Sultan Qaboos University Med J, August 2015, Vol. 15, Iss. 3, pp. e398–404, Epub. 24 Aug 15. doi: 10.18295/squmj.2015.15.03.015.
Submitted 24 Sept 14
Revisions Req. 24 Nov 14 & 16 Feb 15; Revisions Recd. 11 Jan 15 & 4 Mar 15
Accepted 15 Mar 15

Health Beliefs Related to Diabetes Mellitus Prevention among Adolescents in Saudi Arabia

Reem L. Al-Mutairi,[1] *Amen A. Bawazir,[2] Anwar E. Ahmed,[3] Hoda Jradi[2]

المعتقدات الصحية للمراهقين في المملكة العربية السعودية تجاه الوقاية من النوع الثاني لداء السكري

ريم المطيري، أمين باوزير، أنور أحمد، هدى الجرادي

ABSTRACT: ***Objectives:*** The incidence of type 2 diabetes mellitus (T2DM) is growing rapidly in the Saudi population. The purpose of this study was to assess the constructs of the health belief model (HBM) as they relate to T2DM lifestyle and prevention behaviours among adolescents. ***Methods:*** A cross-sectional study was conducted between May and October 2013 among 426 non-diabetic secondary school students from randomly selected schools in Riyadh, Saudi Arabia. An Arabic version of an adapted English language questionnaire was used to assess knowledge and attitudes related to the severity and prevention of T2DM. A preventative behaviour assessment was also conducted to assess physical activity and dietary habits. ***Results:*** The majority of the students (63.4%) had at least one diabetic family member. Obesity was more frequent in males compared to females (P = 0.013). Awareness about the importance of maintaining a healthy body weight to prevent T2DM was lower in males than females (P = 0.037), although males engaged in routine exercise more often (P = 0.001). Males were less likely than females to recognise the risks for T2DM, including obesity (P = 0.030), heredity (P = 0.013) and high fat intake (P = 0.001). ***Conclusion:*** An alarmingly high number of Saudi students were unaware of T2DM severity and associated risk factors. Female students were more aware of the benefits of T2DM preventative lifestyle behaviours than males, although males engaged in routine exercise more often. Raising adolescents' awareness about the primary prevention strategies for T2DM should be a public health priority in Saudi Arabia. The HBM could inform further research on diabetes prevention among Saudi adolescents.

Keywords: Adolescents; Diabetes Mellitus; Knowledge; Lifestyle Risk Reduction; Saudi Arabia.

الملخص: الهدف: إن معدل الإصابة بالنوع الثاني من داء السكري (T2DM) في تزايد مضطرد بين أفراد المجتمع السعودي تهدف هذه الدراسة إلى قياس المعتقدات الصحية اتجاه تبنى نمط حياتي صحي وسلوك وقائي للنوع الثاني من داء السكري بين المراهقين في المملكة العربية السعودية باستخدام نموذج المعتقدات الصحية (HBM). كما تهدف الدراسة إلى قياس التباين بين الجنسين في المعلومات والمعتقدات الصحية للنوع الثاني من السكري. **الطريقة:** أجريت دراسة مستعرضة بين شهري مايو إلى أكتوبر 2013 شملت 426 طالبا غير مصابين بداء السكري من مدارس ثانوية تم اختيارها عشوائيا في مدينة الرياض بالمملكة العربية السعودية. تم استخدام استبيان باللغة العربية والمقتبس من النسخة الإنجليزية حيث تم استخدامها لتقييم المعارف والمواقف ذات الصلة بالوقاية من النمط الثاني من داء السكري. كما شمل الاستبيان بعض الجوانب الخاصة بتقييم سلوك الفرد الوقائي من خلال تقييم النشاط البدني والعادات الغذائية. **النتائج:** أظهرت الدراسة أن 63.4% من الطلاب لهم علاقة بمصاب واحد بالسكري على الأقل من أفراد العائلة. وكانت السمنة أكثر تواترا عند الذكور مقارنة بالإناث (P = 0.013). كما أن الوعي حول أهمية الحفاظ على وزن صحي للجسم للوقاية من النوع الثاني من داء السكري أقل في الذكور عنه من الإناث (P = 0.037)، برغم قيامهم بممارسة الرياضة بشكل روتيني أكثر من الإناث (P = 0.001). كما أن الذكور أقل إدراكا من الإناث إلى التعرف على المخاطر التي تنجم عن النوع الثاني من داء السكري، بما في ذلك السمنة (P = 0.030)، والوراثة (P = 0.013) وارتفاع نسبة تناول الدهون (P = 0.001). **الخلاصة:** أن عددا كبيرا من الطلاب السعوديين يجهل المعلومات الأساسية حول النوع الثاني من داء السكري وعوامل الخطر المرتبطة به بينما أظهرت الطالبات أنهن أكثر وعيا بذلك وعلى اطلاع بالسلوكيات الفعالة في نمط الحياة الصحية وكيفية الوقائية منه.وعليه فإن توعية المراهقين حول استراتيجيات الوقاية الأولية من النوع الثاني من داء السكري يجب أن تكون من أولويات الصحة العامة في المملكة العربية السعودية بالإضافة إلى أهمية إجراء دراسات أعمق بين المراهقين السعوديين في اتجاه الوقاية من مرض السكري.

