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RESEARCH ARTICLE

THE LEVEL OF KNOWLEDGE ABOUT DIABETES MELLITUS COMPLICATIONS AND ITS DETERMINANTS AMONG PATIENTS WITH TYPE 2 DIABETES MELLITUS ATTENDING HERA DIABETIC CENTER IN MAKKAH AL-MUKARRAMAH, SEPTEMBER 2019, A CROSS SECTIONAL STUDY

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ABSTRACT

Background: Ongoing diabetic patient self-management education and support are critical to preventing acute complications and reducing the risk of long-term complications. Their knowledge about these complications could affect their practice toward disease control. **Objectives:** To assess the level of knowledge about DM complications and identify its determinants among T2DM patients attending Hera diabetic center, September 2019. **Subjects and methods:** A cross sectional analytic study was conducted at Hera Diabetic Center, MakkahAl-Mukarramah, Saudi Arabia among a sample of type 2 diabetic patients. A self-administered validated questionnaire was used in data collection. It composed of 3 parts: socio-demographic data, personal history of Diabetes and knowledge About DM complications. **Results:** Two hundred and seventy three patients were included in the present study. Their age ranged from 30 to 83 years (mean±standard deviation of 53.6±11 years). More than half of them were males (52.6%). More than half of the participated type 2 diabetic patients (52.7%) had adequate knowledge while 38.5% had inadequate knowledge regarding diabetic complications. Factors significantly associated with patients' knowledge of diabetic complications were marital status ($p<0.001$), educational level ($p=0.029$), income ($p=0.026$), history of referral for fundus examination (0.033) and checking foot annually ($p=0.029$) by physicians, history of diabetic complications among first degree relatives ($p=0.001$), glycemic control ($p=0.011$), avoid unhealthy food/drinks ($p=0.005$), practicing physical exercise ($p=0.005$), history of diabetic foot ulcer ($p=0.005$), and renal problems ($p=0.024$). **Conclusion:** Knowledge of type 2 diabetic patients regarding diabetic complications is overall acceptable. However, knowledge regarding some important diabetic complications is deficient. Health education for patients and the whole community is urgently needed.

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INTRODUCTION

Background: Diabetes mellitus is a chronic disease characterized by abnormal elevation of blood glucose level due to one of the two following mechanisms: inadequate production of insulin or inadequate sensitivity of body cells to the action of insulin. There are several types of DM. The main two types of correspond to these mechanisms are type 1 DM and type 2 DM. According to ADA diabetes mellitus is diagnosed based on plasma glucose criteria of the fasting plasma glucose or the 2-hours plasma glucose value during a 75gram oral glucose tolerance test, or hemoglobin A1C. Generally, all are equally appropriate for diagnostic testing (1). According to WHO More than 400 million people live with diabetes (2).

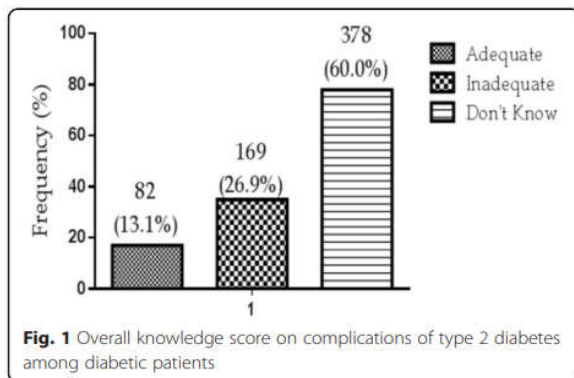
In KSA based on study was done in 2015 the prevalence of DM is 23.7%(3). Moreover, it is a growing health problem in Saudi Arabia(4). Diabetes is a complex, chronic illness requiring continuous medical care with multifactorial risk-reduction strategies beyond glycemic control. Ongoing patient self-management education and support are critical to preventing acute complications and reducing the risk of long-term complications(1). DM is also recognized as an important cause of premature death and disability (2). Therefore, knowledge level could affect patient's practice toward DM control. In this study we aimed to assess the knowledge of DM complications among type 2 DM patients.

Literature Review

After an extensive search of the literatures about knowledge toward dm complications. Researcher found several cross-sectional studies concerning this topic as follows:

- (4) International studies
 (1) Gulf country Studies
 (2) Local studies in KSA

International studies: Obirikorang et al, conducted a cross-sectional study was published in BioMedCentral public health journal in July 2016 to know the level of knowledge about DM complications among type 2 DM patients attending the diabetes clinic at Sampa Government Hospital, Ghana. On 630 patients 243 male and 387 female with mean age 55.28 ± 14.71 years. This study showed 60.0 % of T2DM patients have no knowledge on diabetes complications, 26.9 % had inadequate knowledge while 13.1 % had adequate knowledge. The least common diabetic complication recognised by diabetic patients was renal disease (5.4%), then by heart disease (9.2%), retinal disease (17.7%), arousal disorder (21.5%), hypoactive sexual arousal (25.4%), nerve impairment (29.2%), and high blood pressure (35.4%), while the most common complication were recognized was diabetic foot (51.5%). Male gender, high income, high educational level, and longer duration of T2D were significantly associated with adequate diabetic complications knowledge (5).



Ullah et al in their cross-sectional study published in Journal of Ayub Medical College 2015 which reviewed total of 96 diabetic patients admitted in the Medical Department, Khyber Teaching Hospital, Pakistan, 58 were females and 38 were males. Mean age was 53.29 ± 10.821 years. This study showed the level of knowledge about DM complications, 36 (37.50%) of patients had good knowledge, 24 (25%) of patients had average knowledge and 36 (37.50%) of patients had poor knowledge. Most of them (72.91%) patients were aware that DM is associated with foot ulcers, renal problems 66.66%, 55.2% visual problems and blindness, ranged from 50–60% different cardiovascular complications like angina, myocardial infarction, and hypertension. It is been founded that significant association between university level education and good knowledge regarding the DM complications ($p < 0.05$). women patients are unaware of the complications compared with the male patients, but this difference was not statistically significant ($p > 0.05$). (6) Aruna et al published in International Journal of Comprehensive Nursing, 2014 a cross sectional study conducted in a selected village in kanchipuram District, Tamil Nadu, India. Over 100 diabetic patients, only 7% of patients had adequate knowledge (score 76-100%) on DM complications, 41% of them had moderate knowledge (score 51-75 %) and 52% had inadequate knowledge (score 50 % and less). There was no significant association between Personal statistics (age, gender, religion, education, work pattern, family history of diabetes mellitus, duration of having diabetes mellitus, treatment taken, dietary pattern and

experience of having complications) and knowledge level $p > 0.05$. (7) Shannon Shaleneet al conducted a cross sectional study enrolled 43 diabetic patients attending outpatient pharmacy, Colonial War Memorial Hospital, Fiji. 14% of patients had adequate knowledge (score $\geq 85\%$), 19% had moderate knowledge (score 70-85%), 44% had inadequate knowledge (score 50-70%) and 23% had very low knowledge. There was an association between educational level, duration of DM and knowledge scores. (8)

