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Research Article

Glycemic Control: Pattern, Determinants and Consequences among Patients with Type 2 Diabetes Mellitus in Ajman-United Arab Emirates

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Abstract

Background: About 19.5% of the UAE's population is now living with diabetes. More than 90% of diabetic subjects have type 2 diabetes. Strict glycemic control is imperative to prevent the acute and chronic complications of diabetes.

Aim of Study: To assess the pattern of the glycemic control among patients with type II diabetes mellitus.

Methods: A cross sectional survey was conducted among 256 patients with type 2 diabetes in Ajman, using an interviewer questionnaire to achieve the objectives of this research. The research was approved by the "Ethics and Research Committees" of GMU and MOH, UAE. Data was analyzed using SPSS version 22. Logistic regression analysis was done to identify the predictors of poor glycemic control.

Results: The frequency of poor glycemic control was very high with 62.1% of the participants having HbA1c value of ≥ 7%. The age increased glycemic control improved. Employed participants had almost three times more odds of poor glycemic control than the unemployed participants. There was no significant difference in Age, nationality, marital status, level of education, or living status of the participants. Overweight and obesity had a poor glycemic. Where those with low physical activity had poor glycemic. Those who did not receive diet counseling had almost 3 times more chance of poor glycemic.

Conclusion: The frequency of poor glycemic control was very high with 62.1% of the participants having HbA1c value of ≥ 7.

Keywords: *Glycemic Control; Pattern; Diabetes Mellitus; Ajman; UAE*

Introduction

Diabetes mellitus is described as a metabolic disorder of multiple etiologies characterized by chronic hyperglycemia with disturbance of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both resulting in chronically elevated blood sugar [1].

There is a rapid increase in prevalence of type 2 diabetes globally; it represents 8.3% of the world population in 2014 and expected to reach 10.1% by 2035. Countries of the Eastern Mediterranean region have very high prevalence of diabetes [2,3].

About 19.5% of the UAE's population is now living with diabetes. Ageing population, rapid economic growth and development and technological advances are factors that play a major role in increasing type 2 diabetes in UAE [4,5]. There are several factors that affect the

glycemic control which is influenced by the diabetic profile of the patient such as age at diagnosis, duration of diabetes, type of treatment, complication and family history. The level of physical activity, body mass index and dietary intake also influences it. Socio-demographic characteristics such as gender, age, income, occupational status and educational level are also considered as predictors of poor glycemic control [6].

Poor glycemic control is usually associated with low knowledge of self-management, diabetes prevention and management and poor attitude towards diabetes [7-9]. Promotion of self-care practices among diabetic patients leads to a decrease in the long-term complications [10].

Several studies are conducted on hazardous body shape phenotype and the effect of body fat centralization on the risk of developing diabetes and metabolic complications can be evaluated by waist circumference or waist-to-hip ratio [11-17]. Regular exercises improve glycemic control and reduce cardiovascular disease in addition to improving health status. Regular exercise may prevent the development of type 2 diabetes mellitus [18]. Diabetes mellitus is described as a metabolic disorder of multiple etiologies characterized by chronic hyperglycemia with disturbance of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both resulting in chronically elevated blood sugar.

There are four clinical types of Diabetes. Type1diabetes occurs when there is destruction of the beta cells causing absolute insulin deficiency. Type 2 diabetes results from progressive defect of insulin secretion, the third type includes other specific types due to other causes and the fourth is Gestational diabetes mellitus (GDM), which occurs during pregnancy [1].

Promotion of self-care practices among diabetic patients leads to a decrease in the long-term complications [10].

Body mass index is used in public health and clinical practice for identifying patients at risk for future diabetes and cardiovascular disease [19].

The situation in the UAE is summarized well in a review article done on the analysis of the health status of the UAE-2013 which states that a move from a traditional lifestyle to a modern, urban and technology-driven lifestyle characterized by reduced overall physical activity, along with overconsumption of energy-dense convenience foods has led to a dramatic increase in the prevalence of obesity, diabetes as well as cardiovascular diseases in the UAE [20].

Aim of the Study

This study aimed to assess the pattern of the glycemic control among patients with type II diabetes mellitus in Ajman-United Arab Emirates.

Materials and Methods

Across sectional survey was conducted in Ajman-United Arab Emirates. it was carried out over a period of six months from April 2015 to October 2015 the study was included all patients who attending the OPD of GMC Hospital and Research Center (GMCH&RC) and Musharrif Primary healthcare center (PHC)-Ajman with at least one-year history of type 2 diabetes mellitus. The study excluded any Patient with type I diabetes mellitus, diabetes insipidus and Pregnant women.

