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Association of Sociodemographic Characteristics and Lifestyle with Type 2 Diabetes Mellitus and Glycemic Control: A Cross-Sectional Study

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Abstract

Introduction/Aim: Type 2 diabetes mellitus is a major global public health problem affecting huge number of the population and Qatar is ranked among the top 10 countries with high diabetes prevalence. Identification of factors associated with poor glycemic control may help in planning for more comprehensive strategy of care, and better quality of life of diabetic patients.

Materials and Methods: A cross sectional study was conducted and included 510 type 2 diabetic patients attending non-communicable disease clinics at nine primary health care centers in Qatar aiming to explore sociodemographic factors and lifestyle patterns associated with poor glycemic control among them. A stratified cluster sampling technique with proportional allocation was utilized. HbA_{1c} level >7% was considered as poor control, while HbA_{1c} ≤7% was categorized as good control. The level of significance was set at $p<0.05$. Pre-coded structured interviewing questionnaire, Short form of the International Physical Activity Questionnaire, and Exercise Benefits/Barriers Scale were utilized. Review of medical records was done to collect the required information.

Results: Most patients were males (61.2%), 71.2% aged 50 years or more with a mean age of 53.4 ± 8.5 years. The majority was non-Qatari (73.3%). Near to half of patients (48.7%) had secondary education and above, and 32.5% were not working or housewives. The proportion of patients with poor glycemic control was high; 63.7%. Poor glycemic control was more common among non-smoker patients (65.8%) compared to regular/occasional and ex-smokers (64.5%, 52.2% respectively). Despite a high level of perceived benefits and barriers score of physical activity, very few numbers of the patients were performing physical activity. There was a significant positive correlation between perceived benefits and barriers score of physical activity and each of the days and time of moderate physical activity and those of walking.

Conclusion: Based on the findings of the study, it can be concluded that the proportion of patients with poor glycemic control was high; around two thirds of the patients, which is nearly comparable to that reported from many countries. There was a significant positive correlation between perceived benefits and barriers score of physical activity and each of the days and time of moderate physical activity and days and time of walking. The study demonstrates that poor glycemic control was found more commonly among some sociodemographic factors, however, none of these relations were found to be statistically significant ($p>0.05$).

Keywords: Glycemic control; Type 2 diabetes mellitus; Sociodemographic; Lifestyle; Primary health care

Introduction

Type 2 Diabetes Mellitus (T2DM) is a worldwide major public health problem. It is a global crisis that threatens the health and economy of all nations, particularly developing countries. It is one of the main chronic diseases currently affecting humankind, regardless of socioeconomic status and geographic location. It is the fourth or fifth leading cause of death in most high-income countries and there is a substantial evidence that it is changing into an epidemic in many low- and middle-income countries. Diabetes is certain to be one of the most challenging health problems in the 21st century [1].

The increasing prevalence of Diabetes Mellitus (DM) worldwide has led to a situation where approximately 360 million people had DM in 2011, of whom more than 95% had T2DM. This number is estimated to increase to 552 million by 2030 and it is thought that about half of those will be unaware of their diagnosis [2].

The goal of treatment in T2DM is to achieve and maintain optimal Blood Glucose (BG), lipid, and Blood Pressure (BP) levels to prevent or delay chronic complications of diabetes [3]. A patient's glycosylated hemoglobin (HbA_{1c}) level is an indicator of the status of glycemic control over the previous 3 months. A cut-off point of <7% indicates optimal glycemic control. Each percentage point reduction in HbA_{1c} was associated with a 35% reduction in micro-vascular complications and a 7% reduction in all-cause mortality [4].

The states of The Co-operation Council for the Arab States of the Gulf (GCC) including Qatar have some of the highest rates of T2DM in the world. Five of the International Diabetes Federation's (IDF's) 'top 10' countries for diabetes prevalence in 2010 and in 2030 are in this region [5].

Evidence suggests a link between poor glycemic control and negative health outcomes among patients with diabetes, and the full picture about the exact factors associated with achieving and sustaining glycemic control is fully clear. Glycemic control was found to be associated with age, race/ethnicity, duration of diabetes, type and number of medications taken, obesity, psychological variables, and family support [6].

Promotion of Physical Activity (PA) is one of the most important and effective strategies for reducing the risk of several chronic diseases including T2DM, Cardiovascular Diseases (CVD), osteoporosis, obesity and some types of cancer [7].

Compliance of diabetic patients with medical advice is essential for controlling the disease; it is affected by many factors related to the patient, the disease, the physician and the family [8]. Though there is a considerable evidence about health related benefits of lifestyle modifications for people with type-2 diabetes, it has often been observed that compliance to lifestyle related recommendations is not satisfactory among those patients [9].

Predictors of poor glycemic control can be deduced from the relationships between glycemic control and socio-demographic characteristics (gender, age, income, occupational status and educational level), the level of physical activity, obesity, dietary intake, and diabetic profile (including age at diagnosis, duration of diabetes, type of treatment, and complication) [10].

