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To Study Body Mass Index, Waist Circumference, Waist Hip Ratio,Body Adiposity Index And Lipid Profile Level In Patients With Type-2 Diabetes Mellitus

Dr.Mishra Indira Sushil[1], Dr.J.N.Muneshwar[2], Dr. Mrs.S.T.Khan[3].
[1]*Resident, Department of Physiology, Govt Medical College, Aurangabad, Maharashtra.*
[2,] *Associate Professor, Department of Physiology, Govt Medical College, Aurangabad,(MS)*
[3,] *Professor & HOD, Department of Physiology, Govt Medical College, Aurangabad(MS)*

Abstract: *The prevalence of diabetes is rapidly rising all over the globe at an alarming rate. Diabetes is second only to cardiovascular disease (CVD) as a health burden in India. Type 2 diabetes is commonly associated with obesity, hypertension, CVD and lipid abnormalities.*
Aims and objectives*: The aim of the study is to assess the BMI, WC, WHR, BAI and lipid profile in controlled and uncontrolled type 2 diabetes mellitus patients and to compare the above values with the controlled diabetic patients.*
Method: *N=30 diabetic patients of either sex of age group between 35-50 years were selected from the Diabetic Clinic of Govt Medical College, Aurangabad, Maharashtra. Fasting lipid profile and HbA_1C blood samples were taken. N=15 controlled Type 2 diabetes mellitus patients were diagnosed based on HbA_1C below 7 and N=15 uncontrolled Type 2 diabetes mellitus patients were diagnosed based on HbA1C equal and above 7. BMI, WC, WHR, BAI were measured according to a standard protocol.*
Conclusions*: Our data suggests that BAI, BMI, WC, Waist: Hip ratio and lipid values were higher in uncontrolled DM patients as compared to controlled DM patients.*
Keywords: *Body Mass Index(BMI), Body adiposity Index(BAI),Controlled Diabetes Mellitus(DM),High Density Lipoprotein, Uncontrolled Diabetes Mellitus(DM) Waist Hip Ratio(WHR),Waist Circumference (WC).*

I. Introduction

Diabetes mellitus is a heterogeneous group of metabolic disorders characterized by hyperglycemia with disturbances of carbohydrate, fat and protein metabolism caused by either lack of insulin secretion or decreased sensitivity of tissues to insulin.[1,2].The prevalence of diabetes is rapidly rising all over the globe at an alarming rate. Diabetes is second only to cardio vascular disease (CVD) as a health burden in India. Type 2 diabetes is commonly associated with obesity, hypertension, CVD and lipid abnormalities. The various risk factors for the development of type 2 DM are obesity, ethnicity, sedentary life style, sex, family history, hypertension and smoking. However there is now an overwhelming evidence from experimental, epidemiological and intervention studies that obesity is a major risk factor for Type 2 DM among all risk factors. Among various anthropometric measurements used to measure the obesity, waist circumference (WC) and waist hip ratio (WHR) have been used as measures of visceral obesity whereas BMI as general obesity [3] .Clinical evidence suggests that WC and WHR are better predictors of obesity and type 2 DM. So this study intends to determine WHR, BMI, WC and BAI in diabetic patients. Patients with type 2 diabetes mellitus-associated dyslipidemia remain exposed to a high residual risk of cardiovascular (CVD) complications, even if they are treated with current standards of care, making this one of the major unmet needs in the treatment of patients with diabetes. An understanding of the complex interplay of how treating dyslipidemia reduces the risk for CVD events in patients with type 2 DM and an ability to assess at-risk patients is necessary to ensure the most appropriate treatment strategies are implemented. So this study intends to assess the BMI, WC, WHR, BAI and lipid profile in type 2 diabetic patients and to compare the above values with the controlled diabetic patients.

II. Methodology

Study Type- It was a Cross-Sectional Comparative Study.

Inclusion Criteria N= 30 Type 2 diabetes mellitus patients of either sex between the age of 35-50 years were selected from the Diabetic Clinic of Govt Medical College, Aurangabad, Maharashtra. 15 controlled Type 2 DM patients were diagnosed based on HbA1C below 7% and 15 uncontrolled Type 2 DM patients were diagnosed based on HbA1C equal and above 7%[4].

Exclusion Criteria Smokers, alcoholics, and subjects with hepatic, renal, endocrine disorders, and those on lipid lowering agents were excluded from the study.
Informed written consent was obtained from every participant and the study was approved by the institutional ethical committee.

