

Diabetes awareness and dietary habits of non-diabetic females in private universities in Jeddah city, Saudi Arabia

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Abstract. *Objective:* The study aims to investigate the level of awareness among non-diabetes female students towards the diabetes disease and its association with dietary habit. *Research Methods and Procedures:* A total of 141 female students with high socioeconomic status has been recruited from private universities in the city of Jeddah. The knowledge level of selected participants has been assessed by answering short test about diabetes information. Dietary habit and related anthropometric measurements were examined. *Results:* Non-diabetic students majoring in non-medical field had good background of diabetic disease (average test score was 11.4 out of 15) specially in the disease symptoms and some of the protective factors. However, they are weak in the pathological details of the disease. Majority of the students (77.3%) understood the protective factors of eating fruit and vegetables; however, they are far away from the recommendation intake and were not significantly associated with DM awareness score. Moreover, majority of participants reported a limited consumption of fried or fat-foods and sugary drinks, ranging between never to a few times per week (73.4% and 68.8%, respectively). The mean knowledge regarding Diabetes Mellitus (DM) at the different frequencies of sugary drink intakes was significantly different ($F=2.97$; $p\text{-value}=0.014$). Scheffe test revealed no statistically significant difference between the groups, where all the significant levels were greater than 0.05. *Conclusions:* Medical and healthy educational sessions such as the pathology of the diabetes disease, healthy eating habit seminars, and workshops are recommended to increase non-medical field student's awareness.

Keywords: Diabetes Awareness, Obesity, Dietary Intake, Body Mass Index (BMI), Diabetes Mellitus

Introduction

Diabetes mellitus (DM) is a major health problem in Saudi Arabia (SA) causing medical complications that require more attention (1-2). According to the World Health Organization incidence rate of diabetes, SA is one of the highest diabetic countries in the Middle East; the rate of diabetes in the SA has dramatically increased throughout the years and is associated with morbidity and mortality (3). National statistics reported by the SA Ministry of

Health (MOH) revealed prevalence of DM among 7.8% of the Saudi population aged between 25-34 years and a higher alarming proportion (50.4%) was reported among individuals of 65 years and older individuals (4). This strengthens the importance to control the issue from a younger age as it is also a lifestyle habit dependent. A SA review study explains the alarming dramatic increase in prevalence of diabetes due to the occurrence of obesity especially among females where it reaches 75% of females living in SA (5).

Young people are more likely to have diabetes due to their high popularity of sedentary habits, increased consumption of carbonated sugar beverages, and eating fast food more frequently during the week (6). A recent study in SA revealed that young females are at higher risk of having diabetes than males because they are less likely to be involved in routine exercise, more likely to be obese, higher heredity, and more likely to consume high fat food (7). Since fruits and vegetables intake has been inversely associated with diabetes rate (8), local studies reveal that the majority of female students don't consume the recommended amount of fruit & vegetables where 78% consume <5 servings of fruit & vegetables per day compared to USDA recommendations (9). All the above factors put young females at high risk in addition to their chance to have gestational diabetes during pregnancy. Bellamy et. al., indicated that gestational diabetes increases the risk to have type II diabetes later in life, suggesting that it is important to increase a female's awareness and intervention (10).

It is known from literature that personal knowledge and awareness of the disease may help prevent or delay its incidence (11). A Kuwaiti study investigated the prevalence of prediabetes among college students indicating that high knowledge level of the disease may help to prevent onset of this disease; however high prevalence of the disease was seen among female students who have low knowledge level about the disease, its risk factors, and complications (12). Moreover, High levels of diabetes's knowledge increases the engagement of physical activity and weight management among the US population (13). According to Pelullo et., al., 2019 knowledge of diabetes increased with the level of education where individuals with college degrees or higher have superior knowledge than middle school or lower (14).

Although knowledge of diabetes is important to prevent the disease, only limited studies have tested the awareness of diabetes especially among young populations. A study tested the level of awareness among college students and stated that only 50% were aware that DM2 could be prevented and 60% were unaware that little or no exercise was a risk factor (15). A cross-sectional study in China assessed the level of knowledge related to type 2 diabetes (T2DM) among Chinese college students and explored related factors

influencing their knowledge. The results showed that college students have very limited knowledge about diabetes and suggest additional education among non-medical students and students with poor academic performance (16). Another similar study concluded that groups that underestimated diabetes were more likely to reduce the likelihood of preventing themselves from taking action to diminishing the threat (17).

