

Scientific Foundation SPIROSKI, Skopje, Republic of Macedonia  
 Open Access Macedonian Journal of Medical Sciences. 2020 Feb 05; 8(E):91-97.  
<https://doi.org/10.3889/oamjms.2020.4194>  
 eISSN: 1857-9655  
**Category:** E - Public Health  
**Section:** Public Health Education and Training



# Knowledge and Awareness of Diabetes Mellitus Disease among High School Students in King Abdulaziz Military City, Tabuk, Saudi Arabia

Mohammed Ahmad Alenazi<sup>1\*</sup>, Solaiman Hosaian Alenezi<sup>1</sup>, Maniee Nasser Alhablani<sup>1</sup>, Muhannad Ahmed Matar Alanazi<sup>2</sup>, Waleed H. Alenazi<sup>3</sup>, Majed Saeed AlQahtani<sup>4</sup>, Dana Alenezi<sup>5</sup>, Qasem Abdu Mahzari<sup>1</sup>

<sup>1</sup>King Salman Hospital, Tabuk, Saudi Arabia; <sup>2</sup>North Medical Tower Hospital, Azar 73241, Saudi Arabia; <sup>3</sup>King Khaled Hospital, Diabetic Center, Riyadh, Saudi Arabia; <sup>4</sup>King Fahad Specialist Hospital Dammam, Dammam 32253, Saudi Arabia; <sup>5</sup>Maternity and Children Hospital, Dammam 32253, Saudi Arabia

## Abstract

**Edited by:** Sasho Stoleski  
**Citation:** Alenazi MA, Alenezi SH, Alhablani MN, Alanazi MAM, Alenazi WH, AlQahtani MS, Alenezi D, Mahzari QA. Knowledge and Awareness of Diabetes Mellitus Disease among High School Students in King Abdulaziz Military City, Tabuk, Saudi Arabia. Open Access Maced J Med Sci. 2020 Feb 05; 8(E):91-97. <https://doi.org/10.3889/oamjms.2020.4194>  
**Keywords:** Diabetes mellitus; Knowledge; Awareness; School students; Saudi Arabia  
**\*Correspondence:** Mohammed Ahmad Alenazi, King Salman Hospital, Tabuk, Saudi Arabia. E-mail: Malanazi152@moh.gov.sa  
**Received:** 11-Aug-2019  
**Revised:** 16-Sep-2019  
**Accepted:** 25-Nov-2019  
**Copyright:** © 2020 Mohammed Ahmad Alenazi, Solaiman Hosaian Alenezi, Maniee Nasser Alhablani, Muhannad Ahmed Matar Alanazi, Waleed H. Alenazi, Majed Saeed AlQahtani, Dana Alenezi, Qasem Abdu Mahzari  
**Funding:** This research did not receive any financial support  
**Competing Interests:** The authors have declared that no competing interests exist  
**Open Access:** This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (CC BY-NC 4.0)

**BACKGROUND:** Saudi Arabia is considered to be one of the highest countries in the Middle East for the incidence of diabetes mellitus (DM). Data are lacking regarding knowledge and awareness about DM among school students in Saudi Arabia.

**AIM:** The study aimed to assess the level of knowledge and awareness of DM among high school students within the military city, Tabuk, Saudi Arabia.

**METHODS:** A descriptive type of cross-sectional study was conducted among 278 high school students applying a convenience sampling technique. The sample size was calculated using OpenEpi, Version 3. Self-administered questionnaires were distributed to the high school students (male and female) after official communication with the school's dean. The level of knowledge and awareness was categorized into "adequate" and "inadequate" as per each topic/question, and also as per each response/answer. Data entry and analysis were carried out using the Statistical Package for the Social Sciences. Pearson's Chi-square tests were performed to explore if there is any significant association between the knowledge and awareness level of the high school students and their (i) gender, (ii) age, and (iii) level of education.

**RESULTS:** More than half of the high school students had adequate level of knowledge and awareness about DM in terms of symptoms (67.3%), complications (56.5%), monitoring method (62.6%), lifestyle modifications (63.7%), frequency of routine eye check-up (63.3%), important factors for blood sugar control (79.1%), treatment (56.5%), and management of hypoglycemia symptoms (57.6%). On the contrary, a large number of the students showed inadequate level of knowledge and awareness about the disease in terms of definition (80.6%), major causes (57.9%), effect of high blood pressure (51.8%), frequency of routine blood pressure check-up (55%), rationale of a regular urine test (58.3%), medication for DM (66.9%), and duration of medication (69.8%). However, no significant associations were found between the knowledge and awareness level of the high school students about the definition or major causes of DM and the (i) gender, (ii) age group, and (iii) level of education of the students.

