KNOWLEDGE AND AWARENESS LEVEL OF DM COMPLICATIONS AMONG POPULATIONS IN SAUDI ARABIA

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Abstract

Background: This article discusses DM complications, Diabetes mellitus (DM) is a medical disorder that causes hyperglycemia due to insufficient insulin synthesis or intervention. Diabetes mellitus (DM), which has a high burden of life-threatening complications and associated health problems, is an emerging concern to public health. The management of diabetes mellitus has mostly relied on patient education on the condition's importance as well as the dissemination of awareness and knowledge. Given the high prevalence of diabetes in Saudi Arabia, it is critical for the population to have enough information and understanding about the Diabetic mellitus consequences. **Objective:** The study aimed to assess patient awareness and knowledge of Diabetes complications in Saudi Arabia **Methodology:** A cross-sectional study was conducted among the population of Saudi Arabia in different regions between July 2024 – December 2024. An online questionnaire was used for data collection including all the adult males and females who are 18 Years and older who agreed to answer the questionnaire in this study. According to a calculation based on prevalence estimation, a 95% confidence level, and a 5% allowable error, the minimum intended sample size is 385. **Results**: The study included a total of 616 participants, revealing that 60.6% of participants had a high level of knowledge, while 20.8% exhibited low awareness. Notably, significant gaps were identified regarding critical risks, such as cardiovascular diseases and diabetic foot complications, with 38.8% and 40.1% of respondents uncertain about heart disease and stroke risks, respectively.

Conclusion: In conclusion, while the present study indicates a commendable level of awareness regarding certain diabetes complications among the Saudi population, significant gaps remain that necessitate immediate attention.

Keywords: Knowledge, Awareness, Diabetes mellitus, Complications.

Introduction:

Diabetes mellitus (DM) is a metabolic illness. characterized by elevated glucose levels in the blood over a prolonged time[1]. It presents as periods of elevated blood glucose and glucose intolerance, either due to insufficient insulin secretion, improper insulin utilization, or both[2]. Blood glucose is obtained from food consumption and serves as the body's main energy source. The pancreas secretes insulin, which allows blood glucose to enter cells for utilization. The glucose will stay in the blood vessels in case of inadequate insulin synthesis in the human body which can lead to some serious health issues [3].

Diabetes mellitus (DM) is a complex disease that affects many organ systems, leading to concerns about deteriorating population health status and ever-increasing healthcare expenditure [4,5].Diabetes Mellitus (DM) is expected to expand by 7.7% globally, impacting 439 million by 2030 and 642 million by 2040, with an estimated current burden of more than 400 million adults in 2014, with a preference for the elderly (>65 years). [6–8]. Diabetes has numerous complications, including nephropathy, cardiovascular problems, neuropathy, and diabetic retinopathy [9].

A cross-sectional study carried out in 2023, showed that the majority of participants were aware that Diabetes mullites has major consequences corresponding to 87.4% of the 230 participants, while 11.3% expressed disapproval [10]. Another study that was conducted in 2021 shows that out of 508 participants, 91.1% were aware of the complications of Diabetes mullites [11].

In the past years, most articles have focused on awareness of DM complications among diabetic patients. However, only a few articles have addressed awareness among the general population. Given the high prevalence of diabetes in Saudi Arabia, it is important to gather more information about the knowledge and awareness of DM complications among the general population. This will help in identifying the need for increase health education regarding healthy lifestyles and help diabetic patients for better compliance and control.

Objectives:

The study set out to assess the knowledge and awareness level about DM complications in Saudi Arabia.

Materials and Methods:

Study design:

A cross-sectional study conducted between July 2024 and December 2024, based on an online questionnaire, this study evaluates the Saudi Arabian population's awareness and knowledge about diabetes complications. Recruitment conducted via an online survey distributed through Google Forms and shared on various social media platforms and online communities to reach a diverse audience.

Inclusion and Exclusion Criteria:

The inclusion criteria consist of individuals over 18 years of age, including both male and female, Saudi and non-Saudi residents, regardless of their diabetic status. The exclusion criteria consist of individuals under 18 years of age, medical doctors, and medical students.

Sample size:

The Qualtrics calculator was used to estimate the sample size with a 95% confidence level; the minimum number of samples required was 385. The sample was estimated using this formula:

$$n = \frac{Z^2 \cdot p \cdot (1-p)}{E^2}$$

N=Calculated sample size.