This study aims to investigate the level of knowledge regarding DM among the community of Jeddah, since the knowledge among young female adults was not evidently reported. Given that a large proportion of the females in the country are obese and adopting unhealthy lifestyle, assessment and interventions targeting females of young age is necessary to delay/prevent DM. Additionally, this study is the first to target females from middle to high income levels. It is expected that a low level of awareness of diabetes disease among female college students in Saudi Arabia that are not majoring in the health field. Therefore, the significance of this study is witnessed from the assessment of healthy behaviour and awareness level of female population in Saudi culture. This study is also important for identifying the awareness level of Saudi College students as it has targeted local private colleges that belong to the high socioeconomic class. The study results are likely to provide specific information about this group in regard to knowledge and awareness level about diabetes. The objectives of this study are to assess the DM awareness level among non-diabetic female students in private universities in the city of Jeddah SA and to examine the association between the level of awareness about T2DM with the frequency consumption of fruit & vegetables, fast food, and soft drink. This study also aims to explain the dietary habits of the weight status of non-diabetic female students.

Material and Methods

Sample

The study has recruited 141 females from two private universities in Jeddah, Saudi Arabia during the year 2017-2018. Only female university students (>18 years) were included. Females reporting pregnancy at

the time of assessment or a history of diabetes mellitus type-1 or type-2 were excluded. Accordingly, data of 13 participants were excluded from the dataset; and the final sample was based on the data of 128 participants for analysis.

The university students were invited to participate in the study during a community service event in the midst of the International diabetes week. Two local private universities were targeted to provide community service during healthy social events. During the health event, students who passed the service's stand received some diabetes educational information and were invited to be involved in some activities. Students were asked to participate in the study and a consent form was signed by them to use their feedback to conduct the analysis. Few health assessments were conducted to help in recognizing the health status of the students. Titan weight scales were being used with removing the shoes and any additional clothing like Abaya or head cover for adequate measurements; Seca 213 portable height measurers have also been used to find the participants height. For calculating Body Mass Index BMI, this study uses the standard formula $BMI = \text{kg}/\text{m}^2$. This manuscript follows the Strengthening Reporting of Observational Studies in Epidemiology (STROBE) recommendation (18).

Data Instruments

Two questionnaires have been used in this study to gather information from the students. A Diabetes Awareness Test was used to assess student's level of knowledge regarding DM (one of the activities that have been used in the event). Majority of the questions were adapted from a previous study (19); while, some of the questions were designed by the study's investigator. The test consists of 15 questions and each was worth one point. The total marks which was 15 points were added to find out the participant's knowledge level of diabetes; however, this activity was used to discuss the diabetes information with students among the community. Secondly, a short survey based on four questions about frequency of dietary intake; consumption of fruit, vegetables, soda, and deep-fried food was used. The scale included 6 categories ranging from never to 3 times per day and more.

Statistical Analysis

A Statistical Package for Social Sciences (SPSS) version 24.0 was used for data analysis. Descriptive statistics were utilized to evaluate participants' responses on diabetes related questions. One-way Analysis of Variance (ANOVA) was used to examine the association of frequency of dietary intakes and mean scores of DM awareness. Fisher's exact test was used to examine the association between the overweight/obesity status and frequency of dietary intakes. A probability value of less than 0.05 was considered statistically significant for both the analysis.

Ethical Consideration

Ethical clearance was obtained from the Unit of Biomedical Ethics at King Abdulaziz University (Reference No. 494-17); and confidentiality was maintained as data remained anonymous for all participants.

Results

Total of 128 female students took part in the study. The average weight for participants is 58.21 kg (11.67 SD) ranges between 38-115 kg; their average height was 159.21 cm (6.51 SD) ranges between 135-171 cm. The average BMI was 23.09 which is classified within the normal range. Table 1 displays responses of participants to diabetes awareness which consists of 15 questions about diabetes symptoms, complication and prevention. Only 4 participants (3.1%) obtained the highest DM awareness score. Most participants (78.1%) did not know the difference between T1DM and T2DM and believed that diabetes is incurable (60.9%). About a quarter of the participants (25.8%) did not know that DM is a condition of high blood sugar and 8.6% thought that DM is an infectious disease. Furthermore, 12.5% of the participants were unaware that DM is related to insulin and 15% believed that DM is an inherited disease. Most participants were aware that constant feeling of thirst and frequent urination can be symptoms of DM (84.4% and 91.4%, respectively).