The main goal of this study is identifying the sociodemographic factors and lifestyle patterns associated with poor glycemic control among diabetic patients attending Primary Health Care Centers in Qatar in order to help in planning for more comprehensive strategy of care, and better quality of life of diabetic patients.

Materials and Methods

Study design and settings

A cross-sectional study conducted at non-communicable disease (NCD) clinics in nine health centers related to the Primary Health Care Corporation (PHCC).

Study population and data collection

Participants were adults diagnosed with T2DM and registered in the NCD clinics. Inclusion criteria included being adult aged 18 years or more, with history T2DM and willing to participate. Patients with communication problems (unable to answer the questions as those with dementia, dysarthria, and hearing impairment) were excluded.

Different tools have used in data collection included pre-coded structured interviewing questionnaire, International Physical Activity Questionnaire (IPAQ), Exercise Benefits/Barriers Scale (EBBS) and review of medical records.

Sample size calculation and sampling technique

The total sample size needed was 510. Stratified cluster sample technique with proportional allocation was utilized. Simple random sampling conducted to select nine health centers; three from each geographical region covered the country. A systematic random sampling technique utilized to recruit the participants.

Outcome Measures

Glycemic Control measured by HbA_{1c} percent which indicates the glycemic control during the past three months. A HbA_{1c} level >7% categorized as poor control, while $HbA_{1c} \leq 7\%$ categorized as good control [11,12]. The last HbA_{1c} reading within the medical record of the participant was used.

Study Tools

A. Pre-coded structured interviewing questionnaire.

B. International physical activity questionnaire (IPAQ).

C. Exercise benefits/barriers scale (EBBS).

D. Review of medical records.

International Physical Activity Questionnaire (IPAQ)

The International Physical Activity Questionnaire (IPAQ), [13] comprises a four generic items. The purpose of the questionnaire is to provide a common instrument that can be used to obtain internationally comparable data on health-related physical activity. The questionnaire measures the intensity of physical activity and sitting represented in weekdays. The questionnaire has acceptable measurement properties for use in many settings and in different languages. The questionnaire has passed extensive reliability and validity testing. It is recommended that no changes be made to the order or wording of the questions as this will affect the psychometric properties of the instrument. The questionnaire is already available in English [13] and Arabic [14] languages and both versions were used in the present study according to the nationality of the participants.

The IPAQ has long and short forms; the latter was utilized in the present study. The IPAQ long form asks details about the specific types of activities, including walking for transportation and moderate-intensity leisure-time activity.

The IPAQ short form asks about three specific types of activities including walking, moderate-intensity activities (activities that take moderate physical effort and make person breathes somewhat harder than normal like carrying light loads, bicycling at a regular pace, or doubles tennis) and vigorous-intensity activities (activities that take hard physical effort and make person breathes much harder than normal like heavy lifting, digging, aerobics, or fast bicycling). The items in the short IPAQ form were structured to provide separate scores on walking, moderate-intensity and vigorous-intensity activity.

Computation of the total score for the short form requires summation of the duration (in minutes) and frequency (days) of walking, moderate-intensity and vigorous-intensity activities. For the analysis of the IPAQ short form, the protocol can be achieved by continuous scores or categorical score. In continuous scores, median values and interquartile ranges can be computed for walking (W), moderate-intensity activities (M), vigorous-intensity activities (V) and a combined total physical activity score. All continuous scores are expressed in metabolic equivalent (MET-minutes/week). However, due to the small number of patients practicing physical activity, the categorical score was used in the present study. The categorical score is divided into three categories:

Category 1 (Low): is the lowest level of physical activity; including those who do not meet criteria for Categories 2 or 3.

Category 2 (Moderate): including any of the following criteria:

(a) Three or more days of vigorous-intensity activity of at least 20 minutes / day OR

(b) Five or more days of moderate-intensity activity &/or walking of at least 30 minutes/ day

OR

(c) Five or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum. Total physical activity of at least 600 MET-minutes/week.

Category 3 (High): There are two criteria to be included in this category:

(a) Vigorous-intensity activity on at least 3 days achieving a minimum total physical activity of at least 1500 MET-minutes/ week.

(b) Seven or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum Total physical activity of at least 3000 MET-minutes/week. None of the patients in the present study reached this category.

The sitting question in IPAQ short form is an additional indicator variable of time spent in sedentary activity and is not included as part of any summary score of physical activity. To date, there are few data on sedentary (sitting) behaviors and no well-accepted thresholds for data presented as categorical levels [15].