Z is the Z-score corresponding to the desired confidence level= 1.96

P is the estimated knowledge.

E is the margin of error= 0.05.

Q (1-0.50) = 0.05.

Thus, the minimum sample size is:

$$n = \frac{(1.96)^2 \cdot 0.5 \cdot (1 - 0.5)}{(0.05)^2}$$

Method for data collection and instrument (*Data collection Technique and Tools*):

An online structured questionnaire was utilized as the primary data collection tool for this study. The questionnaire was developed based on relevant research conducted in Saudi Arabia [12]. The final version of the questionnaire comprised 29 items, divided into three main sections. Section 1 included demographic information such as gender, age, nationality, social status, educational level, and occupation. Section 2 provided general information about diabetes mellitus, including questions on the diagnosis of diabetes, the duration of the disease, and sources of information about diabetes complications. Section 3 assessed participants' knowledge of common complications associated with diabetes mellitus, as well as their awareness of hyperglycemia and hypoglycemia complications. Each knowledge item was scored dichotomously, with one point given for correct knowledge ("I know") and zero points for lack of knowledge ("I don't know").

Scoring system:

In all, 29 statements assessed the participants' knowledge of diabetes mellitus complications. 6 statements for demographics, 3 for general information, and 20 for knowledge. One point is given for 'I know' answers and zero point is given for 'I don't know'. For scoring, we utilized a Dichotomous scale. The maximum score was 20 and divided as follows: The original Bloom's cut-off points, 80.0%-100.0%, 60.0%-79%, and 59.0%, The participants divided into three groups based on their scores. Knowledge scores varied from 0 to 20 points and were classified into three levels as follows: those with a score of 12 or below ($\leq$ 12) were classified as having a **low level of knowledge**, those with scores between 13 and 15 as having a **moderate level of knowledge**, and those with scores 16 or above ($\geq$ 16) as a **high level of knowledge.**

Pilot test:

The questionnaire distributed to 20 individuals and they asked to fill it out. This done to test the simplicity of the questionnaire and the feasibility of the study. The data of the pilot study excluded from the final data of the study.

Analyzes and entry method:

The gathered data underwent statistical analysis using the Statistical Package for the Social Sciences (SPSS) software, Version Twenty-Six. Descriptive statistics, such as the mean and standard deviation, were utilized for continuous variables, while categorical variables were represented by proportions. To determine gender-based differences, chi-square tests were applied to categorical data and t-tests to continuous data. A significance level was set at a P-value below five percent.

Results:

Table (1) displays various demographic parameters of the participants with a total number of (616). Participants' average age is 34.8 years with a standard deviation of 12.6 meaning that there is a highly heterogenous age distribution of people at different life stages. Interestingly, the largest age group - and it was notable - is the 36 to 44 age brackets, at 26.8%, and the smallest is the 24 to 33 age brackets, at 22.2%. They highlight a significant female representation of 72.2% in the study's focal area and could point at gender disparities in the study's focal area. Additionally, a prominent 92.9% of the participants are of Saudi nationality, which may portray cultural influence on responses. Marital status also shows this population base with most people married (57.5%) suggesting family browsed dynamics in this population base. A large percentage possesses at least a bachelor's degree (48.5%), while educational attainment is varied. It also notes a final noteworthy fact – a full 35.7% of participants are unemployed, a question that also deserves attention in the context of socio-economic factors impacting health outcomes, particularly for the 16.6% which have been diagnosed with diabetes.

Table (1): Sociodemographic characteristics of participants (n=616)

Parameter		No.	Percent (%)
Age **(Mean:34.8, STD:12.6)**	23 or less	169	27.4
	24 to 33	137	22.2
	34 to 44	146	23.7
	45 or more	164	26.6
Gender	Female	445	72.2
	Male	171	27.8
Nationality	Saudi	572	92.9
	Non-Saudi	44	7.1
Marital status	Single	230	37.3
	Married	354	57.5
	Divorced	23	3.7
	Widowed	9	1.5
Educational status	Primary	12	1.9
	Intermediate	20	3.2
	High school	136	22.1
	Diploma	71	11.5
	College and above	18	2.9
	Bachelor's	299	48.5
	Postgraduate studies	45	7.3
	Illiterate	15	2.4