Studies in gulf countries

In UAE an outpatient hospital based study (Al-Maskari et al. 2013), 572 diabetic patients were involved. 55% were females while The mean (SD) age of the sample was 50 (15) years. In this study the majority of patients 36% had fair knowledge (score of 15–18), followed by good knowledge 33% (score of 19–23), then 31% had poor knowledge (0–14). 93 % of patients recognized blindness is a complication of DM. It's been showed a positive correlation between regular appointments with diabetic educators (in the past 2 years) and patients' knowledge. Also, also shows that a first degree relatives diagnosed with DM has a positive impact on diabetes knowledge. On the other hand, there is no correlation (statistically significant) between the level of knowledge and controlled HbA1c. This study reveal that 27% of patients had good controlled HbA1c (less than 7%). (9)

Studies in KSA: A local study (Alhabshan, Bin Huwaymil, and Alzaid 2018) assessing the level of awareness about complications of diabetic foot was conducted 920 diabetic patients, The mean age was 51 years old and 55.5% were females, Almost 66% of patients do not have diabetic complications. The majority of participant had sufficient knowledge regarding diabetic foot (77%), while 23% had insufficient knowledge. The higher educational level was significantly associated with good knowledge and impacts the care of the diabetic foot injury but there was no correlation between knowledge with age and gender. (10) Another Cross-Sectional study conducted during the period from 2015-2016. (Fatani, Gari, and Alharbi 2018) enrolled 299 DM patients selected from different geographical areas in makkah. Participants were asked if they ever heard of diabetes mellitus complications if HbA1c was uncontrolled, Nearly (80%) heard about it from different information resources (Diabetologists (23.7%), relatives (20%), social media (18.7%), and from other doctors (10.7%). Common complications of DM as recognized by participants were as follow in order: retinopathy (72.9%), diabetic foot (71.2%), nephropathy (56.2%), peripheral neuropathy (53.8%), sexual impairment (42.5%), cardiac disease (40.1%), hypertension (33.1%), sudden death (20.4%), and cerebrovascular disease (18.7%). (11)

Aim of the study: The aim of this study is to evaluate the knowledge of diabetes mellitus complications among type 2 diabetic patients. Therefore increase level of Knowledge about DM complications and improving the glycemic control among them.

Objectives

- To assess the level of knowledge about DM complications among T2DM patients attending Hera diabetic center, September 2019.

- To identify the determinants of the level of knowledge about DM complications among T2DM patients attending Hera diabetic center, September 2019.

MATERIALS AND METHODS

Study Design: A cross sectional analytic study.

Study Area: The study was conducted in MakkahAl-Mukarramah, the center of the Islamic world, known to the Muslim faithful as Umm al-Qura, the Mother of Cities. Which has a large number of different nationalities and different cultures. According to Ministry of Health (MOH) in Makkah, there are two diabetic centers including Al-Noor diabetic center and Hera diabetic center. The researcher applied the study at Hera Diabetic Center. The center was selected through simple random technique.

Study Population: All type 2 diabetic patients attending Hera diabetic center.

Inclusion Criteria

- All diabetes mellitus patients who are officially registered in the Hera diabetic center during the study period
- Type 2
- Both gender
- All nationalities

Sample size: As provided officially by the statistical office of Hera Diabetic Center, The total number of T2DM patients during September is 2310 patients. By using Raosoft statistical program the sample size will be calculated. the prevalence of DM in KSA is 23.7% according to a study was done on 2015 (3), so prevalence of 23.7% will be taken and the confidence interval will be 95% with a margin of error of 5%.As calculated, the sample size is 249T2DM patients. +10% the total sample size is 273.

Sampling technique: The total number of T2D patients during September 2018 was 3106 patients. Sample size 273 was divided by 20 working days during September 2019 (150 T2DM patient seen per day), by proportion the research took 14 participants per day. There are 7 diabetic clinics in the center 2 participants were taken from each clinic, then systematic random sampling technique on participants was applied from the patient's appointments list.

Data collection tool (instrument): Based on self-administered questionnaire in both Arabic and English language with data collection sheet, it was validated by two consultants.

The study questionnaire consists of 3 parts:

- Socio-demographic data
- Personal history of Diabetes
- Knowledge about DM complications

The knowledge of the participants was assessed using multiple questions; each correct question was assigned one mark, addressing:

- The types of DM complications (diabetic foot, neuropathy, nephropathy, retinopathy, sexual impairment and cerebrovascular disease)
- complications screening (wound, nail cut care, annual retinal screen by ophthalmologist, annual foot check up by doctor)
- Based on the correct answers score was calculated. Score was classified as adequate if answered correctly by $\geq 70\%$, fair if answered correctly by 60-69%, or inadequate if answered correctly by $< 60\%$.

Data collection technique: The researcher gave a hard copy of the questionnaire to the selected participant in the waiting area after taking a written consent. The researcher took into consideration that the questionnaire not take more than 5 minutes. For illiterate participants, the researcher herself read the questionnaire as it was written to the participant and wrote their answers. The researcher was available in the waiting area and collected the questionnaire back by herself. Then, the researcher checked the file of each participants. Gathering the result of the investigation and the data collection sheet were filled from files either from the electronic version or the paper version .If the selected participant didn't come to the clinic or refused to participate, he or she was replaced. The total number of the sample size was increased by 10% to overcome the possibility of missing data (uncompleted questionnaire).