Exercise Benefits/Barriers Scale (EBBS)

The (EBBS) consists of 29-item Benefits Scale and 14-item Barriers Scale [16]. The 29-item Benefits Scale is categorized into five subscales: life enhancement, physical performance, psychological outlook, social interaction, and preventative health. The 14-item Barriers Scale is categorized into four subscales: exercise milieu; time expenditure; physical exertion; and family discouragement (Table 1). The instrument may be scored and used in its entirety or as two separate scales. The instrument has a four-response, Likert-type format with responses ranging from 4 (strongly agree) to 1 (strongly disagree). Barrier Scale items are reverse scored. In the questionnaire, Items on the Barrier Scale are numbers 25, 27, 30, 33, 35, 37, 40, 42, 45, 49, 54, 58, 61 and 63. Summation of the score of the two scales leads to the total instrument score which can range from 43 to 172. The higher the score, the more positively the individual perceives exercise. In the present study, the means of the individual EBBS items were calculated and the mean of the benefits, barriers and total score were computed. The instrument has been tested for internal consistency, validity of its constructs, and test-retest reliability. Calculation of Cronbach's alpha for the 43-item instrument yielded a standardized alpha of 0.954. The 29-item Benefits Scale has a standardized alpha of 0.954 and the 14-item Barriers Scale has a standardized alpha of 0.866. Test-retest reliability was found to be 0.89 on the total instrument, 0.89 on the Benefits Scale and 0.77 of the Barriers Scale. The scale was translated into Arabic and back translated into English at HMC accredited translation center and was assured through revision by Community Medicine consultants.

Perceived Benefits to Exercise (29 items)	**Perceived Barriers to Exercise** (14 items)
Life enhancement (8 items)	Exercise milieu (6 items)
Physical performance (8 items)	Time expenditure (3 items)
Psychological outlook (6 items)	Physical exertion (3 items)
Social interaction (4 items)	Family discouragement (2 items)
Preventative health (3 items)	

Table 1: Scales and Sub-scales of the Exercise Benefits/Barriers Questionnaire.

Data analysis

The statistical packages SPSS 22 software was used in data analysis. A descriptive analysis in the form of means and Standard Deviation (SD) was used whenever appropriate. Frequencies and percentages were carried out according to the type of data. Chi-square (X^2) test, Pearson correlation coefficient and multivariate logistic regression were used as needed. The level of significance was set at $p<0.05$ (two tailed).

Ethical considerations

Necessary approvals have been taken. An informed written consent was obtained from each participant. Privacy of participants and confidentiality of data were assured. Results of the completed questionnaires were communicated with the patients and treating physician for the possibility for further actions.

Results

Table 2 reveals that the highest percentage of patients was from the age category 50- 59 years (41.0%) followed by those aged 60 years or more (30.2%) with a mean age of 53.4 ± 8.5 years. The majority of patients were males (61.2%), non-Qatari (73.3%), living inside Doha (79%) and most of them were married (85.1%). Near to half of the patients (48.7%) had secondary education and above, around one third of patients were not working or housewife (32.5%) and had a household income of less than 5000 QR (33.3%).

Variable	**Frequency**	**Percentage (%)**
Age (years)		
< 40	35	(6.8)
40-49	112	(22.0)
50-59	209	(41.0)
≥60	154	(30.2)
Mean (± SD) = 53.4 (± 8.5)		
Gender		
Male	312	(61.2)
Female	198	(38.8)
Nationality		
Qatari	136	(26.7)
Non-Qatari	374	(73.3)
Residential area		
Inside Doha	403	(79.0)
Outside Doha	107	(21.0)
Marital status		
Married	434	(85.1)
Others*	76	(14.9)
Education		
Illiterate/Read and write	142	(27.8)
Primary/Preparatory	120	(23.5)
Secondary	161	(31.6)
University and higher	87	(17.1)
Occupation		
Not working/Housewife	166	(32.5)
Manual	102	(20.0)
Clerk/administrator	136	(26.7)
Others**	106	(20.8)
Household income (QR)		
<5,000	170	(33.3)
5,000 -	160	(31.4)
15,000 -	37	(7.3)
25,000 +	143	(28.0)

*Single, divorced and widowed; **Professional, technical and free business.

Table 2: Distribution of type 2 diabetic patients according to socio-demographic characteristics, Primary Health Care Centers, Qatar, 2014 (n= 510).

Table 3 shows that the majority of the patients were non-smoker (63.1%) and all of them were not performing vigorous physical activity. According to physical activity types, firstly the table reveals that only 22 patients (4.3%) were performing moderate physical activity, 17 patients of them (77%) were practicing it for three days or more and half of them were doing it for half an hour per day. Secondly, the table demonstrates that only 27.3% of the patients were practicing walking; usually for 3-4 days/ week (13.9%). More than two thirds of the patients who were practicing walking (69.7%), were doing it for half an hour or more per day. According to physical activity levels, it was found that most of the patients (95.7%) were categorized as having a low physical activity level. Finally, the table reveals that most of the patients (87.7%) used to sit for four hours or more daily without doing any kind of physical activity.

