

Knowledge of Cardiovascular Risk Factors Among Patients with Diabetes Mellitus: A Cross-Sectional Study in Saudi Arabia

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ABSTRACT

Cardiovascular diseases (CVD)s are common across patients with diabetes mellitus. This study aimed to assess the awareness and knowledge among diabetic's patients about risk factors related to CVDs in Saudi Arabia. This study was an online cross-sectional survey conducted across Saudi Arabia to assess level of knowledge regarding CVDs risk factors among patients with diabetes. A previously validated questionnaire was utilized in this research to examine CVDs knowledge. Regression analysis was conducted to predict significant factors influencing participants' knowledge. The study included 378 participants. The majority of the participants demonstrated good awareness of cardiovascular risk factors. Most correctly believed that smoking is a risk factor (364, 96.3%) and that quitting reduces the risk (355, 93.9%). A high proportion also recognized high blood pressure (332, 87.8%) and high cholesterol (328, 86.8%) as risk factors, and acknowledged the benefits of blood pressure control (339, 89.9%) and fatty food (343, 90.7%) as contributors to heart disease. The total knowledge score mean was 19.21 ± 3.58 , while the median was 20. A total of 163 participant (43.1%) had a knowledge score above the median. Participants aged 20-30 years were 2.68 times more likely to have better knowledge about CVD risk factors compared to those under 20 (OR = 2.68, 95% CI: 1.39-5.18, $p = 0.003$), and those aged 51 and above had a markedly higher likelihood (OR = 11.19, 95% CI: 2.97-42.11, $p < 0.001$). Students were significantly more likely to had better knowledge compared to non-employed individuals (OR= 10.28, 95% CI: 3.17-33.38, $p < 0.001$), and working participants also showed a significant association (OR = 268, 95% CI: 1.01-7.10, $p = 0.04$). The current study showed that there is good knowledge of these sections among the Saudi population of diabetes, but increasing workshops and training related to this matter is of utmost importance to ensure that all patients, without exception, understand these risks and make them aware that they affect their lives.

Keywords: Awareness; Cardiovascular disease; Diabetes mellitus; Knowledge; Saudi Arabia

INTRODUCTION

Diabetes Mellitus (DM) is chronic metabolic disease that occur when the body have high sugar or glucose levels¹. There are many types of diabetes, it can be Type 1, Type 2, or gestational diabetes. Type 1 is associated with immunity, as the insulin production is stopped by pancreas cells, thus make the patient depend on exogenous insulin². While Type 2 diabetes occurs when there is insulin secreted from the pancreas but in the wrong way³. In addition to that diabetes can develop during the pregnancy and in this case, it called gestational diabetes⁴. Diabetes considers one of the most common diseases in the world, in United States of America (USA) millions of people have been diagnosed with it, for example in 2021, more than 10% have been affected with diabetes and more than 300,000 deaths in the same year were due to diabetes⁵. In Saudi Arabia, the prevalence of diabetes is very wide, in 2025 more than nine million of people from different ages were diagnosed with this disease⁶.

Moreover, DM is associated with number of cardiovascular events including arterial clogging, impaired heart function, and abnormal heartbeat⁷. Diabetes is a disease closely linked to heart disease, as there are many factors caused by diabetes that increase the risk of cardiovascular disease (CVD)s, such as high blood pressure and lipid problems. Diabetes can cause vessels damage then elevation of the

blood pressure which is risk factor for atherosclerosis, also it led to accumulation of lipids inside the arteries and formation of plaques and in each conditions the result will be linked to heart problems⁸⁻¹⁰. It is known that diabetics have a higher chance of developing heart disease than people who do not have this disease, and this is what the American Diabetes Association confirmed⁷. When it comes to heart disease, diabetics should have sufficient awareness of the risks that this disease carries, the most important of which are CVDs. The process of awareness begins with determining the factors that cause these diseases, as the patient is advised to make changes in lifestyle, including avoiding smoking, exercising to avoid excess weight, paying attention to a healthy and balanced diet, taking diabetes medications, continuously monitoring blood sugar levels, and following up on the health condition with the responsible physician and medical care providers to reduce the risk of contracting these diseases⁷.