Table 1. Diabetes Mellitus Awareness Test Among Female Students of Private Universities

Assessment Question	Score	N (%)
Do you know the difference between T1DM and T2DM?		
No	0	100 (78.1)
Yes	1	28 (21.9)
Is DM a curable disease?		
No	1	78 (60.9)
Yes	0	50 (39.1)
Is DM a condition of high blood sugar?		
No	0	33 (25.8)
Yes	1	95 (74.2)
Is DM an infectious disease?		
No	1	117 (91.4)
Yes	0	11 (8.6)
Is DM a disease related to insulin?		
No	0	16 (12.5)
Yes	1	112 (87.5)
Is DM an inherited disease?		
No	0	19 (14.8)
Yes	1	109 (85.2)
Does obesity lead to DM?		
No	0	15 (11.7)
Yes	1	113 (88.3)
Is the risk of having DM more common after 40 years?		
No	0	18 (14.1)
Yes	1	110 (85.9)
May high blood pressure lead to DM?		
No	0	69 (53.9)
Yes	1	59 (46.1)
Do you think that no physical activity can lead to DM?		
No	0	29 (22.7)
Yes	1	99 (77.3)
Do you think that eating fruit and vegetables can protect from DM?		
No	0	29 (22.7)
Yes	1	99 (77.3)
Do you think that high fat food (including fast food) can lead to DM?		
No	0	20 (15.6)
Yes	1	108 (84.4)
Do you think that eating high amount of sugar can cause DM?		
No	0	21 (16.4)
Yes	1	107 (83.6)
Is constant feeling of thirst a symptom of DM?		
No	0	20 (15.6)
Yes	1	108 (84.4)
Is frequent urination a symptom of DM?		
No	0	11 (8.6)
Yes	1	117 (91.4)
Mean Score \pm SD (minimum, maximum)	11.4 \pm 2.04 (4.15)	

Score 0 indicate wrong answer whereas 1 indicate right answer

In regard to the DM risk factors questions, a majority of participants were aware that obesity, old age, physical inactivity, high-fat and sugar consumption increased the risk of DM (88.3%, 85.9%, 77.3%, 84.4%, and 83.6%, respectively). Additionally, 77.3% of the participants were aware about the protective effect of fruit and vegetable consumption against DM. However, 53.9% of the participants were unaware that elevated blood pressure may lead to DM.

The frequency of dietary intakes and the mean scores of DM awareness stratified by dietary intakes

have been presented in table 2. The reported overall consumption of fruits and vegetables are far below the recommended daily allowance and were not significantly associated with the DM awareness score. A majority of participants reported a limited consumption of fried/high cholesterol foods and sugary drinks, ranging between never to a few times per week (73.4% and 68.8%, respectively). The mean knowledge of DM at different frequencies of sugary beverage intakes was significantly different ($F=2.97$; $p=0.014$). Scheffe test revealed no statistically significant difference between the groups.

Table 2. Frequency of Dietary Intakes and Mean Scores of DM Awareness Stratified by the Dietary Intake

Dietary Intake	n (%)	Mean of DM Awareness Score (Mean \pm SD)	P-value
Frequency of Fruits Intake			
Never	14 (10.9)	10.5 \pm 2.28	0.18
Once per week	18 (14.1)	10.8 \pm 2.92	
Few times per week	47 (36.7)	11.4 \pm 1.76	
Once daily	29 (22.7)	12.0 \pm 1.69	
2-3 times per day	11 (8.60)	11.8 \pm 1.72	
More than 3 times per day	9 (7.00)	11.7 \pm 1.94	
Frequency of Vegetables Intake			
Never	6 (10.3)	10.3 \pm 1.37	0.11
Once per week	13 (10.3)	10.3 \pm 3.01	
Few times per week	43 (11.7)	11.7 \pm 1.95	
Once daily	38 (11.2)	11.2 \pm 1.85	
2-3 times per day	21 (11.9)	11.9 \pm 1.64	
More than 3 times per day	7 (12.3)	12.3 \pm 2.29	
Frequency of Fried or Fast Food Intakes			
Never	15 (11.7)	11.3 \pm 1.99	0.32
Once per week	46 (35.9)	11.7 \pm 1.91	
Few times per week	33 (25.8)	11.6 \pm 1.75	
Once daily	24 (18.8)	11.0 \pm 2.16	
2-3 times per day	9 (7.00)	10.1 \pm 3.10	
More than 3 times per day	1 (0.80)	12.0 \pm 0.00	
Frequency of Sugary Drinks			
Never	55 (43.0)	12.0 \pm 1.81	0.01
Once per week	17 (13.3)	11.5 \pm 2.10	
Few times per week	16 (12.5)	10.6 \pm 1.36	
Once daily	18 (14.1)	11.7 \pm 2.14	
2-3 times per day	14 (10.9)	10.6 \pm 2.13	
More than 3 times per day	8 (6.3)	9.8 \pm 2.87	