Occupational status	Student	76	12.3
	Employee	262	42.5
	Unemployed	220	35.7
	Free trade	20	3.2
	Retired	38	6.2
Have you been diagnosed with diabetes?	No	514	83.4
	Yes	102	16.6

As shown in figure 1, By analyzing the data that is provided about elapsed time, or duration, that people had Diabetes Mellitus in, across a sample size of 616 people, it follows that a significant number of respondents have yet to be diagnosed with diabetes — 503 of them, or 81.5% of the total sample. Of those diagnosed, 27 people (4.4% of all diagnosed) were living with the condition for over one year, and 35 (5.7% of all diagnosed) had a duration between one and five years. In addition, 22 individuals (3.6%) state that they have suffered with diabetes for 5 to 10 years and 29 people (4.7%) for more than 10 years.

Figure (1): Illustrates duration of DM among participants.
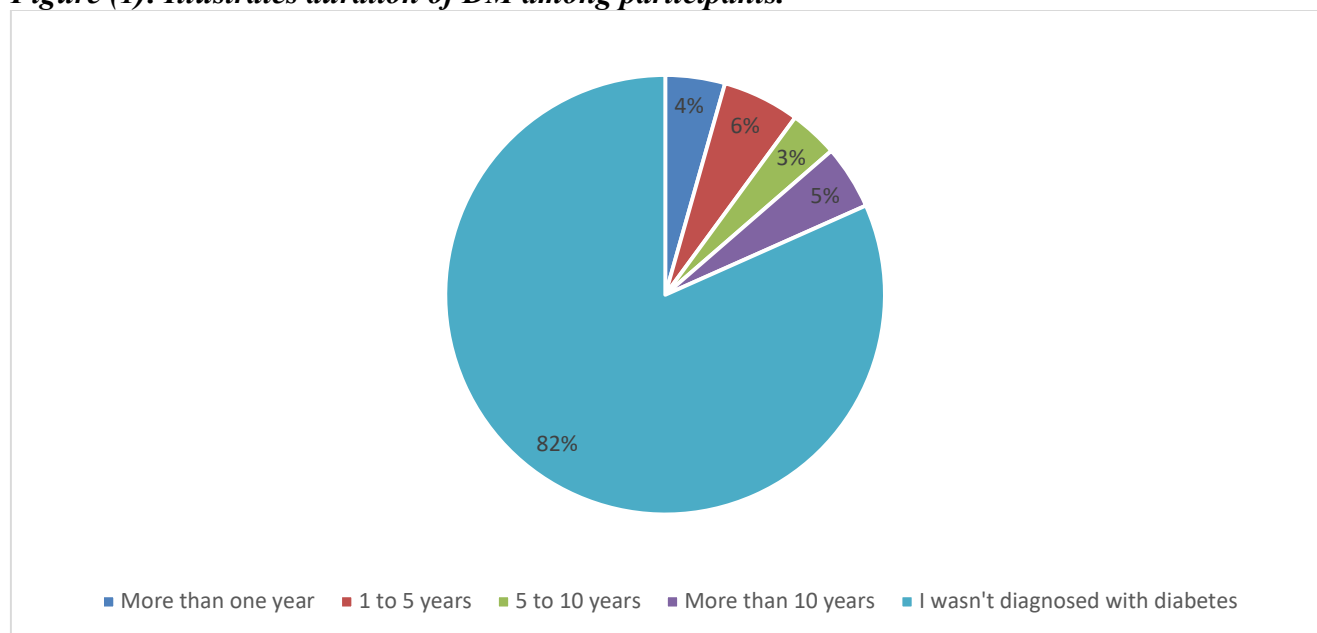

Table 2 contains data which provides critical ones for general knowledge and experience regarding Diabetes Mellitus (DM) among a sample population of 616 individuals. Notably, 81.7 percent indicated not having been diagnosed with diabetes; given this substantial majority a potential need for increased awareness and screening. Duration of diabetes, ranging over one year in the number diagnosed, were only 4.4%, suggesting that many may not be receiving enough follow up care. Among 27.3% who mentioned the sources of information regarding common complications of DM, relatives were dominant in indicating that the networks of family were influential for health education. A critical amount of awareness of DM complications is relatively robust, but a significant portion is still unaware of critical risks to their health, including heart disease and stroke, as 38.8% and 40.1% of respondents expressed uncertainty about those health risks.