Variables	**Frequency**	**Percentage (%)**
Smoking history		
Regular/Occasional smoker	121	(23.8)
Ex-smoker	67	(13.1)
Non-smoker	322	(63.1)
Physical Activity		
Types		
Moderate physical activity		
Days		
0	488	(95.7)
1-2	5	(1.0)
3+	17	(3.3)
Time/minutes (n=22)		
20-	3	(13.6)
30-	11	(50.0)
40+	8	(36.4)
Walking		
Days		
0	371	(72.7)
1-2	38	(7.5)
3-4	71	(13.9)
5+	30	(5.9)
Time/minutes (n=139)		
≤15	9	(6.5)
20-	33	(23.8)
30+	97	(69.7)
Levels		
Low	488	(95.7)
Moderate	22	(4.3)
Sitting (hours/day)		
≤3	62	(12.2)
4-5	292	(57.3)
6+	156	(30.5)

Table 3: Distribution of type 2 diabetic patients according to smoking history and physical activity, Primary Health Care Centers, Qatar, 2014 (n= 510).

Table 4 shows that the highest five mean values were belonging to psychological and social sub-scales "I enjoy exercise" ($\bar{x}$=2.51, SD=0.89), "Exercise is good entertainment for me" ($\bar{x}$=2.44, SD=0.83), "I have improved feelings of wellbeing from exercise" ($\bar{x}$=2.36, SD=0.84), followed by physical performance sub-scale "My muscle tone is improved with exercise" ($\bar{x}$=2.34, SD=0.80), and followed by preventive health sub-scale "I will live longer if I exercise" ($\bar{x}$=2.22, SD=0.77). The total mean score of perceived benefits of physical activity was ($\bar{x}$=89.6, SD=11.7).

No.	Life Enhancement Sub-scale	Mean ± SD
46	My disposition is improved by exercise	2.13 ± 0.81
47	Exercising helps me sleep better at night	1.82 ± 0.47
50	Exercise helps me decrease fatigue	1.97 ± 0.61
53	Exercising improves my self-concept	1.77 ± 0.47
55	Exercising increases my mental alertness	1.76 ± 0.49
56	Exercise allows me to carry out normal activities without becoming tired	2.22 ± 0.68
57	Exercise improves the quality of my work	1.76 ± 0.45
62	Exercise improves overall body functioning for me	1.66 ± 0.47
No.	**Physical Performance Sub-scale**	**Mean ± SD**
28	Exercise increases my muscle strength	1.686 ± 0.47
36	Exercising increases my level of physical fitness	1.680 ± 0.47
38	**My muscle tone is improved with exercise**	**2.34 ± 0.80***
39	Exercising improves functioning of my cardiovascular system	1.43 ± 0.49
43	Exercise increases my stamina	1.73 ± 0.51
44	Exercise improves my flexibility	1.74 ± 0.48
52	My physical endurance is improved by exercising	1.71 ± 0.49
64	Exercise improves the way my body looks	1.56 ± 0.55
No.	**Psychological Outlook Sub-scale**	**Mean ± SD**
22	**I enjoy exercise**	**2.51 ± 0.89***
23	Exercise decreases feelings of stress and tension for me	1.99 ± 0.64
24	Exercise improves my mental health	1.93 ± 0.59
29	Exercise gives me a sense of personal accomplishment	1.91 ± 0.61
31	Exercising makes me feel relaxed	1.82 ± 0.56
41	**I have improved feelings of well-being from exercise**	**2.36 ± 0.84***
No.	**Social Interaction Sub-scale**	**Mean ± SD**
32	Exercising lets me have contact with friends and persons I enjoy	2.14 ± 0.67
51	Exercising is a good way for me to meet new people	2.09 ± 0.54
59	**Exercise is good entertainment for me**	**2.44 ± 0.83***
60	Exercising increases my acceptance by others	1.91 ± 0.52
No.	**Preventive Health Sub-scale**	**Mean ± SD**
26	I will prevent heart attacks by exercising	1.51 ± 0.51
34	Exercising will keep me from having high blood pressure	1.45 ± 0.50
48	**I will live longer if I exercise**	**2.22 ± 0.77***

*Perceived benefits with the highest mean values. Total mean score of perceived benefits of physical activity 89.6 ± SD 11.7.

Table 4: Mean values of perceived benefits of physical activity among type 2 diabetic patients, Primary Health Care Centers, Qatar, 2014 (n=510).

Table 5 reveals that the highest five mean values were belonging to exercise milieu sub-scale "I think people in exercise cloths look funny" ($\bar{x}$=3.36, SD=0.51), "I am too embarrassed to exercise" ($\bar{x}$=3.23, SD=0.54), family discouragement sub-scale including "My family members do not encourage me to exercise" ($\bar{x}$=3.33, SD=0.56), "My spouse (or significant other) does not encourage exercising" ($\bar{x}$=3.30, SD=0.60), and lastly time expenditure sub-scale "Exercise takes too much time from family relationships" ($\bar{x}$=3.07, SD=0.48). The total mean score of perceived barriers of physical activity was ($\bar{x}$=41.5, SD=5.6). In addition, the total mean score of perceived benefits and barriers of physical activity was 131.1±SD 16.0.