مفتاح الكلمات: المراهقين؛ داء السكري؛ المعرفة؛ الحد من مخاطر نمط الحياة؛ المملكة العربية السعودية.

Advances in Knowledge

- *The study demonstrated the effectiveness of using the health belief model in assessing knowledge and attitudes of diabetes among a sample of Saudi adolescents.*
- *Results of the study showed that a high percentage of Saudi adolescents were unaware of the severity of type 2 diabetes mellitus (T2DM) and its associated risk factors.*

Department of [1]Public Health, College of Public Health & Informatics, University of Hail, Hail, Saudi Arabia; Departments of [2]Community & Environmental Health and [3]Epidemiology & Biostatistics, College of Public Health & Health Informatics, King Saud bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia

**Corresponding Author e-mail: bawazir56@hotmail.com*

Application to Patient Care

- *Adolescents should be able to recognise the risk factors for developing T2DM so as to ensure preventative measures and lifestyle modifications can be implemented before the disease progresses. This may aid in reducing the future burden of diabetes on the healthcare system.*
- *The results of this study may help tailor diabetes prevention and education programmes targeting Saudi adolescents.*

Type 2 diabetes mellitus (T2DM) is fast becoming a global epidemic and the number of individuals with diabetes in the world is expected to reach 330 million by 2030, with the majority residing in developing countries.[1,2] The rate of T2DM is rapidly increasing in developing countries, particularly among younger age groups.[1] In some countries in the Middle East, T2DM contributes to one in four deaths of adults between 35–64 years old.[2] Although it is a debilitating and life-threatening disease with severe complications, T2DM can be prevented with lifestyle modifications.[3]

Saudi Arabia is a developing country with a young population (53% ≤24 years old).[4] Saudi adolescents are at a high risk of developing diabetes as many suffer from obesity, a sedentary lifestyle and hereditary diabetes.[5] In 2004, almost a quarter (23.7%) of the Saudi population was diagnosed with T2DM; this was 10 times the number of diabetic individuals in 1980.[6] The occurrence of T2DM has been linked to the high rate of overweight adults (35.5%) in the Saudi population and the number of overweight and obese Saudi adolescents is high among both genders.[7,8] A study of both obese and non-obese Saudi women found that 75% did not exercise or did so infrequently.[9] In Saudi Arabia, diabetic patients suffer from neuropathy (56%), neuroarthropathy requiring amputation (0.7%) or nephropathy requiring dialysis (30.4%).[10–12]

Low levels of awareness of T2DM and its risk factors have been reported in Saudi adults, with awareness varying significantly according to education level.[13] The same study found that a low percentage of the Saudi population believed that obesity (35.8%) and a lack of physical activity (32.3%) were risk factors for T2DM.[13] Mohieldein *et al*. found that almost 68.7% of the non-diabetic population in Saudi Arabia believed that T2DM was a curable disease.[14] A cross-sectional study indicated that Saudi adolescents exhibited more health-related knowledge than the older population; the majority of the adolescents believed that obesity was dangerous and that regular exercise was beneficial for their health.[15] Nevertheless, sedentary lifestyles and high obesity rates among Saudi youth are still reported, placing them at a high risk of developing T2DM and raising the need for theoretically-grounded interventions targeting this segment of the population.[7,16,17]

