Study of Association of BMI With Glycemic Control in Type 2 Diabetes Mellitus Patients

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Abstract: **Background**: The prevalence of diabetes is rapidly rising in the world at an alarming rate. Obesity is a complex disorder associated with variety of diseases such as cardiovascular disease (CVD), stroke, cancer, hypertension, diabetes, osteoarthritis and early death. Present study was aimed to study association of BMI with glycemic control in type 2 diabetes mellitus patients. **Material and Methods:** Present study was single-center, prospective, observational study, conducted in subjects (males and females between 40–60 years) attending outpatient department of Medicine, known case of type 2 diabetes melltes, underwent BMI &HbA1c estimation. **Results:** In present study, 120 diabetic subjects satisfying study criteria were considered for study. Patients were classified into group A, B, C depending on duration of diabetes as 5,10 & 15 years respectively. In each group 40 subjects (20 male & 20 female) were included. divided according to BMI values & compared with gender. We did not observe any difference in age, gender & BMI distribution among 3 groups & difference was not significant statistically. ($p < 0.05$). According to BMI majority had normal BMI (56.67 %) followed by overweight (26.67 %) & obese (16.67 %). HbA1c $\geq$ 8 was common in overweight & obese subjects as compared to normal BMI subjects, difference was statistically significant ($p<0.01$).On comparison between BMI and glycated Hb values within the three groups (A, B & C), a significant correlation was noted between BMI and glycated Hb values, as BMI was increasing raised HbA1c values were noted (using Pearson's correlation).**Conclusion:** Higher BMI was associated with poor glycemic control in type 2 diabetes mellitus patients. evidenced by raised glycated haemoglobin (HbA1C) concentrations.

Key words*:* BMI, glycemic control, type 2 diabetes mellitus,glycated haemoglobin (HbA1C)

INTRODUCTION

The prevalence of diabetes is rapidly rising in the world at an alarming rate. The International Diabetes Federation (IDF) estimates that the total number of diabetic subjects in India will rise to 69.9 million by the year 2025.[1,2] Diabetes Mellitus comprises a group of common metabolic disorders that share the phenotype of hyperglycemia. Depending on the etiology of Diabetes Mellitus, factors contributing to hyperglycemia may include reduced insulin secretion, decreased glucose utilization and increased glucose production. Sustained hyperglycemias is associated with complications in the macro vasculature, microvasculature and nerves, causing protracted morbidity and premature mortality.[3] Obesity is a complex disorder associated with variety of diseases such as cardiovascular disease (CVD), stroke, cancer, hypertension, diabetes, osteoarthritis and early death.[4] Globally one in six adults is obese and nearly 2.8 million individuals die each year due to overweight or obesity.[5] Glycemic control is a critical issue in clinical management of diabetes and its complications. It has been suggested that intensive glycemic control is associated with lower prevalence of micro-vascular and neuropathic events in patients with type 2 diabetes mellitus. Present study was aimed to study association of BMI with glycemic control in type 2 diabetes mellitus patients.

MATERIALS AND METHODS

Present study was single-center, prospective, observational study, conducted in Department of Pharmacology, at SRTR Medical College & Hospital, Ambajogai, India. Study duration was of 6 months. Study was commenced after getting the approval of the Institutional Human Research Ethics Committee.

Inclusion criteria

Subjects (males and females between 40–60 years) attending outpatient department of Medicine, known case of type 2 diabetes melltes, willing to participate in present study

Exclusion criteria

Subjects taking steroids/females taking oral contraceptive pills, Known hypertensives, Subjects with on treatment for thyroid disorders

Study was explained to patients in local language & written consent was taken for participation & study. All patients underwent demographic data collection, history taking, general examination & details were noted in case record proforma. Body Mass Index (BMI) was

calculated after taking the patient's weight in kilograms, divided by height in meters squared (Kg / m^2). BMI was classified as underweight if BMI was < 18.5 Kg/m^2, normal if BMI was 18.5 – 24.9 Kg / m2, overweight if BMI was 25 – 29.9 Kg / m2, and obese if BMI was ≥ 30 Kg /m^2. Each subject was instructed to visit laboratory with 6 hours of fasting on a specific date, the blood samples (3 ml volume) was drawn for estimation glycated hemoglobin. Blood was collected from the ante cubital vein in K3EDTA (Ethylene-diamine-tetra-acetic acid) vacutainers. Random blood sugar value and HbA1c was measured usings emi quantitative technique. Any patient with a HbA1c of more than 8 was defined as having poor glycaemic control. Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Frequency, percentage, means and standard deviations (SD) was calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Difference of proportions between qualitative variables were tested using chi- square test or Fisher exact test as applicable. P value less than 0.05 was considered as statistically significant.

