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Study of Body Mass Index (BMI) and Waist Hip Ratio(WHR) in Type II Diabetes Mellitus Subjects

Dr.Swapnil Baliram Shinde[1], Dr.Dadasaheb Shankarrao Kulkarni[2], Dr Sudhir L. Tungikar[3]

[1, 2]Assistant Professor, Department of Medicine, Dr.Balasaheb Vikhe Patil,Rural Medical College, Loni, Ahmednagar, Maharashtra, INDIA.
[3]Professor, Department of Medicine, Dr.Balasaheb Vikhe Patil,Rural Medical College, Loni, Ahmednagar, Maharashtra, INDIA.

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ABSTRACT

Background- Diabetes mellitus is a heterogeneous group of metabolic disorders characterized by hyperglycemia. Obesity is a major potentially modifiable risk factor for type 2 diabetes mellitus patients. Clinical evidence suggests that the association of diabetes with central obesity is stronger than its association with general fat. Waist circumference and waist/hip ratio have been used as measures of central obesity and body mass index has been used as a measure of general obesity. **Methodology-**The above study was conducted in the Department of Medicine, Dr. D. Y. Patil Medical College, Hospital and Research Centre, Pimpri, Pune from April 2015 to September 2017. 50 cases of diagnosed Type II Diabetes Mellitus patients fulfilling the inclusion and exclusion criteria were included in this study. A standard questionnaire was used to interview all participants which have information regarding age, height, weight, waist hip ratio, and duration of diabetes. Data management and analysis was done using Microsoft excel and Epi-info software. **Results**- Mean WHR in Normal BMI cases was 0.859 ± 0.093, mean WHR in Overweight cases was 0.951 ± 0.118 and mean WHR in Obese cases was 1.088 ± 0.103. The association between WHR level and category of BMI is statistically significant ($p<0.05$). Mean HbA1c in Normal BMI cases was 6.12 ± 0.596 %, mean HbA1c in Overweight cases was 6.93 ± 0.837 % and mean HbA1c in Obese cases was 7.54 ± 1.321 %. **Conclusion-** It was concluded that there was a significant association between type of Obesity and Waist hip ratio (WHR). There was a significant association between abnormal Waist-hip ratio and Body Mass Index (BMI).

Keywords: BMI, WHR, Diabetes, obesity, association.

Corresponding Author: Dr.Swapnil Baliram Shinde, Assistant Professor, Department of Medicine, Dr.Balasaheb Vikhe Patil,Rural Medical College, Loni, Ahmednagar, Maharashtra, INDIA.
Email: swapnilshinde55@yahoo.com

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] The various risk factors for the development of type 2 DM are obesity, ethnicity, sedentary life style, sex, family history, hypertension and smoking. [2] Diabetes is second only to cardio vascular disease (CVD) as a health burden in India. [3] Obesity is a major potentially modifiable risk factor for type 2 diabetes.[4] It is associated with poorer control of blood glucose levels, blood pressure and cholesterol, placing persons with diabetes at higher risk for both cardiovascular and microvascular disease. Studies have indicated that central obesity might be more important in

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 10, 2023

the Indian population.[5] Central obesity has been associated with decreased glucose tolerance, alterations in glucose insulin homeostasis, reduced metabolic clearance of insulin, and decreased insulin-stimulated glucose disposal.[6] A positive association between overweight and obesity and risk of type 2 diabetes has been established repeatedly in many cross-sectional and prospective studies.[7] It was shown that the risk conferred by obesity for developing diabetes was higher by over 40 times in obese women compared to those who remained slim; and the risk would be reduced significantly with weight loss. BMI measures the "total" adiposity of the body and may miss many cases of "central/abdominal" obesity, in which the body fat accumulates mainly around the waist. A BMI ≥ 25 is associated with increased morbidity, primarily from DM and CVD, while a BMI >30 is associated with increased risk for both morbidity and mortality, the latter mainly from diabetes, coronary heart disease (CHD), and stroke.[8] BMI does not reflect body fat distribution, whereas the intra-abdominal deposition of adipose tissue is a major contributor to the development of hypertension, insulin resistance, DM and dyslipidaemia. Thus, other anthropometric indices such as waist circumference (WC), and waist-to-hip ratio (WHR) have been used as alternatives to BMI. Waist circumference is increasingly being accepted as the best anthropometric indicator of abdominal adiposity and metabolic risk. A WHR >1.0 in men and WHR >0.85 in women are used as cut-offs for identifying individuals with central obesity. However, WC is the preferred and more commonly used measure of abdominal obesity compared with WHR. [9]

The above study was aimed to learn about body mass index (BMI), waist hip ratio (WHR) and its correlation in type II diabetes mellitus patients.

