



ORIGINAL ARTICLE

Assessment of physical activity level and glycemic control among patients with type-II diabetes mellitus.

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ABSTRACT... Objective: To assess the physical activity level (PAL) and its impact on glycemic control in patients with T2DM. **Study Design:** Cross-sectional study. **Setting:** Darul Sehat Hospital, Karachi. **Period:** February 2021 to June 2021. **Material & Methods:** Patients with T2DM were included through convenience sampling method. The sample size was calculated by Open Epi Version 3 assuming 69% frequency of outcome in population, margin of error 5% and confidence level 95%. PAL was assessed by using the short version of the International Physical Activity Questionnaire (IPAQ-SF). **Results:** Out of 330 patients 225(68.2%) were female and 105(31.8%) were males. The mean age of subjects was 55.2 ± 8.32 and the mean duration of diabetes 9.6 ± 6.4 years. Of the patients, 122 (37%) had low, 175(53%) had moderate, and 33 (10%) had high PAL. The mean sitting duration was 527.4 (95% CI 516 to 538) minutes. The mean weekly total energy was 938 ± 1171 MET-min/week. **Conclusion:** Our majority of patients were engaged in moderate physical activity level. The study results imply convincing impact of physical activity level and glycemic control. Women and older age Pakistani diabetic patients do not meet the physical activity recommendations.

Key words: Glycemic Control, IPAQ-SF, Life Style Modification, Physical Activity Level (PAL), Type 2 Diabetes Mellitus (T2DM).

INTRODUCTION

Type 2 Diabetes mellitus (T2DM) is a chronic disease. It increases morbidity and mortality by development of numerous complications mostly linked to the cardiovascular system.¹ In recent decades, the prevalence of T2DM has rapidly increased worldwide especially in Asian countries.² The estimated worldwide prevalence of diabetes in adults is 9.3%, while the number is alarmingly higher in Pakistani population that is 17.1%.³ T2DM has multifactorial etiology that include genetic and modifiable non-genetic risk factors. The known non-genetic modifiable risk factors for pathogenesis of T2DM are unhealthy lifestyle, intake of junk food and other multiple environmental factors. The high prevalence in region of South Asia is mainly contributed by major lifestyle changes associated with rapid development and urbanization. The key elements in this increasing burden are sedentary behaviors,

low physical activity and consumption of low-quality food.²

The cornerstone of prevention and management for T2DM is life style modification that includes regular physical activity, maintaining a healthy weight, healthy nutrition and avoidance of any addiction. Research literature suggest co-occurrence of hypertension, dyslipidemia and hyperinsulinemia with T2DM which associate it with an increased risk of premature cardiovascular disease.^{4,5} It is common observation that physical activity and exercise have positive impact on overall well-being of individuals. Review of data suggest that sufficient physical activity in diabetics improves glycemic control by increasing sensitivity of skeletal muscles to insulin and inhibit the development of atherosclerosis.^{6,7} Moreover, the additional benefits of weight reduction and emotional well-being can also be achieved. These

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attributes of regular physical activity thereby reduce the associated cardiovascular morbidity and mortality in type 2 diabetes (T2DM).

In country like Pakistan which has high prevalence of T2DM, there are very few studies conducted on association of life style in terms of diabetes management. Although few local studies are conducted in past, there is still paucity of local data on prevalence and associated factors of physical activity level among patients with T2DM.^{8,9} Apart from prevalence, the local data on association between glycemic control and physical activity level is too scarce. The objectives of our study are to assess: I) the prevalence of physical activity level (PAL) and its associated factors and, II) the impact of PAL on glycemic control in Pakistani patients with type 2 diabetes mellitus.

MATERIAL & METHODS

This cross-sectional observational study was conducted in Darul Sehat Hospital between February 2021 to June 2021 after approval from ethical committee (IRB/M-000011/21). Type 2 diabetic patients were included through convenience sampling method. The sample size was calculated by Open Epi Version 3 assuming 69% frequency¹⁰ of outcome in population, margin of error 5% and confidence level 95%. The short version of the International Physical Activity Questionnaire (IPAQ-SF)¹¹ was used to assess physical activity level in patients. Patient interviews were conducted by face-to-face and demographic details, qualifications, occupation along with BMI (body mass index) and laboratory values of HbA1c were added in predesigned proforma.

By IPAQ-SF following information was gathered: I) total sitting time, II) duration and frequency of walking, III) moderate and vigorous intensity activity that was performed for at least 10 minutes for each session. Weekly minutes were calculated for moderate intensity activity, vigorous intensity activity and walking. Calculation was done by multiplying the duration of activity on a regular day by number of days per week. The reported minutes per week were also expressed by a metabolic equivalent (MET; multiples of resting

energy expenditure) resulting in a physical activity estimate independent of body weight. It was specified in MET-minutes/week and calculated by multiplying METs by minutes/week.

On standard scoring criteria, the physical activity level was projected by following three levels:¹⁰

Level 1 (Low): This physical activity level was the lowest level among all three levels. It was defined as physical activity that did not meet the criteria for level 2 or 3.