RESULTS

In present study, 120 diabetic subjects satisfying study criteria were considered for study. Patients were classified into group A, B, C depending on duration of diabetes as 5,10 & 15 years respectively. In each group 40 subjects (20 male & 20 female) were included. divided according to BMI values & compared with gender. We did not observed any difference in age, gender & BMI distribution among 3 groups & difference was not significant statistically. ($p < 0.05$).

Table 1: General characteristics

Characteristic	Group A (%)	Group B (%)	Group C (%)	P value
Mean age	52.42 ± 6.34	53.26 ± 3.72	55.01 ± 4.09	0.0632
Gender				--
Male	20 (50 %)	20 (50 %)	20 (50 %)	
Female	20 (50 %)	20 (50 %)	20 (50 %)	
BMI (kg/m^2)				0.056
Normal (18.5-24.9)	29 (72.5 %)	23 (57.5 %)	16 (40 %)	
Overweight (25-29.9)	8 (20 %)	11 (27.5 %)	13 (32.5 %)	
Obese (>30)	3 (7.5 %)	6 (15 %)	11 (27.5 %)	

In present study, according to BMI majority had normal BMI (56.67 %) followed by overweight (26.67 %) & obese (16.67 %). HbA1c ≥ 8 was common in overweight & obese subjects as compared to normal BMI subjects, difference was statistically significant ($p<0.01$)

Table 2: Correlation between BMI and HBA1C

HbA1c	BMI (kg/m^2)		
	Normal (18.5-24.9)	Overweight (25-29.9)	Obese (>30)
< 6.5%	43 (35.83 %)	9 (7.5 %)	0
6.5-8%	15 (12.5 %)	10 (8.33 %)	3 (2.5 %)
8-10%	9 (7.5 %)	7 (5.83 %)	8 (6.67 %)
> 10%	1 (0.83 %)	6 (5 %)	9 (7.5 %)
	68 (56.67 %)	32 (26.67 %)	20 (16.67 %)

On comparison between BMI and glycated Hb values within the three groups (A, B & C), a significant correlation was noted between BMI and glycated Hb values, as BMI was increasing raised HbA1c values were noted (using Pearson's correlation).

Table 3: Correlation between BMI, HBA1C & duration of diabetes

Group	BMI	HbA1c	R value (correlation)	p-value
A	23.81 ± 2.38	7.12 ± 3.21	0.023	0.001
B	26.51 ± 3.13	8.09 ± 2.82	0.012	
C	27.30 ± 2.56	9.01 ± 2.36	-0.019	

DISCUSSION

As evident from recent studies, higher proportions of patients are poorly controlled and microvascular and macrovascular complications continue to persist, despite steps taken for strict glycemic control. Optimal glycemic control attainment in clinical practice is difficult and the reasons for its poor control are complex. Factors identified in influencing glycemic control include age, sex, education, marital status, BMI, smoking, diabetes duration, and type of medications.[6] Asian Indian phenotype is characterized by a high percentage of body fat and increased WHR which predisposes to diabetes and metabolic syndrome.[7]Chandalia et al have shown that for any BMI the migrant Indians have higher body fat and for

any given fat, they also had higher insulin resistance as compared to ethnic groups.[8] A study of clustering of cardiovascular risk factors in urban Asian Indians revealed that while only 31.6% of the IGT and 34.7% of the diabetes patients had a BMI value of more than 25, the WHR was abnormal in 59.1% of the IGT patients and 74.8% of the diabetics.[9] The risk of complication in type 2 DM is directly related to prior glucose control level. A study revealed that in patients with type 2 diabetes, HbA(1c) levels were associated with lower risks of macrovascular events and death down to a cutpoint of 7.0% while microvascular events down to a cutpoint of 6.5%.[10] Kumar A et al.,[11] studied 1000 diabetic individuals, 120 had good, 469 had fair and 411 had poor glycaemic control on the basis of their HbA1C status. Age was similar for all 3 groups and was insignificantly related to glycaemic control (p-0.663). Out of 1000 individuals, 703(70.30%) had normal BMI while 297 (29.7%) were overweight. Data from both the SHIELD and NHANES surveys reported reflect and support the common clinical observation that patients with higher BMI are at higher risk for having diabetes mellitus, hypertension and dyslipidaemia. It also confirms the converse – that the majority of patients with these metabolic diseases are either overweight or obese. These results provide nationally representative data regarding the important relationship between BMI and these metabolic diseases.[12] Rana JS et al.[13] found that obesity and physical inactivity independently contribute to the development of type 2 diabetes; however, the magnitude of risk contributed by obesity is much greater than that imparted by lack of physical activity. In overweight and obese T2DM patients, insulin sensitivity is impaired, resulting in excess of lipolysis with raised concentration of nonesterified free fatty acids (NEFA) and TG in circulation. Uptake of glucose by muscle tissue also gets reduced.[14]Adipose tissues affect metabolism by releasing hormones, proinflammatory substances, glycerol, and NEFA. Nonesterified free fatty acids and visceral fat are key factors to diminish sensitivity of insulin and develop IR. [15,16] Screening tests are now routinely employed for early detection of diabetic retinopathy, peripheral neuropathy, and nephropathy. People with impaired glucose levels and obesity are more prone for developing atherosclerosis. obesity plays a role in insulin resistance and hyperglycemia, and is an independent risk factor for cardiovascular events.[17,18] Diabetes is a chronic disease requiring continuous medical care and patient self-management education to achieve good glycemic control and prevent long term complication. Comprehensive management of diabetes put ample emphasis on life style modification therapy. Comprehensive and appropriate management of patients with diabetes should include early screening for complications and optimize control of glucose, blood pressure and cholesterol. The combination of a low-calorie diet, increased physical activity, and behavioral therapy as the first-line intervention for weight loss should be stressed for the effective management of T2DM