Rather than a call for public health education programmes concerning T2DM risk factors, the above findings could be interpreted as a need among healthcare workers for knowledge of the psychosocial factors that affect engagement in preventative behaviours and avoidance of harmful actions. The health belief model (HBM) provides systematically defined variables that can be used to measure the impact of various psychosocial constructs upon a person's willingness to engage in and maintain health-related behaviours.[18] The model hypothesises that individuals will generally not seek preventative care or health screening unless they possess minimal levels of health-related motivation and knowledge; view themselves as potentially vulnerable and threatened by the condition; are convinced of the efficacy of intervention; and see few difficulties in undertaking the recommended actions.[18,19]

The use of the HBM has been established as a reliable research tool in preventative health behaviours, sick-role behaviours and clinical utilisation.[19] Several studies have assessed the effectiveness and application of the HBM in diabetes care, patient compliance with treatment plans and in designing prevention programmes.[20,21] The model enhances the understanding of outcomes after the implementation of a prevention programme, predicts health-related behaviours and is recommended as a part of any health education programme.[19] However, this is the first study using this model to investigate T2DM knowledge and beliefs among adolescents in Saudi Arabia. The current study aims to determine the level of knowledge of T2DM and the health beliefs influencing healthy lifestyle behaviours associated with T2DM prevention among Saudi adolescents living in Riyadh, Saudi Arabia.

Methods

This cross-sectional study was carried out in randomly selected public and private secondary schools in Riyadh between May and October 2013. A total of 426 male and female adolescents from four secondary schools (a male-only private school, male-only public school, female-only public school and female-only private school) participated in the study. These schools were randomly selected from a list of schools

in Riyadh. Each secondary school had three class levels (levels 1–3). One classroom was randomly selected from each level in each school to cover the calculated sample size. All students present in the selected classrooms during the data collection period were asked to participate in the study.

Data collection included demographics such as age, gender, grade and current health status (i.e. presence of other chronic diseases). Knowledge of and attitudes towards T2DM prevention behaviours and healthy lifestyle behaviours were assessed using an adapted version of Whitford *et al*.'s HBM-based questionnaire.[22] Questions were adapted to take into account cultural and social variations in Saudi Arabia. The first part of the survey assessed knowledge of T2DM in four categories (nature, risk factors, complications and prevention methods) using 15 questionnaire items, each with three possible responses: "true," "false" or "unsure". The second part of the questionnaire aimed to determine cognitive factors from the HBM in five categories. The first category covered perceived susceptibility to T2DM while the second covered severity of T2DM in comparison with other chronic and acute diseases. In this section, participants were asked to rank the severity of various diseases or conditions (T2DM, hypertension, acquired immune deficiency syndrome, cancer, influenza and asthma) on a 5-point scale using a score of 1 (not serious) to 5 (critically serious). The third and fourth sections, respectively, were dedicated to assessing the perceived benefits of and barriers to healthy lifestyle behaviours. For the analysis of the cognitive factors related to susceptibility to the development of diabetes and benefits of and barriers to adopting a healthy lifestyle, only correct responses were considered in the analysis.

A quantitative measure was also included in the survey instrument to assess T2DM prevention behaviours (regular physical activity and healthy dietary habits), to indicate whether participants were making a conscious effort to modify their lifestyle habits. For instance, in the first category, students were asked whether or not they exercised regularly and to identify the type and duration of sports or exercises usually performed. With regards to their dietary habits, students were asked if they were in the habit of having infrequent meals, skipping breakfast or consuming a large quantity of sugary or sweetened beverages.

Data were entered and analysed using the Statistical Package for the Social Sciences (SPSS), Version 20.0 (IBM Corp., Chicago, Illinois, USA). Demographic characteristics in relation to gender were examined using either the Chi-squared test or t-test as appropriate. Students' knowledge of T2DM by gender was examined using the Chi-squared test. Attitudes and perceptions regarding T2DM susceptibility, disease severity and the advantages/drawbacks of lifestyle choices in relation to gender were also examined using the Chi-squared test. Percentages were used to determine the frequency distribution of T2DM and other chronic and non-chronic diseases by perceived severity. The level of significance for all analyses was set at $\alpha < 0.05$.

