Original Research Article

Study of correlation between obesity and glycated hemoglobin in type 2 diabetes patients: a retrospective cross-sectional study from Bundelkhand medical college

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Abstract

Background: With the rapid rise in incidence and prevalence over the last two decades, type 2 diabetes has become a global issue. The economic burden of diabetes on individuals and the nation is expected to rise as the epidemiological burden of diabetes grows. Glycemic control is critical for diabetes management because obesity is a significant risk factor for the development of T2DM and its complications. **Aims and objectives:** The aim of this research was to observe if there was a link between obesity and T2DM, as well as to see if there was a link between obesity and dysglycemia.**Materials and methods:** Hundred T2DM patients with age between 30-70 years with more than one year duration of diabetes were studied.Participants had their anthropometric measurements, comprehensive histories, and biochemical indices evaluated. All the subjects' medical history was documented, including their age, gender, diabetes length, and diabetes family history. The subjects were measured without the use of shoes or clothes, and according to the updated consensus guidelines. Body mass index, waist circumference, glycemic profile and blood pressure were also measured. Participants were divided based on BMI in to 3 groups viz. Normal BMI (18.0-22.9 kg/m^2), Overweight (23.0-24.9 kg/m^2) and Obesity (>25 kg/m^2).**Results**: T2DM was more prevalent in 40-60 years of age (60%) and among males (60%). The mean age, duration of diabetes, FPG, were higher in male than in female diabetics while the mean levels of BMI and HbA1c are higher in female than male diabetics but not statistically significant. Duration of diabetes was longer in male as compared to female diabetics and statistically significant. Age of onset, systolic and diastolic blood pressure were found to be only marginally elevated in males as compared to female diabetics. A positive correlation was observed between the BMI and WC of both female (r=0.68, p<0.001) and male diabetics (r=0.66, p<0.001), between BMI and HbA1c of both female (r=0.41, p=0.002) and male diabetics (r=68, p=0.021) and between WC and HbA1c of both female (r=-0.54, p=0.001) and male diabetics (r=0.75, p=0.021). An increasing trend in WC and BMI and HbA1c is seen from Normal BMI group to Obese group, p<0.05. A statistically significant difference was noted also for age of the diabetics (p=0.001), and age of onset of diabetes (p=0.002) on comparison of the three groups.**Conclusion:** Dysglycemia was found to be on the rise in diabetic subjects with average BMI, overweight, and obese. Diabetic subjects had a higher prevalence of both central and peripheral obesity.

Keywords: Glycemic control, HbA1c, obesity,Type 2 diabetes, relationship

Introduction

Combination of Type 2 diabetes (T2DM) and obesity have become a deadly combination. Exact reasons for developing are still less understood, however it is believed that T2DM occurs due to several factors. Previous studies have found a close relationship between obesity and T2DM[1].Overweight and obese people are at higher risk of developing T2DM. As per the recent data, more than 1.9 billion adults who were 18 years and older, were overweight. Of these over 600 million were obese[2].Previous studies have documented 7 times higher risk of T2DM in people with obesity compared to those of healthy weight, with a threefold increase in risk for Obesity is thought to trigger changes to the body's metabolism. Both insulin secretion and insulin resistance develop early in obese persons who progress later to T2DM[3].The increase in the incidence in developed countries of T2DM may be due to the change in diet, nutrition, and lifestyles[4].In India, despite lower rates of overweight and obesity, prevalence of diabetes is on rise compared to western population. This highlight that T2DM can occur at much lower body mass index (BMI) in Indians[5,6]. Hence through present study we tried to find out the association between obesity and T2DM and to identify the role of abdominal obesity in T2DM.

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Materials and methods

Presentobservational study was performed on 100 patients with T2DM obese of either sex having age 30-70 years with more than one year duration of diabetes.The subjects were selected by a systematic random sampling initially and divided into groups based on BMI. Subjects having cardiovascular or renal diseases and pregnant women, those who were on drugs (other than anti diabetics) that could alter the blood glucose and glycosylated haemoglobin levels like corticosteroids, oral contraceptives, thiazides diuretics, ascorbic acid, quinolones, beta blockers were excluded from the study. Anthropometric measurements, detailed history and biochemical indices were assessed for all the selected individuals. History regarding age, sex, duration of diabetes and family history of diabetes was recorded for all the subjects. Measurements were taken without the subjects wearing shoes or heavy clothing and according to the revised consensus guidelines.BMI was calculated using the formula, weight in kilograms divided by height in meters squared (kg/m^2). The waist circumference (WC) was measured using non stretchable flexible tape in horizontal position, just above the iliac