The instrument for data collection was an interviewer administered questionnaire, which was constructed after extensive review of literature to obtain the information required as per the objectives of the research. The questionnaire included the information about Socio-demographic variables, Anthropometric measurement and some lab. investigation, diabetes history, history of other co-morbidities. The study was conducted after getting an approval from the ethics committee of Gulf Medical University and Ministry of Health - United Arab Emirates.

Data was entered in Microsoft excel and data analyzed Using SPSS version. Descriptive statistics was used to describe the study participants. Chi square test was done for associations. Multiple logistic regression analysis was done to find the net effect of each variable and after adjusting the odds.

Results

A total of 256 patients with Type 2 Diabetes were enrolled in the study from the patients attending GMC hospital and Musharrif PHC, Ajman.

A total of 94 participated from GMC hospital and 162 from Musherrif PHC Data was analyzed using 256 questionnaires.

The mean age of the participants was 55.2 ± 11.7 years. Majority of the participants (54.3%) being in the age between 40 - 59 years, 37.1% between 18 - 39 years and 8.6% were ≥ 60 years. Majority of the participants were females with 147 (57.4%) of the participants being female and 109 (42.6%) were males. The WHO regions classified Nationality. Where (230) 89.8% were from Eastern Mediterranean Region, 30 (7%) from South East Asia and 8 (3.1%) from other regions (Table 1).

Most of the participants 232 (90.6%) were married and only 24 (9.4%) were unmarried. occupational categories were as per the collar categorization: Majority of the participants was in the No collar/unemployed category (housewives, retired) 148 (57.8%). Followed by White collar workers 32(12.5%); Blue collar (Manual, drivers) 30 (11.7%) Gold Collar workers (highly professional - Doctors, Engineer, teachers, lawyers) 28 (10.9%); and 18 (7%) were Pink collar workers (secretaries, clerks, lady workers). Most were educated up to secondary school or below 155 (60.5%) and the remaining were educated to graduation and above. Only 15 (5.9%) of our participants lived alone the remaining lived with their families. as shown in table 1.

Socio-demographic Characteristics	No.	%
Age		
18 - 39 years	22	8.6
40 - 59 years	139	54.3
≥ 60 years	95	37.1
Gender		
Male	109	42.6
Female	147	57.4
Nationality		
Eastern Mediterranean Region	230	89.8
South East Asia Region	18	7.0
Other Regions	8	3.1
Marital status		
Married	232	90.6
Single	24	9.4
Occupation		
Gold Collar	28	10.9
White collar	32	12.5
Blue collar	30	11.7
Pink collar	18	7.0
No collar/unemployed	148	57.8
Level of Education		
Secondary and Less	155	60.5
Graduation and Above	101	39.5
Living status		
Alone	15	5.9
With other	241	94.1

Table 1: *Distribution of Socio-demographic characteristics of the participants (N = 256).*

Body mass index was calculated and as seen in figure 1. Majority of the participants (51%) were found to be obese and 37% were overweight and 12% were normal. The mean BMI of the participants was high with a standard deviation 30.4 ± 11.71.