No.	Exercise Milieu Sub-scale	Mean ± SD
30	Places for me to exercise are too far away	2.94 ± 0.77
33	**I am too embarrassed to exercise**	**3.23 ± 0.54***
35	It costs too much money to exercise	2.91 ± 0.60
37	Exercise facilities do not have convenient schedules for me	2.70 ± 0.69
49	**I think people in exercise clothes look funny**	**3.36 ± 0.51***
63	There are too few places for me to exercise	2.95 ± 0.62
No.	**Time Expenditure Sub-scale**	**Mean ± SD**
25	Exercising takes too much of my time	2.98 ± 0.63
45	**Exercise takes too much time from family relationships**	**3.07 ± 0.48***
58	Exercise takes too much time from my family responsibilities	3.05 ± 0.48
No.	**Physical Exertion Sub-scale**	**Mean ± SD**
27	Exercise tires me	2.36 ± 0.71
40	I am fatigued by exercise	2.72 ± 0.70
61	Exercise is hard work for me	2.56 ± 0.79
No.	**Family Discouragement Sub-scale**	**Mean ± SD**
42	**My spouse (or significant other) does not encourage exercising**	**3.30 ± 0.60***
54	**My family members do not encourage me to exercise**	**3.33 ± 0.56***
*Perceived barriers with the highest mean values; Total mean score of perceived barriers of physical activity 41.5 ± SD 5.6.		

Table 5: Mean values of perceived barriers of physical activity among type 2 diabetic patients, Primary Health Care Centers, Qatar, 2014 (n=510).

Table 6 shows that there was a significant week positive correlation between perceived benefits and barriers score and each of the days and time of moderate physical activity (r=0.282, p=0.001, r=0.300, p=0.001 respectively). The table also demonstrates that there was a significant moderate positive correlation between perceived benefits and barriers score and each of the days and time of walking (r=0.540, p=0.001, r=0.592, p=0.001 respectively).

Variable	Perceived benefits and barriers score	
	r	*p*- value
Days of moderate physical activity	0.282	**0.001***
Time of moderate physical activity	0.300	**0.001***
Days of walking	0.540	**0.001***
Time of walking	0.592	**0.001***
*p<0.01		

Table 6: Correlation between perceived benefits and barriers score and each of moderate physical activity parameters (days and time) and walking parameters (days and time) among type 2 diabetic patients, Primary Health Care Centers, Qatar, 2014 (n=510).

Table 7 demonstrates that poor glycemic control was found more commonly among those aged 40-49 years (66.1%) and least common among those aged less than 40 years (57.1%), among females rather than males (64.1 % vs. 63.5%), among non-Qatari rather than Qatari (65.2% vs. 59.6%). It was also more common among those living inside Doha more than those living outside Doha (64.3% vs. 61.7%), and among unmarried rather than married patients (65.8% vs. 63.4%).

Socio-demographic characteristics	**Glycemic control**				**Total**	**χ^2 (*p*-value)**
	Good ($HbA_{1c} \leq 7\%$)		**Poor** ($HbA_{1c} > 7\%$)			
	No.	**(%)**	**No.**	**(%)**		
Age (years)						
<40	15	(42.9)	20	(57.1)	35	0.973 (0.808)
40-49	38	(33.9)	74	(66.1)	112	
50-59	77	(36.8)	132	(63.2)	209	
≥60	55	(35.7)	99	(64.3)	154	
Gender						
Male	114	(36.5)	198	(63.5)	312	0.024 (0.876)
Female	71	(35.9)	127	(64.1)	198	
Nationality						
Qatari	55	(40.4)	81	(59.6)	136	1.393 (0.238)
Non-Qatari	130	(34.8)	244	(65.2)	374	
Residential area						
Inside Doha	144	(35.7)	259	(64.3)	403	0.245 (0.621)
Outside Doha	41	(38.3)	66	(61.7)	107	
Marital status						
Married	159	(36.6)	275	(63.4)	434	0.165 (0.685)
Others[⌂]	26	(34.2)	50	(65.8)	76	
Education						
Illiterate/Read and write	43	(30.3)	99	(69.7)	142	4.609 (0.203)
Primary/Preparatory	50	(41.7)	70	(58.3)	120	
Secondary	63	(39.1)	98	(60.9)	161	
University and higher	29	(33.3)	58	(66.7)	87	
Occupation						
Not working/Housewife	58	(34.9)	108	(65.1)	166	0.409 (0.938)
Manual	36	(35.3)	66	(64.7)	102	
Clerk/Administrator	52	(38.2)	84	(61.8)	136	
Others[ɸ]	39	(36.8)	67	(63.2)	106	

Household income						
<5000	60	(35.3)	110	(64.7)	170	1.137 (0.768)
5000–	55	(34.4)	105	(65.6)	160	
15000–	13	(35.1)	24	(64.9)	37	
25000+	57	(39.9)	86	(60.1)	143	
^ΔSingle, divorced and widowed; ^ΦProfessional, technical and free business.						

Table 7: Relationship between socio-demographic characteristics and glycemic control (HbA1c level) among type 2 diabetic patients, Primary Health Care Centers, Qatar, 2014 (n=510).