Frequency of dietary intakes by overweight/obesity status was also investigated (Table 3). Out of 128 participants, 38 (30%) of the female students were classified as overweight or obese. Majority of the non-overweight/obese participants and overweight or obese participants reported similarly that they tend to consume fruits and vegetables a few times per week. Additionally, once per week consumption of fried or fast foods was reported by the majority of both groups. A significant association between the overweight/obesity status and frequency of sugary drinks consumption was observed ($p < 0.05$). Majority of non-overweight/

obese and overweight/obese groups reported that they never consume sugary drinks (33.3% and 65.8%, respectively).

Discussion

The study has investigated the level of awareness of DM among non-diabetic young female students from non-medical colleges. These students were expected to have none to low medical background and to have limited recognition of the relation between diabetes and

Table 3. Frequency of Dietary Intakes Stratified by Overweight/Obesity Status

Dietary Intakes	Not Overweight or Obese n= 90 (70.3%)	Overweight or Obese n=38 (29.7%)	P-Value*
Frequency of Fruits Intake			0.16
Never	9 (10.0)	5 (13.2)	
Once per week	13 (14.4)	5 (13.2)	
Few times per week	35 (38.9)	12 (31.6)	
Once daily	24 (26.7)	5 (13.2)	
2-3 times per day	5 (6.60)	6 (15.8)	
3 times per day or more	4 (4.40)	5 (13.2)	
Frequency of Vegetables Intake			0.36
Never	3 (3.30)	3 (7.90)	
Once per week	10 (11.1)	3 (7.90)	
Few times per week	31 (34.4)	12 (31.6)	
Once daily	30 (33.3)	8 (21.1)	
2-3 times per day	12 (13.3)	9 (23.7)	
3 times per day or more	4 (4.40)	3 (7.9)	
Frequency of Fried or Fast-Food Intakes			0.21
Never	8 (8.90)	7 (18.4)	
Once per week	30 (33.3)	16 (42.1)	
Few times per week	24 (26.7)	9 (23.7)	
Once daily	21 (23.3)	3 (7.9)	
2-3 times per day	6 (6.70)	3 (7.9)	
3 times per day or more	1 (1.10)	0 (0.00)	
Frequency of Sugary Drinks			0.04
Never	30 (33.3)	25 (65.8)	
Once per week	13 (14.4)	4 (10.5)	
Few times per week	14 (15.6)	2 (5.3)	
Once daily	15 (16.7)	3 (7.9)	
2-3 times per day	11 (12.2)	3 (7.9)	
3 times per day or more	7 (7.80)	1 (2.6)	

dietary habit. Areas of deficiency and misconception have been identified in the study questionnaire for targeted health education effort, despite the overall eating habit among the young female students. Majority of participants were unaware of the difference between T1DM and T2DM, as one-third of them believed that DM is a curable disease. While, one-quarter of female students were unaware that DM is a condition of high blood sugar. These results reflect a significant lack of awareness about the consequential effect of DM.

A similar study conducted in Riyadh, Saudi Arabia, recruited 426 high school students and found that about one-third of the participants (32.4%) perceived DM as a curable disease (7). Another study conducted a survey among 2,007 non-diabetic adults in Al-Qaseem, Saudi Arabia found that over two-thirds of the participants (67%) perceived DM as curable (19). Surprisingly, the overall diabetes knowledge of the present study showed better knowledge status among young students as compared to a similar study which used similar survey questions but with diabetic patients from the Northern Saudi Arabian population as well as being of a different age group. Although they found that the majority of the subjects had high educational level (77.8%), the majority have poor knowledge on several aspects of diabetes including; its causes (only 48% of respondents thought that lack of exercise is major risk of diabetes), complication (only 24.9% indicated that thirst and frequent urination is symptoms of DM), management, and prevention (only 63% thought that weight loss is important to prevent DM) (20). These differences in awareness level indicates a direct effect of age on personal knowledge of diabetes and further study is required.