Table (2): Parameters related to general information about DM and knowledge of common complications of DM (n=616).

Parameter		No.	Percent (%)
Duration of Diabetes Mellitus	More than one year	27	4.4
	1 to 5 years	35	5.7
	5 to 10 years	22	3.6
	More than 10 years	29	4.7
	I wasn't diagnosed with diabetes	503	81.7
From whom you heard about DM complications?	Diabetologists	119	19.3
	Family Medicine doctors	76	12.3
	Other doctors	30	4.9
	Relatives	168	27.3
	Social media	115	18.7
	Books, Papers	36	5.8
	Volunteer campaigns	10	1.6
	Others	30	4.9
	Never heard about it	32	5.2
Do you Know If DM can lead to heart disease?	I know	377	61.2
	I don't know	239	38.8
Do you Know If DM can lead to Stroke?	I know	369	59.9
	I don't know	247	40.1
Do you Know If DM can lead to loss of vision?	I know	526	85.4
	I don't know	90	14.6
Do you Know If DM can lead to renal disease?	I know	440	71.4
	I don't know	176	28.6
Do you Know If DM can lead to Sexual impairment?	I know	418	67.9
	I don't know	198	32.1
Do you Know If DM can lead to Peripheral neuropathy?	I know	434	70.5
	I don't know	182	29.5
Do you Know If DM can lead to Amputation?	I know	553	89.8
	I don't know	63	10.2
Do you Know If DM can lead to Poor wound healing?	I know	548	89.0
	I don't know	68	11.0
Do you Know If DM can lead to Dental Problems?	I know	464	75.3
	I don't know	152	24.7

As shown in figure (2), The results presented suggest a strong level of awareness by the surveyed population regarding hyperglycaemia's complications, such as increased thirst. From a total n=616 size sample, 85.5% (n=527) recognized the critical association between this and managing diabetic symptoms, with a solid foundation regarding how to manage such symptoms with diabetes. However,

14.5% (n=89) of respondents reported a lack of knowledge about hyperglycaemia-related increased thirst.

Figure (2): Illustrates whether increased thirst is a complication of hyperglycemia among participants.
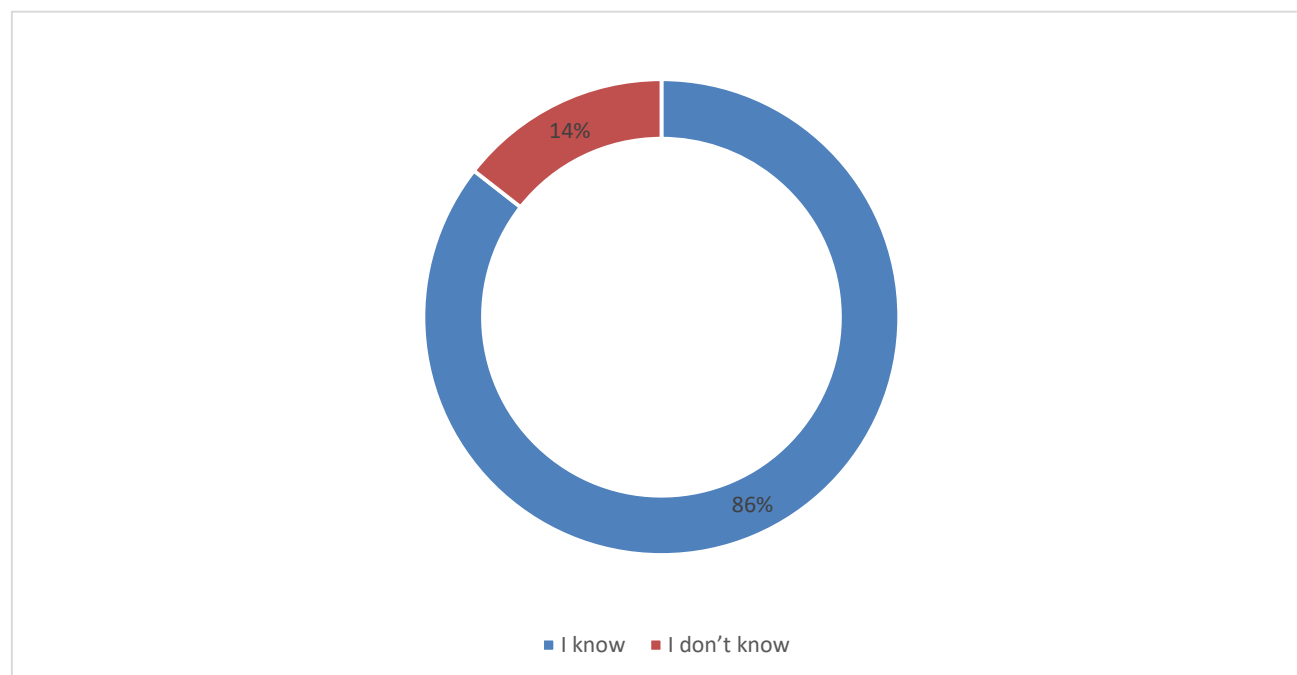