MATERIALS AND METHODS

Study place- The study was conducted in the Department of Medicine, Dr. D. Y. Patil Medical College, Hospital and Research Centre, Pimpri, Pune from April 2015 to September 2017.

Study design-Prospective observational study.

Inclusion criteria- Patients with known duration of Diabetes mellitus of at least 6 months, BSL (Random) ≥200 mg/dl, BSL (Fasting) ≥126 mg/dl, HbA1c, and those who gave informed consent.

Exclusion criteria- Chronic alcoholic patients, CRF patients, patients having hypothyroidism, family dyslipidaemia and unwilling to give written informed consent.

Sample size- 50 cases of diagnosed Type II Diabetes Mellitus patients in Department of Medicine, Dr. D. Y. Patil Medical College, Hospital and Research Centre, Pimpri, Pune.

Data analysis- Data management and analysis was done using Microsoft excel and Epi-info software. The frequency distribution and graph were prepared for the variables. The test was considered significant only if the p value comes out to be less than 0.05.

Ethical considerations- The study protocol was approved by the Scientific and Ethical Committee of the Institution. A voluntary informed written consent was taken from the participant those who consented were included in the study. A strict confidentiality was maintained about the personal details of the participants and information related to the study.

A standard questionnaire with used to interview all participants which have information regarding age, height, weight, waist hip ratio, and duration of diabetes. All the necessary laboratory examination were conducted including HbA1C.

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 10, 2023

RESULTS

Table 1: Age wise distribution of cases

Age group (in years)	Frequency	Percent
41-50	17	34.0
51-60	23	46.0
61-70	10	20.0
Total	50	100.0

The above table shows the age distribution of cases. It was seen that 17 (34.0) cases were between 41-50 years, 23 (46.0) cases were between 51-60 years and 10 (20.0) cases were between 61-70 years of age. Mean age of the patients was 54.32 year (standard deviation 7.12yr). Age of the patients ranged from minimum 42 years to maximum 70 year.

Table 2: Anthropometric measurement of study subjects (n=50)

Variable	Minimum	Maximum	Mean	Std. Deviation
Weight (kg)	50	85	67.38	8.99
Height (cms)	144	180	161.34	8.81
BMI	20.17	34.55	26.08	3.13
WHR	0.81	1.23	1.02	0.11

It was seen that mean weight of cases was 67.38 ± 8.99 kg, mean height of cases was 161.34 ± 8.81 cms, mean BMI of cases was 26.08 ± 3.13 and mean WHR of cases was 1.02 ± 0.11.

Table 3: Distribution of study subjects according to BMI categories

BMI Categories	Frequency	Percent
Normal BMI (18.50-24.9)	10	20.0
Overweight (23-25)	19	36.0
Obese (More than 25)	21	42.0
Total	50	100.0

The above table shows distribution of cases according to BMI categories. It was observed that 10 (20.0) cases were Normal BMI (18.50-24.9), 19 (36.0) cases were Overweight (23-25) and 21 (42.0) cases were Obese (More than 25).

Table 4: Duration of diabetes mellitus

Duration	Frequency	Percent
0-4 years	6	12.0
5-9 years	29	58.0
10-14 years	12	24.0
15 and above	3	6.0
Total	50	100.0

The above table shows distribution of cases according to Duration of diabetes mellitus. It was observed that 6 (12.0) cases were 0-4 years, 29 (58.0) cases were 5-9 years, 12 (24.0) cases were 10-14 years and 3 (6.0) cases were 15 and above older.

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 10, 2023

Table 5: Distribution of study subjects according to Waist Hip Ratio Risk Category

Waist Hip Ratio Risk Category	Frequency	Percent
Normal Cardiac Risk (<0.9 for M and <0.85 for F)	16	32.0
Increased Cardiac Risk (≥0.9 for M and ≥0.85 for F)	34	68.0
Total	50	100.0

The above table shows distribution of cases according to Waist Hip Ratio Risk Category. It was observed that 16 (32.0) cases were having Normal Cardiac Risk (<0.9 for M and <0.85 for F) and 34 (68.0) cases were having Increased Cardiac Risk (≥0.9 for M and ≥0.85 for F).