Methods:
Body height (Ht) - Body height (Ht) in centimeters was measured by having the subjects stand with their heels, buttocks, and heads against a wall. A flat object was placed on top of the subjects' head, and their height was marked on a tape measure affixed to the wall.

Body weight - Body weight was measured in kilograms (kg) with a standard portable scale. Body weight and body height were measured with light clothes and bare feet.

Waist Circumference - Waist Circumference measurement was taken midpoint between the lower margin of the last palpable rib and the top of the iliac crest in a horizontal plane by the measurer sitting by the subject and fitting the tape snugly but not compressing soft tissues.

Hip circumference - Hip circumference was measured around the pelvis at the point of maximal protrusion of the buttocks. For both WC and HC subject were instructed to stand with arms at the sides, feet positioned close together, and weight evenly distributed across the feet. Circumference was measured at the end of a quiet expiration of the subject to the nearest 0.1 cm. Waist circumference WC) and Hip circumference (HC) were measured according to the recommendation of the World Health Organization. [5]

BAI - BAI was calculated using hip circumference and height (BAI= [hip (cm)/height (m) $^{1.5}$]-18) [6].

Body mass index (BMI)- BMI was calculated as body weight in kilogram divided by the square of body height in meters. Waist hip ratio (WHR) was calculated by dividing WC by HC.
Cut off values for BMI was 23 kg/m2, for WC 85cm, for WHR 0.95. The reference values for cut off were taken from studies done on Indian or Asian population. [7,8] .

HbA1c And Lipid Profile- Venous blood samples were taken after an overnight fast for glycosylated hemoglobin and lipid profile. HbA1c was done by High Pressure Liquid Chromatography and lipid profile by colorimetric method. The cut off values for dyslipidemia were according to National Cholesterol Education Program Adult Treatment Panel III criteria. [9]

Statistical Analysis:- The Data were entered into a computer and Statistical analysis was done. Values were reported as Means ± Standard deviation using Student Unpaired t test. P value was considered significant when < 0.05.

III. Results

Anthropometric measurements are shown in Table 1

The mean ± Standard deviation of BMI in group 1 of controlled diabetic patients was 24.14±2.61 (Kg/m2) and in group 2 of uncontrolled diabetic patients was 28.43±3.75 (Kg/m2) .It was found to be statistically significant. The mean ± Standard deviation of Waist Circumference (cm) in group 1 of controlled diabetic patients was 79.46±11.43 (cm) and in group 2 of uncontrolled diabetic patients was 93.57± 12 . 54 (cm). It was found to be statistically significant .

The mean ± Standard deviation of Waist Hip Ratio in group 1 of controlled diabetic patients was 0.95±0.03 and in group 2 of uncontrolled diabetic patients was 0.98± 0 .07 . It was found to be statistically non significant .The mean ± Standard deviation of BAI in group 1 of controlled diabetic patients was 23.12±6.07 and in group 2 of uncontrolled diabetic patients was 33.06± 6 .71 . It was found to be statistically non significant. So BMI and WC is significant and higher values in uncontrolled group 2 of diabetic patients shows that poor control of glucose is more in overweight and obese diabetic individuals.

Lipid profile values are shown in Table 2

The mean ± Standard deviation of total cholestrol in group 1 of controlled diabetic patients was 109±33.816 (mg %) and in group 2 of uncontrolled diabetic patients was 209±38.40 (mg %) . It was found to be statistically non significant .

The mean ± Standard deviation of tryglycerides in group 1 of controlled diabetic patients was 126.88 ±41.23 (mg %) and in group 2 of uncontrolled diabetic patients was 151.88±41.11 (mg %) . It was found to be statistically significant .

The mean ± Standard deviation of HDL in group 1 of controlled diabetic patients was 39.33±2.82 (mg %) and in group 2 of uncontrolled diabetic patients was 39.12±6.91 (mg %) . It was found to be statistically non significant .

The mean ± Standard deviation of LDL in group 1 of controlled diabetic patients was 119.33±23.88 (mg %) and in group 2 of uncontrolled diabetic patients was 95.94±33.26 (mg %) . It was found to be statistically significant. The mean ± Standard deviation of VLDL in group 1 of controlled diabetic patients was 27.33±3.63 (mg %) and in group 2 of uncontrolled diabetic patients was 60±29.37 (mg %) .It was found to be statistically significant. The significant and higher values in group 2 shows that deranged lipid profile values are associated more with poor control of glucose in diabetics and need to be controlled in order to avoid complications.