Despite the risks that diabetes carries for the patient, there is a lack of knowledge among them, as some of their beliefs lead to some problems in diagnosis, which increases the risks to their health. Therefore, knowledge must be increased about the importance of adhering to medications and following a healthy lifestyle to improve their quality of life¹¹. Many studies in the Kingdom of Saudi Arabia have proven that there are many people who suffer from diabetes have diseases related to the heart and arteries, as one in five people has

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diabetes and heart disease together¹². The problems related to CVDs that are prevalent among diabetics have been greatly exacerbated in the Kingdom of Saudi Arabia due to the lack of commitment to a healthy lifestyle that leads to a balance between disease and health. There are many problems among people regarding food, exercise, weight and other factors that lead to an increase in the burden of these diseases. Therefore, it was important to increase research to understand what the problem is that people are exposed to, especially diabetics, to avoid the risks related to this disease and improve the health of patients and their quality of life¹³. This study assessed the awareness and knowledge among diabetic's patients about risk factors related to CVDs in Saudi Arabia.

METHODS

Study design: This study was an online cross-sectional survey conducted across Saudi Arabia to assess level of knowledge regarding CVD risk factors among patients with diabetes. The study utilized a self-administered, Arabic-language questionnaire distributed online using Google Forms.

Participants recruitment: Participants were selected using convenience sampling, distributed through online platforms such as WhatsApp, Twitter, and public health awareness forums. Efforts made to ensure geographic and demographic diversity.

Study population: The study population comprised patients diagnosed with DM, aged 18 years and older, residing in Saudi Arabia. This study included both male and female participants without any exclusion criteria related to their sociodemographic factors.

Questionnaire tool: A previously validated questionnaire was utilized in this research to examine CVDs knowledge¹⁴. Besides, the questionnaire tool comprised of two sections and examined participants' a)- demographic characteristics such as age, gender, residency, marital status, education level, and occupation. Moreover, the questionnaire tool examined awareness of CVD risk factors using 24 questions of yes/no format.

Ethical approval: Ethical approval for this study was secured from the institutional review board of Imam Mohammad Ibn Saud Islamic University (Reference number: 808-2025). Participants were notified that the completion of the questionnaire constitutes informed consent for participation.

Sample size: Based on the most recent census data from the General Authority for Statistics (GASTAT), the adult population in Saudi Arabia is approximately 24 million. Using a confidence level of 95% and a margin of error of 5%, the required sample size is approximately 385 participants.

Data analysis: Categorical variables such as the demographic characteristics including for example age group, gender and residency, were expressed as frequencies and percentages. The continuous data such as the total knowledge score was expressed by mean and standard deviation (SD). For group comparisons such as the gender, and residency and independent sample t-tests was performed, while to compare the knowledge among other demographic variables one-way ANOVA was employed, Tukey-post hoc test was applied for multiple comparisons. Additionally, a logistic regression analysis was conducted to predict significant factors influencing participants knowledge. Prior to logistic regression, the score was categorized into two groups based on the median score of 20. All data analysis was conducted utilizing SPSS software, version 29. A p-value less than 0.05 considered as significant.

RESULTS

The study included 378 participants. Most were aged 20-30 years (110, 29.1%), followed by those aged 51 and above (92, 24.3%). Males represented 204 participants (54.0%), while females accounted for 174 (46.0%). The majority lived in cities (348, 92.1%), with only 30 (7.9%) residing in villages. Regarding marital status, 191 participants (50.5%) were single, 172 (45.5%) married. Most participants held a university degree (222, 58.7%), while 103 (27.2%) had a secondary education. In terms of occupation, 158 (41.8%) were students, 120 (31.7%) were working, 58 (15.3%) retired, and 42 (11.1%) were not employed, Table 1.