**CONCLUSION:** The level of knowledge and awareness of a considerable number of high school students regarding DM was inadequate, and some of them possessed various misconceptions about this particular chronic disease. Health authorities and school authorities in the region should offer special efforts to improve the level of knowledge and awareness of the students through regular health education campaigns.

## Introduction

Diabetes mellitus (DM) (Type 1 and Type 2) is a serious, chronic, and lifelong condition. Its prevalence is increasing worldwide due to the fast-changing in lifestyle and modernization [1,2]. Its incidence is more commonly seen in Arab world countries, especially the Gulf Cooperation Council countries, including the Kingdom of Saudi Arabia [1,3].

Saudi Arabia is considered to be one of the highest countries in the Middle East for the incidence of DM. The World Health Organization estimated that around 7 million Saudis are diabetic and around 3 million are pre-diabetic [4,5]. Diabetes

is estimated to increase more than 550 million by the year 2030 [6].

Diabetes can lead to serious and lifelong complications that affect general health and worsen the quality of life. It is always considered to be a heavy burden for every medical institute [4,5]. Diabetes can cause damage to many organs and systems in the human body, including renal and nervous systems. The risks of stroke, cardiac disease, and limb problems are high as well [1,3]. Early detection of diabetes is effective for improving clinical outcomes and quality of life [6]. Therefore, increasing the awareness of diabetes is essential and important for the management, prevention, and control of the disease.

## Background

In Saudi Arabia, data are lacking regarding knowledge and awareness about DM among school students. A study conducted at Tabuk University showed that 55% of the students were unaware of diabetes risk factors. This study included 200 subjects; among them, 103 were males and 97 were females. Their ages ranged from 18 to 24 years, and 16.5% of them were diabetic patients [7].

Another study was performed in the Al-Qassim region that evaluated more than 2000 citizens of Saudi nationality, which showed that most of the young population had a misconception that diabetes is a curable medical problem [8].

Another study was carried out in Oman among more than 500 students. It illustrated that knowledge of DM among high school students is suboptimal. In most cases, their knowledge deficiency was particularly in diabetes complications [9].

Therefore, the present study aimed to assess the level of knowledge and awareness of DM among high school students within the military city, Tabuk, Saudi Arabia. Identifying the lack of knowledge or misconception about DM might be a triggering point to increase the awareness by education campaign to ensure early detection and proper management of this chronic disease.

### Objectives of the study

The objectives are as follows:

- To assess the level of the awareness and knowledge regarding DM among high school students.
- To explore if there is any significant association between the awareness and knowledge level of the high school students and their (i) gender, (ii) age, and (iii) level of education.

## Methods

### Study design

This was a cross-sectional study based on a questionnaire.

### Study area/setting

This study was conducted at high school students in the military city, Tabuk, Saudi Arabia.

## Study subjects

### Inclusion criteria

Student, high school, and male and female in the military city in Tabuk were included in the study.

### Exclusion criteria

Students with DM, students who were taking hypoglycemic agents, and the students who did not give written informed consent or refused to participate in the study were excluded from the study.

### Sample size

Population size = 1000

Design effect = 1

We assumed confidence level = 95%, so accordingly, our sample size was 278 as calculated using OpenEpi, Version 3.

### Equation used for calculation of sample size

Sample size  $n = [DEFF * Np(1-p)] / [(d2 / Z21 - / 2 * (N - 1) + p * (1 - p))]$ .

### Sampling technique

This was a convenience sampling of the students who were attending high schools in the military city area in Tabuk, Saudi Arabia, and who fit the inclusion criteria.

### Data collection methods, instruments used, and measurements

The questionnaire used in this study was adapted from P & T Journal, Medimedia USA, Inc., and was developed by Subish *et al.* [10]. It has been used in the previous KAP studies among diabetic patients and has been proven to be reliable [10,11]. The self-administered questionnaire included demographic information (sex, age, education level, and diabetes status), knowledge questions about symptoms, causes, management and complication of DM, and questions about diet and physical activities. The questionnaires were distributed to the high school students (male and female) after official communication with the school's dean and taking permission. Each participant required 5–10 min to fill up the questionnaire. The level of knowledge and awareness was categorized into "adequate" (accurate response/answer) and "inadequate" (inaccurate response/answer, or partially know, or do not know) as per each topic/question and also as per each response/answer (Table 1).

