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Study of type 2 diabetes patients and its association between obesity and glycated hemoglobin

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Abstract
Background: Obesity plays a central role in the pathophysiology of both T2D and its macrovascular complications. The present study was conducted to assess correlation between obesity and glycated hemoglobin in type 2 diabetes patients.
Materials and Methods: 94 type II DM patients of both genders were included. Anthropometric measurements such as weight, height and BMI (kg/m2) was calculated. The waist circumference (WC) was measured. Patients were classified as Normal BMI: 18.0-22.9 kg/m2, Overweight: 23.0-24.9 kg/m2, Obesity: >25 kg/m2. Fasting plasma glucose was analyzed by glucose oxidase method and HbA1c by Latex agglutination inhibition assay.
Results: There were 23 normal, 30 overweight and 41 obese patients. The difference was significant (P<0.05). The mean FBG (mg/dl) was 151.4, 148.6 and 168.2, SBP (mm Hg) was 132.4, 128.4 and 130.6, DBP (mm Hg) was 86.2, 78.2 and 80.2, WC (cm) was 81.2, 94.5 and 100.6 and HbA1C (%) was 6.2, 8.1 and 8.9 in normal, overweight and obese patients respectively. The difference was significant (P<0.05).
Conclusion: Diabetic subjects had a higher prevalence of obesity. Dysglycemia was high in diabetic subjects with average BMI, overweight and obese.

Keywords: Diabetic, dysglycemia, obesity

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.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 [1].
Obesity plays a central role in the pathophysiology of both T2D and its macrovascular complications. Nevertheless, some normal-weight individuals have considerable risk of developing T2D and cardiovascular disease because they have a metabolically adverse profile, including hyperinsulinemia, insulin resistance, and hypertriglyceridemia [2]. Thus, a high body mass index (BMI) is not necessary for the occurrence of these conditions, suggesting that the underlying mechanisms of cardiovascular complications of T2D are not straightforward. Epidemiologic research of cardiovascular risk factors among patients with T2D and different BMI ranges may provide clues as to the relative contribution of obesity to the cardiovascular risk of patients who already have a higher risk of cardiovascular complications because of T2D [13].
Both insulin secretion and insulin resistance develop early in obese persons who progress later to T2DM [4]. The increase in the incidence in developed countries of T2DM may be due to the change in diet, nutrition, and lifestyles. 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]. The present study was conducted to assess correlation between obesity and glycated hemoglobin in type 2 diabetes patients.

Materials and Methods
The present study comprised of 94 type II DM patients of both genders. The consent was obtained from all enrolled patients.

Data such as name, age, gender etc. was recorded. A detailed history and biochemical indices were assessed. Duration of diabetes and family history of diabetes was recorded. Anthropometric measurements such as weight, height and BMI (kg/m2) was calculated. The waist circumference (WC) was measured. Patients were classified as Normal BMI: 18.0-22.9 kg/m2, Overweight: 23.0-24.9 kg/m2, Obesity: >25 kg/m2. Fasting plasma glucose was analyzed by glucose oxidase method and HbA1c by Latex agglutination inhibition assay. Data thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

Results

Table 1: Distribution of patients

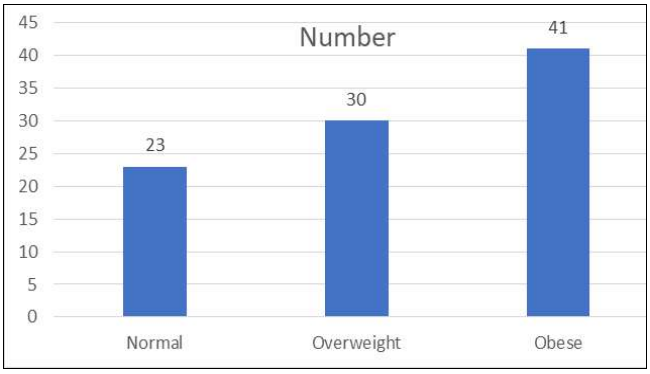
Total- 94		
Gender	**Males**	**Females**
Number	54	40

Table 1 shows that out of 94 patients, males were 54 and females were 40.

Table 2: Distribution of patients based on BMI

BMI	Number	P value
Normal	23	0.17
Overweight	30	
Obese	41	

Table 2, graph 1 shows that there were 23 normal, 30 overweight and 41 obese patients. The difference was significant (P<0.05).