Table 1 Anthropometric Measurements

PARAMETERS	**GROUP-1 (Controlled Diabetic Patients) MEAN±SD**	**GROUP-2 (Uncontrolled Diabetic Patients) MEAN±SD**	**P VALUE**
BMI(Kg/m2)	24.14±2.61	28.43±3.75	P=0.00129S
WAIST CIRCUMFERENCE(cm)	79.46±11.43	93.57±12.54	P=0.0038S
WAIST:HIP RATIO	0.95±0.03	0.98±0.07	P=0.16NS
BAI	23.12±6.07	33.06±6.71	P=0.00027NS

Reference Values BMI ≥ 25 kg/m ^{2} WC , M: ≥ 90 cm; F: ≥ 85 cm, WHR, M: ≥ 0.90 ; F: ≥ 0.85 BAI , M ≥28.75, F ≥36.65 M-Males, F-Females , NS- Non Significant, S- Significant

Table 2 Lipid Profile Values

PARAMETERS	**GROUP-1 (Controlled Diabetic Patients) MEAN±SD**	**GROUP-2 (Uncontrolled Diabetic Patients) MEAN±SD**	**P VALUE**
TOTAL CHOLESTROL (mg%)	109±33.816	209±38.40	P=0.55NS
TRIGLYCERIDES (mg%)	126.88 ±41.23	151.88±41.11	P=0.026S
HDL (mg %)	39.33±2.82	39.12±6.91	P=0.961NS
LDL (mg %)	119.33±23.88	95.94±33.26	P=0.037S
VLDL (mg %)	27.33±3.63	60±29.37	P=0.002S

NS- Non Significant, S- Significant

IV. Discussion

In our study, markers of obesity that are found statistically significant are body mass index (BMI) and waist circumference (WC).The BMI in uncontrolled diabetic patients had higher values (28.43±3.75)than the BMI of the controlled diabetic patients (24.14±2.61).The WC in uncontrolled diabetic patients had higher values (93.57±12.54) than the WC of the controlled diabetic patients (79.46±11.43).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 [10] . In the present study, higher BMI was significant and has been widely used as an indicator of total adiposity; its limitations are clearly recognized by its dependence on race (Asians having large percentages of body fat at low BMI values), and age. As compared to BMI, WC have been used as surrogates of body fat centralization. This fact demonstrates the importance of early interventions for control and treatment of these risk factors for prevention of the cardiovascular complications in these patients. 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 [11]. Cortisol induced insulin resistance is partly explained by its metabolic effects in opposing insulin action [12]. The metabolic consequences of obesity are varied depending on the etiology, distribution and character of the excess adipose tissue. In the late1940s, Vague [13] suggested that the relative proportion of body fat in the upper body versus lower body was an important factor to consider while investigating obesity-related health problems. However, it was only since the 1980s that more attention has been focused on abdominal

obesity, rather than obesity per se as an important correlate for various metabolic disturbances [14-19]. In the present study, we found that the mean levels of TC, TG ,LDL-C , HDL-C and VLDL in uncontrolled diabetic patients were (209±38.40mg %,151.88±41.11 mg%,95.94±33.26mg%,39.12±6.91mg%,60±29.37 mg%), respectively. Our findings showed that majority of type 2 diabetic patients with dyslipidaemia have inadequate control of plasma lipid. The significant triglyceridemia levels was found. This is in conformity with other Indian studies [20] .Some studies have shown a positive association between lipid levels and measures of adiposity [20, 21], whereas other studies have failed to detect such a relationship [19, 20]. Furthermore, poor glycaemic control is strongly associated with abnormalities in lipid levels. These results, along with the high prevalence of overweight and obesity, suggest that diabetic patients should be counselled regarding their diets, physical activity and life habits. These patients also need frequent monitoring to ensure optimal lipid level control.

V. Conclusion

Since Diabetes Mellitus and BMI are having closer relationship with each other hence it is essential to identify risk factors predicting risk of diabetes. For the Indian population BMI , WC and deranged lipid profiles can be considered as better indices to predict the risk in diabetics. The non significance of Waist Hip Ratio and BAI in this study need to be further evaluated by studies comparing both WHR and BAI in a larger population. 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 patients with a family history of high BMI and diabetes. Weight management is a necessary therapeutic task for most obese type 2 diabetic patients, which helps in avoiding complications due to the Diabetes Mellitus.

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