crest, at the end of normal expiration, in fasting state, with the subject standing erect and looking straight forward and observer sitting in front of the subject. The currently recommended cut-offs of BMI and WC were based on the revised consensus guidelines for India[7] are, Normal BMI: 18.0-22.9 kg/m^2, Overweight: 23.0-24.9 kg/m^2, Obesity: >25 kg/m2 and for WC are, Men: 90 cm, women: 80 cm, so grouping done accordingly as mentioned above. The subject was asked to fast overnight for a period of minimum eight hours. Venous blood sample was collected from the antecubital vein and analyzed for fasting plasma glucose (FPG) and glycosylated haemoglobin (HbA1c). Fasting plasma glucose was analyzed by glucose oxidase method and HbA1c by Latex agglutination inhibition assay on Randox Daytona automated analyzer. Subjects were defined as having diabetes if there is documented evidence of diabetes or they were on oral hypoglycemics drugs or on insulin. Hypertension was diagnosed in subjects who were on antihypertensive medications or had a systolic BP≥140 mmHg and/or a diastolic BP ≥90 mmHg. Generalised obesity (GO) is obesity based on BMI, Abdominal obesity (AO) based on waist circumference (WC) and combined obesity (CO) when subjects have both GO and AO. Based on the gender and BMI the subjects were divided into three groups as those with normal BMI, overweight and obese. All the Data were analyzed using SPSS software version 20. Non-parametric statistics were used for non-normally distributed continuous variables, while parametric statistics were used for normally distributed continuous variables. The total sample's demographic and clinical information were determined using descriptive statistics. The unpaired two-tailed 't' test and Pearson's correlation coefficient were used in the statistical study.

Results

Majority of the patients and age between 40-60 years (60%) and were males (60%). The most predominant occupation for female diabetics was housework [34 (85%)] while for males it was agriculture [33 (55%)]. There were 68%, 78% and 58% diabetic patients with Generalised obesity (GO), Abdominal obesity (AO) and combined obesity (CO) respectively.

Table 1: Distribution according to occupation

Occupation	Male (n=60)	Female (n=40)
Housework	1 (16.67)	24 (85)
Daily Wage	12 (20)	8 (20)
Agriculture	33 (55)	5 (12.5)
Teacher	1 (16.67)	0 (0)
Office/disability	1 (16.67)	0 (0)
Shop owner	6 (10)	3 (7.5)
Driver	5 (8.33)	0 (0)
Carpenter/painter	1 (16.67)	0 (0)

Data is expressed as no of participants (percentage)

Table 2: Comparing different parameters between genders

Parameters	Male	Female	P value
Age, years	54.23±12.55	46.12±8.42	0.182
Age of onset	46.54±11.92	42.36±13.46	0.421
Duration of diabetes	8.24±1.24	5.28±2.48	0.021
FPG	146.56±28.52	132.66±35.82	0.002
SBP	128.24±17.88	124.46±18.24	0.482
DBP	88.22±13.24	86.42±12.28	0.667
WC	93.88±10.12	97.45±11.54	0.08
BMI	28.28±8.21	32.24±4.68	0.228
HbA1c	10.42±2.21	11.28±1.28	0.686

Data is expressed as mean±standard deviation

The mean age, duration of diabetes, FPG, were higher in male than in female diabetics while the mean levels of BMI and HbA1c are higher in female than male diabetics but were not statistically significant. Duration of diabetes was longer in male as compared to female diabetics and statistically significant. Age of onset, systolic and diastolic blood pressure were found to be only marginally elevated in males as compared to female diabetics (Table 1).

A positive correlation was observed between the BMI and WC of both female (r=0.68, p<0.001) and male diabetics (r=0.66, p<0.001), between BMI and HbA1c of both female (r=0.41, p=0.002) and male diabetics (r=68, p=0.021) and between WC and HbA1c of both female (r=-0.54, p=0.001) and male diabetics (r=0.75, p=0.021).