Table 1. Demographic characteristics of participants

Demographic characteristics of participants	N	%	
Age (years)	Less than 20	84	22.2%
	20-30	110	29.1%
	31-40	38	10.1%
	41-50	54	14.3%
	51 and older	92	24.3%
Gender	Female	174	46.0%
	Male	204	54.0%
Residency	City	348	92.1%
	Village	30	7.9%
Marital status	Single	191	50.5%
	Married	172	45.5%
	Divorced	6	1.6%
	Widowed	9	2.4%
Education level	Primary	15	4.0%
	Secondary	103	27.2%
	Diploma	31	8.2%
	University	222	58.7%
	PhD	7	1.9%
Occupation	Non	42	11.1%
	Student	158	41.8%
	Working	120	31.7%
	Retired	58	15.3%

The majority of the participants demonstrated good awareness of cardiovascular risk factors. Most correctly believed that smoking is a risk factor (364, 96.3%) and that quitting reduces the risk (355, 93.9%). A high proportion also recognized high blood pressure (332, 87.8%) and high cholesterol (328, 86.8%) as risk factors, and acknowledged the benefits of blood pressure control (339, 89.9%) and fatty food (343, 90.7%) as contributors to heart disease. However, only 195 (51.6%) correctly disagreed that high HDL increases risk, and 160 (42.3%) acknowledged low HDL as common in diabetics. Further details about the participants responses to cardiovascular risk factors are provided in Table 2.

Table 2. Awareness of cardiovascular disease risk factors.

Item	N (%)
1 Do you think a person is always aware that they have heart disease?	315 (83.3%)
2 Do you think having a family history of heart disease is enough to diagnose the condition?	209 (55.3%)
3 Do you believe that the risk of heart disease increases with age?	299 (79.1%)
4 Is smoking considered a risk factor for heart disease?	364 (96.3%)
5 Do you believe that quitting smoking reduces the risk of heart disease?	355 (93.9%)

6	Do you think high blood pressure is a risk factor for heart disease?	332 (87.8%)
7	Do you think controlling blood pressure reduces the risk of heart disease?	339 (89.7%)
8	Do you think high cholesterol is a risk factor for heart disease?	328 (86.8%)
9	Do you believe that eating fatty foods affects cholesterol levels?	343 (90.7%)
10	Do you think that high levels of good cholesterol (HDL) increase the risk of heart disease?	195 (51.6%)
11	Do you think that high levels of bad cholesterol (LDL) increase the risk of heart disease?	319 (84.4%)
12	Does being overweight increase the risk of heart disease?	340 (89.9%)
13	Do you think regular physical activity reduces the risk of heart disease?	357 (94.4%)
14	Do you believe that walking and jogging are beneficial exercises for the heart?	356 (94.2%)
15	Do you think diabetes is a risk factor for heart disease?	262 (69.3%)
16	Do you believe high blood sugar puts a strain on the heart?	275 (72.8%)
17	Do you think persistent high blood sugar over several months can raise cholesterol and increase the risk of heart disease?	246 (65.1%)
18	Do you believe that diabetic patients can reduce their risk of heart disease by managing their blood sugar?	304 (80.4%)
19	Do you think it is rare for diabetic patients to have high cholesterol?	156 (41.3%)
20	Do you think controlling cholesterol in diabetic patients reduces the risk of heart disease?	311 (82.3%)
21	Do you think diabetic patients often have low levels of good cholesterol (HDL)?	160 (42.3%)
22	Do you think controlling blood pressure in diabetic patients reduces the risk of heart disease?	329 (87.0%)
23	Do you believe that weight management in diabetic patients reduces the risk of heart disease?	338 (89.4%)
24	Do you think men with diabetes are more likely to develop heart disease than women with diabetes?	134 (35.4%)

The total knowledge score mean was 19.21±3.58, while the median was 20. A total of 163 participant (43.1%) had a knowledge score above the median. Participants aged 51 and above had highest mean score of CVD risk factor (20.49 ± 2.62), with a significant difference across age groups (p = 0.002). participant with PhD degree had significantly higher mean of knowledge compared to primary held degree (21.29 ± 2.43) (17.20 ± 5.56) (p = 0.015), Table 3.