Study variables:

Dependent variables: Diabetes: level of diabetes complications knowledge

Independent variables:

- Personal: Age, gender, nationality, marital status, education status , occupation, place of residence and income.
- Diabetes: duration of the disease, compliance to medication, compliance to diet and exercise, compliance to follow up, control of the disease, compliance to complication screening, current or previous DM complication and regular visit to diabetic educators.
- Other comorbidities.
- Family: Health care family member, family support and family member have DM or DM complications.

Data entry and analysis: Data were analyzed using the Statistical Program for Social Sciences (SPSS) software version 25.0. Qualitative variables were expressed in frequency and percentage while quantitative variables were expressed in mean and standard deviation (SD). Knowledge categorical variable association with other categorical variables were assessed with chi square test. One-way analysis of variance test (ANOVA) was utilized to compare means of a continuous variables between the three categories of knowledge level and significance was considered at $p\text{-value} < 0.05$.

Pilot study/pretesting: A pilot study was conducted on 10% of the sample size (25 patients) in Al-Noor diabetic center due to similarity to the target population using same data collection techniques, and applied full methodology to test if the study questionnaire is understandable and acceptable. As a result, the questionnaire was understandable and methodology was feasible and no change needed.

Budget, Fund or Grant: Self-funded study.

RESULTS

Socio-demographic characteristics: Two hundred and seventy three type 2 diabetic patients were included in the present study. Their age ranged from 30 to 83 years (mean±standard deviation of 53.6±11 years). More than half of them were males (52.6%) and majority (86.4%) were Saudis. Approximately two-thirds of them (69.6%) were married and majorities (87.5%) live in Makkah. University graduated patients represent 30.7% of the participants whereas illiterates represent 22% of them. Nearly half of the patients (47.6%) had a family income of 5000 SR or less. Unemployed patients represent 42.5% of the participants while 31.1% were employed.

Table 1. Socio-demographic characteristics of type 2 diabetic patients, Hera Diabetic Center, MakkahAl-Mukarramah

Socio-demographic characteristics	Frequency N=273	Percentage
Gender		
Male	145	52.6
Female	128	47.4
Age (years)		
Range	30-83	
Mean±SD	53.6±11	
Nationality		
Saudi	236	86.4
Non-Saudi	37	13.6
Marital status		
Married	190	69.6
Single	23	8.4
Divorced	21	7.7
Widowed	39	14.3
Place of residence		
Makkah	239	87.5
Outside Makkah	34	12.5
Level of education		
University	84	30.7
Secondary school	48	17.6
Intermediate school	42	15.4
Primary school	39	14.3
Illiterate	60	22.0
Family income (SR/month)		
<5000	130	47.6
5000-<10000	66	24.2
10000-<150000	48	17.6
≥15000	29	10.6
Occupation		
Student	4	1.5
Unemployed	116	42.5
Employed	85	31.1
Retired	68	24.9

Diabetes-related, life style and medical characteristics of the participants

Table 2 describes the diabetes-related, life style and medical characteristics of the participants. Duration of the disease was less than 5 years among 23.5% of the participants whereas it exceeded 20 years among 20.1% of them. Always commitment to diabetic diet was reported by 11.4% of patients while always avoidance of unhealthy food was mentioned by 26.7% of them. Almost half of patients (51.3%) never performing exercise whereas 20.5% performing exercise three or more times a week. Almost one-third (37.6%) of those who practicing exercise spent more than one hour or more as an average per day in performing exercise; mainly walking (91.7%). Always compliance with daily medication was mentioned by majority of patients (76.2%). Number of

antihyperglycemic drugs taken daily was two in 40.7% of patients whereas it exceeded three in 11.4% of them. More than half of patients (57.1%) were using insulin to treat diabetes. Most of the patients (70.7%) claimed always following diabetes regularly whereas only 11% always regularly visit any diabetic educators. Most of the participants (71.8%) reported that doctor arranged the referral for their fundus examination regularly, either every 6 months (48.5%) or every year (40.3%). Almost two-thirds (62.6%) had eye examination annually by ophthalmologist. Among those who had no annual eye examination, 26.5% believed that there is no need for such examination. Less than half of the patients (41.4%) had foot examination by doctor every year. Among those who had no annual eye examination, 23.1% believed that there is no need for such examination. About two-thirds of the participants (68.5%) have first degree relative with diabetes. Among them, 19.8% had one or more of the diabetic complications, mainly retinopathy (97.3%) and peripheral neuropathy (89.2%).

The prevalence of smoking among type 2 diabetic patients was 15.4% as realized from Figure 1. More than one-quarter of the patients (27.8%) had history of having family member in the medical field Figure 2. Most of the participants (71.4%) had history of co-morbid chronic diseases; mainly hypertension (48.4%) and dyslipidaemia (16.5%) as shown in Figure 3. More than half of the participants (52.4%) had history of one or more of diabetic complications; mainly peripheral neuropathy (37%), cataract (16.5%) and retinopathy (16.1%). Figure 4.

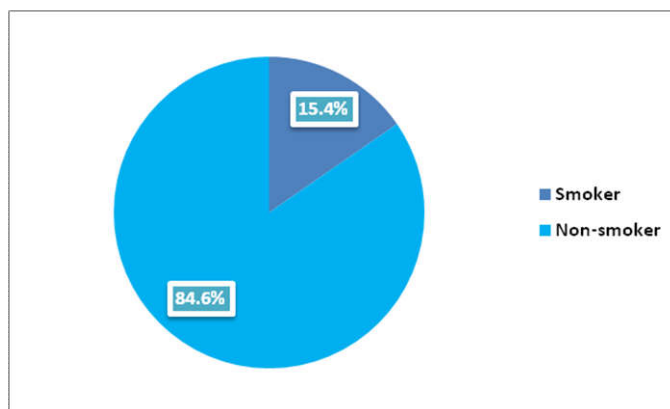


Figure 1. Prevalence of smoking among type 2 diabetic patients, Hera Diabetic center, MakkahAl-Mukarramah