Table 3: Clinical and biochemical characteristics among gender as per BMI groups

Parameters	Normal BMI	Overweight	Obese	P value
Age, years	56.8±6.23	42.4±8.88	48.6±12.27	0.001
Age of onset, years	52.4±6.28	38.8±4.21	45.6±12.12	0.002
Duration of diabetes, years	10.4±8.21	4.88±2.82	6.62±5.6	0.228
FPG, mg/dl	152±73.25	146.2±32.89	167.8±48.8	0.682
SBP, mmHg	129.8±21.46	128.8±11.1	130.4±12.89	0.882
DBP, mmHg	82.6±10.6	80.2±12.48	78.8±10.24	0.889
WC, cm	81.4±9.12	92.8±4.89	101.4±7.43	0.001
BMI, kg/m^2	20.2±1.22	24.12±0.89	31±2.78	< 0.001
HbA1c, %	6.48±0.89	8.68±2.42	8.88±2.65	0.0021

Data presented as Mean ± SD, P value of <0.05 is considered as significant

An increasing trend in WC and BMI and HbA1c is seen from Normal BMI group to Obese group with a statistically significant difference (p<0.05). A statistically significant difference was noted also for age of the diabetics (p=0.001), and age of onset of diabetes (p=0.002) on comparison of the three groups(Table 3).

Discussion

A HbA1c target of less than or equal to 7% has been linked to a substantially lower risk of diabetes-related microvascular complications in several previous major randomised prospective trials[2]. Diabetes mellitus is rapidly approaching epidemic proportions in India, with immense morbidity and mortality associated with diabetes and its possible complications. Diabetes has a significant financial impact on patients, families, culture, and the nation's healthcare system[4].T2DM is becoming more common as obesity becomes more common. Obesity has reached epidemic proportions, resulting in a rise in the incidence and prevalence of type 2 diabetes over the last few decades[1].Obesity prevalence has risen steadily in both urban and rural India over the years[8].The participants in this study had a mean BMI and WC of 30.26 kg/m^2 and 95.67cm, respectively, suggesting that they were obese on average. The prevalence of diabetes and the BMI vary by race. The mean BMI of Asian subjects was lower than that of patients from other ethnic groups, according to studies, and the incidence of type 2 diabetes begins at a lower BMI for Asians than for other ethnicities. The mean BMI of the subjects in other studies was 26 kg/m^2, and the BMI of female diabetics was 28.60 4.91 and male diabetics was 26.47 4.68 in another study [14]. Our findings are consistent with this report, with BMIs of 28.585.02 and 26.644.87 in female and male diabetics, respectively.While mean BMI and WC were significantly more prevalent in women than men in Yousefzadeh G et al[10], our study found that while mean BMI and WC were significantly more prevalent in women than men, the difference was not statistically significant.In a study conducted by Sheth et al, central obesity was found to be more prevalent (75%) than peripheral obesity (59.83%) in the overall study population[11].Generalized obesity (GO), abdominal obesity (AO), and combined obesity (CO) with glucose intolerance all showed an upward trend, according to Pradeepa R et al. GO, AO, and CO were found in 48.5 percent, 57.9%, and 44.6 percent of diabetics, respectively[8].In our sample, the prevalence of all three forms of obesity was higher in GO, AO, and CO, with 68 percent, 78 percent, and 58 percent, respectively.Female diabetics are more likely to be associated with housework, while male diabetics are more likely to be associated with agriculture, according to our findings. This may also explain why female diabetics had a higher rate of obesity in our sample. In our sample, approximately one-third of the diabetic rural and urban population had good glycaemic control (HbA1c 7%), which is consistent with the findings of Unnikrishnan et al[12].Another research found that the mean HbA1c level in all subjects was 8.56 4.72 percent (mean 7.80 percent), with only 31.66 percent of men and 26 percent of women having a controlled HbA1c level (7%)[10].Our findings revealed a lower mean HbA1c and a higher percentage of diabetics with a HbA1c of 7%. Hypertension (both identified and newly diagnosed) was found in about one-fourth of the studied population in a study by Bhansali et al[13], while our study found that more than one-third of the diabetic population is hypertensive.According to Firouzi S et al, there were no statistically significant variations in glycemic and metabolic status between men and women. Women, on the other hand, had a slightly higher mean BMI and a smaller mean waist circumference than men[9].Despite the fact that women have a higher BMI and WC, there are no statistically significant variations in glycemic and metabolic status between men and women in our research.Although Anari et al[14] found no connection between obesity and HbA1c regulation, Sheth et al found a substantial linear association of HbA1c in T2DM patients with central and peripheral obesity[11]. In T2DM patients, we discovered a strong linear association between BMI, WC, and HbA1c.

Conclusion

Obesity is substantially associated with poorer glycemic regulation in both male and female diabetic subjects, with prevalence of both central and peripheral obesity found in approximately half of male diabetics and three-quarters of female diabetic subjects, with a growing pattern of dysglycemia in obese diabetic subjects.

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