Level 2 (Moderate): This physical activity level was defined when any one of following criteria was fulfilled: (a) At least 20 minutes of vigorous activity per day for 3 days a week; (b) Moderate-intensity activity or walking of more than 30 minutes per day for more than 10 minutes at a time for at least 5 days a week; or (c) Any combination of walking, moderate-intensity or vigorous-intensity activities for 5 days a week that achieve at least 600 MET-minutes per week.

Level 3 (High): This physical activity level was defined when any one of the following criteria was fulfilled: (a) Any vigorous-intensity activity performed on at least 3 days per week that achieve at least 1500 MET-minutes per week; or (b) Any combination of walking, moderate-intensity or vigorous intensity activities for 7 days per week that achieve at least 3000 MET-minutes per week.

Glycosylated hemoglobin (HbA1c) level was used for glycemic control as an outcome variable. The HbA1c level less than 6.5% considered good glycemic control, HbA1c level less than 7% as acceptable and HbA1c level more than 7% considered poor glycemic control.¹²

Data was analyzed using SPSS version 21. Frequencies and percentages were calculated for categorical variables. Mean \pm sd was reported for numerical variables. Chi-square test was applied to compare physical activity with HbA1c levels and other variables at $p < 0.05$ as significant.

RESULTS

Out of 330 patients 225(68.2%) were female and 105(31.8%) were males. In Table-I, demographic and clinical data of the study patients are presented. The mean age of the study patients was 55.2 ± 8.3 years. The mean duration of diabetes was 9.6 ± 6.4 years. In Table-II, the results of the IPAQ-SF questionnaire are presented as total and subgroup scores. Among 330 patients, 122 (36.9%) had low, 175(53.1%) had moderate, and 33 (10%) had high physical activity levels. There was mean sitting duration of 527.4 minutes (95% CI 516 to 538). The total mean energy per week was 938 ± 1171 MET-min/week.

Characteristics		Mean \pm SD or n (%)
Age		55.2 \pm 8.3
Duration of diabetes (years)		9.6 \pm 6.4
Gender	Female	225(68.2%)
	Male	105 (31.8%)
Weight (kilograms)		79.0 + 13.6
Height (meters)		1.6 + 0.1
HbA1c (%)		7.4 + 1.3
Education	Matric	33(10%)
	Intermediate	66(20%)
	Graduate	98(29.7%)
	Postgraduate	33(10%)
	Not educated	49(14.8%)
	Others	51(15.5%)
Occupation	Housewife	119(36.1%)
	Office job	89(27%)
	Retired	56(16.9%)
	Teacher	33(10%)
	Others	33(10%)
BMI (kg/m ²)		29.3 + 5.2
BMI categories	Normal	76(23%)
	Overweight	99(30%)
	Obese	155(47%)

Table-I. Demographic and Clinical Characteristics of the Study Participants. (n=330)

Variables		Mean \pm SD Median (min, max)
MET-min/week	Total score	938 \pm 1171
		594 (0-5493)
Levels of physical activity	Walking	460 \pm 380.8
		429 (0-1386)
(MET-min/week)	Moderate activity	397.3 \pm 715.1
		530 (0-3360)
	Vigorous activity	80 \pm 310.9
		128 (0-1440)
	Sitting time (min)	8.8 \pm 3.6
		9(2-18)
IPAQ-SF	High level	33(10%)
Weekly physical activity level	Moderate	175(53.1%)
	Low	122(36.9%)
Reason of not doing any activity	Lack of time	66(20%)
	Lack of energy	66(20%)
	None	198(60%)

Table-II. The IPAQ-SF survey responses.

DISCUSSION

The adequate physical activity plays important role in maintenance of health and prevention of complications in diabetic individuals. Despite the beneficial effects of physical activity, many adult diabetics could not accomplish the desired level of physical activity to achieve those benefits. There are many factors and barriers which seem to impact physical activity level (PAL) such as gender, age, social and educational status and physical fitness.^{13,14} In this study, we have observed that 63% of type 2 diabetic patients met the standard recommendation of physical activity level. PAL was higher in men and young to middle age group participants. While female gender, advancing age and higher BMI were associated with lower PAL. Our data showed strong statistical association between higher PAL and good glycemic control in terms of HbA1c values.

Our study showed that half of our study population (53.1%) met the desired goal of PAL, while the 10% were engaged in high level of PAL. The remaining one third diabetics (37%) had low physical activity level.

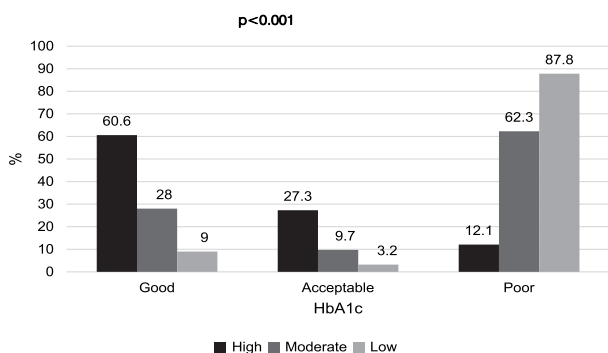


Figure-1: Comparison of Level of Physical Activity with Glycemic Control.

