Body Mass Index Changes in Patients with Type 2 Diabetes Mellitus

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Abstract: Background: The association between body mass index and Diabetes Mellitus has been revealed in many studies. Psychophysiological and pharmacological factors alter the BMI in type 2 Diabetes Mellitus. Body Mass Index with adverse health outcomes related to metabolic disturbances are understudied. Aim: To examine the BMI changes in relation to the duration of Type 2 Diabetes Mellitus. Materials and Methods: In this study, type 2 diabetic patients (n-135) and age, height and weight matched controls (n-130) of both sexes with different disease duration were recruited. Blood sample was collected to analyse Fasting blood sugar (FBS) and Glycosylated Hemoglobin (HbA1c). Result: The glycemic level was higher in the diabetic patient (Male- 144.6±43.8 & Female- 140.7±41.4) when compared with the control group (Male- 105.6±22.5 & Female- 91.4±15.4). The BMI was found to be reduced in male diabetic patients (Male- 26.9±3.8) than the female diabetic patients (Female-27.8±5.0). BMI was increased in patients with duration of 5 -10 years of disease (28.4±4.1) when compared with duration of 0-5 years and 10-15 years (26.9±5.2 and 27.2±4.6). The pharmacological treatments in type 2 diabetic patients were statistically not significant between male and female diabetic patients. Conclusion: With the results of our study we conclude that duration of disease in diabetic patients and BMI were profoundly correlated. Awareness of weight management in diabetes patients greatly helps in avoiding further complications.

Key words: Body Mass Index • Type 2 Diabetes Mellitus • HbA1c

INTRODUCTION

Diabetes Mellitus is rapidly developing a major health problem throughout the world. According to WHO, the prevalence of diabetes of all age group was 2.8% in 2000 and expected to be 4.4% in 2030 that is 171 million in 2000 and 366 million in 2030. It is due to aging, urbanization and physical inactivity causing increasing prevalence of obesity [1]. According to the International Diabetes Foundation (IDF), India has more diabetes than any other country in the world. About 50 million people that are 7.1% of nation’s adults were affected by diabetes and 1 million people die every year [2]. The relationship between BMI and Type 2 Diabetes Mellitus are well identified for the reason that weight loss in individuals with diabetes arise in short-term betterment in glycemic control. The combination between higher BMI and increasing weight gain causes risk of diabetes are strongly marked among Asians, the greater risk of diabetes among Asians are identified by making lower cut off BMI values [3]. The cause for such high number of incidence is because that a combination of genetic susceptibility plus adoption of a high calorie, low activity lifestyle of India’s growing middle class [4]. The interplay between genetic and environmental factors develops heterogeneous phenotype of obesity [5]. The metabolic and cardiovascular risk factors due to increased BMI are including hypertension, dyslipidemia, infertility, back pain, skin infection ulcers, gallstones, but there is increasing evidence that sub-phenotypes of obesity exist that appear to deviate from the standard dose-response relationship between increased BMI and its adverse clinical outcomes [6]. Most of the type 2 diabetes are overweight which is a leading cause for early death, CHD, stroke, kidney disease, blindness and cancer. Being overweight or obese can lead to a buildup of plaque in arteries. Eventually, an area of plaque can rupture, causing a blood clot to form. If the clot is close to brain, it can block the flow of blood and oxygen to brain and cause a stroke. The risk of having a stroke rises as BMI increases. Men and women with diabetes have different psychosocial, behavioral and clinical characteristics.
These differences can affect the risk of diabetes, attitudes and behavior toward self-care and health outcomes [7]. The purpose of this study is to indicate the change in BMI in relation to the duration of the disease.

**MATERIALS AND METHODS**

**Study Population:** This study was carried out in the Department of Physiology, SreeBalaji Medical College and Hospital. For this study we recruited the patients who attended the outpatient of the Diabetology clinic, SreeBalaji Medical College and Hospital. A total number of 135 diabetic patients of age 44.6±6.7 year of both sexes and 130 age and sex matched control subjects 40.6±8.3 years were recruited. The procedure to be performed was explained in detail in the local language to each subject. Informed consent was obtained from all the subjects who participated in this study. This study was approved by the institutional ethical committee. Subjects were asked to fill up the questionnaire to obtain history related to our study like duration, medicine and the medicine intake etc. In this study the subjects were divided into two groups. The first group was diabetes patients and second was control group.

**Parameter Measured:** In our study, the weight in kilogram (kg) and height in meter (m) of the patients as well as control group were measured. BMI was calculated using the formula Quetelet Index. BMI = kg / m².

**Blood Parameters:** Around 5ml of venous blood has been collected in our Central Laboratory from all the patients to assess their glycosylated hemoglobin level (HbA1c), fasting, post prandial blood sugar levels. HbA1c was assessed by terbitometric method. Fasting and post prandial blood samples were assessed by GOD-POD [Glucose oxidase – Peroxidase] method.

**Result**

In our study Table: 1. represents the physical characteristic features and blood glucose level and glycosylated hemoglobin levels of the diabetic patients and the control group. The glycemic level was higher in the diabetic patient when compared with the control group. The BMI was found to be reduced in male diabetic patients then the female diabetic patients. Fig: 1 represents the bar diagram of BMI between control group and the Diabetic Patients. It was statistically significant with the p value 0.02. Fig: 2 represent the comparison of fasting blood sugar level between control group and the diabetes patients which is statistically significant p value is 0.000. In our results Fig:3 represent the correlation between BMI and the male and female diabetic patients. Female diabetic patients were found to have increased BMI when compared with male diabetic patients. As shown in Fig: 4 represents the bar diagram of

<table>
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<tr>
<td>Weight (kg)</td>
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<td>65.1±9.7</td>
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<td>BMI (%)</td>
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<td>26.9±3.8</td>
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<tr>
<td>FBS (mg/dl)</td>
<td>105.6±22.5</td>
<td>144.6±43.8</td>
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<tr>
<td>HbA1C (%)</td>
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Values are expressed in mean±standard deviation.