Ethical approval for this study was obtained from the Institutional Review Board at King Saud Bin Abdul-Aziz University for Health Sciences and King Abdullah International Medical Research Center (#IRBC/070/13). Verbal consent was received from all participants before inclusion in the study.

Results

A total of 426 students participated in the study, including 224 (52.6%) from public and 202 (47.4%) from private schools. There were 205 females (48.1%) and 221 males (51.9%). Of the total sample, 6.8% were smokers while 41.1% were from families with at least one smoker. The mean age of the students was 17.0 ± 1.0 years old (range: 15–22 years old) and mean weight was 64.5 ± 20.4 kg. None of the participants had T2DM; however, 63.4% had at least one family member with diabetes, while 10% had another type of chronic disease, including asthma, heart disease, gastrointestinal diseases, sickle cell anaemia and epilepsy. Among the students, 68.1% reported that they exercised regularly.

The demographic characteristics of the sample are shown in Table 1. The number of participants with Saudi nationality was higher for females than males (92.7% versus 81.9%; $P = 0.001$). Obesity (23.7% versus 10.7%; $P = 0.013$) and smoking (10.4% versus 2.9%; $P = 0.002$) was more common among males than females. A family history of T2DM was higher among females than males (68.8% versus 58.4%; $P = 0.026$). More male students engaged in routine exercise or physical activity compared to the female students (77.4% versus 58.0%; $P = 0.001$). Males also tended to weigh more than females (72.3 ± 23.1 kg versus 57.0 ± 14.0 kg; $P = 0.001$). The average age was similar for both genders (16.9 ± 0.9 years old in the female group versus 17.1 ± 1 years old in the male group; $P = 0.086$). No significant relationships were observed between gender and grade level, school sector or a family history of smoking.

Table 2 presents the associations between gender and knowledge of T2DM among the students. In response to the questionnaire item, 93.2% of females and 80.1% of males incorrectly stated that T2DM was an infectious disease ($P = 0.001$). Awareness of high sugar intake, genetic factors, obesity and physical inactivity as risk factors for T2DM was high (88.3%,

Table 1: Demographic characteristics by gender among surveyed adolescents in Saudi Arabia (N = 426)

Characteristic	n (%)			*P* value
	Total	Female (n = 205)	Male (n = 221)	
Nationality				
Saudi	371 (87.1)	190 (92.7)	181 (81.9)	0.001*
Non-Saudi	55 (12.9)	15 (7.3)	40 (18.1)	
Mean age in years ± SD	17.0 ± 1.0	16.9 ± 0.9	17.1 ± 1.0	0.086
Grade level				
1	143 (33.6)	64 (31.2)	79 (35.7)	0.585
2	125 (29.3)	61 (29.8)	64 (29.0)	
3	158 (37.1)	80 (39.0)	78 (35.3)	
School sector				
Public	224 (52.6)	103 (50.2)	121 (54.8)	0.352
Private	202 (47.4)	102 (49.8)	100 (45.2)	
Chronic disease				
No	383 (89.9)	187 (91.2)	196 (88.7)	0.386
Yes	43 (10.1)	18 (8.8)	25 (11.3)	
BMI category				
Underweight	41 (16.7)	23 (17.6)	18 (15.8)	0.013*
Normal	123 (50.2)	76 (58.0)	47 (41.2)	
Overweight	40(16.3)	18 (13.7)	22 (19.3)	
Obese	41 (16.7)	14 (10.7)	27 (23.7)	
Family history of diabetes				
No	156 (36.6)	64 (31.2)	92 (41.6)	0.026*
Yes	270 (63.4)	141 (68.8)	129 (58.4)	
Smoker				
No	397 (93.2)	199 (97.1)	198 (89.6)	0.002*
Yes	29 (6.8)	6 (2.9)	23 (10.4)	
Family history of smoking				
No	251 (58.9)	124 (60.5)	127 (57.5)	0.526
Yes	175 (41.1)	81 (39.5)	94 (42.5)	
Regular physical exercise				
No	136 (31.9)	86 (42.0)	50 (22.6)	0.001*
Yes	290 (68.1)	119 (58.0)	171 (77.4)	
Mean weight in kg ± SD	64.5 ± 20.4	57.0 ± 14.0	72.3 ± 23.1	0.001†

SD = standard deviation; BMI = body mass index.

