores. Older males were associated with increased odds of high ARABRISK total scores. A previous study reported an association of T2D prevalence with age and sex.⁴³ The prevalence of T2D was 4.2% and 2.7% in men and women, respectively. In the present study, a higher BMI and waist circumference were associated with higher ARABRISK scores. In addition, obesity and waist circumference were significantly associated with increased odds of high ARABRISK total scores. Such an outcome is strongly supported by many longitudinal studies that have reported BMI as a strong risk factor for T2D.^{39,43-45} Similarly, Li et al⁴⁶ reported an association of obesity measures and waist circumference with T2D and abnormal glucose metabolism. In the present study, approximately 37% and 28% of the participants suffered from hypertension and high blood glucose levels, respectively, which were associated with increased odds of high ARABRISK scores. Similarly, studies have reported the progression of hypertension and glucose impairment as an important predictor of T2D.⁴⁶⁻⁴⁹ The study participants were active; approximately two-thirds of the male and more than half of the female participants reported that they were physically active. In the present study, a lack of daily physical activities was associated with increased odds of high

TABLE 5. Multivariate Logistic Regression Analyses for Risk Factors for ARABRISK Total Scores

Factors	Multivariate Logistic regression		
	OR	95% CI	P
Age, y			
40-44	1		
45-54	1.11	1.08-1.14	<0.001
55-64	1.19	1.15-1.24	<0.001
65-74	1.23	1.19-1.28	<0.001
Sex			
Female	1		
Male	1.03	1.01-1.04	<0.001
BMI			
<25	1		
25-29	1.01	0.99-1.03	0.203
30-34	1.09	1.06-1.12	<0.001
≥35	1.18	1.14-1.22	<0.001
Waist circumference			
Male<94/female<80	1		
Male 94-102/female 80-88	1.05	1.02-1.08	<0.001
Male >102/female >88	1.08	1.06-1.11	<0.001
Daily physical activity ≥30 minutes			
Yes	1		
No	1.02	1.01-1.03	0.014
Daily consumption of fruits/vegetables			
Every day	1		
Not every day	1.02	1.01-1.04	0.004
HBP			
No	1		
Yes	1.07	1.05-1.08	<0.001
HGB			
No	1		
Yes	1.12	1.09-1.14	<0.001
History of gestational diabetes			
No, do not know, or not applicable	1		
Yes	1.04	0.97-1.10	0.255
Positive family history of diabetes (mother, father, siblings, children)			
No/do not know	1	0.89-0.98	0.007
One of them	0.94	0.93-1.01	0.111
Two of them	0.97	0.92-0.99	0.025
Three of them	0.96	0.94-1.01	0.136
All of them	0.97		
Education			
College or university degree	1		
Some high school or less	1.06	1.04-1.08	<0.001
High school diploma	0.99	0.98-1.02	0.894

CI = confidence interval, BMI = body mass index, HGB = high blood glucose, HBP = high blood pressure, OR = odds ratio.

ARABRISK total scores. Additionally, approximately half of the women and men participants reported eating vegetables or fruits; eating fruits and vegetables was associated with increased odds of high ARABRISK scores. However, ARABRISK does not consider the type or frequency of physical activity or types of vegetables and fruits. Previous studies have reported a strong association between physical inactivity and the risk of developing

T2D.^{45,50–53} In addition, prolonged television watching, which is a sedentary lifestyle marker, was strongly associated with the risk of developing diabetes in both men and women.^{54–56} Moderate and heavy physical activity were associated with a low risk of developing T2D.^{50,57} With regard to fruits and vegetables, an important life style factor associated with the development of T2D is dietary habits. Food intake pattern is associated with the risk of developing T2D.^{58–60} In contrast, another study reported no association between the consumption of fruits and vegetables and T2D.⁴³

In the present study, more than two-thirds of the participants had a direct relative who was diagnosed with diabetes. Such results would help in knowing the role of this factor in increasing their risk in developing diabetes because previous studies have reported that genetic factors play a vital role in the pathogenesis of T2D.^{61–63} A positive family history among first-degree relatives was associated with an increased risk of T2D; the risk was greater if both parents are affected.^{61–65} Moreover, diabetes prevalence varies considerably among different ethnic groups.⁶⁶ Nonetheless, there was no difference in ethnicity among Amman population because our participants were all Arabs.

CONCLUSIONS

The present study demonstrates a high risk of developing T2D in the Jordanian population. Participants with higher scores in all risk factors for developing T2D including age, BMI, waist circumference, high blood pressure, high blood glucose, and gestational diabetes, had higher ARABRISK total scores. Participants with higher scores in protective factors from developing T2D including regular physical activity and daily vegetable or fruit consumption had lower ARABRISK total scores.

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