ORIGINAL ARTICLE

COMPARISON OF BMI AND WAIST CIRCUMFERENCE IN GOOD AND POOR CONTROL TYPE 2 DIABETES MELLITUS

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ABSTRACT

Type 2 diabetes is a common chronic disease resulting from a complex inheritance-environment interaction along with other risk factors such as obesity and sedentary lifestyle. Type 2 diabetes and its complications constitute a major worldwide public health problem. The mortality and morbidity increase if there is poor glycemic control. The aim of this study was to compare the BMI and waist circumference in good and poor control type 2 diabetes mellitus. The present study was carried out in departments of Biochemistry, Medicine and Endocrinology of Sir Salimullah Medical College and Mitford Hospital, Dhaka, Bangladesh during the period of July 2020 to June 2021. By convenient sampling, a total of 50 subjects aged between 30-59 years were enrolled in this study. Study subjects were divided into two groups. Group A included subjects with good glycemic control (n=25) and Group B included subjects with poor glycemic control (n=25). The mean HbA1c level was significantly higher in poor glycemic control group than good glycemic control group (10.9±5.73% vs 5.98±0.95%). Mean weight, BMI and waist circumference were significantly higher in subjects with poor glycemic control in comparison to subjects with good glycemic control. A strong association was found between obesity indices and diabetes. BMI and WC could be used in clinical practice for suggesting lifestyle modifications.

Key words: Type 2 DM, FPG, HbA1c%, BMI, Waist circumference

Introduction

Anthropometric measurements generally include height, weight, body mass index (BMI), waist circumference, hip circumference, and waist-to-hip ratio[1]. These measures, when compared to reference standards, are capable of assessing the risk of various diseases. In recent years, the proportion of people with obesity (BMI ≥ 30 kg/m2) has been rising substantially worldwide[2].

BMI is a simple method which is used to calculate the prevalence of overweight and obesity in the population. Waist circumference

(WC) is the best measure of both intra-abdominal fat mass and total fat[3]. But BMI can be misleading in individuals with a high proportion of lean muscle mass[4]. WC, a more accurate measure of the distribution of body fat, has been shown to be more strongly associated with morbidity and mortality[4]. Recently, the waist-to-stature ratio (WSR) has been proposed as a better screening tool than WC and BMI for adult metabolic risk factors[5]. Obesity, especially central obesity where high body mass index (BMI), waist circumference (WC), waist-to-hip circumference ratio (WHC) and waist-to-height ratio (WHR) could strongly predict risks of insulin resistance, diabetes mellitus and risks of poor glycemic control[6].

Diabetes mellitus (DM) refers to a group of metabolic disorders characterized by hyperglycemia with disturbances in carbohydrate, lipid and protein metabolism resulting from defects in insulin secretion, insulin action or both[7]. The total number of diabetes cases is projected to increase from 171 million in 2000 to 366 million in 2030[8]. Type 2 diabetes mellitus (T2DM) is the most common current metabolic disorder as it affects more than 385 million people and it is expected to reach about 590 million by 2035 worldwide[9].

Fasting plasma glucose (FPG), post-prandial plasma glucose (PPPG) and glycated hemoglobin (HbA1c) are most widely used as glycemic control markers. HbA1c is used as a biomarker of glycemic control over a preceding 8-12 weeks. It is used as an indicator for the state of glycemic control, progression of the disease and development of complications in diabetic patients[10,11]. Increased HbA1c has also been considered as an independent risk factor for CVD, even in undiagnosed diabetics[12]. Poor glycemic control is a major cause of increased cardiovascular, renal, nervous and other complications with a huge economic burden[13].

The aim of this study is to compare the BMI and waist circumference in good and poor control type 2 diabetes mellitus in a tertiary care hospital in Dhaka, Bangladesh.

Materials and Methods

The study was conducted at Sir Salimullah Medical College (SSMC) and Mitford Hospital, Dhaka, Bangladesh from July 2020 to June 2021. By convenient sampling, a total of 50 subjects of age between 30-59 years attending in Biochemistry department and department of Medicine and Endocrinology of SSMC, were enrolled in this study. The subjects with type 1 diabetes mellitus, liver disease, severe gastrointestinal disease, thyroid disease, underweight or morbid obese, taking medications like corticosteroids, antiepileptics, methotrexate, amiodarone, tamoxifen or other hepatotoxic drugs were excluded from this study. Ethical permission was taken from the Institutional Ethical Review Board of SSMC.

After enrollment, they were grouped on the basis of glycemic control. Among them 25 were diabetics with good glycemic control (T2DM subjects having duration of ≤ 8 years and HbA1c level $\leq 7\%$) (Group A) and 25 were diabetics (Group B) with poor glycemic control (T2DM subjects having duration of > 8 years and HbA1c level $> 7\%$). Informed written consent was taken from each patient. With all aseptic precautions fasting blood sample was collected from each study subject. Initial evaluation of the study subjects by history and clinical examination was performed and data were recorded in the preformed data collection sheet. Demographic profile and pulse, blood pressure, height, weight, WC etc. were measured. Fasting plasma glucose was measured by glucose-oxidase method. HbA1c% was measured using immunoflurescence method. The statistical analysis was carried out using the SPSS version 23.0. Categorical variables were expressed as frequency and percentage. Continuous variables were expressed as mean and standard deviation. An unpaired t-test was performed to compare the variables between good and poor glycemic control. A p value<0.05 was considered statistically significant.