Participants of the present study have presented good awareness of DM symptoms due to previous family history of DM and their involvement of the disease diagnosis. This has been already noted in a previous study that knowledge of the disease increases with individuals who have close relatives diagnosed with diabetes (14). In addition, the mean BMI ranges within the normal category and the majority understand the benefit role of physical activity to prevent the incidence of the disease. However, a previous study indicated lack of awareness about DM risk factors is

a significant barrier in the adoption of a healthy lifestyle at earlier stage to prevent DM, especially with the alarming increased prevalence of obesity and physical inactivity among the females in Saudi Arabia (61.5% and 75.1%, respectively) (4). The current study is lacking in indicating the current physical activity pattern of the young female students to compare it with their perception of the prevention effect of diabetes. In accordance with a previous study conducted in Al-Qassim region, Saudi Arabia, majority of the participants perceived obesity, older age and family history as DM risk factors and recognized frequent urination and constant feeling of thirst as symptoms of DM (19).

The results of this study reveal unhealthy eating habits where over half of the respondents from the present study reported a limited consumption of fruits and vegetables. Number of servings consumed by this large proportion of the young female sample is far below the "Choose MyPlate" USDA recommendation (2018) that states 2 serving of fruits and 2-3 serving of vegetables per day for an average adult (21). Such results were unexpected, given that the female participants were recruited from private universities of high cost, representing individuals of middle to high income level. Previous studies have attributed the low consumption of fruits and vegetables to several factors, including its high cost (22). It is important to increase public awareness to incorporate fruits and vegetables in daily diet, given that fruits and vegetables consumption have been linked to lower mortality of all causes (23). However, a healthy habit that is seen among the participants is that a majority of the participants of this study reported a limited consumption of fast/fried foods and sugary drinks.

The significant finding of the current study regarding the DM awareness and the frequency intake of sugary drinks have been seen before in a similar study where they found an association between DM awareness and healthy lifestyles (24). However, stratifying weight status showed a significantly lower reported consumption of sugary drinks among the overweight and obese females as compared to non-overweight/obese females. It is possible that these individuals are aware of the effect of sugary drinks on body weight or they might be following a low calories diet.

Limitations

The study is limited in investigating the family history of DM as having a family member with DM may affect the knowledge of the participants. Secondly, participants of this study may under/overestimated the frequency of their intakes of fruits and vegetables, fast/fried foods, and sugary drinks. Future research utilizing food diary or dietary recall could be more useful to accurately estimate food intakes to obtain more accurate information. In addition, the results have suggested to perform future studies investigating barriers towards the lack consumption of recommended servings of fruits and vegetables and increase awareness of the health benefits and risks associated with the limited consumption. Since the study was part of the community service event, it was conducted during a time of attracting participants who are interested in the topic. However, the time of the study might exaggerate the results of the data due to it being an awareness week for diabetes.

Conclusion

This study investigated personal awareness of diabetes and eating habits performed in young female Saudi adults to improve the quality of life. Although the study shows a good average score of DM knowledge presented among young female students, their knowledge about the pathology of the disease is poor. Further studies are needed to investigate the relationship between lifestyle habits such as physical activity patterns with students' perception of the role of physical activity on incidence of the disease. Therefore, there is an urgent need to promote public awareness of DM among the young population to facilitate the understanding of the disease at an earlier age to prevent the occurrence of DM and related complications. Healthy educational meetings, seminars and workshops should be conducted, especially about diabetes pathology, symptoms and prevention. Therefore, improving health awareness should be customized through continuous education and intervention programs to expand individual's knowledge and ensure appropriate weight and diabetes management for a healthy community.

The inclusion of young participants especially college age in the health education programs allows a better representation of the demographic structure of the community and creates a baseline for future community service and surveys. Future interventions should be aimed at younger populations in which the level of diabetes awareness is low in specific areas. Educational diabetes awareness for young students may be needed for more support and encouragement since they may be involved in the treatment of their parents and relatives like using new diabetic machines and technology, understanding the glycaemic index, and calculating carbohydrate servings.

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