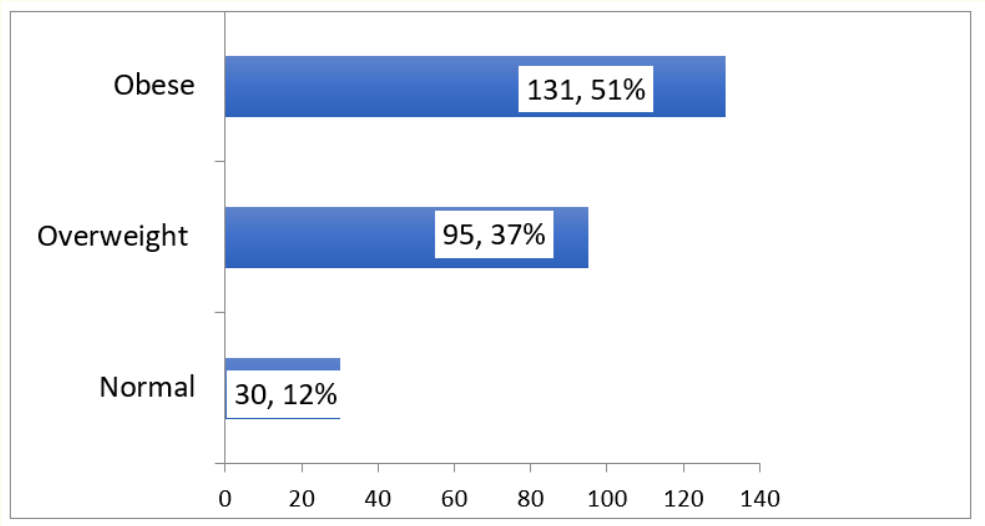

Figure 1: *Body Mass Index of the participants (N = 256).*

Based on HbA1c levels participants were classified as having good and poor glycemic control. The frequency of poor glycemic control was very high with 62% of the participants having HbA1c value of ≥ 7% or poor glycemic control and 38% had good glycemic control. as shown in figure 2.

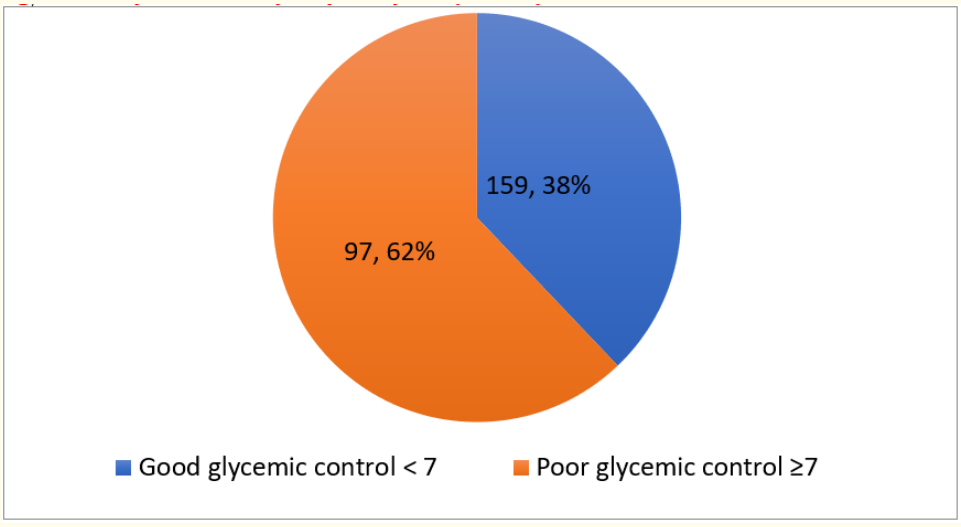

Figure 2: *Glycemic control of the participants (N = 256).*

As shown in table 2; the mean fasting blood sugar was 141.58 ± 49.82 mg/dl. Total cholesterol was 155.94 ± 51.33 mg/dl; High Density Lipoproteins was 58.09 ± 27.28 mg/dl Low Density Lipoproteins was 108.2 ± 47.4 mg/dl and Triglycerides was 130.62 ± 65.84. systolic blood pressure was 128.67 ± 14.21 mmHg and diastolic blood pressure was 76.8 ± 10.55 mmHg. The mean age of diagnosis of the disease was 47.9 ± 10.3 years and the mean duration of the disease was 8.8 ± 5 years.

Variables	Mean	SD
Systolic pressure (mmHg)	128.67	14.21
Diastolic pressure (mmHg)	76.8	10.55
Age of Diagnosis (years)	47.9	10.3
Duration of the Disease (years)	8.8	5.0
Fasting Blood Sugar (mg/dl)	141.58	49.82
Total Cholesterol (mg/dl)	155.94	51.33
High Density Lipoproteins (mg/dl)	58.09	27.28
Low Density Lipoproteins (mg/dl)	108.2	47.4
Triglycerides (mg/dl)	130.62	65.84

Table 2: *Mean and standard deviation (SD) of blood lipid, blood pressure, fasting blood sugar, age of diagnosis and duration of the disease among participants (N = 256).*

Table 3 shows that dyslipidemia was the most common comorbidity with 198 (77%) having dyslipidemia, 146 (57%) had hypertension, 9 (3.5%) each had stroke and peripheral artery disease and 8 (3%) had myocardial infarction

Comorbidities	No.	%
Hypertension	146	57.0
Dyslipidemia	198	77.3
Stroke	9	3.5
Myocardial infarction	8	3.1
Peripheral artery disease	9	3.5

Table 3: *Distribution of comorbidities in participants (N = 256).*

Overall physical activity was low with 80.5% of the participants having low physical activity using the IPAC scale while remaining practiced moderate and high physical actvtity as seen in figure 3.