Results

Table I shows distribution of the respondents according to the gender. There was no difference in relation of age between the male and female. Table II shows comparison of age and glycemic status between two groups of the study subjects.

Table I: Distribution of the respondents according to the gender (n=50)

Variables		Group A (n=25)		Group B (n=25)		p value (Significance)
Sex	Male	14	56.0	18	72.0	p= 0.239 (Non-significant)
	Female	11	44.0	7	28.0	

*p value obtained from $\chi 2$ test

Table II: Comparison of age and glycemic status between two groups (n=50)

Variables	Group A (n=25) Mean±SD (Range)	Group B (n=25) Mean±SD (Range)	p values
Age (in years)	42.04±9.14 (33−58)	47.8±7.88 (30-58)	p= 0.001
FPG (mmol/l)	5.45±0.88 (4.1−8)	10.8±5.62 (3.8-25.2)	p= 0.001
HbA1c (%)	5.98±0.95 (5.5−7)	10.9±5.73 (7.6-10.2)	p= 0.035

unpaired t-test was done

The mean age was 42.04±9.14 years in Group A and 47.8±7.88 years in Group B. Besides the mean FPG was 5.45±0.88 mmol/L in Group A and 10.8±5.62 mmol/L in Group B. The mean HbA1c was 5.98±0.95% in Group A and 10.9±5.73% in Group B. The differences between two groups are statistically significant ($p<0.05$).

Table III shows that the mean weight was 56.48±9.09 kg in Group A and 64.92±11.45 kg in Group B. The mean height was 1.6±0.04 meter in Group A and 1.62±0.05 meter in Group B. The mean BMI was 22.61±3.55 kg/m2 in Group A and 26.06±4.72 kg/m2 in Group B. The mean WC was 87.4±6.58 cm in Group A and 92±7.73 cm in Group B. The difference in weight, BMI and WC were significantly more in Group A ($p<0.05$).

Table III: Comparison of anthropometric characteristics between two groups (n=50)

Variables	Group A (n=25) Mean±SD (Range)	Group B (n=25) Mean±SD (Range)	p values
Weight (kg)	56.48±9.09 (45−75)	64.92±11.45 (46−82)	p= 0.001
Height (m)	1.6±0.04 (1.52−1.7)	1.62±0.05 (1.55−1.74)	p= 0.125
BMI (kg/m^2)	22.61±3.55 (18.73−32)	26.06±4.72 (18.73−32.8)	p= 0.001
WC (cm)	87.4±6.58 (74−102)	92±7.73 (79−105)	p= 0.001

unpaired t-test was done

Table IV shows the distribution of the respondents according to BMI and WC. It was observed that two-thirds patients (64%) had normal BMI in Group A and 32% in Group B.

More than one- third of patients (36%) had normal WC in Group A and 24% in Group B. The difference between two groups in BMI is statistically significant ($p<0.05$).

Table IV: Distribution of the respondents according to BMI and WC (n=50)

Variables		Group A (n=25)		Group B (n=25)		p values
		n	%	n	%	
BMI (kg/m^2)	Normal	16	64.0	8	32.0	p=0.011
	Overweight	8	32.0	8	32.0	
	Obese	1	4.0	9	36.0	
WC (cm)	Normal	9	36.0	6	24.0	p=0.354
	High	16	64.0	19	76.0	

*p value obtained from $\chi 2$ test

Discussion

The rapid development of modernization, urbanization and accelerated socio-economic growth favored an improved living standard but a more stressful and sedentary lifestyle and unhealthy dieting habits in most parts of the world. Especially in the last two decades, obesity has become a global pandemic threatening people's life by affecting almost every organ system and is now a severe public health problem as one of the most common non-communicable diseases (NCDs)[14-16]. Obesity has become a major worldwide epidemic affecting more than 300 million people[17]. The booming population of obesity around the globe is inevitably contributing to the increase in the prevalence of T2DM, which is also a chronic and overgrowing disease[18]. Both chronic conditions have multisystem impact and are associated with increased mortality and cardiovascular risk[19].

The mean age of this study was 42.04±9.14 years in Group A and 47.8±7.88 years in Group B with the age range 30-59 years. HbA1c% is significantly higher in T2DM with poor glycemic control when compared to good glycemic control group. This observation was consistent with the study by Tabazzum et al[20] Poor glycemic control is a major concern for diabetes patients affecting 60.5-65.6%[21,22]. Mean weight, BMI and waist circumference were significantly higher in subjects with poor glycemic control in comparison to subjects with good glycemic control. Sisodia et al[23] observed a significant positive correlation between BMI and HbA1c. A study by Colditz et al[24] examined the relation between adult weight change and the risk of diabetes among middle-aged women.

Waist circumference, an indicator of central adiposity, is a predictor of risk for developing T2DM[25]. Visceral fat is known to be metabolically active and modulates numerous adipocytokines such as leptin and adiponectin, which have been associated with insulin resistance and hence diabetes[26-28].

It is evident that diabetes could be prevented through the prevention of overweight and obesity in more than 80% cases. Both are clearly linked to the glycemic control level of diabetic patients[29].

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