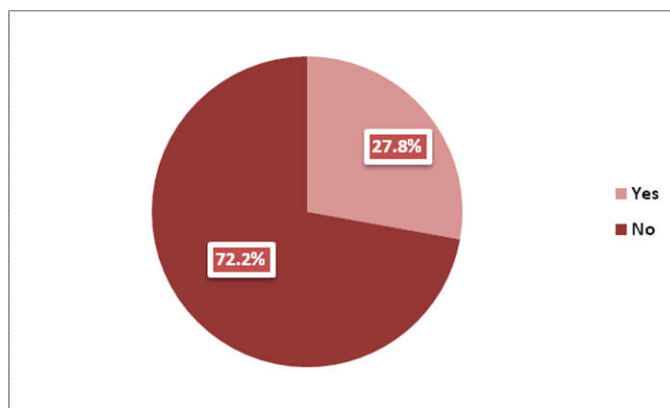


Figure 2. History of having family member in the medical field among type 2 diabetic patients, Hera Diabetic center, MakkahAl-Mukarramah

Table 2. Diabetes-related, life style and medical characteristics of of type 2 diabetic patients, Hera Diabetic Center, MakkahAl-Mukarramah

	Frequency	Percentage
Duration of diabetes (years)		
<5	64	23.5
5-<10	56	20.5
10-<15	59	21.6
15-<20	39	14.3
≥20	55	20.1
Commitment to diabetic diet		
Always	31	11.4
Usually	37	13.6
Often	58	21.2
Sometimes	122	44.6
Never	25	9.2
Avoid unhealthy foods/drinks		
Always	73	26.7
Usually	35	12.8
Often	63	23.1
Sometimes	77	28.2
Never	25	9.2
Commitment to exercise		
Three and more times a week	56	20.5
Less than three times a week	77	28.2
Never do exercise	140	51.3
Average duration of each exercise per day (n=133)		
< one hour	83	62.4
≥one hour	50	37.6
Type of regularly performed exercise (n=133)		
Walking	122	91.7
Others	11	8.3
Taking medications everyday on time		
Always	208	76.2
Usually	19	7.0
Often	27	9.9
Sometimes	14	5.1
Never	5	1.8
Number of antihyperglycemic drugs taken daily		
One	64	23.4
Two	111	40.7
Three	67	24.5
>three	31	11.4
Use of insulin to treat diabetes		
Yes	156	57.1
No	117	42.9
Follow diabetes regularly		
Always	193	70.7
Usually	27	9.9
Often	23	8.4
Sometimes	25	9.2
Never	5	1.8
Regular visit any diabetic educators		
Always	30	11.0
Usually	29	10.6
Often	26	9.5
Sometimes	58	21.2
Never	130	47.6
Doctor arrange the referral for fundus examination regularly		
Yes	196	71.8
No	77	28.2
If yes, how frequent? (n=196)		
Every 6 months	95	48.5
Every year	79	40.3
Every 2 years	22	11.2
Check the eye annually by ophthalmologist		
Yes	171	62.6
No	102	37.4
If no, what is the reason (n=102)		
Forget appointment	13	12.7
No transportation	15	14.7
No need	27	26.5
Others	47	46.1
Check the foot annually by the doctor		
Yes	113	41.4
No	160	58.6
If no, what is the reason (n=160)		
Forget appointment	31	19.4
No transportation	18	11.3

No need	37	23.1
Others	74	46.2
Having first degree relative with diabetes?		
Yes	187	68.5
No	86	31.5
If yes, does they have complications? (n=187)		
Yes*	37	19.8
Foot ulcer	10	27.0
Amputation	5	13.5
Stroke	18	48.6
Peripheral neuropathy	33	89.2
Renal diseases	25	67.6
Heart failure	17	45.9
Myocardial infarction	18	48.6
Glucoma	10	27.0
Cataract	24	64.9
Retinopathy	36	97.3
No/don't know	150	80.2

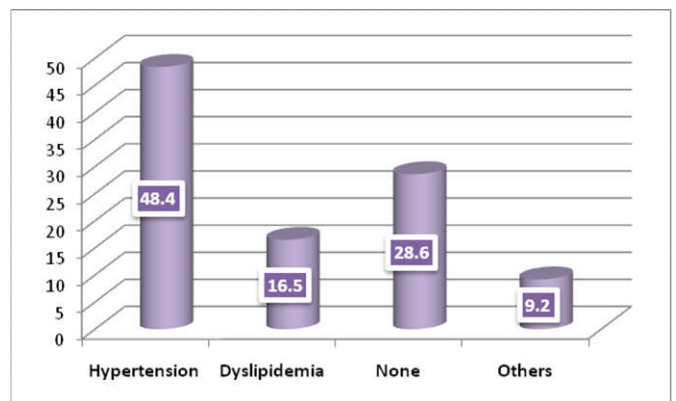


Figure 3. History of co-morbid chronic diseases among type 2 diabetic patients, Hera Diabetic center, MakkahAl-Mukarramah

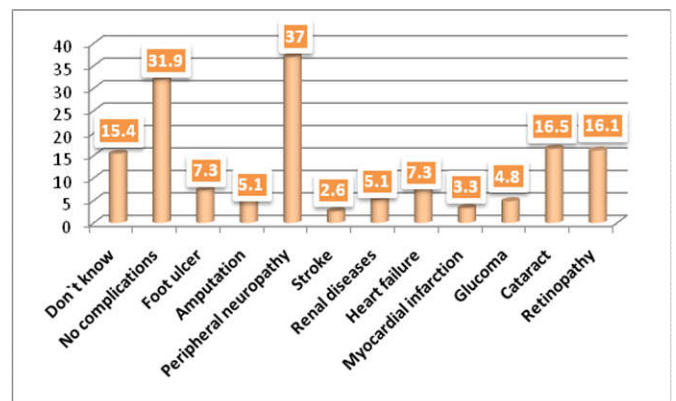


Figure 4. History of complications among type 2 diabetic patients, Hera Diabetic center, MakkahAl-Mukarramah

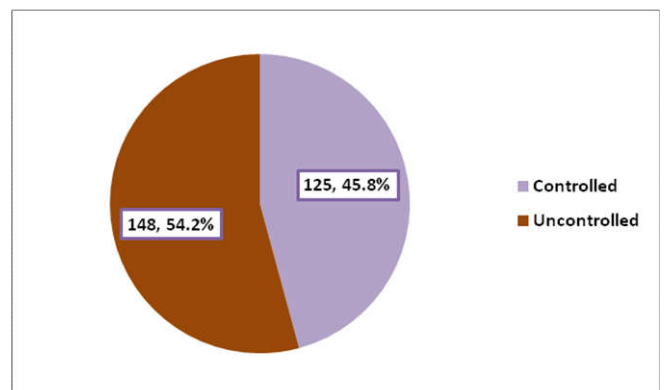


Figure 5. Glycemic control, based on HbA1c% among type 2 diabetic patients, Hera Diabetic center, MakkahAl-Mukarramah.