Table 6: Association of BMI and WHR

Variables	BMI	N	Mean	SD	P value
WHR	Normal BMI	10	0.859	0.093	0.001
	Overweight	19	0.951	0.118	
	Obese	21	1.088	0.103	
HbA1c	Normal BMI	10	6.12	0.596	0.003
	Overweight	19	6.93	0.837	
	Obese	21	7.54	1.321	

It was observed that mean WHR in Normal BMI cases was 0.859 ± 0.093, mean WHR in Overweight cases was 0.951 ± 0.118 and mean WHR in Obese cases was 1.088 ± 0.103. The association between WHR level and category of BMI is statistically significant ($p<0.05$). Also, mean HbA1c in Normal BMI cases was 6.12 ± 0.596 %, mean HbA1c in Overweight cases was 6.93 ± 0.837 % and mean HbA1c in Obese cases was 7.54 ± 1.321 %. The association between HbA1c level and category of BMI is statistically significant ($p<0.05$).

Table 7: Association of WHR and BMI and Lipid profile

Variables	WHR	N	Mean	SD	P value
BMI	(≥0.9 for M and ≥0.85 for F)	34	27.64	1.680	0.001
	(<0.9 for M and <0.85 for F)	16	22.78	2.328	
HbA1c	(≥0.9 for M and ≥0.85 for F)	34	7.31	1.247	0.25
	(<0.9 for M and <0.85 for F)	16	6.93	0.556	

It was observed that mean BMI in Normal WHR cases was 22.78 ± 2.328 and mean BMI in abnormal WHR cases was 27.64 ± 1.680. The association between BMI and category of WHR is statistically significant ($p<0.05$). It was also observed that mean HbA1c in Normal WHR cases was 6.93 ± 0.556 % and mean HbA1c in abnormal WHR cases was 7.31 ± 1.247. The association between HbA1c and category of WHR is statistically insignificant ($p>0.05$).

Table 8: Correlation of BMI with WHR and HbA1C

BMI	Correlation Co-efficient r	P value
WHR	0.564	0.001
HbA1C	0.426	0.001

The BMI is significantly correlated with WHR and HbA1C with Correlation Co-efficient 0.564 and 0.426 respectively.

Table 9: Correlation of WHR with HbA1C

WHR	Correlation Co-efficient r	P value
HbA1C	0.411	0.001

The WHR is significantly correlated with HbA1c with Correlation Co-efficient 0.411.

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 10, 2023

DISCUSSION

In the above study, it was seen that 17 (34.0) cases were between 41-50 years, 23 (46.0) cases were between 51-60 years and 10 (20.0) cases were between 61-70 years of age. Mean age of the patients was 54.32 year (standard deviation 7.12yr). Age of the patients ranged from minimum 42 years to maximum 70 year. In the study conducted by Katamreddy Alekhya et al[10], a total of 102 type 2 diabetic subjects with a mean age of 51.8 ± 10.72 years were studied. In the study conducted by Prashant Tayde et al[11], a total of 50 type 2 diabetic subjects with a mean age of 41.32 ± 3.26 years were studied. In the study conducted by Purohit A et al[12]. the mean age of the patients was 49.98• ± 8.3 years. The mean age of the subjects is in accordance with other Indian studies, from 47-50 years [13-14], however, less than that reported by others.[15-16]. The above study indicated that mean weight of cases was 67.38 ± 8.99 kg, mean height of cases was 161.34 ± 8.81 cms, mean BMI of cases was 26.08 ± 3.13 and mean WHR of cases was 1.02 ± 0.11.