The table also shows that the higher percentage of poor glycemic control was found among those who were illiterate or read and write (69.7%) and least common among those who had primary/preparatory education (58.3%). Moreover, poor glycemic control was more common among those who were not working or housewife (65.1%), and among those with a household income of 5,000 to less than 15,000 QR (65.6%) and least common among those with income of 25,000 QR or more (60.1%). However, none of these relations were found to be statistically significant (p>0.05).

Table 8 reveals that poor glycemic control was more common among non-smoker patients (65.8%) compared to regular/occasional and ex-smokers (64.5%, 52.2% respectively).

Socio-demographic characteristics	**Glycemic control**				**Total**	**χ^2 (*p*-value)**
	Good ($HbA_{1c} \leq 7\%$)		**Poor** ($HbA_{1c} > 7\%$)			
	No.	**(%)**	**No.**	**(%)**		
Smoking						
Regular/Occasional smoker	43	(35.5)	78	(64.5)	121	4.475 (0.107)
Ex-smoker	32	(47.8)	35	(52.2)	67	
Non-smoker	110	(34.2)	212	(65.8)	322	
Physical activity levels						
Low	177	(36.3)	311	(63.7)	488	0.000 (0.993)
Moderate	8	(36.4)	14	(63.6)	22	
Sitting hours/day						
≤3	22	(35.5)	40	(64.5)	62	0.022 (0.989)
4-5	106	(36.3)	186	(63.7)	292	
6+	57	(36.5)	99	(63.5)	156	

Table 8: Relationship between lifestyle and glycemic control (HbA1c level) among type 2 diabetic patients, Primary Health Care Centers, Qatar, 2014 (n=510).

According to physical activity levels, the table reveals that poor glycemic control was nearly similar among those with low and moderate physical activity (63.7%, 63.6% respectively).

Moreover, the prevalence of poor glycemic control was nearly similar among patients who used to sit without doing any kind of activity for less than or equal three hours, four to five hours and six hours or more (64.5%, 63.7% and 63.5% respectively). However, the differences in glycemic control as regards smoking, physical activity levels and sitting hours per day were not statistically significant (p-value>0.05).

Discussion

Type 2 diabetes mellitus is a progressive disease in which the risks of myocardial infarction, stroke, micro-vascular complications and mortality are all strongly associated with hyperglycemia [17]. Achieving glycemic control is the main therapeutic goal for the prevention of organ damage and other complications of diabetes [18].

Many studies from different countries have shown variable results regarding poor glycemic control among type 2 diabetic patients. This variation could be partially explained by different cutoff points used for categorization of poor glycemic control among these patients enrolled in studies. In Jordan, the prevalence of poor glycemic control was 65.1% using a cutoff point of $HbA_{1c} \geq 7\%$. (18) In Kuwait, the prevalence of poor glycemic control was 66.7% using a cutoff point of HbA1c ≥ 8%. [19]. On the other hand, the prevalence of poor glycemic control was 46.7% in Pakistan using a cutoff point of $HbA_{1c} > 7.5\%$ [20].

In the present study, the level of $HbA_{1c} > 7\%$ was utilized as an indicator for uncontrolled glycemia according to European DM guidelines, American diabetes association, and Primary Health Care National Guidelines in Qatar [11,21,22]. The results of the present study, revealed a prevalence of uncontrolled glycaemia of 63.7%. Different studies have used same indicator as our study and revealed different outcome such as two studies from KSA (76.4%, and 78%) [23,24].

In addition to the use of different cutoff points of HbA1c level, differences in the degree of glycemic control in different studies may reflect variability in the quality of services provided in different countries, including availability of certain medications, guidelines in PHC settings, the efforts given to patient's education and motivation from the healthcare providers, and the degree of understanding of the importance of glycemic control and self-management practices among type 2 DM patients, physicians or both [25].

Moreover, differences in the degree of glycemic control in different studies may reflect variability in participants characteristics included in the study. Among the socio-demographic characteristics which were found to be associated with poor glycemic control is the age of the diabetic patients. The present study demonstrated better glycemic control among patients with younger age group (<40 years) compared to the older age groups. However, the relation between age and glycemic control was statistically insignificant. This was also found in other studies e.g. Khattaba M, et al. among Jordanian type 2 diabetic patients [18], Mwera EC among type 2 diabetic patients in public hospitals in Dar Essalaam Tanzania [25], and in a study in Jordan 2006 [26]. However, these results are not consistent with other studies which found that younger age was associated with poor glycemic control; like a study conducted in UAS 1998 to examine association of younger age with poor glycemic control and obesity in urban African Americans with type 2 diabetes [27], and a study conducted by Juarez DT, et al. to determine factors associated with poor glycemic control or wide glycemic variability among diabetes patients in Hawaii 2006-2009 [28].

