

Original Article

GLYCEMIC CONTROL AND ITS RELATION WITH PHYSICAL ACTIVITY AND BODY MASS INDEX IN TYPE II DIABETES MELLITUS

Faiza Kamal, Sarfraz Ahmad Khan, Rashid Ahmed, Rozina Arshad and Bilal Bin Younis

Objective: To determine the correlation between glycemic control, physical activity and body mass index among type II diabetics.

Methods: A cross-sectional study was conducted with a total of 500 people with type II diabetes mellitus not affected with co-morbidities like cardiovascular disease, cancer, gestational diabetes and type I diabetes. Study was conducted in an outpatient department, Sakina Begum Institute of Diabetes and Endocrine Research (SiDER), in Shalamar hospital, Lahore. Results were analyzed using SPSS version 20.

Results: Out of the 500 individuals, 36.8% were male and 63.2% were females. The mean age and mean HbA1c was 48.81 ± 10.118 and 10.4 ± 5.9 , respectively. Only 38.80% were performing physical activity whereas 61.20% were not performing any form of physical activity. Out of these, 32.2% were female and 48.4% were males. The mean body mass index was 29.88 ± 6.189 . Body mass index distribution data revealed that 27.6% had normal BMI, 35.2% were overweight and 37.2% were obese.

Conclusions: It was concluded that there is a direct association between body mass index and blood sugar levels and indirect relation with physical activity and glycemic control.

Keywords: glycemic control, physical activity, body mass index and type-II diabetes mellitus.

Introduction

Diabetes mellitus is a lifelong disease in which there is an inability of the pancreas to secrete insulin properly resulting in insulin resistance and hyperglycemia¹. According to IDF Atlas 2017, 425 million people live with Diabetes Mellitus worldwide and by 2045; this number will increase to 438 million. Almost 7 million people have Diabetes Mellitus and an equal numbers of patients remain undiagnosed in Pakistan². Pakistan ranks 7th and 9th among the top ten countries with the highest number of people living with diabetes and obesity, respectively³.

Obesity is no longer a condition affecting elderly but all age groups⁴. Obesity triggers changes in the body's metabolism, thereby causing adipose tissue to release fat molecules into the blood which affects the insulin responsiveness of the cells negatively; hence, people who are overweight or obese cannot utilize blood glucose sufficiently and end up having high blood glucose⁵.

Overweight and obese people are less motivated to perform physical activity as excess body weight becomes a hindrance⁶. Physical activity assists in weight loss and weight maintenance⁷. The individuals engaged in physical activity tend to have lower fat deposition. Physical activity results in loss of visceral rather than subcutaneous fat, which is strongly associated with insulin resistance⁸. It is also

recommended that a minimum of 150 minute per week of physical activity needs to be performed as it has an impact on glycemic control in type II diabetes⁹. Fewer studies are available which target the combination of body mass index, physical activity and glycemic control especially, in our part of the world. Hence, this paper aims to find statistical evidence of the relationship between these parameters in Pakistan.

Methods

A cross-sectional study was planned to find out the correlation of body mass index and physical activity and its effect on blood sugar levels. A total of 500 people with type II Diabetes Aged 20-65 years were included in the study. People with co-morbidities like cardiovascular disease, Diabetic Nephropathy, Diabetic Retinopathy, cancer, decompensated chronic liver disease were excluded. Type I diabetes and gestational diabetes were also not included. Informed consent was obtained and study was approved by (IRB) Institutional review board Shalamar Medical and Dental College Lahore. Questionnaire and interview were scheduled to assess Physical activity and glycemic control. Study was conducted in outpatient department SiDER (Sakina Begum Institute of Diabetes and Endocrine Research) at Shalamar Hospital, Lahore from May 2017 to November 2017. Results were analyzed using SPSS (Statistical package

Results were analyzed using SPSS (Statistical package for the social sciences) Version 20.

Results

Table-1 shows that out of 500 type 2 diabetics, 36.8% were male and 63.2% were females. The mean age and duration of disease was 48.81 ± 10.11 and 6.81 ± 5.36 respectively. Mean HbA1c of males were 10.1 ± 5.7 and female were 11.0 ± 5.8 . **Table-2** shows that the mean BMI was 29.88 ± 6.1 . Distribution of BMI shows that 27.6% had normal, 35.2% were overweight and 37.2% were obese. It also shows overall mean and distribution the physical activity in both male and females which is above the routine activity. The physical activity is taken as 150 min per week; the distribution shows, male doing better as compared to females i.e. 48.8% and 32.3% respectively.

Table-1: Descriptive statistics.

		Frequency (%) mean \pm SD
Gender	Male	184 (36.8%)
	Female	316 (63.2%)
Age in years		48.81 \pm 10.11
Duration of Disease	Male	49.59 \pm 10.26
	Female	48.36 \pm 10.09
HbA1c		6.18 \pm 5.36
HbA1c		10.4 \pm 5.9
	Male	10.1 \pm 5.7
	Female	11.0 \pm 5.8

Table-2: Descriptive variables.