Table 3. Comparison the awareness level regarding the demographic characteristics of participants

Variables	Mean ± SD	P value	
Age (years)	Less than 20	18.75 ± 3.45	
	20-30	19.13 ± 4.13	
	31-40	18.29 ± 4.01	0.002
	41-50	18.61 ± 3.22	
	51 and older	20.49 ± 2.62	

Gender	Female	19.05 ± 3.65	0.39
	Male	19.36 ± 3.53	
Residency	City	19.30 ± 3.56	0.14
	Village	18.30 ± 3.83	
Marital status	Single	19.04 ± 3.60	0.34
	Married	19.51 ± 3.41	
	Divorced	17.50 ± 4.04	
Education level	Widowed	18.56 ± 5.79	0.015
	Primary	17.20 ± 5.56	
	Secondary	18.81 ± 3.60	
	Diploma	18.45 ± 4.83	
	University	19.59 ± 3.15	
Occupation	PhD	21.29 ± 2.43	0.13
	Non	18.02 ± 3.73	
	Student	19.28 ± 3.58	
	Working	19.35 ± 3.83	
	Retired	19.62 ± 2.77	

The logistic regression analysis revealed significant associations between age, occupation, and the knowledge. Participants aged 20-30 years were 2.68 times more likely to have better knowledge about CVD risk factors compared to those under 20 (OR = 2.68, 95% CI: 1.39-5.18, p =0.003), and those aged 51 and above had a markedly higher likelihood (OR = 11.19, 95% CI: 2.97-42.11, p < 0.001). Regarding occupation, students were significantly more likely to had better knowledge compared to non-employed individuals (OR= 10.28, 95% CI: 3.17-33.38, p <0.001), and working participants also showed a significant association (OR = 2.68, 95% CI: 1.01-7.10, p =0.04), Table 4.

Table 4. Factors associated with the cardiovascular disease risk factors knowledge

Variables	OR (95% CI)	p value	
Age (years)	Less than 20	Reference	
	20-30	2.68 (1.39–5.18)	0.003
	31-40	1.75 (0.50–6.16)	0.384
	41-50	1.67 (0.47–5.95)	0.425
	51 and older	11.19 (2.97–42.11)	0.000
Gender	Female	Reference	
	Male	0.86 (0.52–1.43)	0.565
Residency	City	Reference	
	Village	1.42 (0.60–3.34)	0.421
Marital status	Single	Reference	
	Married	2.51 (0.84–7.48)	0.100
	Divorced	1.38 (0.17–11.52)	0.766
	Widowed	4.76 (0.64–35.61)	0.128
Education level	Primary	Reference	
	Secondary	0.89 (0.21–3.75)	0.870
	Diploma	1.05 (0.21–5.23)	0.949
	University	0.97 (0.24–4.03)	0.971
	PhD	2.98 (0.31–28.25)	0.341
Occupation	Non	Reference	
	Student	10.28 (3.17–33.38)	0.000
	Working	2.68 (1.01–7.10)	0.047
	Retired	0.65 (0.22–1.90)	0.433
	Constant	0.05 (0.00–0.00)	0.002

DISCUSSION

The current study aims to know the level of awareness among diabetic patients in the Kingdom of Saudi Arabia about the risk factors associated

with increasing cases of CVDs, as these diseases are considered one of the main causes of death among these patients and one of the most common causes of increased mortality rates worldwide. This study came first to study their level of knowledge, then the relationship of demographic factors such as age and work on awareness of these risks to clarify the next steps that the medical staff must take to improve the quality of life of these patients.