**Table 1: Knowledge and awareness level of high school students (n=278) about diabetes mellitus, Tabuk, Saudi Arabia**

Topic/question with response options	Overall knowledge and awareness level as per each topic/question		Knowledge and awareness level as per each response/answer	
	Adequate (%)	Inadequate (%)	Adequate (%)	Inadequate (%)
Definition of diabetes mellitus	54 (19.4)	224 (80.6)		
A higher level of sugar in blood than normal			54 (19.4)	
A lower level of sugar in blood than normal				22 (7.9)
Either a higher or a lower level of sugar in blood than normal				140 (50.4)
Do not know				62 (22.3)
Major cause of diabetes mellitus	117 (42.1)	161 (57.9)		
Increased availability of insulin in the body			117 (42.1)	95 (34.2)
Decreased availability of insulin in the body				66 (23.7)
Do not know				
Symptoms of diabetes mellitus	187 (67.3)	91 (32.7)		
Increased frequency of urination				44 (15.8)
Increased thirst and hunger				4 (1.4)
Increased tiredness				3 (1.1)
Slow healing of the wounds				5 (1.8)
All of the above			187 (67.3)	
Do not know				35 (12.6)
Complications of diabetes mellitus	157 (56.5)	121 (43.5)		
Eye problems				18 (6.5)
Kidney problems				16 (5.7)
Foot ulcers				8 (2.9)
Heart problems				11 (3.9)
All of the above			157 (56.5)	
Do not know				68 (24.5)
The most accurate method of monitoring diabetes mellitus	174 (62.6)	104 (37.4)		
Checking blood glucose levels			174 (62.6)	
Checking urine sugar				61 (21.9)
Do not know				43 (15.5)
Effect of high blood pressure among patients with diabetes mellitus	134 (48.2)	144 (51.8)		
Increase or worsen the risk of heart attack				42 (15.1)
Increase or worsen the risk of stroke				11 (4.0)
Increase or worsen the risk of eye problems				9 (3.2)
Increase or worsen the risk of kidney problems				12 (4.3)
All of the above			134 (48.2)	
Do not know				70 (25.2)
Frequency of routine blood pressure check-up for patients with diabetes mellitus	125 (45.0)	153 (55.0)		
Once a year				11 (3.9)
Once every 6 months				29 (10.4)
Once every 2 months				25 (9.0)
Once every month			125 (45.0)	
Need not to check at all				13 (4.7)
Do not know				75 (27.0)
Lifestyle modifications required for patients with diabetes mellitus	177 (63.7)	101 (36.3)		
Weight reduction				28 (10.1)
Quitting smoking				12 (4.3)
Ceasing alcohol intake				8 (2.9)
All of the above			177 (63.7)	
Do not know				53 (19)
Frequency of routine eye check-up for patients with diabetes mellitus	176 (63.3)	102 (36.7)		
Once a year				29 (10.4)
Once every 6 months			176 (63.3)	
Need not to check at all				73 (26.3)
Rationale of a regular urine test for patients with diabetes mellitus	116 (41.7)	162 (58.3)		
To control diabetes			116 (41.7)	
To know the status of kidney function				72 (26)
To know the status of liver function				19 (6.8)
Do not know				71 (25.5)
Important factors for blood sugar control	220 (79.1)	58 (20.9)		
Regular exercise				26 (9.4)
A controlled and planned diet				20 (7.2)
Medication				12 (4.3)
All of the above			220 (79.1)	
Treatment of diabetes mellitus	157 (56.5)	121 (43.5)		
Substituting insulin			157 (56.5)	
Taking more bitter vegetables				18 (6.5)
Antibiotic therapy				16 (5.7)
Blood transfusions				10 (3.6)
Do not know				77 (27.7)
Not a medication for diabetes mellitus	92 (33.1)	186 (66.9)		
Insulin				21 (7.5)
Glibenclamide				25 (9.0)
Metformin				140 (50.4)
Antibiotics			92 (33.1)	
Duration of medication for control of diabetes mellitus	84 (30.2)	194 (69.8)		
Can be stopped immediately				49 (17.6)
Can be stopped after 1 month				32 (11.5)
Should be continued for life			84 (30.2)	
Do not know				113 (40.7)
Management of hypoglycemia symptoms	160 (57.6)	118 (42.4)		
Giving sugar to the patient			160 (57.6)	
Giving medicines to the patient				19 (6.8)
Giving insulin to the patient				39 (14.0)
Do not know				60 (21.6)