Knowledge about diabetic complications: Table 3 summarizes the responses of the participants regarding knowledge statements about diabetes complications. Most of them could recognize that diabetes mellitus could lead to eye and retinal diseases (86.1%), diabetic patient may have foot gangrene (81%), loss of sensation, numbness and tingling of extremities are amongst diabetic complications (78%) and diabetic patients should take extra care when cutting their toenails than non-diabetic subjects (77.7%).

(52.7%) had adequate knowledge while 38.5% had inadequate knowledge regarding diabetic complications as seen in Figure 6.

Factors associated with knowledge about diabetic complications:

Socio-demographic factors: From Table 4, it is clear that the highest level of adequate knowledge about diabetic complications was observed among divorced patients (81%)

Table 3. Response of the participants to knowledge statements regarding diabetic complications

Statements	Right answers	
	No.	%
Loss of sensation, numbness and tingling of extremities are amongst diabetic complications (YES)	213	78.0
Wounds heal normally in diabetic patients (NO)	167	61.2
Diabetic patients should take extra care when cutting their toenails than non-diabetic subjects (YES)	212	77.7
Foot ulcers are not existing in diabetic patients (NO)	137	50.2
Diabetes mellitus could lead to renal failure (YES)	183	67.0
Diabetes mellitus could lead to eye and retinal diseases (YES)	235	86.1
Sexual dysfunction is one of the diabetic complications (YES)	154	56.4
Diabetes mellitus does not lead to cerebrovascular diseases (NO)	97	35.5
Diabetic patient may have foot gangrene (YES)	221	81.0
Regular annual feet check-up by physicians is not important to prevent complications (NO)	174	63.7
Periodic eye check-up by physicians is not important to prevent complications (NO)	194	71.1

Table 4. Association between socio-demographic characteristics of type 2 diabetic patients and their knowledge about diabetic complications

	Level of Knowledge about diabetic complications			p-value
	Inadequate N=105 N (%)	Fair N=24 N (%)	Adequate N=144 N (%)	
Gender				
Male (n=145)	49 (33.8)	11 (7.6)	85 (58.6)	
Female (n=128)	56 (43.8)	13 (10.2)	59 (46.1)	0.117*
Age (years)				
Mean±SD	54.4±11.9	55.0±10.9	52.8±10.3	0.444**
Nationality				
Saudi (n=236)	87 (36.9)	21 (8.9)	128 (54.2)	
Non-Saudi (n=37)	18 (48.6)	3 (8.1)	16 (43.2)	0.385*
Marital status				
Married (n=190)	61 (32.1)	22 (11.6)	107 (56.3)	
Single (n=23)	13 (56.5)	1 (4.3)	9 (39.1)	
Divorced (n=21)	4 (19.0)	0 (0.0)	17 (81.0)	
Widowed (n=39)	27 (69.2)	1 (2.6)	11 (28.2)	<0.001*
Place of residence				
Makkah (n=239)	92 (38.5)	22 (9.2)	125 (52.3)	
Outside Makkah (n=34)	13 (38.2)	2 (5.9)	19 (55.9)	0.800*
Level of education				
University (n=84)	23 (27.4)	7 (8.3)	54 (64.3)	
Secondary school (n=48)	16 (33.3)	3 (6.3)	29 (60.4)	
Intermediate school (n=42)	17 (40.5)	3 (7.1)	22 (52.4)	
Primary school (n=39)	15 (38.5)	4 (10.3)	20 (51.3)	
Illiterate (n=60)	34 (56.7)	7 (11.7)	19 (31.7)	0.029*
Family income (SR/month)				
<5000 (n=130)	62 (47.7)	11 (8.5)	57 (43.8)	
5000-<10000 (n=66)	26 (39.4)	6 (9.1)	34 (51.5)	
10000-<150000 (n=48)	10 (20.8)	5 (10.4)	33 (68.8)	
≥15000 (n=29)	7 (24.1)	2 (6.9)	20 (69.0)	0.026*
Occupation				
Student (n=4)	2 (50.0)	1 (25.0)	1 (25.0)	
Unemployed (n=116)	50 (43.1)	12 (10.3)	54 (46.6)	
Employed (n=85)	28 (32.9)	4 (4.7)	53 (62.4)	
Retired (n=68)	25 (36.8)	7 (10.3)	36 (52.9)	0.259*
History of having family member in medical field				
Yes (n=76)	28 (36.8)	8 (10.5)	40 (52.6)	
No (n=197)	77 (39.1)	16 (8.1)	104 (52.8)	0.805*

* Chi-square test** ANOVA test

On the other hand, only 56.4% of them know that sexual dysfunction is one of the diabetic complications and 50.2% knew that foot ulcers are existing in diabetic patients. Almost one-third of the participants (35.5%) could recognize that diabetes mellitus can lead to cerebrovascular diseases. Overall, more than half of the participated type 2 diabetic patients

while the lowest rate was reported among widowed participants (28.2%). Overall, the marital status of the participants was significantly associated with knowledge level about diabetic complications, $p < 0.001$. University graduated participants were more knowledgeable compared to illiterates as adequate level of knowledge were reported among 64.3%

Table 5. Association between diabetes-related characteristics of type 2 diabetic patients and their knowledge about diabetic complications