BMI-Body Mass Index-Weight / Height² (kg/m²).
FBS-Fasting Blood Sugar; HbA1C-Glycosylated Haemoglobin.
Fig. 2: Comparison of FBS in Diabetes patients and control group:

Fig. 3: Correlation between male and female diabetic patients with their BMI:

Fig. 4: Comparison of duration of the disease and BMI of the patients:

Fig. 5: Comparison of male and female patients taking metformin and insulin:

In our study, the BMI in diabetes patients had higher values (27.6±4.4) than the BMI of the control group (27.6±4.7). Similar studies had been reported that there is strong interrelation between BMI and type 2 Diabetes Mellitus which states that increase in BMI predisposes to type 2 Diabetes Mellitus [8]. Weight is the single most important predictor of diabetes. After adjustment for BMI, lack of exercise and a poor diet were also associated with increased risk of diabetes [9]. The glycemic level was found to be higher in type 2 diabetic patients (Male-144.6±43.8 & Female-140.7±41.4) when compared with the control group (Male-105.6±22.5 & Female-91.4±15.4), which was statistically significant (p value is 0.000). The alterations in cortisol metabolism and the local activation of cortisol in adipose tissue provide an important link between glucocorticoids and development of the metabolic syndrome in clinically obese individuals [10]. Cortisol induced insulin resistance is partly explained by its metabolic effects in opposing insulin action [11]. Apart from their antagonizing action on insulin sensitivity, glucocorticoids also inhibit pancreatic ß-cells from secreting insulin [12]. The diabetic patients have increased physical and mental stress. On response to stress the catecholamines are secreted by the adrenal medulla and sympathetic nerve endings. The catecholamines decreases the insulin’s effect on glucose utilization and leads to elevation of blood glucose [13].

As shown in our results the male diabetic patients (Male-26.9±3.8) in our study had lesser BMI values when compared with the female diabetic patients (Female-27.8±5.0). Looker et al., concluded that mean BMI in women had consistently greater values than men, but the rate of change in BMI was similar in both sexes. In general it was not statistically significant [14]. A study done by K. M. Prasanna Kumar stated that men having BMI more than 27 were found to be 13.2% while as women with BMI higher than 25 were found to be 55%. He states that females are more obese than males [15]. Humans with visceral obesity are found with multiple endocrine disturbances, including low growth hormone and elevated cortisol and androgens in women and low testosterone secretion in men [16]. Adipose tissue by secreting leptin influences appetite and energy expenditure by signaling the body’s state of adiposity to the brain[17]. Leptin deficiency causes both severe insulin resistance and obesity. In obese and insulin-resistant humans and also in subjects with a genetic predisposition for type 2 diabetes, leptin levels were reported to be elevated [18, 19].

DISCUSSION

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In our study BMI range was observed between 23 to 32 kg/m² in diabetic patients. The BMI of the diabetic patients with the duration of 0-5 years and 10-15 years of diseases duration had lesser BMI when compared with the 5-10 years duration of the disease, which was statistically significant in our study (p value is 0.02). In Pima Indians with diabetes, there is a tendency to lose weight such that BMI declines at a rate of 0.4 – 0.6 kg/m² per year after the onset of diabetes in individuals who are not taking anti-diabetic medication [14]. Individuals on oral hypoglycemic therapy showed less marked weight loss than those treated with diet alone. However, we were not able to determine whether weight loss was voluntary, for example in response to medically prescribed dietary therapy, or involuntary, perhaps due to catabolic effects of severe hyperglycemia. Weight loss seems to be a desirable goal for most individuals in this population with a high mean BMI, because glycemic control, hyperlipidemia and hypertension are all improved with weight loss in the short term [20, 21]. A report from another American Indian population showed that over a 4 years period, there was an average individual weight loss of 3.7 kg in a group on various medical therapies for diabetes [22]. In Irish people with symptomatic, newly diagnosed type II diabetes, most individuals underwent weight loss that was sustained for 10 years of follow up [23]. Our result coincides with the results of Looker et al., [14] who observed that Insulin therapy was associated with greater weight loss at short duration of diabetes but with less weight loss or even weight gain at duration of diabetes more than 5 years and also he mentioned the relation between BMI changes and oral anti-diabetic therapy. After 10 years of diabetes, individuals who do not take medication always had a greater degree of decrease in BMI than those taking any medication.

As shown in fig 5. The differences between metformin and Insulin in both sexes were found to be not statistically significant in our study group (p value - 0.08). When there is an increase in weight, as indicated by increased BMI, insulin resistance also increases, which denotes that the ability of insulin to mobilize glucose into fat and muscle and release of glucose from liver is decreased. But when there is a reduction of weight, BMI is decreased and the insulin resistance is also decreased and the reversal occurs [24]. Over the 10-year treatment period, the metformin group gained about 1 kg, the same as the dietary advice group, while the sulfonylureas group gained 3 kg and the insulin group, 6 kg [25].

CONCLUSION

Since Diabetes Mellitus and BMI are having closer relationship each other. Awareness should be encouraged among the diabetic patients by giving diabetes self management sessions and to stress upon the benefits of self care, regular diabetes screening, especially diabetic women with a family history of high BMI and diabetes. Weight management is a necessary therapeutic task for most obese type 2 diabetes patients, which helps in avoiding complications due to the Diabetes Mellitus.

REFERENCES