		Frequency (%) mean \pm SD
Body Mass Index (BMI)		29.88 \pm 6.1
Body Mass Index of male		26.6 \pm 4.25
Body Mass Index of female		31.78 \pm 6.34
Duration of BMI	Normal	138 (27.6%)
	Over Wight	176 (35.2%)
	Obese	186 (37.2%)
Physical activity (159min/week)	Yes	194 (38.8%)
	No	306 (61.2%)
Physical activity in male (159min/week)	Yes	89 (48.4%)
	No	95 (51.6%)
Physical activity in female (159min/week)	Yes	102 (32.3%)
	No	214 (67.7%)

Table-3: Relation between BMI and HbA1c.

BMI	N	HbA1c Mean \pm SD	P-value*
Normal	138	7.7 \pm 3.2	
Overweight	176	9.64 \pm 4.4	0.001
Obese	186	12.08 \pm 4.8	

*P-Value ≤ 0.05 will be considered as significant.

Table-4: Relation of BMI distribution and Physical Activity.

BMI	Physical activity		P-value*
	Yes	No	
Normal wight	60 (43.5%)	78 (567.5%)	
Over weight	80 (45.5%)	96(54.5%)	0.002
Obese	54 (29.0%)	132 (71.0%)	

*P-Value ≤ 0.05 will be considered as significant.

Table-5: Comparison between physical activity and HbA1c.

Physical activity ^l	N	HbA1c Mean \pm SD	P-value*
Yes	194	9.5 \pm 2.5	
No	306	11.2 \pm 3.6	0.001

*P-Value ≤ 0.05 will be considered as significant.

Table-3 shows that as the body weight of the increases blood sugar level also increases with significant p-value 0.001. **Table-4** shows that in normal body mass index category 43.5% people were involved in physical activity whereas in obese category only 29% were performing it. **Table 5** shows that physical activity had significant effect on blood sugar levels. A direct relation with glycemic control. To obtain a holistic assessment of the role of education for diabetes management exclusive to the importance of physical activity and weight reduction, similar studies can be conducted in other centers of Pakistan.

Discussion

There is a paradigm shift in the epidemiology of non-communicable diseases in Pakistan. The diseases which were once thought to be very rare, are not very uncommon now. This disease pattern is especially seen in diabetes, obesity and other metabolic problems.¹⁰ Technology and modern living has transformed our traditional lifestyle by declining regular form of physical activity from our daily lives and introducing more comfort through sedentary habits and handy availability of fast food. According to Indo-Asian specific BMI cut off value, one fourth of the

population of Pakistan is labeled as overweight or obese.¹¹ Diabetes and cardiovascular disease is closely related with obesity especially the visceral obesity.¹² Leptin and fatty acids levels are increased in obesity leading to insulin resistance. It is evident that accumulation of fat in viscera is directly related to diabetes.¹³ Studies showed that fewer women are engaged in physical activity. The indulgence in the household tasks keeps them away from the physical activity, as they get exhausted in normal routines. Secondly, the cultural and social restrictions do not allow the majority of women to take part into leisure physical activity. This is further restricted as it is deemed necessary for a women to have a male family member to accompany her.¹⁴ The findings of our study showed that only 32.3% women were performing physical activity and 67.7% were not. A study conducted on Chinese population in 2012 revealed that BMI was more strongly correlated with type II diabetes and dyslipidemia.¹⁵ Another cross sectional study in 2016, which utilizes the data from US physician electronic health records from 2009-11, concluded that type II diabetes patients who were overweight and obese (class I, II, or III) were associated with a significantly higher probability of having HbA1c $\geq 7\%$ and $< 8\%$, $\geq 8\%$ and $< 9\%$, or $\geq 9\%$ respectively. The study found that type II diabetic patients had a significant association with patients being overweight or obese and having suboptimal glycemic control.¹⁶ Increased body mass index is an independent risk factor for poor glycemic control as it is also observed in this study. Excess body weight correlated inversely with diabetes control and it also adds difficulty in undertaking physical activity.^{17,18} These finding correlate with our results as only 29% of obese people were performing physical activity as compared to normal and overweight people i.e. 43% and 45%

respectively. Thus it is evident that high BMI itself influenced the activity level of individual negatively. Another study by Blumenthal et.al showed that body mass index has greater impact on glycemic control as compared to physical activity.¹⁹ However, both physical inactivity and high BMI are considered as independent variables, they may be affecting each other and sharing the same pathway eventually causing diabetes.²⁰ Physical activity plays an important role in the prevention of diabetes mellitus and in diagnosed diabetics it improves glycemic control. Study published in JAMA revealed that body mass index and physical inactivity are strongly associated with type II Diabetes Mellitus.²⁰ Our study revealed a statistically significant reduction in the HbA1c levels in diabetic people who are involved in physical activity.