	Level of Knowledge about diabetic complications			p-value
	Inadequate N=105 N (%)	Fair N=24 N (%)	Adequate N=144 N (%)	
Duration of diabetes (years)				
<5 (n=64)	26 (40.6)	7 (10.9)	31 (48.4)	
5-<10 (n=56)	26 (46.4)	3 (5.4)	27 (48.2)	
10-<15 (n=59)	26 (44.1)	3 (5.1)	30 (50.8)	
15-<20 (n=39)	10 (25.6)	7 (17.9)	22 (56.4)	
≥20 (n=55)	17 (30.9)	4 (7.3)	34 (61.8)	0.186
Taking medications everyday on time				
Always (n=208)	76 (36.5)	19 (9.1)	113 (54.4)	
Usually (n=19)	9 (47.4)	3 (15.8)	7 (36.8)	
Often (n=27)	10 (37.0)	2 (7.4)	15 (55.6)	
Sometimes (n=14)	5 (35.7)	0 (0.0)	9 (64.3)	
Never (n=5)	5 (100)	0 (0.0)	0 (0.0)	0.134
Number of antihyperglycemic drugs taken daily				
One (n=64)	23 (35.9)	7 (10.9)	34 (53.1)	
Two (n=111)	45 (40.5)	9 (8.1)	57 (51.4)	
Three (n=67)	20 (29.9)	8 (11.9)	39 (58.2)	
>three (n=31)	17 (54.8)	0 (0.0)	14 (45.2)	0.216
Use of insulin to treat diabetes				
Yes (n=156)	58 (37.2)	14 (9.0)	84 (53.8)	
No (n=117)	47 (40.2)	10 (8.5)	60 (51.3)	0.881
Follow diabetes regularly				
Always (n=193)	74 (38.3)	18 (9.3)	101 (52.3)	
Usually (n=27)	13 (48.1)	3 (11.1)	11 (40.7)	
Often (n=23)	10 (43.5)	0 (0.0)	13 (56.5)	
Sometimes (n=25)	6 (24.0)	3 (12.0)	16 (64.0)	
Never (n=5)	2 (40.0)	0 (0.0)	3 (60.0)	0.579
Regular visit any diabetic educators				
Always (n=30)	13 (43.3)	2 (6.7)	15 (50.0)	
Usually (n=29)	11 (37.9)	1 (3.4)	17 (58.6)	
Often (n=26)	11 (42.3)	2 (7.7)	13 (50.0)	
Sometimes (n=58)	18 (31.0)	5 (8.6)	35 (60.3)	
Never (n=130)	52 (40.0)	14 (10.8)	64 (49.2)	0.846
Doctor arrange the referral for fundus examination regularly				
Yes (n=196)	66 (33.7)	18 (9.2)	112 (57.1)	
No (n=77)	39 (50.6)	6 (7.8)	32 (41.6)	0.033
If yes, how frequent? (n=196)				
Every 6 months (n=95)	34 (35.8)	6 (6.3)	55 (57.9)	
Every year (n=79)	23 (29.1)	10 (12.7)	46 (58.2)	
Every 2 years (n=22)	9 (40.9)	2 (9.1)	11 (50.0)	0.547
Check the eye annually by ophthalmologist				
Yes (n=171)	62 (36.3)	17 (9.9)	92 (53.8)	
No (n=102)	43 (42.2)	7 (6.9)	52 (51.0)	0.506
If no, what is the reason (n=102)				
Forget appointment (n=13)	8 (61.5)	1 (7.7)	4 (30.8)	
No transportation (n=15)	3 (20.0)	1 (6.7)	11 (73.3)	
No need (n=27)	14 (51.9)	3 (11.1)	10 (37.0)	
Others (n=47)	18 (38.3)	2 (4.3)	27 (57.4)	0.186
Check the foot annually by the doctor				
Yes (n=113)	35 (31.0)	10 (8.8)	68 (60.2)	
No (n=160)	70 (43.8)	14 (8.8)	76 (47.5)	0.029
If no, what is the reason (n=160)				
Forget appointment (n=31)	17 (54.8)	3 (9.7)	11 (35.5)	
No transportation (n=18)	5 (27.8)	0 (0.0)	13 (72.2)	
No need (n=37)	17 (45.9)	6 (16.2)	14 (37.8)	
Others (n=74)	31 (41.9)	5 (6.8)	38 (51.4)	0.104
Having first degree relative with diabetes?				
Yes (n=187)	64 (34.2)	19 (10.2)	104 (55.6)	
No (n=86)	41 (47.7)	5 (5.8)	40 (46.5)	0.084
Having first degree relative with diabetic complications (n=187)				
Yes (n=37)	21 (56.8)	4 (10.8)	12 (32.4)	
No (n=150)	43 (28.7)	15 (10.0)	92 (61.3)	0.001
History of co-morbid diseases				
Yes (n=195)	78 (40.0)	13 (6.7)	104 (53.3)	
No (n=78)	27 (34.6)	11 (14.1)	40 (51.3)	0.137
Glycemic control				
Controlled (n=125)	37 (29.6)	10 (8.0)	78 (62.4)	
Uncontrolled (n=148)	68 (45.9)	14 (9.5)	66 (44.6)	0.011

and 31.7% of them, respectively ($p=0.029$). Also, patients with higher income (≥ 15000 SR/month) were more knowledgeable compared to those whose income was < 5000 SR/month as adequate level of knowledge were reported among 69% and 43.8% of them, respectively ($p=0.026$). Other factors (gender, age, nationality, place of residence, occupation and having family member in the medical field) were not significantly

associated with level of knowledge about diabetic complications.

Diabetes-related factors: More than half (57.1%) of patients whose doctor arranged the referral for fundus examination regularly for them compared to 41.6% of their counterparts had adequate knowledge regarding diabetic complications,

$p=0.033$. Similarly, 60.2% of patients who reported checking the foot annually by the doctor compared to 47.5% who did not have this history expressed adequate knowledge regarding diabetic complications, $p=0.029$. Patients whose first degree diabetic relative had no complications were more knowledgeable about these complications compared to those whose first degree diabetic relatives had complications (61.3% versus 32.4%), $p=0.001$. Type 2 diabetic patients with glycemic control (HbA1c <7%) were more knowledgeable than their counterparts (62.4% versus 44.6%), $p=0.011$. Table 5.