### Data management and analysis plan

Data entry and analysis were carried out using the Statistical Package for the Social Sciences. Frequencies and percentages were calculated for categorical variables, while mean, median, mode, maximum value, minimum value, and standard deviation were calculated for continuous variables. Pearson's Chi-square tests were performed to explore if there is any significant association between the knowledge and awareness level of the high school students and their (i) gender, (ii) age, and (iii) level of education.

## Results

Table 2 shows the sociodemographic characteristics and diabetes status of high school students. Of 278 high school students, approximately two-thirds (66.9%) of the high school students belonged to the age group of 15–17 years, while the remaining 33.1% of them were adult, i.e., 18 years old or above. The mean age of the high school students who participated in the study ( $n = 278$ ) was  $17.15 \pm 1.012$  years ranging from a minimum age of 15 years to a maximum age of 22 years. Of 278 high school students, the majority (61.2%) were male, while the remaining 38.8% of the respondents were female. More than half (56.2%) of the respondents belonged to the second level of education in their school, approximately one-fourth (25.5%) belonged to the third level, and 18.3% belonged to the first level in their school. Of 278 high school students, the majority (79.5%) were non-diabetic, while only 2.5% were diabetic. However, the diabetes status of 18% of the respondents was unknown (Table 2).

Table 1 illustrates the knowledge and awareness level of high school students about DM. More than half of the high school students had an adequate level of knowledge and awareness about DM in terms of symptoms (67.3%), complications (56.5%), monitoring method (62.6%), lifestyle modifications (63.7%), frequency of routine eye check-up (63.3%), important factors for blood sugar control (79.1%), treatment (56.5%), and management of hypoglycemia

**Table 2: Sociodemographic characteristics and diabetes status of high school students (n=278), Tabuk, Saudi Arabia**

Characteristics	Frequency (%)
Gender	
Male	170 (61.2)
Female	108 (38.8)
Age group*	
15–17 years	186 (66.9)
18–22 years	92 (33.1)
Level of education	
First Level	51 (18.3)
Second level	156 (56.2)
Third level	71 (25.5)
Diabetes status	
Diabetic	7 (2.5)
Non-diabetic	221 (79.5)
Unknown	50 (18.0)

\*Mean age:  $17.15 \pm 1.012$  years; Minimum age: 15 years; Maximum age: 22 years.

symptoms (57.6%). On the contrary, a large number of the students showed an inadequate level of knowledge and awareness about the disease in terms of definition (80.6%), major causes (57.9%), effect of high blood pressure (51.8%), frequency of routine blood pressure check-up (55%), rationale of a regular urine test (58.3%), medication for DM (66.9%), and duration of medication (69.8%).

Only 19.4% of 278 respondents knew the correct definition of the DM disease, while 22.3% of them did not know the definition of DM. However, more than half (58.3%) of the high school students had a wrong perception of the definition of DM. Of 278 respondents, 23.7% could not mention the major cause for occurring DM disease, while the maximum (42.1%) of them correctly knew that a decreased availability of insulin in the body is the major cause of DM. However, around one-third (34.2%) of the high school students had an incorrect perception of the major cause of DM (Table 1).

Table 1 also shows that among 278 respondents, more than two-thirds (67.3%) knew the multiple symptoms of DM correctly, while 15.8% of the high school students mentioned "increased frequency of urination" as the only symptom of DM. However, 12.6% of the respondents did not have any concept about the symptoms of DM. Of 278 high school students, the majority (56.5%) were aware of the multiple complications of DM (e.g., eye problems, kidney problems, foot ulcers, and heart problems), while 19% of them knew at least one complication of this disease. Nevertheless, approximately one-fourth (24.5%) respondents did not have any idea about the complications of DM.