**Chi-squared test significance was set at α <0.05. †Independent t-test significance was set at α <0.05.*

83.1%, 82.2% and 68.1%, respectively). Obesity (86.3% versus 78.3%; *P* = 0.030), genetic factors (87.8% versus 78.7%; *P* = 0.013) and high fat intake (52.7% versus

Table 2: Levels of accurate* awareness and knowledge of diabetes by gender among surveyed adolescents in Saudi Arabia (N = 426)

Item	n (%)			*P* value
	Total	Female (n = 205)	Male (n = 221)	
Disease type				
Infectious	368 (86.4)	191 (93.2)	177 (80.1)	0.001†
Chronic	266 (62.6)	131 (63.9)	135 (61.4)	0.589
Curable	138 (32.4)	71 (34.6)	67 (30.3)	0.341
Risk factors				
Obesity	350 (82.2)	177 (86.3)	173 (78.3)	0.030†
Heredity	354 (83.1)	180 (87.8)	174 (78.7)	0.013†
Smoker	80 (18.8)	39 (19.0)	41 (18.6)	0.901
Physical inactivity	290 (68.1)	130 (63.4)	160 (72.4)	0.047†
High sugar intake	376 (88.3)	183 (89.3)	193 (87.3)	0.535
High fat intake	188 (44.1)	108 (52.7)	80 (36.2)	0.001†
Complications				
Blindness	154 (36.2)	96 (46.8)	58 (26.2)	0.001†
Kidney failure	107 (25.1)	66 (32.2)	41 (18.6)	0.001†
Prevention methods				
Healthy diet	384 (90.1)	188 (91.7)	196 (88.7)	0.296
Regular physical activity	380 (89.2)	184 (89.8)	196 (88.7)	0.723
Control of body weight	344 (80.8)	174 (84.9)	170 (76.9)	0.037†
Cessation of smoking	143 (33.6)	74 (36.1)	69 (31.2)	0.287

**Using correct responses only. †Chi-squared test significance was set at α <0.05.*

36.2%; *P* = 0.001) were more frequently recognised as risk factors for T2DM by female students than male students. Inversely, males were more aware that physical inactivity was a risk factor of T2DM in comparison to females (72.4% versus 63.4%; *P* = 0.047). Only 36.2% and 25.1% of students, respectively, were aware that blindness and renal failure were complications of T2DM. For the latter, awareness of the relationship between renal failure and T2DM was higher among females than males (32.2% versus 18.6%; *P* = 0.001). Awareness of eye complications caused by T2DM was also higher among females than

Table 3: Gender differences in accurate* perceptions of diabetes susceptibility and healthy lifestyle habits among surveyed adolescents in Saudi Arabia (N = 426)