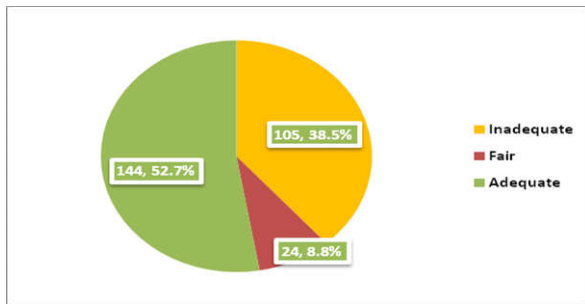


Figure 6. Overall knowledge level about diabetic complications among the participants

Life style-related factors: Adequate knowledge about diabetic complications was highest among patients who always avoid unhealthy foods/drinks and lowest among those who never avoid unhealthy foods/drinks (64.4% versus 44%), $p=0.005$.

Table 6. Association between life-style related characteristics of type 2 diabetic patients and their knowledge about diabetic complications

	Level of Knowledge about diabetic complications			p-value
	Inadequate N=105 N (%)	Fair N=24 N (%)	Adequate N=144 N (%)	
Commitment to diabetic diet				0.803
Always (n=31)				
Usually (n=37)	13 (41.9)	2 (6.5)	16 (51.6)	
Often (n=58)	10 (27.0)	3 (8.1)	24 (64.9)	
Sometimes (n=122)	27 (46.6)	5 (8.6)	26 (44.8)	
Never (n=25)	46 (37.7)	12 (9.8)	64 (52.5)	
Avoid unhealthy foods/drinks				0.005
Always (n=73)				
Usually (n=35)	24 (32.9)	2 (2.7)	47 (64.4)	
Often (n=63)	9 (25.7)	8 (22.9)	18 (51.4)	
Sometimes (n=77)	24 (38.1)	5 (7.9)	34 (54.0)	
Never (n=25)	34 (44.2)	9 (11.7)	34 (44.2)	
Commitment to exercise				0.005
Three and more times a week (n=56)	18 (32.1)	3 (5.4)	35 (62.5)	
Less than three times a week (n=77)	19 (24.7)	9 (11.7)	49 (63.6)	
Never do exercise (n=140)	68 (48.6)	12 (8.6)	60 (42.9)	
Average duration of each exercise per day (n=133)				0.620
< one hour (n=83)	22 (26.5)	9 (10.8)	52 (62.7)	
≥one hour (n=50)	15 (30.0)	3 (6.0)	32 (64.0)	
Type of regularly performed exercise (n=133)				0.497
Walking (n=122)	33 (27.0)	12 (9.8)	77 (63.1)	
Others (n=11)	4 (36.4)	0 (0.0)	7 (63.6)	
Smoking				0.235
Yes (n=42)	13 (31.0)	2 (4.8)	27 (64.3)	
No (n=231)	92 (39.8)	22 (9.5)	117 (50.6)	

Similarly, adequate knowledge about diabetic complications was highest among patients who practiced physical exercise in a rate of three and more times a week and lowest among those who never do exercise (62.5% versus 42.9%), $p=0.005$. Table 6.

History of diabetic complications: Patients who had diabetic foot ulcer were more knowledgeable about diabetic complications than those who had not (85% versus 50.2%), $p=0.005$. Patients who had peripheral neuropathy were more knowledgeable about diabetic complications than others (60.4% versus 48.3%). However, the difference was borderline insignificant, $p=0.053$. Patients who had renal problems were more knowledgeable about diabetic complications than their counterparts (71.4% versus 51.7%). The difference was statistically significant, $p=0.024$. Table 7

Table 7. Association between history of diabetic complications among type 2 diabetic patients and their knowledge about them

	Level of Knowledge about diabetic complications			p-value
	Inadequate N=105 N (%)	Fair N=24 N (%)	Adequate N=144 N (%)	
Diabetic foot ulcer				0.005
Yes (n=20)	1 (5.0)	2 (10.0)	17 (85.0)	
No (n=253)	104 (41.1)	22 (8.7)	127 (50.2)	
Amputation				0.344
Yes (n=14)	3 (21.4)	1 (7.1)	10 (71.5)	
No (n=259)	102 (39.4)	23 (8.9)	134 (51.7)	
Stroke				0.525
Yes (n=7)	2 (28.6)	0 (0.0)	5 (71.4)	
No (n=266)	103 (38.7)	24 (9.0)	139 (52.3)	
Peripheral neuropathy				0.053
Yes (n=101)	32 (31.7)	8 (7.9)	61 (60.4)	
No (n=172)	73 (42.4)	16 (9.3)	83 (48.3)	
Renal problems				0.024
Yes (n=14)	1 (7.1)	3 (21.4)	10 (71.4)	
No (n=259)	104 (40.2)	21 (8.1)	134 (51.7)	
Heart failure				0.722
Yes (n=20)	6 (30.0)	2 (10.0)	12 (60.0)	
No (n=253)	99 (39.1)	22 (8.7)	132 (52.2)	
Myocardial infarction				0.935
Yes (n=9)	3 (33.3)	1 (11.1)	5 (55.6)	
No (n=264)	102 (38.6)	23 (8.7)	139 (52.7)	
Glucoma				0.424
Yes (n=13)	3 (23.1)	2 (15.4)	8 (61.5)	
No (n=260)	102 (39.2)	22 (8.5)	136 (52.3)	
Cataract				0.905
Yes (n=45)	16 (35.6)	4 (8.9)	25 (55.6)	
No (n=228)	89 (39.0)	20 (8.8)	119 (52.2)	
Overall				0.854
Yes (n=87)	32 (36.8)	7 (8.0)	48 (55.2)	
No (n=186)	73 (39.2)	17 (9.1)	96 (51.6)	

DISCUSSION

Management of diabetes aims to decrease the disease symptoms, avoid immediate complications (hypoglycemia and hyperglycemia) as well as delaying the onset of long-term complications as these complications can result in morbidity and mortality (12). It has been documented that improving patient knowledge regarding diabetes and its complications has significantly increase patient compliance to therapy and consequently reduced diabetic complications. (13, 14) In this context, this study was carried out to assess the level of knowledge about DM complications among T2DM patients and identifying the factors associated with it. In the current study, more than half of the type 2 diabetic patients (52.7%) had adequate knowledge regarding diabetic complications.