CONCLUSION

Higher BMI was associated with poor glycemic control in type 2 diabetes mellitus patients. evidenced by raised glycated haemoglobin (HbA1C) concentrations. Efforts should be taken to make aware the importance of disease, role of medication adherence, and regular counseling sessions regarding life style changes need to be arranged to increase outcome of patients.

References

1. Huizinga MM, Rothman RL. Addressing the diabetes pandemic: A comprehensive approach. Indian J Med Res.2006; 124 : 481-4.
2. Sicree R, Shaw J, Zimmet P. Diabetes and impaired glucose tolerance. Diabetes Atlas. International Diabetes Federation. 3rd ed. Belgium: International Diabetes Federation; 2006 p. 15-103.
3. Alvin C. Powers., Diabetes Mellitus – Harrison's Principles of Internal Medicine, 16th edition. Mc.Graw-Hill Publishers, 2005; 2152-2180.
4. World Health Organization (WHO). Obesity: preventing and managing the global epidemic. Report of a WHO consultation. (1-253). World Health Organ Tech Rep Ser, 2000; 894: i-xii.
5. Geneva: WHO. World Health Statistics, 2011; November, 8.
6. Ghazanfari Z, Niknami S, Ghofranipour F, Larijani B, Alinejad HA, Montazeri A. Determinants of glycemic control in female diabetic patients: a study from Iran. Lipids in Health and Disease 2010;9:83.
7. Joshi SR. Metabolic syndrome – emerging clustures of the Indian phenotype. J Assoc Physicians India 2003;51:445-46.
8. Chandalia M, Abate N, Garg A, et al. Relationship between generalized and upper body obesity to insulin resistance in Asian Indian men. J Clin Endocrinol Metab1999;84:2329-35.
9. Ramachandran A, Snehlata C, Latha E, et al. Clustering of cardiovascular risk factors in urban Asian Indians. Diabetes Care 1998;21:967-71.
10. Zoungas S, Chalmers J, Ninomiya T, Li Q, Cooper M, Colagiuri S, et al. Association of HbA1c levels with vascular complications and death in patients with type 2 diabetes: evidence of glycaemic thresholds. Diabetologia. 2011;55:636–43.
11. Kumar A, Pandey MK, Singh A, Mittra P, Kumar P. Level of glycaemic control in Type 2 Diabetes Mellitus in Bareilly region (India). Int J Med Sci Public Health 2013; 2:84-87.
12. Bays HE, Chapman RH, Grandy S. The relationship of body mass index to diabetes mellitus, hypertension and

dyslipidaemia: comparison of data from two national surveys. Int J Clin Pract. 2007;61(5):737–47.
13. Rana JS, Li TY, Manson JE, Hu FB. Adiposity Compared With Physical Inactivity and Risk of Type 2 Diabetes in Women. Diabetes Care. 2007;30(1):53–8.
14. II'yasova D, Wang F, D'Agostino RB Jr, Hanley A, Wagenknecht LE. Prospective association between fasting NEFA and type 2 Diabetes: Impact of post-load glucose. Diabetologia 2010 May;53(5):866-874.
15. Fain JN, Madan AK, Hiler ML, Cheema P, Bahouth SW. Comparison of the release of adipokines by adipose tissue, adipose tissue matrix, and adipocytes from visceral and subcutaneous abdominal adipose tissues of obese humans. Endocrinology 2004 May;145(5):2273-2282.
16. Karpe F, Dickmann JR, Frayn KN. Fatty acids, obesity, and insulin resistance: time for a reevaluation. Diabetes 2011 Oct;60(10):2441-2449.
17. Carr DB, Utzschneider KM, Hull RL, Kodama K, Retzlaff BM, Brunzell JD, et al. Intra-abdominal fat is a major determinant of the National Cholesterol Education Program Adult Treatment Panel III criteria for the metabolic syndrome. Diabetes.2004;53(8):2087-94.
18. Carey VJ, Walters EE, Colditz GA, Solomon CG, Willet WC, Rosner BA, et al. Body fat distribution and risk of non-insulin dependent diabetes in women: the Nurses' Health Study. Am J Epidemiol. 1997;145:614-9.