Demographic and Clinical Characteristics (no)		Physical Activity Level			P-Value
		Low Frequency (%)	Moderate Frequency (%)	High Frequency (%)	
Age (years)	<40 (54)	8 (9%)	39 (21%)	7 (13%)	<0.001
	40-60 (205)	48(54.6%)	120 (64%)	37 (68%)	
	>60 (71)	32(36.4%)	29(15%)	10(19%)	
Gender	Male (105)	20(14%)	70(50%)	15(30%)	<0.001
	Female (225)	120 (86%)	70 (50%)	35 (70%)	
Duration of Diabetes (years)	<10 (177)	90 (49%)	55 (60%)	32 (56%)	0.210
	>10 (153)	92 (51%)	36 (40%)	25 (44%)	
Education	Matric (33)	7 (8%)	18 (12%)	8 (9%)	0.278
	Intermediate (68)	19(21%)	32(21%)	17(20%)	
	Graduate (98)	22(25%)	55(35%)	21(24%)	
	Postgraduate (33)	13(15%)	11(7%)	9(10%)	
	Not educated (49)	17(19%)	17(11%)	15(17%)	
Occupation	Others (51)	11(12%)	23(14%)	17(20%)	0.463
	Housewife (119)	48(39%)	40(32%)	31(37%)	
	Office job (89)	39(32%)	30(24%)	20(24%)	
	Retired (56)	15(12%)	28(23%)	13(16%)	
	Teacher (33)	10(8%)	14(11%)	9(11%)	
BMI	Others (33)	11(9%)	12(10%)	10(12%)	0.0019
	Normal (76)	28(15%)	35(31%)	13(38%)	
	Overweight (99)	64(35%)	25(22%)	10(30%)	
	Obese (155)	91(50%)	53(47%)	11(32%)	

Table-III. Association between demographic characteristics and level of physical activity. (n=330)

These results were comparable to other studies that were conducted locally and in neighbor countries in diabetic patients.^{14,15} However, these results were higher compare to many other studies that reported lower physical activity levels.^{16,17} The subjects who were not meeting the goal of required physical activity, among them 60% had suggested no specific reason for being inactive while 40% considered lack of energy and time for their inactivity. These findings highlight the need for intervention for increasing motivation, appropriate knowledge and awareness about importance of physical activity in diabetic population. Presence of depression, older age, diabetes related physical disabilities and lack of social support are known contributing factors to lack of motivation in diabetic patients.^{16,18}

Glycemic control is the mainstay of diabetes management and prevention of complications. In our study, it was found that HbA1C level was in control range in patients who were engaged in moderate to higher level of PAL. Those who were doing vigorous activities have good HbA1c levels

while those with low physical activity had poor HbA1c levels. The medical research emphasizes the strong association between PAL and glycemic control.^{19,20} A recently conducted systematic review and meta-analysis showed that almost all the studies reported decrease in HbA1c level after exercise intervention in diabetic patients.²¹

In our analysis, we have also observed strong statistical association of age and gender with physical activity level. Gender and age are well reported factors that can influence amount and type of exercise.²² We found that diabetic men were more active and were involved in moderate to high PAL as compare to females. A study from Bangladesh²³ with similar culture and social circumstances reported socially endorsed behaviors, lack of opportunities and lack of time for this gender difference to PAL. Similarly, patients in young and middle age group were able to achieve required level of PAL as compare to adults more than 60 years of age. The scientific literature suggests health related issues, lifestyle and time management as known

important factors that limit PAL particularly during the aging process in diabetics.²⁴ Therefore more effort is required to support the women and old age diabetics to maintain PAL in order to prevent and manage associated complications. Management plan should be individualized for them to meet specific needs. Care providers and immediate family members should be engaged in their management plan for getting them more opportunities for physical activity.

It is a well-documented observation that most of the diabetic patients are overweight or obese.^{22,25} Similarly among our study participants, most of them were in overweight or obese category of BMI. Physical Activity Level of those patients was low as compare to those who have normal BMI. This result is in accordance with the findings from previous studies.^{16,19,26}

When considering other demographic factors, the results heir in were not statistically significant for occupation and educational status of study participants.

CONCLUSION

The study results imply convincing impact of physical activity level and glycemic control. Women and older age Pakistani diabetic patients do not meet the physical activity level recommendations; therefore, more emphasis is needed on how to increase physical activity in them.






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AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
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2	Shabnam Naveed	Drafted the manuscript, Contributed to interpretation of results.	
3	Abdul Malik	Drafted the manuscript, Contributed to interpretation of results.	
4	Mohammad Athar Khan	Contributed to conception or design, Critically revised the manuscript	
5	Rashid Naseem Khan	Agress to be accountable for all aspects of work, Ensuring integrity and Accuracy.	
6	Kiran Kumari	Critically Revised the Manuscript.	