Similar studies conducted locally or in different parts of the world reported different results mostly because of using various tools and cut-off values to assess knowledge of diabetic complications as well as different demographic characteristics of the participants. In Jeddah, the majority of diabetic patients had sufficient knowledge regarding diabetic foot (77%) (10). In UAE, 36% of diabetic patients had fair knowledge, 33% good knowledge whereas 31% had poor knowledge about diabetic complications (9). In Pakistan, 37.5% of diabetic patients had good knowledge of diabetic complications (6). In India, only 7% of patients had adequate knowledge on DM complications while 41% and 52% of them had moderate and inadequate knowledge, respectively (7). In Kenya, 26% of diabetic patients had good knowledge (15). In Ghana, only 13.1% of type 2 diabetic patients had adequate knowledge about diabetic complications, whereas 26.9% had inadequate knowledge and 60% had no knowledge at all (5). In Fiji, only 14% of patients had adequate knowledge, 19% had moderate knowledge, 44% had inadequate knowledge and 23% had very low knowledge (8). In the current study, the commonest known diabetic complications were those related to eye and retinal diseases (86.1%), followed by diabetic foot (81%), whereas the lowest known were sexual dysfunction (56.4%) and cardiovascular diseases (35.5%). In another Saudi study carried out in Makkah, the commonest recognized complications of DM were retinopathy (72.9%), diabetic foot (71.2%), nephropathy (56.2%), peripheral neuropathy (53.8%), sexual impairment (42.5%), cardiac disease (40.1%), hypertension (33.1%), sudden death (20.4%), and cerebrovascular disease (18.7%) (11). In UAE, blindness was recognized as a diabetic complication by 93% of patients (9). In Ghana (5), the most common recognized diabetic complication was diabetic foot (51.5%) while the least common diabetic complication recognized were renal disease (5.4%), heart disease (9.2%) and retinal disease (17.7%). In Pakistan, 72.91% of diabetic patients knew that DM is associated with diabetic foot, followed by renal problems (66.6%), visual problems (55.2%) and cardiovascular diseases (50%) (6). Also, in India, the most frequent known diabetic complication was diabetic foot (74.2%). (16) Visual problems and blindness were recognized by almost half of diabetic patients in Kenya. (17) In another Indian study, cardiovascular complications of diabetes mellitus were recognized by 64.4% of patients. (18) These differences could be attributed to variations in the rate of these complications in different countries and locations.

In the current study, patients with higher educational level were more knowledgeable regarding diabetic complications. The same has been observed in similar studies carried out in Jeddah (10), Ghana (5), Pakistan (6, 19), South Africa (20) and Fiji (8). In accordance with results of studies carried out in Ghana (5), patients with higher income in the current study had better knowledge regarding diabetic complications. Gender had no role in knowledge about diabetic complications in the present study. The same has been observed in a study carried out in Jeddah (10). However, in disagreement with this finding, males were more knowledgeable than females in a study carried out in Ghana (5). In the present survey, duration of diabetes was not related to knowledge level regarding diabetic complications. The same has been observed in other studies carried out in UAE (9) and India (7). However, in other studies conducted in Ghana (5) and Fiji (8), longer duration of T2D was significantly associated with adequate diabetic complications' knowledge. In this study, knowledge

regarding diabetic complication was influenced by marital status of the patients as the highest level of knowledge was observed among divorced patients while the lowest rate was reported among widowed participants. We have no explanation for that and we did not find similar findings in other studies. It could be influenced by other factors. Further research is needed to clarify this finding

In the current study, patients who seek care regularly such as fundus and foot examinations were more knowledgeable about diabetic complications. Also, patients whose first degree diabetic relative had no complications were more knowledgeable about diabetic complications, which could reflect the sufficient knowledge of the whole family about diabetic complication that manifested in lower rate or none of these complications among their members. This also confirmed by finding that patients with glycemic control (HbA1c <7%) were more knowledgeable than their counterparts. In a study carried out in UAE (9), first degree relatives diagnosed with DM has a positive impact on diabetes knowledge, but there was no correlation between the level of knowledge and controlled HbA1c. In the present study, regular visit of patients to diabetic educators was not associated with improvement of knowledge about diabetic complications among them. However in UAE (9), regular appointments with diabetic educators (in the past 2 years) were positively correlated with patients' knowledge. So, in our Region, the quality of information given by health educators to diabetic patients needs reconsideration. As regards life style, better knowledge about diabetic complications was observed among patients with healthy life style, manifested by always avoidance of unhealthy foods/drinks and practicing physical exercise in a rate of three and more times a week. In India (7), there was no significant association between dietary pattern and knowledge level about diabetic complications. In the present study, patients who had diabetic foot ulcer or renal problems were more knowledgeable about diabetic complications than those who hadn't these complications. However, due to the nature of the study as a cross-sectional one, we cannot decide who came first, but mostly these patients got enough knowledge after development of the complications. This study has two main limitations, firstly the included patients were recruited from a single diabetic center which affects our ability to generalize the results over diabetic patients in Makkah. In the same context, we included only type 2 diabetic, so we cannot generalize our results over the whole community. Secondly, the applied cross-sectional study had a problem in the temporal association regarding the cause-effect relationship.

Conclusion

Knowledge of type 2 diabetic patients attending Hera diabetic center, Makkah Al-Mukarramah regarding diabetic complications is overall acceptable as over half of them has adequate knowledge. However, knowledge regarding some important diabetic complications is deficient, particularly sexual dysfunction and cardiovascular disease complications. Knowledge regarding diabetic complications was influenced by patients' marital status, educational level, income, history of referral for fundus examination and checking foot annually by physicians, history of diabetic complications among first degree relatives, glycemic control, avoid unhealthy food/drinks, practicing physical exercise, history of diabetic foot ulcer, and renal problems.

Recommendations

1. Organizing health education activities to all diabetic patients attending healthcare facilities regarding diabetic complications and how to avoid and early discover them.
2. Mass media and social media should play an active role in educating people, not only patients regarding different diabetic complications.
3. Healthcare providers should pay more attention to educate diabetic patients.
4. Encourage diabetic patients to visit diabetic educators regularly and reconsider the quality of information given by diabetic educator to patients, by revision of the education contents by consultants of diabetology and family medicine.
5. Further more comprehensive study, preferably community-based is highly recommended as diabetes and its avoidable complications are quite common in our community.

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