Concerning gender, the present study revealed slightly higher but insignificant difference in the prevalence of poor glycemic control among females. Significantly higher level of poor glycemic control was also found in different studies; e.g. a study done among diabetic patients attending King Abdul-Aziz University Hospital medical clinic KSA from June 1998 to January 2000 [29], and the study which was conducted in Jordan 2006 [26]. In the study done in KSA [29], the author related this to different factors including the social norms of women in some conservative Arab communities which limit their ability to carry on exercise or employment outside the home. Moreover, male diabetics are observed to deal more effectively with diabetes with lesser depression and anxiety, with more energy and better wellbeing. Also, cooking and caring for the family may make it difficult for the female to follow their own diet, medications and eating schedules.

On the other hand, other studies found that males have more poor glycemic control; like a study conducted to predict glycemic control in insulin-using adults with type 2 diabetes 1997 in USA [30], and a study done by Gopinath B, et al. between May 2001 to April 2012 in in India [31]. However, according to a study done in France [32], gender was not associated with glycemic control.

Another socio-demographic characteristic which can be associated with poor glycemic control is the educational attainment. The present study showed that the highest percentage of poor glycemic control was found among those who were illiterate or just read and write. However, the difference in the level of glycemic control according to the educational level was found to be statistically insignificant. This was consistent with the results of other studies; e.g. a study conducted by Al-Rasheedi A. A. to determine the role of educational level in glycemic control among patients with T2DM over a period of 6 months in 2012-2013 in

Primary Care Clinic of King Khalid University Hospital KSA [33], and another study done by Kirk JK, et al. in 2011 in USA [34].

The study which was conducted in KSA by Al-Rasheedi A. A. [33] found that the educational level had no impact on glycemic control, but the patients of high educational level had better awareness about the complications and a high rate of adherence to diet. On the other hand, other studies; like a study conducted in primary health centers in the Al Hasa district of Saudi Arabia during the period of June 2010 to June 2011 [35], and the study conducted by Khattaba M, et al. among Jordanian type 2 diabetic patients [18], found that low educational status had been significantly associated with negative effect on glycemic control. Moreover, another study conducted in USA by Winkleby MA, et al. [36] found that patients with higher education levels were more likely to have better glycemic control, and the authors attributed this to stronger problem-solving and coping capacities arising from educational experience.

Regarding marital status, the present study showed that it didn't significantly affect the level of glycemic control. This finding was similar to what was found in other studies; like the study which was conducted among type 2 diabetic patients in public hospitals in Dar Essalaam Tanzania [25], in addition to a study done by Ghazanfari Z, et al. among female diabetic patients in Iran from November 2008 to July 2009 [37].

Concerning occupation, the present study revealed that it was not significantly associated with poor glycemic control. This was also found in other studies; including a study done by Chiu CJ, et al. among middle-aged and older adults with type 2 diabetic patients in USA [6], and the study done in public hospitals in Dar Essalaam Tanzania [25].

In addition, patients with lower household income (<25000 QR) had higher percentages of poor glycemic control. However, this association was statistically insignificant. These findings are consistent with what was found in the study done by Mansour A. and Almutairi, et al in KSA [23]. Generally, the present study didn't show any significant association between socio-demographic variables and glycemic control. This was also found in other studies; including a study conducted by Blaum CS, et al. in Michigan primary care centers USA [38], in addition to a study done by Eberhardt MS, et al. among 2 South Carolina communities in USA [39].

On the contrary, low socioeconomic status was associated with poor glycemic control in other studies; like a study carried out by Cook CB, et al. among low socio-economic status urban African Americans with T2DM in 2005 USA [40], in addition to another American study carried out by Chou AF, et al. in 2007 [41]. Generally, patients with low socioeconomic status had lower chance of access to high quality healthcare and to better healthy lifestyle choices. The present study also revealed higher but insignificant percentage of poor glycemic control among non-Qatari compared to Qatari diabetic patients. This may be partially explained by the generally lower household income among non-Qatari compared to Qatari diabetic patients. Moreover, this could be also due to the privilege of the Qatari diabetic patients compared to non-Qatari as regards self- monitoring of blood glucose due to the free provision of the blood glucose monitoring devices (glucometers) and diabetes test strips to the Qatari patients. Lack of practicing of Self-monitoring of blood glucose was found to be significantly associated with poor glycemic control in the univariate and multivariate analyses in the present study.

Regarding lifestyle variables, the present study showed that there was no significant association between smoking and glycemic control. This finding was similar to the results demonstrated from the study done in Iran [37]. However, other studies; like a study from UK by Gulliford MC, et al. in 2001 among diabetic patients aged 18 years old and above [42], in addition to another study from Sweden by Nilsson PM, et al. in 2001 [43], found that there was a significant association between smoking and poor glycemic control. Increased insulin resistance occurs in smokers with and without diabetes [44]. In addition, another study from Australia by Jenny E, et al. [45] found improvement in HbA1c with smoking cessation among both type 1 and type 2 diabetes. The authors suggested that this improvement in HbA1c may reflect a change in lifestyle factors with the decision to stop smoking or a direct effect on glycosylation of hemoglobin.