In our study, the majority of the participants demonstrated good awareness of cardiovascular risk factors. Knowledge of cardiovascular risk factors has been shown to be high and good in diabetics in two separate studies in Saudi Arabia and Ethiopia^{14,15}. As is known, diabetes occurs before a period of time in the human body, then appears in the form of symptoms, and after that, this disease is discovered. Diabetes is associated with many complications that can affect the body's organs, the most important of which is the heart. It can cause brain attack, hardening of the arteries, and poor circulation to the limbs, in addition to other complications that occur in other organs^{16,17}. Moreover, in our study most correctly believed that smoking is a risk factor (364, 96.3%) and that quitting reduces the risk (355, 93.9%). A high proportion also recognized high blood pressure (332, 87.8%) and high cholesterol (328, 86.8%) as risk factors, and acknowledged the benefits of blood pressure control (339, 89.9%) and fatty food (343, 90.7%) as contributors to heart disease. There are many risk factors associated with heart disease that increase it, such as smoking, hypertension, dyslipidemia, diabetes, excess weight, a family history of the disease, kidney disease, and some diseases related to the immune system. Some people also suffer from cardiovascular disorders depending on their age and race¹⁸. Many patients are aware of the factors that increase the risk of heart disease. This has been proven by a study in Saudi Arabia in which patients were able to identify some of these factors, including smoking, high blood pressure, advanced age, and high levels of lipids. However, it was found that their knowledge about the harmful effects of cholesterol is very weak. In another study in Lebanon, also with the aim of identifying factors that can increase a person's risk of heart problems, the participants had identified some risk factors that could increase these diseases. Some participants agreed that heart diseases are hereditary diseases, and some of them were aware that diabetes is closely linked to heart diseases. The majority of participants identified high blood pressure as the most important risk factor associated with these diseases, and cancer was also considered¹⁹. In another study similar to ours, participants identified some factors that increase the risk of heart disease. These factors included high blood pressure, diabetes, lack of exercise, and smoking. Participants proved that exercising and quitting smoking are among the most important factors that help reduce the risks that can affect the arteries, veins, and heart.

In our study, the total knowledge score mean was 19.21 ± 3.58 , while the median was 20. A total of 163 participant (43.1%) had a knowledge score above the median. And this mean that less than half of participants from this study have scored more than 20 which suggest that less than 50% of them have a good knowledge about cardiac disease risk factors. This result was consistent with a study in Turkey, where the participants were type 2 diabetics. In this study, they had insufficient knowledge of the risks that can cause CVDs, as most of those who answered incorrectly were among the people who are likely to develop heart diseases. Therefore, this study has highlighted the need for many awareness campaigns about these risks²⁰.

Regarding the level of knowledge and its relationship to demographic factors of patients with diabetes, the patient's age played a role in the level of awareness about these risks, as the study showed that participants aged 20-30 years were 2.68 times more likely to have better knowledge about CVD risk factors compared to those under

20 (OR = 2.68, 95% CI: 1.39-5.18, $p = 0.003$), and those aged 51 and above had a markedly higher likelihood (OR = 11.19, 95% CI: 2.97-42.11, $p < 0.001$). The results of our study were consistent with several studies, including a study in Riyadh, Saudi Arabia, which proved that people who suffer from type 2 diabetes and are over forty years old, this was linked to their knowledge of the risks that cause heart disease. In another study that include patients from many countries, knowledge among them differed according to their age, as it increased with the increase in the patient's age^{15,21}.