Table 3 displays compelling data concerning what is known about complications related to hyperglycemia and hypoglycemia amongst 616 participants. A notable majority (85.6%) recognized increased thirst as a complication of hyperglycemia, and (91.9%) increased urination, and a very strong awareness of these key symptoms. However, understanding of weight loss is more varied as 77.3% agreed there is an association with hyperglycemia suggesting a need for further education regarding this less discussed consequence. In hypoglycemia, for instance, dizziness (88.1 percent) and loss of consciousness (87.7 percent) were also well-known complications, and the level of awareness of participants in these areas was at a high level. Attention is however needed to the fact that as many as one third (35.2 %) of participants were not aware of palpitations as a hypoglycemia symptom, hence, a large gap in knowledge that calls for specific educational interventions.

Table (3): participants' knowledge of hyperglycemia and hypoglycemia complications (n=616).

Parameter		No.	Percent (%)
Increased thirst is a complication of hyperglycemia	I know	527	85.6
	I don't know	89	14.4
Increase urination is a complication of hyperglycemia	I know	566	91.9
	I don't know	50	8.1
Blurred vision is a complication of hyperglycemia	I know	524	85.1
	I don't know	92	14.9
Fatigue is a complication of hyperglycemia	I know	506	82.1

	I don't know	110	17.9
Weight loss is a complication of hyperglycemia	I know	476	77.3
	I don't know	140	22.7
Palpitation is a complication of hypoglycemia	I know	399	64.8
	I don't know	217	35.2
Tremor is a complication of hypoglycemia	I know	489	79.4
	I don't know	127	20.6
Increased sweating is a complication of hypoglycemia	I know	469	76.1
	I don't know	147	23.9
Dizziness is a complication of hypoglycemia	I know	543	88.1
	I don't know	73	11.9
Increase hunger is a complication of hypoglycemia	I know	486	78.9
	I don't know	130	21.1
Loss of consciousness is a complication of hypoglycemia	I know	540	87.7
	I don't know	76	12.3

Table 4 shows data that demonstrates the level of knowledge and awareness among a geographically surveyed population in comparing their levels of knowledge and awareness regarding complications associated with diabetes mellitus (DM). A large majority of 60.6% (373 people) showed a high knowledge level about potential DM complications and associated preventive measures, implying that the community has quite a lot of the knowledge about possible DM complications and thus required preventive measures. On the flip side, the data also reveals that moderate knowledge levels were also present within 18.7% of participants (115 people) and low knowledge within 20.8% (128 people).

Table (4): Shows knowledge and awareness about DM complications score results.

	Frequency	Percent
High level of knowledge	373	60.6
Moderate knowledge	115	18.7
Low knowledge	128	20.8
Total	616	100.0

Table (5) shows that knowledge of DM complications has statistically significant relation to gender (P value=0.007), age (P value=0.0001), nationality (P value=0.014), and marital status (P value=0.0001). It also shows statistically insignificant relation to educational level, occupational status, being diagnosed with DM, and duration of DM. Participants of female gender, age 45 or more, and married were found to have higher knowledge of DM complications.

Table (5): Relation between knowledge of DM complications and sociodemographic characteristics.