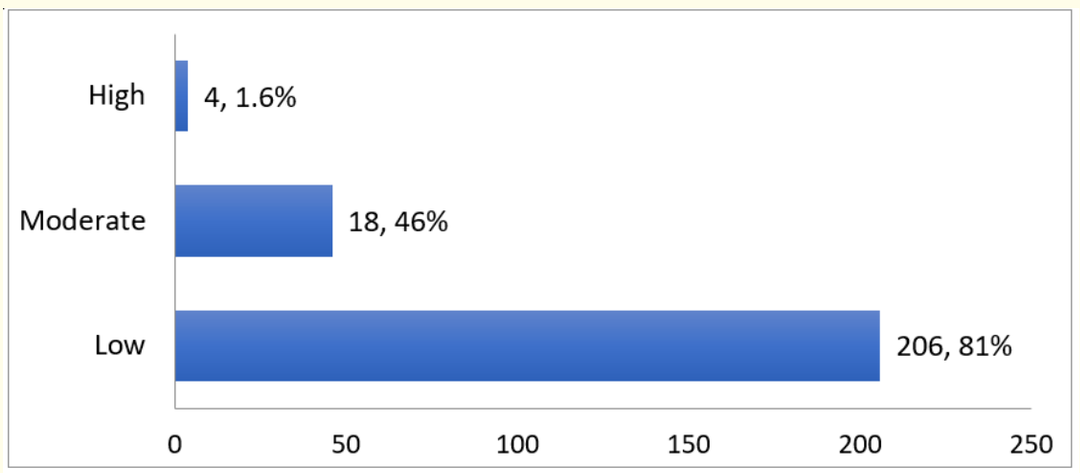

Figure 3: *Level of physical activity of the participants.*

Overall dietary practices were poor with 184 (72%) of the participants not having received diet counseling, 202 (79%) not having received a diet plan, 202 (79%) rarely adhering to prescribed diet plan, 194 (78%) did not take care while preparing their meals and 221 (86%) did not follow dietary restrictions as found in table 4.

Dietary Practice	No.	%
Receive diet counseling		
No	184	71.9
Receive meal plan		
No	202	78.9
Manage to adhere with diet		
Rarely	202	78.9
Take care while preparing meal		
No	194	75.8
Follow diet restrictions		
No	221	86.3

Table 4: *Dietary practices in patients with type 2 diabetes.*

A trend was observed with the variable age, where, as the age increased glycemic control was good. Poor glycemic control (PGC) was seen in the younger age groups where 68% of those in the 18 - 39 age group had PGC and 63.3% in 40 - 59 age group and 58.9% in those 60 years and above. This difference was not significant (Table 5).

Glycemic control was poorer in males 71 (65%) when compared to females 88 (59.9%). However, this finding was not statistically significant (Table 5).

There were only 18 subjects from south east Asia of which 12 (66.7%) had PGC, majority of the participants were from EMRO region where 61.3% had PGC

More proportion of unmarried people (66.7%) had PGC than the married participants 61.6% (Table 5).

The unemployed people had significantly better glycemic control than the employed ($P < 0.05$). 77.8% of the workers in pink color jobs had the poorest glycemic control, followed by those in gold collar job jobs (75%), blue-collar jobs (73.3%) and white-collar jobs 65.6% (Table 5).

There was no significant difference in the glycemic control between those who are achieved Secondary and Less education when compared to those who educated to graduation and above (Table 5).

There were very few participants 13 who lived alone, and it was seen that they had PGC when compared to those who lived with families (Table 5).

Socio-demographic Characteristics	Glycemic control				P Value
	Good		Poor		
	No.	%	No.	%	
Age					
18 - 39 years	7	31.8	15	68.2	0.65
40 - 59 years	51	36.7	88	63.3	
≥ 60	39	41.1	56	58.9	
Gender					
Male	38	34.9	71	65.1	0.39
Female	59	40.1	88	59.9	
Nationality					
EMR	89	38.7	141	61.3	---
South East Asia	6	33.3	12	66.7	
Others	2	25.0	6	75.0	
Marital status					
Married	89	38.4	143	61.6	0.66
Single	8	33.3	16	66.7	
Occupation					
Gold Collar	7	25.0	21	75.0	0.04
White collar	11	34.4	21	65.6	
Blue collar	8	26.7	22	73.3	
Pink collar	4	22.2	14	77.8	
No collar/unemployed	67	45.3	81	54.7	
Level of Education					
Secondary and Less	59	38.1	96	61.9	0.95
Graduation and Above	38	37.6	63	62.4	
Living condition					
Alone	3	20.0	12	80.0	0.14
With other	94	39.0	147	61.0	

Table 5: *Association between participants glycemic control and the socio-demographic characteristics (No = 256).*

Regarding; Glycemic control with blood lipid levels and blood pressure: Table 6 shows that total cholesterol, HDL, LDL and Triglycerides values were higher in those with poor glycemic control, however this difference was statistically significant only for Triglycerides. There was no significance difference in Systolic as well as the diastolic blood pressure between participants with good and poor glycemic control.