Regarding the most accurate method of monitoring DM, the majority (62.6%) of the respondents knew the correct method as "checking blood glucose level" (Table 1). Approximately 22% of them mentioned "checking urine sugar" as the most accurate method, which is actually not correct. However, 15.5% of the high school students did not have any idea about it. Of 278 high school students, the highest number (48.2%) were aware of the multiple effects of high blood pressure among the patients with DM (e.g., risk of heart attack, stroke, eye problems, and kidney problems), while 26.6% of them knew at least one type of such effects. However, approximately one-fourth (25.2%) respondents did not possess any knowledge about the effect of high blood pressure among diabetes patients. Of 278 high school students, the maximum number (45%) were aware that patients with DM should measure their blood pressure once every month, while 23.3% of them did not know the accurate frequency (Table 1). Moreover, 4.7% of respondents were not at all aware of the necessity of regular blood pressure check-up for diabetes patients, and more than one-fourth (27%) respondents did not have any idea about the frequency of regular blood pressure measurement.



Table 1 shows that among 278 respondents, the majority (63.7%) knew that several lifestyle modifications (e.g., weight reduction, quitting smoking, and ceasing alcohol intake) are required for the patients with DM. Of all respondents, 17.3% knew at least one type of lifestyle modification process. However, 19% of the high school students did not know what lifestyle modifications are required to control DM. Of 278 respondents, the majority (63.3%) were aware that patients with DM should check their eye once every 6 months, while 10.4% of them did not know the accurate frequency. However, 26.3% of the high school students were not at all aware of the necessity of regular eye check-ups for diabetes patients. Table 1 also shows that among 278 respondents, the highest number (41.7%) were conscious that patients with DM should perform urine tests regularly to control their diabetes. Approximately 32.8% of them had a wrong concept about the usefulness of regular urine tests. However, around one-fourth (25.5%) of the high school students did not have any idea about the usefulness of regular urine tests.

Of 278 respondents, the majority (79.1%) had an appropriate concept about the multiple important factors (e.g., a controlled and planned diet, regular exercise, and medication) to control blood sugar, while remaining 20.9% of the respondents knew at least one of the important factors (Table 1). Of 278 respondents, the majority (56.5%) had the proper concept about the treatment of DM, while 15.8% of them had wrong ideas (e.g., antibiotic therapy, blood transfusion, and taking more bitter vegetables) about this issue. However, more than one-fourth (27.7%) of the high school students did not have any idea about the treatment of diabetes.

Table 1 illustrates that among 278 respondents, approximately one-third (33.1%) knew correctly that antibiotics cannot be used for the treatment of diabetes. Remaining two-thirds (66.9%) did not have an appropriate idea about the medication for DM. Of 278 respondents, only 30.2% had the proper concept about the duration of medication for DM (i.e., medication should continue for life), while 29.1% of them had the wrong idea about this issue. However, 40.7% of the high school students did not have any idea about the duration of medication for DM. Table 1 also shows that among 278 respondents, the majority (57.6%) knew correctly that sugar can be used for the management of hypoglycemia symptoms, while 20.8% of high school students had an incorrect concept about this issue. However, 21.6% of the respondents did not know anything about the management of hypoglycemia symptoms.

Table 3 shows that there were no significant associations between the awareness and knowledge level of the high school students about the definition of DM and their (i) gender ( $p = 0.06$ ), (ii) age group ( $p = 0.97$ ), and (iii) level of education ( $p = 0.37$ ). Table 4 depicts that there were no significant associations between the awareness and knowledge level of the

**Table 3: Association of awareness and knowledge level about the definition of diabetes mellitus with gender, age, and level of education**

Variable	Category	Total (n=278)	Level of knowledge and awareness		p-value*
			Adequate (accurate response) (n=54)	Inadequate (inaccurate response, or do not know) (n=224)	
Gender	Male	170	27	143	0.061
	Female	108	27	81	
Age group	15–17 years	186	36	150	0.967
	18–22 years	92	18	74	
Level of education	First level	51	12	39	0.375
	Second level	156	32	124	
	Third level	71	10	61	

\*p-value was calculated by Pearson's Chi-square test.

high school students about the major causes of DM and their (i) gender ( $p = 0.06$ ), (ii) age group ( $p = 0.66$ ), and (iii) level of education ( $p = 0.7$ ).

## Discussion

Our study findings are similar to a number of previous study results that showed an inadequate level of knowledge and awareness of DM among the respondents in Saudi Arabia [12]. Al-Aboudi *et al.* [13] reported that 15% of the study participants in Riyadh had inadequate knowledge of DM, while 72% had moderate knowledge. In a study by Binhemd [14], the respondents in Dammam were found to obtain low scores regarding knowledge and attitudes toward DM. In another survey by Al Malki *et al.* [15], the percentage of correct answers to questions about DM was 49%, indicating a gap in DM knowledge among the Saudi population.