Parameters		Knowledge of DM complications		Total (N=616)	P value*
		High level of knowledge	Moderate or low knowledge		
Gender	Female	284	161	445	0.007
		76.1%	66.3%	72.2%	
	Male	89	82	171	

		23.9%	33.7%	27.8%	
Age	23 or less	66	103	169	0.0001
		17.7%	42.4%	27.4%	
	24 to 33	75	62	137	
		20.1%	25.5%	22.2%	
	34 to 44	100	46	146	
		26.8%	18.9%	23.7%	
	45 or more	132	32	164	
		35.4%	13.2%	26.6%	
Nationality	Saudi	354	218	572	0.014
		94.9%	89.7%	92.9%	
	Non-Saudi	19	25	44	
		5.1%	10.3%	7.1%	
Marital status	Single	110	120	230	0.0001
		29.5%	49.4%	37.3%	
	Married	250	104	354	
		67.0%	42.8%	57.5%	
	Divorced	7	16	23	
		1.9%	6.6%	3.7%	
	Widowed	6	3	9	
		1.6%	1.2%	1.5%	
Educational level	Primary	6	6	12	0.164
		1.6%	2.5%	1.9%	
	Intermediate	11	9	20	
		2.9%	3.7%	3.2%	
	High school	83	53	136	
		22.3%	21.8%	22.1%	
	Diploma	39	32	71	
		10.5%	13.2%	11.5%	
	College and above	8	10	18	
		2.1%	4.1%	2.9%	
	Bachelor's	191	108	299	
		51.2%	44.4%	48.5%	
	Postgraduate studies	30	15	45	
		8.0%	6.2%	7.3%	
	Illiterate	5	10	15	
		1.3%	4.1%	2.4%	
Occupational status	Student	39	37	76	0.319
		10.5%	15.2%	12.3%	
	Employee	165	97	262	
		44.2%	39.9%	42.5%	
	Unemployed	130	90	220	
		34.9%	37.0%	35.7%	
	Free trade	13	7	20	

		3.5%	2.9%	3.2%	
	Retired	26	12	38	
		7.0%	4.9%	6.2%	
Have you been diagnosed with diabetes?	No	304	210	514	0.108
		81.5%	86.4%	83.4%	
	Yes	69	33	102	
		18.5%	13.6%	16.6%	
Duration of Diabetes Mellitus	More than one year	16	11	27	0.103
		4.3%	4.5%	4.4%	
	1 to 5 years	22	13	35	
		5.9%	5.3%	5.7%	
	5 to 10 years	17	5	22	
		4.6%	2.1%	3.6%	
	More than 10 years	23	6	29	
		6.2%	2.5%	4.7%	
	I wasn't diagnosed with diabetes	295	208	503	
		79.1%	85.6%	81.7%	

***P value was considered significant if ≤ 0.05.**

Discussion:

The aim of the present study was to evaluate the awareness and the knowledge of diabetes mellitus (DM) complications in the Saudi Arabian population. Diabetes is a growing health problem in Saudi Arabia and we believe it has affected 2.5 million people [13] and so understanding the public knowledge of it's complications is key to improving health outcomes and providing effective educational interventions. However, in our study, we observed a very high DM complication knowledge levels among participants (60.6%) and low DM complication knowledge levels (20.8%). Consistent with [14], who also found that many of the participants in their study did not know about the complications of diabetes, especially with respect to glycemic control. Similar to [15], we showed that misconceptions about diabetes treatment persisted among attendees of primary health care center, highlighting a broader problem of misinformation which could undermine effective disease management. Results from the current study underscore the need for targeted educational programs to fill these knowledge gaps, and in particular those groups that had relatively less awareness, such as younger individuals and those with less formal education.

Our demographic analysis of our participants showed that a lot were women (72.2%) which is in line with what has been seen in other studies that the prevalence of diabetes awareness is higher among women as opposed to men [16]. This may result from various socio-cultural influence of health seeking behaviors and access to information. For instance, [16] comment that female patients are more active in taking part in health education initiatives which may account for their higher level of diabetes complications awareness. Also, our results indicated that marital status and age were independent variables which significantly influenced knowledge levels, married persons and those above the age of 45 years being more aware. This is backed up by research from [17] which indicate that older adults have more exposure to the management of diabetes and so have some understanding of the complications associated with it. Interestingly, although a number of participants agreed on the more common forms of hyperglycemia, such as the increased thirst and urination, a large number of the