Several studies; like a study conducted in Canada to explore patterns in physical activity behaviors among type 2 diabetic patients aged 18 years old and older in 2007 [46], and another study by Patja K, et al. among middle-aged Finnish men and women in 2005 [47], have shown that physical activity improves glycemic control, reduces blood pressure, and positively affects other coronary heart disease risk factors for individuals who already living with type 2 diabetes.

In a review of nine trials of exercise training in a total of 337 patients with T2DM, an average absolute reduction in HbA1c of 0.5% to 1% was reported indicating better control [48].

Both aerobic and resistance training have been shown to be of benefit for the control of diabetes; however, resistance training may have greater benefits for glycemic control compared to aerobic training may have [49]. A meta-analysis of 14 controlled trials revealed that exercise interventions resulted in a small but clinically and statistically significant reduction in HbA1c compared with no exercise interventions [50].

The present study showed a week but subjective significant negative correlation between number of walking days and HbA1c level. However, there was no significant association between physical activity level and glycemic control. This may be explained by the fact that only 4.3% of the patients were performing moderate PA, slightly more than quarter of them were practicing walking and only (5.9%) of them achieved the recommended frequency of 5 days per week or more sufficient for health benefits. These findings are much similar to a study done in KSA [23], where only 3.6% of the participants engaged in moderate or vigorous PA and there was no significant association between PA and glycemic control. This was also found in a study among diabetic patients by Al- Kaabi J, et al. from UAE at the diabetes center of Tawam Hospital and 5 primary health care centers in Al- Ain District of Abu Dhabi in 2006 [51].

The benefits of regular physical activity for physiological and psychological health are well documented. However, despite the well published benefits of PA, many individuals from different countries do not engage in PA sufficient for health benefits. Understanding why individuals do not participate in sufficient PA is complex and multifaceted including but not limited to personal, interpersonal, environmental, and policy determinants. Research on any of these factors has a strong potential PA promotion' interventions and thus support positive public health outcomes, both physiological and psychological [52].

The present study showed that participants felt high perceived benefits and barriers to exercise as detected by the total mean score of perceived benefits and barriers ($\bar{x}$ 131.1±SD 16.0). It also revealed that there was a significant positive correlation between perceived benefits and barriers score and each of the days and time of moderate physical activity and days and time of walking. Moreover, there was weak but significant negative correlation between walking days and glycemic control. In a study done in UAE [51], it was found that most of the diabetic patients (95%) recognized the importance of PA. However, only 25% reported that their PA had increased following the diagnosis of diabetes. Another study among diabetic patients in UK [9], active patients were less likely to think exercise was difficult, that lack of local facilities was an obstacle and that they had no spare time. Moreover, active patients were more likely to continue exercise if tired or depressed, if there was something good on television, if they had no exercise partner, or if they had more hypoglycemic episodes than usual than inactive patients.

In the present study, the most common perceived benefits of physical activity were psychosocial “I enjoy exercise”, “Exercise is good entertainment for me”, and “I have improved feelings of wellbeing from exercise”. However, specific preventive health benefits like prevention of heart attacks or prevention of high blood pressure, were not at the top perceived benefits of PA in the present study. On the other hand, a study done among Mauritians [53] found that there was no relationship between perceived health benefits of PA and the practice of physical exercise which was more related to the perceived barriers which the participants expressed. In the present study, the most common perceived barriers of physical activity were “I think people in exercise cloths look funny” and “I am too embarrassed to exercise”. These two barriers were also the most common barriers to exercise among Mauritian people [53]. Another two important barriers to exercise among diabetic patients in the present study were related to psychological support; “My family members don’t encourage me to exercise” and “My spouse (or significant other) doesn’t encourage exercising”. Similarly, low social support had the highest influence in establishing low PA in patients with T2DM in Nigeria [54]. The strict regimen of food intake, medications and PA needed to maintain target glucose levels among T2DM patients, required them to look into others for companionship, assistance or other types of support, thereby increasing their demand for social support [55].

In contrast, the most important reported barriers to PA among UAE type 2 diabetic patients [51] were cultural issues specially pertaining to women which make it difficult to attend public gyms, sport clubs or recreational centers together with the traditional clothes for both genders which may hinder PA. Lack of past experience with exercise was also a major problem since PA is not given adequate attention at schools.

It seems that glycemic control is multifactorial; some factors are modifiable, others are not. Improving glycemic control among type 2 diabetic patients is a challenge. Intensive effort should be offered by the healthcare system, health care providers, the patients and their families, to achieve better glycemic control and hence decrease diabetic complications and improve patient’s outcome.

Conclusion

Based on the findings of the study, it can be concluded that about two thirds of patients with T2DM in Qatar had a poor glycemic control with HbA_{1c} level of >7%. Despite a high level of perceived benefits and barriers score of physical activity, very few numbers of the patients were performing physical activity; mostly of the low-grade level. There was a significant positive correlation between perceived benefits and barriers score of physical activity and each of the days and time of moderate physical activity and days and time of walking.

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