In our study, students were significantly more likely to had better knowledge compared to non-employed individuals (OR= 10.28, 95% CI: 3.17-33.38, $p < 0.001$), and working participants also showed a significant association (OR = 268, 95% CI: 1.01-7.10, $p = 0.04$). This result from our study was contrary to the study in Türkiye, which showed that university students in particular need a lot of education about the risks that CVDs can cause among diabetics²². Another study was conducted in Jordan on university students regarding knowledge of the risks of diabetes and its role as a risk factor for CVDs. The study showed that this group needs a lot of increased awareness and education about these topics, as they have a low level of knowledge about these matters²³. Another study aimed to know the awareness among medical college students in universities about the risks of heart-related diseases. It became clear that students in the first years of study had less awareness of these risks, while awareness was more evident among students in the later years, as they knew some of these risks correctly. These mentioned risks were diabetes, especially type 2. However, the study showed that awareness campaigns and education on this subject should be increased among students^{24,25}. As for the work state, in a study on employees from the Netherlands to study the risks of diabetes and cardiovascular and heart disease, it was found that those who work have some information about the risks that can cause these diseases, but on the other hand, this knowledge needs to increase because there is a gap in some information among these employees²⁶.

Recommendations for healthcare professional and practice: Knowledge and understanding of the risks of heart disease are very limited among the population, as they do not know that there are some factors that increase the incidence of these diseases. Many daily practices that the patient feels are normal are a danger to their health, such as smoking, not adhering to a balanced diet, not exercising, and other factors²⁷. As a result, it is important for healthcare providers to develop strategies and plans regarding the risks of developing CVDs among diabetics to avoid any danger that could be to the patient health. Therefore, the importance of increasing awareness campaigns among them has become clear²⁸.

It is important to increase awareness of some lifestyle changes in diabetes and to inform people that these factors lead to reducing the risks to the heart in the future. Therefore, since heart diseases are closely linked to diabetes, patients must be warned to change some of their lifestyles, such as exercising to lose weight, adhering to a diet that contains important nutritional elements, reducing alcohol, and working to stop smoking in order to improve the results of human health on both the endocrine system and the heart system²⁹.

Encouraging diabetics to use some applications on their mobile phones to monitor their diabetes levels and CVDs. The patient can, for example, enter their glucose level in this application, which then gives them the results of the health indicators associated with it. If there are any developments in the disease, the patient is given an alert for early diagnosis of any condition that could cause an increased risk of heart disease in the future. These applications are considered convenient and easy for the patient, as they provide quick communication between the

physicians and the patients in a better way to improve the treatment provided to them based on the information that the patient enters in these applications³⁰.

Healthcare providers from all fields, whether physicians, pharmacists or other medical staff, are responsible for organizing the disease with the patient. In the case of a diabetic patient, dialogue and discussion with patients is very important to know all the patient's activities because some activities are considered normal by some patients and do not affect their health, while they do have an effect. Therefore, the medical team are responsible for providing appropriate advice about lifestyle, how medications work, and how to monitor sugar levels. In addition, the patients feeling that there is someone who pays attention to their illness make them better adhere to their medications, and through dialogue with the healthcare provider, they can inquire about any question that can be asked in order to reach a better quality of life.

Another important thing for a diabetic patient is to strengthen the role of family and friends to be a part of this treatment journey because this helps the patients in support process in many decisions related to the disease, as the medical staff can communicate with these people in order to convince them of the importance of adhering to medications to improve the patient's health^{18,31,32}.

CONCLUSION

This study was conducted to assess the level of awareness and knowledge among diabetics about the risks of heart disease in Saudi Arabia, as it is known that these two diseases are associated with each other, as diabetes alone, are considered one of the risks of increasing CVDs due to many processes related to blood flow to the heart and arteries. The current study showed that there is good knowledge of these sections among the Saudi population of diabetes, but increasing workshops and training related to this matter is of utmost importance to ensure that all patients, without exception, understand these risks and make them aware that they affect their lives. It is important for the patient to adhere to the medications for his disease, in addition to a healthy lifestyle for better health, increasing communication between him and the medical energy, and strengthening the role of family and friends in this process.

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