**Table 4: Association of awareness and knowledge level about major causes of diabetes mellitus with gender, age, and level of education**

Variable	Category	Total (n=278)	Level of knowledge and awareness		p-value*
			Adequate (accurate response) (n=117)	Inadequate (inaccurate response, or do not know) (n=161)	
Gender	Male	170	64	106	0.06
	Female	108	53	55	
Age group	15–17 years	186	80	106	0.657
	18–22 years	92	37	55	
Level of education	First level	51	24	27	0.703
	Second level	156	63	93	
	Third level	71	30	41	

\*p-value was calculated by Pearson's Chi-square test.

A study was conducted among medical students that also reported that the medical students achieved low scores regarding knowledge about DM, and 90% of the students were not aware of the correct procedure for administering insulin injections [16]. Another study was carried out exclusively among secondary school students in Riyadh by Al-Mutairi *et al.* [17]. This study revealed that the awareness about the role of body weight in DM was lower in males ( $p = 0.037$ ); males were less likely to recognize the risks for the disease than females, including obesity ( $p = 0.030$ ), heredity ( $p = 0.013$ ), and high-fat intake ( $p = 0.001$ ).

In our study, the high school students showed both adequate and inadequate levels of knowledge and awareness about DM (Table 1). More than half of the high school students had an adequate level of knowledge and awareness of the disease in terms of symptoms, complications, monitoring technique, lifestyle modification, routine eye check-up, blood sugar control, treatment, and management of hypoglycemia. On the other hand, a considerable number of the students showed an inadequate level of knowledge and awareness about DM in terms of definition, causes, the effect of high blood pressure, routine blood pressure check-up, urine test, medication, and duration of medication.

Our study is limited by the fact that we employed a non-probability convenient sampling method instead of a random sampling method. Therefore, our study participants should not be considered as a representative sample for generalization of the study findings, and caution should be taken in interpreting the results given that it was a convenience sample. In the present study, the use of a unique sample only from Tabuk may limit the generalizability of the study findings to other provinces in Saudi Arabia. Another limitation of the study was the severe time constraint faced by the researcher to complete the assignment within a strict deadline.

## Conclusion

Our study concluded that the level of awareness and knowledge of a considerable number of high school students regarding DM was inadequate, and some of them possessed various misconceptions about this particular chronic disease. However, no significant associations were found between the knowledge and awareness level of the high school students about the definition or major causes of DM and the (i) gender, (ii) age group, and (iii) level of education of the students.

Health authorities and school authorities in the region should offer special efforts to improve the level of knowledge and awareness through regular health education campaigns about DM, particularly for school students, school teachers, and parents of the school students. Simultaneously, incorporation of health education messages about major chronic diseases into textbooks and school curriculum will provide opportunities for increasing awareness of school students regarding DM.

## Acknowledgment

I would like to express my sincere gratitude to my supervisor Dr. Meniee Nasser Al-Hablani, Consultant

Family Medicine and Diabetologist, King Salman Armed Forces Hospital, Tabuk, Saudi Arabia, for his continuous guidance and support for completing this research. Furthermore, I would like to offer my heartfelt thanks to the authorities and students of Al-abnaa (Boys and Girls) High School in King Abdulaziz Military City, Tabuk, Saudi Arabia, for their sincere cooperation during data collection.