Conclusion

Treating diabetes is not limited to prescribing medicines, patient education is one of the most important pillars of diabetes management. It was concluded that people with high body mass index and no physical activity had poor glycemic control. It was also observed that males were indulged more in physical activity as compared to females and had a better glycemic control. Hence, it was proved that physical activity and maintaining body mass index had a direct relation with glycemic control. To obtain a holistic assessment of the role of education for diabetes management exclusive to the importance of physical activity and weight reduction, similar studies can be conducted in other centers of Pakistan.

*Department of Medicine
Shalamar Medical College Lahore .
www.esculapio.pk*

References

1. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes care. 2010 Jan;33(Suppl 1):S62.
2. Ogurtsova K, da Rocha Fernandes JD, Huang Y, Linnenkamp U, Guariguata L, Cho NH, et al. IDF Diabetes Atlas: Global estimates for the prevalence of diabetes for 2015 and 2040. Diabetes research and clinical practice. 2017 Jun 1;128:40-50.
3. Kosek M, Bern C, Guerrant RL. The global burden of diarrhoeal disease, as estimated from studies published between 1992 and 2000. Bulletin of the World Health Organization. 2003;81:197-204.
4. Yoon KH, Lee JH, Kim JW, Cho JH, Choi YH, Ko SH, et al. Epidemic obesity and type 2 diabetes in Asia. The Lancet. 2006 Nov 11;368(9548):1681-8.
5. Kahn SE, Hull RL, Utzschneider KM. Mechanisms linking obesity to insulin resistance and type 2 diabetes. Nature. 2006 Dec 13;444(7121):840.
6. Shils ME, Shike M, editors. Modern nutrition in health and disease. Lippincott Williams & Wilkins; 2006.
7. Swift DL, Johannsen NM, Lavie CJ, Earnest CP, Church TS. The role of exercise and physical activity in weight loss and

- And maintenance. Progress in cardiovascular diseases. 2014 Jan 1;56(4):441-7.
8. Guilherme A, Virbasius JV, Puri V, Czech MP. Adipocyte dysfunctions linking obesity to insulin resistance and type 2 diabetes. Nature reviews Molecular cell biology. 2008 May;9(5):367.
 9. Sigal RJ, Kenny GP, Wasserman DH, Castaneda-Sceppa C, White RD. Physical activity/exercise and type 2 diabetes: a consensus statement from the American Diabetes Association. Diabetes care. 2006 Jun 1;29(6):1433-8.
 10. Wasay M, Zaidi S, Jooma R. Non communicable diseases in Pakistan: burden, challenges and way forward for health care authorities.
 11. Jafar TH, Chaturvedi N, Pappas G. Prevalence of overweight and obesity and their association with hypertension and diabetes mellitus in an Indo-Asian population. Canadian Medical Association Journal. 2006 Oct 24;175(9):1071-7.
 12. Mokdad AH, Ford ES, Bowman BA, Dietz WH, Vinicor F, Bales VS, et al. Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. Jama. 2003 Jan 1;289(1):76-9.
 13. Carey VJ, Walters EE, Colditz GA, Solomon CG, Willett WC, Rosner BA, et al. Body fat distribution and risk of non-insulin-dependent diabetes mellitus in women: the Nurses' Health Study. American journal of epidemiology. 1997 Apr 1;145(7):614-9.
 14. Hu FB, Sigal RJ, Rich-Edwards JW, Colditz GA, Solomon CG, Willett WC, et al. Walking compared with vigorous physical activity and risk of type 2 diabetes in women. Journal of Cardiopulmonary Rehabilitation and Prevention. 2000 Mar 1;20(2):130-1.
 15. Feng RN, Zhao C, Wang C, Niu YC, Li K, Guo FC, et al. BMI is strongly associated with hypertension, and waist circumference is strongly associated with type 2 diabetes and dyslipidemia, in northern Chinese adults. Journal of epidemiology. 2012 Jul 5;22(4):317-23.
 16. Bae JP, Lage MJ, Mo D, Nelson DR, Hoogwerf BJ. Obesity and glycemic control in patients with diabetes mellitus: Analysis of physician electronic health records in the US from 2009-2011. Journal of diabetes and its complications. 2016 Mar 1;30(2):212-20.
 17. Kohl III HW, Cook HD. Physical activity and physical education: Relationship to growth, development, and health.
 18. Wilding JP. The importance of weight management in type 2 diabetes mellitus. International journal of clinical practice. 2014 Jun 1;68(6):682-91.
 19. Blumenthal JA, Sherwood A, Gullette EC, Babyak M, Waugh R, Georgiades A, et al. Exercise and weight loss reduce blood pressure in men and women with mild hypertension: effects on cardiovascular, metabolic, and hemodynamic functioning. Archives of internal medicine. 2000 Jul 10;160(13):1947-58.
 20. Weinstein AR, Sesso HD, Lee IM, Cook NR, Manson JE, Buring JE, et al. Relationship of physical activity vs body mass index with type 2 diabetes in women. Jama. 2004 Sep 8;292(10):1188-94.