participants understood nothing about other risks, such as diabetic foot complications and cardiovascular diseases. In particular, 38.8 percent and 40.1 percent of respondents were unsure about the risks of heart disease and stroke. This gap in knowledge is troubling, because it supports the findings in [18], who noted the crucial role of education on all different aspects of diabetes management to avoid complicated diseases. It is particularly alarming that in Saudi Arabia, the foot ulcers are the most common cause, second only to gangrene, of admission of diabetic patients to the hospital [19]. This highlights the pressing need to educate the public beyond mere awareness of common symptoms to lessons of the much less known yet equally critical complications of diabetes.

In addition, over 70% of participants found that relatives are their source for where to learn about diabetes complications and in fact, 27.3% of respondents revealed relatives as their main source of diabetes complications information. Similarly, our work echoes that of [20], who found that patients frequently lacked professional health education pertaining to diabetes management, causing many to hold misconceptions about its treatment. The implication of this finding was that healthcare professionals to disseminate the correct information on diabetes and its complications needed to work with families and communities to achieve so. This could improve our understanding of the disease and give patients an opportunity to take more active steps to help improve their health.

The present study must also be acknowledged for its limitations. Due to their cross-sectional design, knowledge levels cannot be directly linked causally with demographic factors. Additionally, the online survey may have been skewed due to exclusionary methods in that people without internet access were most likely excluded, however this sample, would have been more educated and more tech savvy. Future studies could use mixed method approaches that will capture a more complete view of diabetes knowledge across diverse populations in Saudi Arabia.

Conclusion:

In conclusion, while the present study indicates a commendable level of awareness regarding certain diabetes complications among the Saudi population, significant gaps remain that necessitate immediate attention. The findings underscore the importance of targeted educational interventions that address the specific knowledge deficits identified in this study. By enhancing public understanding of diabetes and its complications, we can improve health outcomes and reduce the burden of this chronic disease in Saudi Arabia.

Acknowledgement:

Ethical approval:

After fully explaining the study and emphasizing that participation is optional, each participant gave their informed consent. The information gathered was safely stored and utilized exclusively for study.

Funding:

Conflict of interests:

The authors declare no conflict of interest.

Informed consent:

Written informed consent was acquired from each individual study participant.

Data and materials availability:

All data associated with this study are present in the paper.

References:

1. Belsti Y, Akalu Y, Fekadu H, Animut Y. Awareness of complications of diabetes mellitus and its associated factors among type 2 diabetic patients at Addis Zemen District Hospital, northwest Ethiopia. BMC Res Notes [Internet]. 2019;12(1):1–7. Available from: https://doi.org/10.1186/s13104-019-4637-x

2. Abdulghani HM, AlRajeh AS, AlSalman BH, AlTurki LS, AlNajashi NS, Irshad M, et al. Prevalence of diabetic comorbidities and knowledge and practices of foot care among diabetic patients: A cross-sectional study. Diabetes, Metab Syndr Obes. 2018;11:417–25.

3. Ahmed IB, Binnwejim MS, Alnahas TM, Raes AAA, Basamad MA, Alqurashi AE, et al. Level of diabetic patients' knowledge of diabetes mellitus, its complications and management. Arch Pharm Pract. 2019;10(4–2019):80–6.

4. Malik S, Billimek J, Greenfield S, Sorkin DH, Ngo-Metzger Q, Kaplan SH. Patient complexity and risk factor control among multimorbid patients with type 2 diabetes: Results from the R2D2C2 study. Med Care. 2013;51(2):180–5.

5. Caroline S. Blaum, MD, MS*, Christine T. Cigolle, MD, MPH†, Cynthia Boyd, MD, MPH‡, Jennifer L. Wolff, PhD§, Zhiyi Tian, MA, MS¶, Kenneth M. Langa, MD, PhD‖ and DR, Weir P. Clinical Complexity in Middle-Aged and Older Adults With Diabetes: Bone [Internet]. 2014;23(1):1–7. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3624763/pdf/nihms412728.pdf

6. AlOwais M, Shido O. Knowledge and practice of foot care in patients with diabetes mellitus attending primary care center at Security Forces Hospital, Riyadh, Saudi Arabia: A cross-sectional study. J Fam Med Prim Care. 2020;9(12):5954.