	Glycemic control				P Value
	Good		Poor		
	Mean	SD	Mean	SD	
Total Cholesterol	148.29	43.11	158.86	55.37	0.04
High Density Lipoprotein	55.24	27.96	59.78	26.81	0.15
Low Density Lipoprotein	101.15	55.79	112.49	41.41	0.95
Triglycerides	119.40	62.61	137.23	66.99	0.24
Systolic pressure	128.83	14.68	128.58	13.96	0.66
Diastolic pressure	75.64	9.72	77.49	10.98	0.81

Table 6: *Mean values of TC, HDL, LDL, TG, SBP and DBP in participants with good and poor glycemic control (No = 256).*

About 76.1% of the participants who did not receive diet counseling had significantly poor glycemic control than those who received diet counseling (P value ≤ 0.001). 71.3% of those who did not receive a meal plan had significantly poor glycemic control than those who received a meal plan (P value ≤ 0.001) (Table 7).

Taking care while preparing meal was associated with glycemic control as 73.2% of those who did not take care while preparing their meal plan had poor glycemic control than those who took care (P value ≤ 0.001) (Table 7).

Those who did not adhere to any prescribed meal plan had significantly higher proportion of poor glycemic control (69.8%) when compared to those who adhered (P value ≤ 0.001) (Table 7).

Details	Glycemic control				P value
	Good		Poor		
	No.	%	No.	%	
Received diet counseling					
Yes	53	73.6	19	26.4	0.001
No	44	23.9	140	76.1	
Received meal plan					
Yes	39	72.2	15	27.8	0.001
No	58	28.7	144	71.3	
Take care while preparing meal					
Yes	45	72.6	17	27.4	0.001
No	52	26.8	142	73.2	
Do you follow any particular diet					
None	92	37.4	154	62.6	0.51
Food plan	5	50.0	5	50.0	

Table 7: *Association between participants' diet details and glycemic control (No = 256).*

Discussion

Glycemic control is considered as the main therapeutic goal for prevention of organ damage and other complication of diabetes. ADA 2015 guidelines recommend glycemic goal HbA1C of < 7.0% for non-pregnant adults for prevention of long-term complications [21].

The primary finding revealed that was the proportion of participants with poor glycemic control was very high (62.1%, HbA1c value of ≥ 7%) when compared to the other study from Al Ain UAE (2010) where 59% had poor glycemic control [22]. This rate is slightly lower than the studies done in Saudi Arabia (KSA) which showed that poor glycemic control was present in 67.7% [23] and 67.9% [24]. A study in Jordan revealed poor glycemic control was in 65.1% [21]. In a study from Kuwait 79.8% of the population had HbA1c ≥ 8% [25]. In the Canadian primary care setting, 49% of diabetic patients had AIC ≥ 7% [26] in UK, 69% had AIC ≥ 7.51 [27].

A reason for such high prevalence of poor glycemic control among patients with type 2 diabetes in Ajman may perhaps reflect a gap in patient education and motivation from healthcare providers, another possible reason may be an absence of uniform guidelines in assessing glycemic control for physicians to follow when treating patients, Another explanation may be a lack of understanding on the importance of glycemic control and diabetes self-management among patients.

Our study showed a trend for younger patients to have poor glycemic control when compared to the older patients although the difference was not statistically different in the different age groups. Another study among African Americans where HbA1c level was measured at the initial visit and at follow-up 5 to 12 months later it showed that that younger patients had higher levels of HbA1c both initially as well as after one year [28]. A study from Hawaii on factors associated with poor glycemic control showed that younger patients had poor glycemic control [29]. Study among patients with type 2 diabetes in Singapore showed that Younger T2DM patients had poorer glycemic and cholesterol control than older patients [30]. Our findings are also consistent with other previous studies in that older patients tended to achieve better control [27,31].