Item	n (%)			*P* value
	Total	Female (n = 205)	Male (n = 221)	
DM susceptibility				
In 10–15 years	89 (21.0)	55 (26.8)	34 (15.5)	0.008†
In 20–30 years	129 (30.4)	67 (32.7)	62 (28.3)	0.572
In the future	115 (27.1)	67 (32.7)	48 (21.9)	0.017†
Disease severity‡				
AIDS	415 (97.5)	204 (99.5)	211 (95.5)	0.010†
HTN	141 (33.1)	74 (36.1)	67 (30.3)	0.131
T2DM	123 (28.9)	49 (23.9)	74 (33.5)	0.084
Cancer	410 (96.2)	199 (97.1)	211 (95.5)	0.201
Influenza	15 (3.5)	8 (3.9)	7 (3.2)	0.200
Asthma	44 (10.3)	14 (6.8)	30 (13.6)	0.048†
Advantage of healthy habits				
Prevent diabetes in the future	389 (91.5)	193 (94.1)	196 (89.1)	0.116
Prevent other chronic diseases	369 (86.8)	183 (89.3)	186 (84.5)	0.288
Increase physical fitness	378 (88.9)	185 (90.2)	193 (87.7)	0.601
Help maintain a normal body weight	359 (84.5)	182 (88.8)	177 (80.5)	0.047†
Barriers to a healthy lifestyle				
Lack of time to exercise	197 (46.5)	110 (53.7)	87 (39.7)	0.009†
Unappetising taste of low-calorie foods	196 (46.2)	95 (46.3)	101 (46.1)	0.991
Difficulty finding low-calorie foods	148 (34.9)	61 (29.8)	87 (39.7)	0.083
Hot weather impedes exercise	181 (42.7)	95 (46.3)	86 (39.3)	0.005†
Ability to maintain healthy habits				
Avoid smoking	400 (94.3)	197 (96.1)	203 (92.7)	0.130
Eat low-fat meals	221 (52.1)	102 (49.8)	119 (54.3)	0.345
Exercise regularly	210 (49.5)	86 (42.0)	124 (56.6)	0.003†
Eat low-sugar snacks	244 (57.5)	116 (56.6)	128 (58.4)	0.698

DM = diabetes mellitus; AIDS = acquired immune deficiency syndrome; HTN = hypertension; T2DM = type 2 diabetes mellitus.

**Using correct responses only. †Chi-squared test significance was set at α <0.05. ‡Percentage of students indicating a disease severity score of 4 (extremely serious) or 5 (critically serious).*

males (46.8% versus 26.2%; *P* = 0.001). A significantly higher percentage of females reported that controlling body weight could prevent T2DM (84.9% versus 76.9%; *P* = 0.037).

Table 3 displays the associations between gender and attitudes towards T2DM susceptibility and healthy lifestyle habits. Perceived susceptibility to developing T2DM within the next 10–15 years (26.8% versus 15.5%; *P* = 0.008), or at any time in the future (32.7% versus 21.9%; *P* = 0.017) was significantly higher among females than males. The perception of T2DM as a serious disease was similar between males and females (33.5% versus 23.9%; *P* = 0.084). The belief that healthy habits were advantageous in maintaining a normal body weight was more common among females than males (88.8% versus 80.5%, *P* = 0.047). Almost half of the students identified lack of time and hot weather as barriers to engaging in physical activity (46.5% and 42.7%, respectively), although 49.5% were confident that they could nevertheless maintain a routine of regular exercise. Females were more inclined than males to view lack of time (53.7% versus 39.7%; *P* = 0.009) and hot weather (46.3% versus 39.3%; *P* = 0.005) as barriers to physical activity, whereas males were more confident that they would be able to maintain an exercise regimen (56.6% versus 42%; *P* = 0.003).

The frequency distribution of selected diseases by perceived severity is presented in Table 4. Of the participants, 28.9% perceived T2DM as being either extremely or critically serious and more than half (56.3%) perceived it to be moderately serious. However, 14.8% believed that T2DM was either minimally serious or not serious at all.

Discussion

This study aimed to characterise the knowledge, preventative behaviours and health beliefs regarding T2DM among a sample of secondary school students in Saudi Arabia. The perceived threat of developing T2DM in the future was low among the study sample. Less than a quarter of the students believed that they might develop T2DM within the next 10–15 years. Despite the fact that a high proportion of the participants reported a first-degree relative with diabetes, many did not perceive themselves as

Table 4: Frequency distribution of selected diseases by perceived severity* among surveyed adolescents in Saudi Arabia (N = 426)

Disease	Severity ranking, %				
	1	2	3	4	5
T2DM	3.5	11.3	56.3	17.6	11.3
HTN	0.4	8.7	54.2	17.8	15.3
AIDS	0.2	0	2.3	3.8	93.7
Cancer	0.5	0.2	3.1	12.4	83.8
Influenza	48.4	30	18.1	1.6	1.9
Asthma	14.8	32.9	42	7.7	2.6

T2DM = type 2 diabetes mellitus; HTN = hypertension; AIDS = acquired immune deficiency syndrome.