7. World Health Organization (WHO). Global Report on Diabetes. Geneva SW 2016. World Health Organization (WHO). Global Report on Diabetes. Isbn. 2016;978(April):6–86.

8. 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.

9. Alluhaymid YM, Alotaibi FY, Alotaibi AB, Albasha AM, Alnaim AS, Sabi EM, et al. Awareness of diabetic retinopathy among Saudis with diabetes type 2 in Riyadh city. J Fam Med Prim Care. 2020;9(8):4229–33.

10. Alreshidi FS, Alreshidi R, Al Shammary RN, Al-Bluwe AJ, Aldogeman RZ, Alrasheedi HM, et al. Awareness of Saudi diabetic adults about complications of diabetes mellitus in Hail region. Med Sci. 2023;27(132):1–8.

11. Alanazi MA, Almutaz AI, Aldhwain SE, Alasmari BA, Alfarhan SM, Barakat MY, et al. Awareness of General Population of Saudi Arabia toward Diabetic Complications. World Fam Med J /Middle East J Fam Med. 2021;19(10):1–8.

12. Alrasheedi AA, Alqesair MH, Aljurbua HF, Alfanoud GA, Almakrami MH, J. Mohammad JE. Knowledge of Complications of Diabetes Mellitus Among Patients Visiting the Diabetes Clinics: A Cross-Sectional Study in the Qassim Region. Cureus. 2023;15(Dm):1–8.

13. Shaqra, S., Bashawri, H., Bahadur, R., Bahadur, O., Abdulmajeed, R., Alshalihi, M., … & Alharbi, K. (2022). Assessment of diabetes mellitus related knowledge and its association with glycemic control level among adult diabetic patients attending ministry of health primary health care centers in makkah al mukarramah, saudi arabia. International Journal of Health Sciences, 4230-4258. https://doi.org/10.53730/ijhs.v6ns9.13674

14. Alzaheb, R. and Altemani, A. (2018). The prevalence and determinants of poor glycemic control among adults with type 2 diabetes mellitus in saudi arabia. Diabetes Metabolic Syndrome and Obesity Targets and Therapy, Volume 11, 15-21. https://doi.org/10.2147/dmso.s156214

15. Alwan, Y., Alayed, I., Albarakati, M., Alaryni, M., Kashaba, G., Alkateeb, A., … & Adham, S. (2017). Assessing awareness about diabetes mellitus among attendees of primary health care centers, makkah, saudi arabia. The Egyptian Journal of Hospital Medicine, 66, 57-65. https://doi.org/10.12816/0034634

16. Bakhuraysah, M., Alsalmi, S., Alfadli, S., Alotaibi, S., Althomali, D., Gharib, A., … & Alhuthali, H. (2022). Assessing the knowledge and awareness of self-management among diabetic patients in saudi arabia. Research Review. https://doi.org/10.52845/jmrhs/2022-5-7-5

17. Alshammari, Z., Alsaid, L., Parameaswari, P., & Alzahrani, A. (2019). Attitude and knowledge about foot care among diabetic patients in riyadh, saudi arabia. Journal of Family Medicine and Primary Care, 8(6), 2089. https://doi.org/10.4103/jfmpc.jfmpc_248_19

18. Alramadan, M., Afroz, A., Siddiquea, B., Alabdullah, N., Alameer, S., Alragas, A., … & Billah, B. (2019). Health-related quality of life for people with type 2 diabetes in saudi arabia: a cross-sectional study.. https://doi.org/10.21203/rs.2.19689/v1

19. Algshanen, M., Almuhanna, M., Almuhanna, A., Alghobaish, F., bari, O., Alajji, N., … & Alzamanan, M. (2017). Diabetic foot awareness among diabetic patients in saudi arabia. The Egyptian Journal of Hospital Medicine, 68(2), 1289-1290. https://doi.org/10.12816/0039063

20. Alhazmi, R., Ahmed, A., Alshalan, M., Alfuhigi, Z., Alhazmi, S., Aldughmi, A., … & Almadani, S. (2017). Prevalence of diabetes mellitus and its relation with obesity in turaif (saudi arabia) in 2017. Electronic Physician, 9(10), 5531-5535. https://doi.org/10.19082/5531