In our study there was no significant difference in the glycemic control between males and females. This finding is consistent with several studies [27,32,33] which failed to show significant association between gender and glycemic control, an indication that other factors and individual characteristics have much influence on glycemic control than the sex of an individual. However, these in contrast to another study in Jordan which revealed that women had poorer glycemic control than males [21].

Our results showed that there was no significant difference between the Secondary and Less (61.9%) and Graduation and Above (62.4%) groups with respect to poor glycemic control The educational level of the participants in a similar study in Saudi revealed that education had no significant impact on glycemic control, but the patients of high educational level had better awareness of the complications and a high rate of adherence to diet [34]. However, the study in Jordan demonstrated that participants with high school education or more had better glycemic control when compared to those who were educated less than high school [21].

In our research among the occupational categories' majority (57.8%) were unemployed as there were many housewives in the study. Unemployed had significantly better glycemic control than the employed ($P > 0.04$). Our findings are similar to another study by Davila., *et al.* among US workers [35] and to study in the Kingdom of Saudi Arabia [23].

In our study the majority of the participants (51.2%) were found to be obese and 37.1% were overweight, 63% of the overweight and obese people had poor glycemic control when compared to 50% of normal weight subjects although this finding was not statistically significant. The study in Jordon and another study in KSA revealed that overweight and obesity increased the odds of poor glycemic [21,34]. This may be due to aggravation of insulin resistance due to increased fat mass and visceral adiposity, which affect insulin sensitivity and cause insulin resistance.

A study in Yemen concluded that Poor glycemic control was independently related to long duration of diabetes, habitual khat chewing and lower BMI [36].

In our study, about 63% of the participants with the disease more than 10 years had poor glycemic control when compared to 61.5% of those with duration of disease less than 10 years this finding was not statistically significant. Other studies have demonstrated that the proportion of poor glycemic control was significantly higher in patients who presented with longer duration of more than 10 years [29,32].

In our study there was no significant difference in the mean systolic blood pressure, diastolic blood pressure, HDL, LDL cholesterol and triglycerides in those with good and poor glycemic control. Only total cholesterol was significantly higher among those with poor glycemic control when compared to those with good glycemic control. The studies from Ethiopia and Darussalam showed that hypertension and coronary heart diseases were the most frequent coexisting diseases [37].

In our study overall physical activity was low with 80.5% of the participants having low physical activity. The reasons for low physical activity among our participants could be due to the desert climate that does not encourage people to have outdoor physical activity and also almost all indoor activities in Ajman are in the form of gyms which have a heavy fees. In our study 73.3% of those with low physical activity had poor glycemic control when compared to only 16% in those who did moderate to high physical activty.

Studies have concluded that only way to achieve a good glycemic control is through exercise, which has a well-known effect on type 2 diabetes [21,29,38,39].

For Adherence to Diet, in our study 76.1% of the participants who did not receive diet counseling had significantly poor glycemic control than those who received diet counseling (P value ≤ 0.001). 71.3% of those who did not receive a meal plan had significantly poor glycemic control than those who received a meal plan (P value ≤ 0.001). Taking care while preparing meal was associated with glycemic control as 73.2% of those who did not take care while preparing their meal plan had poor glycemic control than those who took care (P value ≤ 0.001). Those who did not adhere to any prescribed meal plan had significantly higher proportion of poor glycemic control (69.8%) when compared to those who adhered (P value ≤ 0.001).

This result similar to other studies that showed poor adherence to diet was associated with poor glycemic control [21,33,40].

Esposito., *et al.* conducted a cross-sectional analysis of a population of 901 diabetic outpatients attending diabetes clinic in south Italy. In this study, adherence to Mediterranean diet was inversely associated with both postprandial glucose levels and HbA1c. Other studies also showed that greater adherence to a Mediterranean-type diet is associated with lower HbA1c [41-43].

Strengths of this study include its focus on providing an overview on factors associated with glycemic control among patients with type 2 diabetes mellitus. In addition, our study is one of the first to determine the prevalence of poor glycemic control among the population of Ajman attending the PHCs.

Conclusion

The frequency of poor glycemic control was very high with 62.1% of the participants having HbA1c value of ≥ 7.

The age increased glycemic control improved. Employed participants had almost three times more odds of poor glycemic control There was no significant difference in Age, nationality, marital status, level of education, or living status of the participants. Overweight and obese individuals had a poor glycemic control. where those with low physical activity had seven times more odds of poor glycemic control than those with moderate to high physical activity. Overall, significantly poor glycemic control was noticed among participants who did not receive diet counseling.

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