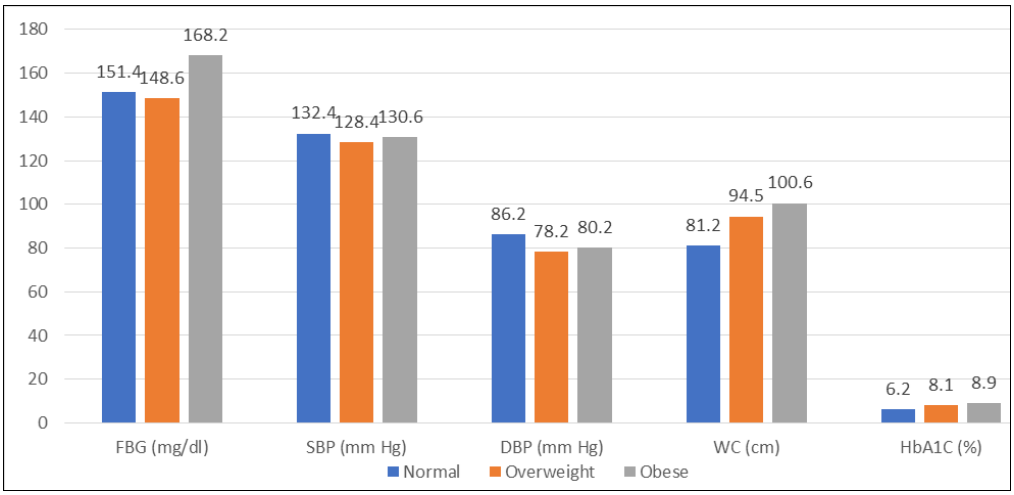


Graph 1: Distribution of patients based on BMI

Table 3: Assessment of parameters

Parameters	Normal	Overweight	Obese	P value
FBG (mg/dl)	151.4	148.6	168.2	0.05
SBP (mm Hg)	132.4	128.4	130.6	0.12
DBP (mm Hg)	86.2	78.2	80.2	0.15
WC (cm)	81.2	94.5	100.6	0.02
HbA1C (%)	6.2	8.1	8.9	0.01

Table 3, graph 2 shows that mean FBG (mg/dl) was 151.4, 148.6 and 168.2, SBP (mm Hg) was 132.4, 128.4 and 130.6, DBP (mm Hg) was 86.2, 78.2 and 80.2, WC (cm) was 81.2, 94.5 and 100.6 and HbA1C (%) was 6.2, 8.1 and 8.9 in normal, overweight and obese patients respectively. The difference was significant (P<0.05).



Graph 2: Assessment of parameters

Discussion

Diabetes Mellitus is the most common metabolic disorder characterized by a series of hormone induced metabolic abnormalities and long-term complication. The worldwide prevalence of Diabetes mellitus has risen dramatically over the past two decades, from an estimated 30 million cases in 1985 to 415 million in 2017.[6] Obesity is a state of excess adipose tissue mass. However, in the presence of nutritional abundance and a sedentary lifestyle, and influenced importantly by genetic endowment, this system increases adipose energy stores and produces adverse health consequences [7, 8].

Hyperinsulinemia and insulin resistance are pervasive features of obesity, increasing with weight gain and diminishing with weight loss.2 The exact pathogenesis of microvascular complications in Diabetes mellitus is unknown [9]. Oxidative stress activated Renin Angiotensin System (RAS), hyperglycemia, Advanced Glycosylation End-products (AGE), and oxidized low- density lipoproteins are factor contributing to initiation and progression of endothelial inflammation, ultimately leading to diabetic vascular complications [10]. The present study was conducted to assess correlation between obesity and glycated hemoglobin in type 2 diabetes patients.

We found that out of 94 patients, males were 54 and females were 40. Shah *et al.* [11] in their study 100 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/m2), Overweight (23.0-24.9 kg/m2) and Obesity (>25 kg/m2). 2DM 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.

We observed that there were 23 normal, 30 overweight and 41 obese patients. We found that mean FBG (mg/dl) was 151.4, 148.6 and 168.2, SBP (mm Hg) was 132.4, 128.4 and 130.6, DBP (mm Hg) was 86.2, 78.2 and 80.2, WC (cm) was 81.2, 94.5 and 100.6 and HbA1C (%) was 6.2, 8.1 and 8.9 in normal, overweight and obese patients respectively. Sheth *et al*. [12] determined the association of dyslipidemia and obesity with glycated hemoglobin (HbA1c) in T2DM and non-diabetic subjects> It comprise of 931 subjects from urban Western India including 430 diabetic and 501 non-diabetic subjects with detailed anthropometric parameters. All subjects were investigated for HbA1c and lipid parameters like TC, TG, HDL-C, LDL-C and non-HDL-C. Dyslipidemia, central- and peripheral-obesity were observed (50.27%; 75% and 59.83%) in all the study subjects respectively. Additionally, hyper-non-HDL-C was detected in 23.49% and 22.56% in T2DM and non-diabetic subjects. Significant linear associations of hyper-TC, hyper-LDL-C and hyper-non-HDL-C were observed with HbA1c in T2DM and non-diabetic control subjects respectively. Centrally- and peripherally- obese dyslipidemic subjects also showed a significant association with HbA1c in T2DM and control subjects respectively.

Conclusion

Authors found that diabetic subjects had a higher prevalence of obesity. Dysglycemia was high in diabetic subjects with average BMI, overweight and obese.

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