**Severity was ranked as follows: 1 = not serious, 2 = minimally serious, 3 = moderately serious, 4 = extremely serious and 5 = critically serious.*

susceptible to developing the disease at any point in the future. This could be due to the low level of knowledge related to T2DM and its complications among this group of adolescents. In contrast, Whitford *et al*. reported that people with a family history of T2DM had a high awareness level of their susceptibility to the same disease.[22] Alarmingly, results from the National Health & Nutrition Examination Survey in the USA have indicated that individuals with one or two first-degree relatives with T2DM are 2–5 times more susceptible to developing T2DM than those with none.[23]

Approximately one-third of the students in the present study described T2DM as a serious disease compared to other chronic and acute diseases, while another third falsely believed that T2DM was a simple curable disease. Similarly, in a study conducted among 2,007 non-diabetic adult subjects in Al-Qaseem, Saudi Arabia, two-thirds (67%) of the participants believed that T2DM was curable.[14] Such findings in both studies are most likely due to poor knowledge of T2DM risk factors or methods of T2DM prevention. A study conducted among high school students in Mexico showed an association between gender and T2DM knowledge, with female students demonstrating higher levels of knowledge than males.[24]

In the current research, a greater number of female students perceived the benefits of adopting a healthy lifestyle. This indicates that the majority of females believed that prevention behaviours were key to preventing T2DM. Gender differences could be driven by higher levels of awareness among females, especially with regards to obesity and maintaining a normal body weight, as reported by Memish *et al*.[25] According to the current study's findings, females were less likely than males to be obese. However, they were also more likely to perceive barriers to engaging in T2DM prevention behaviours. Almost half of the participants identified hot weather and lack of time as restrictions to exercise. Female students were significantly more affected than male students by these two barriers.

Walking is a cost-effective physical activity that can improve health; however, findings from another study conducted in Saudi Arabia indicated that participants did not regard walking as exercise—the Saudi population was noted to associate physical activity, and its associated health benefits, exclusively with sports and activities conducted in fitness clubs.[26] Additional factors that have been described as barriers to routine exercise include time limitations and a reliance on cars for transportation.[27,28] Previous studies have also reported lack of time as a barrier to exercise.[22,29,30] One such study reported that 80% of college students in Dammam, Saudi Arabia, felt that lack of time restricted their ability to partake in physical activity.[29] In another study, conducted among people with a family history of T2DM, half of the subjects identified lack of time as a challenge to exercising.[22] However, Al-Hazzaa *et al*. determined via logistic regression analysis that Saudi adolescents had an increased chance of being overweight or obese if they did not engage in sufficient amounts of vigorous physical activity.[30]

The use of the HBM as a theoretical framework is controversial. Some meta-analyses indicate that the theory of reasoned action is a substantially more effective predictor of health behaviours than the HBM as a value-expectancy theory-based model.[31] However, relationships between the four fundamental dimensions of the HBM (perceived susceptibility and severity of a disease and perceived barriers and benefits of the preventative action) indicate that the model is a useful theoretical framework in describing attitudes toward diabetes prevention behaviours. The authors of the current study remain convinced of the value of this model in providing a relatively comprehensive understanding of the influence of social, economic and environmental factors on health behaviours, in addition to cognitive factors, in evaluating knowledge and behaviours among this group of students. Therefore, a further nationwide study based on this framework is recommended to help develop more effective T2DM prevention interventions among adolescents in Saudi Arabia.

This study should be interpreted within the context of its limitations. First, the use of a unique sample from Riyadh may limit the generalisability of the findings to other regions in Saudi Arabia. In addition, this study was conducted among a sample of secondary school students who may have limited knowledge of the benefits of some health interventions.

Conclusion

Although almost two-thirds of the students had at least one family member with diabetes, the current study revealed poor recognition of T2DM risk factors and the importance of adopting a healthy lifestyle among this Saudi Arabian population. Furthermore, many students were unaware of the severity of this chronic disease. Female students perceived the benefits of effective lifestyle behaviours more frequently than male students, although the latter reported engaging in physical activity more often. Raising awareness of T2DM and its primary prevention strategies should be a priority in the Saudi Arabian public health agenda. The use of the HBM, as in this study, could form the framework for further research on diabetes prevention among Saudi adolescents.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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