In the study conducted by N. Jayarama et al[17], it was seen that mean weight of cases was 65.68 ± 11.17 kg, mean height of cases was 162.91 ± 8.87 cms, mean BMI of cases was 24.69 ± 4.23 and mean WHR of cases was 1.01 ± 0.12. Also, in the study conducted by Sanjeev Dhakal et al[18], it was seen that mean weight of cases was 89.2±20.9 kg, mean height of cases was 1.625±0.04 metres, mean BMI of cases was 30.0±11.1 and mean WHR of cases was 0.99±0.35. In the above study conducted, it was observed that 10 (20.0) cases were Normal BMI (18.50-22.9), 19 (36.0) cases were Overweight (23-25) and 21 (42.0) cases were Obese (More than 25). In the study conducted by Koo HC [19], it was observed that 3 (1.4) cases were Underweight, 74 (35.2) cases were Normal BMI, 75 (35.7) cases were Overweight, 39 (18.6) cases were Obese Grade 1, 15 (7.1) cases were Obese Grade 2 and 4 (1.9) cases were Obese Grade 3.Adamu G Bakari et al. (2005) found mean BMI of 24.9±4.02 kg/m2 in type 2 DM patients while 22.9 ± 4.02kg/m2.in controls which were consistent with the results of our study.[20] Akira Katsuki et al (2001) found that mean BMI was 26.0±2 kg/m2 in 55 patients of T2 DM.[21] Michael l ganz et al (2014) also found similar association of BMI with risk of type 2 DM. [22] Koichi akiyama et al (2014) The 16q12.2 locus in the first intron of FTO has been robustly associated with BMI and type 2 DM in genome wide associated studies. [23]

In the above study, it was observed that 6 (12.0) cases were 0-4 years, 29 (58.0) cases were 5-9 years, 12 (24.0) cases were 10-14 years and 3 (6.0) cases were 15 and above older. In the study conducted by Katamreddy Alekhya et al[10] , the mean duration of diabetes was 81 months. 16 (32.0) cases were having Normal Cardiac Risk (<0.9 for M and <0.85 for F) and 34 (68.0) cases were having Increased Cardiac Risk (≥0.9 for M and ≥0.85 for F). In the study conducted by C. Tirupathi Reddy et al [24], Increased waist hip ratio was present more in females (82.76%) (24) than (40.85%) (29) Males. In the study conducted by Koo HC [19], it was noted that 78% of males had WHR > 0.9 and 88% of females had WHR > 0.85. The prevalence of abdominal adiposity was significantly higher (p<0.001) among the females compared with that of the males. In study of Adamu G Bakari et al. (2005), study mean WHR was 1.03±0.08 in 42 type 2 DM patients. This finding is similar to present study. [20]

In the above study, the BMI is significantly correlated with WHR with Correlation Co-efficient 0.564. (p<0.05). The BMI is significantly correlated with HbA1c with Correlation Co-efficient 0.426. (p<0.05). J. Sheth et al. found in T2DM, higher waist circumference (WC) or higher BMI in a person had no independent association with HbA1c levels in diabetic women.[25]

Besides Indian authors similar studies have been conducted in other nations too.[26-28] It was observed that mean WHR in Normal BMI cases was 0.859 ± 0.093, mean WHR in Overweight cases was 0.951 ± 0.118 and mean WHR in Obese cases was 1.088 ± 0.103. The association between WHR level and category of BMI is statistically significant (p<0.05). It was also observed that mean HbA1c in Normal BMI cases was 6.12 ± 0.596 %, mean HbA1c in

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 10, 2023

Overweight cases was 6.93 ± 0.837 % and mean HbA1c in Obese cases was 7.54 ± 1.321 %. The association between HbA1c level and category of BMI is statistically significant ($p<0.05$). In the present study, WHR is significantly correlated with HbA1c ($r=0.411$). In a study conducted by Himabindu (2013) [29], it was observed that mean BMI in Normal WHR cases was 22.78 ± 2.328 and mean BMI in abnormal WHR cases was 27.64 ± 1.680. The association between BMI and category of WHR is statistically significant ($p<0.05$). It was observed that mean HbA1c in Normal WHR cases was 6.93 ± 0.556 % and mean HbA1c in abnormal WHR cases was 7.31 ± 1.247. The association between HbA1c and category of WHR is statistically insignificant ($p>0.05$). Anthropometric parameters above the threshold cut off values were found to be predictors of diabetes and other cardiovascular risk factors in various populations even though it is not clear which anthropometric parameter is ideal for a particular population.

CONCLUSION

From the above study it can be concluded that there was a significant association between type of Obesity and Waist hip ratio (WHR), HbA1c. There was a significant association between abnormal Waist-hip ratio and Body Mass Index (BMI). There was a significant positive correlation between Body Mass Index (BMI) and WHR, HbA1c. There was a significant positive correlation between Waist Hip Ratio (WHR) and HbA1c. BMI and WHR are important indicators of obesity and can be used to predict incidence of obesity in Indian population. WHR is the important anthropometric indices to indicate central obesity and distribution of fat in the body.

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