## References

1. Foma MA, Saidu Y, Omoleke SA, Jafali J. Awareness of diabetes mellitus among diabetic patients in the Gambia: A strong case for health education and promotion. *BMC Public Health* 2013;13:1124. <https://doi.org/10.1186/1471-2458-13-1124> PMID:24304618
2. Shaw JE, Sicree RA, Zimmet PZ. Global estimates of the prevalence of diabetes for 2010 and 2030. *Diabetes Res Clin Pract* 2010;87(1):4-14. <https://doi.org/10.1016/j.diabres.2009.10.007> PMID:19896746
3. Meo SA. Prevalence and future prediction of type 2 diabetes mellitus in the Kingdom of Saudi Arabia: A systematic review of published studies. *J Pak Med Assoc* 2016;66(6):722-5. PMID:27339576
4. Al Dawish MA, Robert AA, Braham R, Al Hayek AA, Al Saeed A, Ahmed RA, *et al.* Diabetes Mellitus in Saudi Arabia: A Review of the Recent Literature. *Curr Diabetes Rev* 2016;12(4):359-68. <https://doi.org/10.2174/1573399811666150724095130> PMID:26206092
5. Robert AA, Al Dawish MA, Braham R, Musallam MA, Al Hayek AA, Al Kahtany NH. Type 2 Diabetes Mellitus in Saudi Arabia: Major Challenges and Possible Solutions. *Curr Diabetes Rev* 2017;13(1):59-64. <https://doi.org/10.2174/1573399812666160126142605> PMID:26813972
6. Wang C, Yu Y, Zhang X, Li Y, Kou C, Li B, *et al.* Awareness, treatment, control of diabetes mellitus and the risk factors: Survey results from Northeast China. *PLoS One* 2014;9(7):e103594. <https://doi.org/10.1371/journal.pone.0103594> PMID:25068894
7. Hamdi NH, Alanazi FK, Albalawi MA, Hamdi NH, Alshehri RA, Mirghani HO. Diabetes mellitus awareness among Tabuk University students, Saudi Arabia. *Int J Healthc Sci* 2016;4(1):45-6. <https://doi.org/10.24087/iam.2017.1.1.32>
8. Mohieldin AH, Alzohairy MA, Hasan M. Awareness of diabetes mellitus among Saudi nondiabetic population in Al-Qassim Region, Saudi Arabia. *J Diabetes Endocrinol*. 2011;2(2):14-9. <https://doi.org/10.5539/gjhs.v3n2p123>
9. Al-Mahrooqi B, Al-Hadhrani R, Al-Amri A, Al-Tamimi S, Al-Shidhani A, Al-Lawati H, *et al.* Self-reported knowledge of diabetes among high school students in Al-Amerat and Quriyat, Muscat Governate, Oman. *Sultan Qaboos Univ Med J* 2013;13(3):392-8. <https://doi.org/10.12816/0003261> PMID:23984024
10. Subish P, Leelavathy DA. Knowledge, attitude, and practice outcomes: Evaluating the impact of counseling in hospitalized diabetic patients in India. *PTJ*. 2006;31(7):389-92.
11. Ng SH, Chan KH, Lian Z, Yee HC, Waseem AN, Kadirvelu A. Reality vs illusion: Knowledge, attitude and practice among diabetic patients. *Int J Collab Res Int Med Public Health*.

- 2012;4:709.
12. Alanazi FK, Alotaibi JS, Paliadelis P, Alqarawi N, Alsharari A, Albagawi B. Knowledge and awareness of diabetes mellitus and its risk factors in Saudi Arabia. *Saudi Med J*. 2018;39(10):981-9. <https://doi.org/10.15537/smj.2018.10.22938>  
PMid:30284579
  13. Al-Aboudi IS, Hassali MA, Shafie AA. Knowledge, attitudes, and quality of life of Type 2 diabetes patients in Riyadh, Saudi Arabia. *J Pharm Bioallied Sci* 2016;8(3):195-202. <https://doi.org/10.4103/0975-7406.171683>  
PMid:27413347
  14. Binhemd TA. Diabetes mellitus: Knowledge, attitude, practice and their relation to diabetes control in female diabetics. *Ann Saudi Med* 1992;12:247-51. <https://doi.org/10.5144/0256-4947.1992.247>  
PMid:17589175
  15. Almalki TM, Almalki NR, Balbaid K, Alswat K. Assessment of diabetes knowledge using the Michigan brief diabetes knowledge test among patients with Type 2 diabetes mellitus. *J Endocrinol Metab*. 2017;7(6):185-9. <https://doi.org/10.14740/jem473w>
  16. Al Wadaani FA. The knowledge attitude and practice regarding diabetes and diabetic retinopathy among the final year medical students of King Faisal University Medical College of Al Hasa region of Saudi Arabia: A cross sectional survey. *Niger J Clin Pract* 2013;16(2):164-8. <https://doi.org/10.4103/1119-3077.110133>  
PMid:23563455
  17. Al-Mutairi RL, Bawazir AA, Ahmed AE, Jradi H. Health Beliefs Related to Diabetes Mellitus Prevention among Adolescents in Saudi Arabia. *Sultan Qaboos Univ Med J* 2015;15(3):e398-404. <https://doi.org/10.18295/squmj.2015.15.03.015>  
PMid:26355752