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ASSOCIATION BETWEEN VARIOUS ANTHROPOMETRIC PARAMETERS AND TYPE 2 DIABETES MELLITUS IN PATIENTS OF A TERTIARY CARE HOSPITAL IN NORTH EAST INDIA

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ABSTRACT **Introduction:** Diabetes mellitus is not a single disease entity but rather a group of metabolic disorders sharing the common underlying feature of hyperglycemia. Obesity and particularly abdominal obesity are strongly associated with insulin resistance. Clinical evidence indicates a stronger association of diabetes with central obesity than general obesity. **Material And Methods:** A Cross-sectional , observational study conducted at the diabetic clinic of AGMC and GBP hospital. Diagnosed Type 2 diabetes mellitus cases attending the clinic were recruited after simple random sampling. Data was collected by a predesigned questionnaire. Height, Weight , waist circumference and hip circumference were measured . The data was subjected for statistical analysis using SPSS-26 software for windows. P-value <0.05 was considered to be significant. **Results:** 270 patients with type 2 diabetes mellitus (age>20 years) were studied out of which 138(51.1%) were male and 132(48.9%) were female. The overall prevalence of obesity according to BMI, WC, WHR was 41.90%, 57% and 87.80% respectively. In male, the prevalence of BMI, WC and WHR obesity was 26.80%, 35.50% and 83.30% respectively. However, in females the prevalence of BMI, WC and WHR obesity was 57.60%, 79.50% and 92.4% respectively. **Conclusions:** This study concluded that obesity is a highly prevalent co-morbidity in diabetic patients. The change in waist hip ratio was a better predictor of the disease. First line intervention for weight loss should be stressed for the effective management of T2DM.

KEYWORDS : Type 2 Diabetes mellitus, Obesity, Waist circumference, Waist hip ratio, BMI

INTRODUCTION

Diabetes mellitus is not a single disease entity but rather a group of metabolic disorders sharing the common underlying feature of hyperglycemia. Hyperglycemia in diabetes results from defect in insulin secretion, insulin action, or both. The chronic hyperglycemia and attendant metabolic dysregulation may be associated with secondary damage in multiple organ systems, especially the kidneys, eyes, nerves, and blood vessels. The prevalence of diabetes is increasing sharply in the developing world as people adopt more sedentary lifestyles, with India and China being the largest contributors to the world's diabetic load.[1]

According to ninth edition of diabetes atlas published by the International Diabetes Forum during 2019, diabetes is one of the fastest growing global health emergencies of the 21st century. In 2019, it is estimated that 463 million people have diabetes and this number is projected to reach 578 million by 2030, and 700 million by 2045. Two-thirds of people with diabetes live in urban areas and three out of four are of working age. Over four million people aged 20–79 years are estimated to die from diabetes-related causes in 2019. Another cause for alarm is the consistently high percentage of people with undiagnosed diabetes (overwhelmingly type 2 diabetes), which is currently over 50%. This reveals the urgent need to diagnose the undiagnosed people with diabetes and provide appropriate and timely care for all people with diabetes as early as possible.[2]

Tripura, a small state in north eastern part of India, according to a report published by ICMR-INDIAB in 2017, has the highest prevalence of diabetes (9.4%) among all the north eastern states followed by Mizoram (5.8%). The prevalence was more in urban Tripura (15.5%) then rural (7.2%). The prevalence of pre-diabetes was also high in Tripura (14.7%).[3]

Type 2 diabetes is a chronic disease characterized by hyperglycemia and dyslipidemia due to underlying insulin resistance. The condition commonly progresses to include micro vascular and macro vascular complications. Obesity and particularly abdominal obesity are strongly associated with insulin resistance.[4]

In recent years increasingly sedentary life styles and poor eating habits have contributed to the simultaneous escalation of diabetes and obesity worldwide, which some have termed as the diabesity epidemic. Sadly, obesity and diabetes have now percolated even to children exposed to "junk" food and lacking adequate exercise.[5]

Clinical evidence indicates a stronger association of diabetes with central obesity than general obesity. In spite of a relatively lower rate of obesity as defined by the Body Mass Index (BMI) cut points, South Asians tend to have larger waist measurements and waist-to-hip ratios (WHR), indicating a greater degree of central body obesity. This is associated with a characteristic metabolic profile with higher insulin levels, a greater degree of insulin resistance, a higher prevalence of diabetes. [6]

Simple anthropometric measurements have been used as surrogate measurements of obesity and have more practical value in both clinical practice and for large-scale epidemiological studies. 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. But BMI can be misleading, such as in individuals with a high proportion of lean muscle mass. WC, a more accurate measure of the distribution of body fat, has been shown to be more strongly associated with morbidity and mortality. Recently, the waist-to-stature ratio (WSR) has been proposed as a better screening tool than WC and BMI for adult metabolic risk factors.[7]

The anthropometric parameters have ethnic susceptibility, so the objective of this study is to determine the proportion of obesity using the anthropometric parameters of WC, WHR, and BMI among type 2 diabetes mellitus (T2DM) patients and its associated risk factors.

MATERIALS AND METHODS

Study Design: Cross-sectional study.

Type Of Study: Observational study.

Study Setting: Diabetic clinic at AGMC and GBP hospital

Study Population: Diagnosed Type 2 diabetes mellitus cases attending diabetic clinic in AGMC & GBP Hospital.

Inclusion Criteria:

i) Age ≥20 years of both gender.
ii) Diagnosed with T2DM willing to participate.
iii) Patients attending the Diabetic clinic of AGMC and GBP hospital.

Cases were interviewed in the hospital and additional details about other investigations & complications obtained from OPD patient records for cases.

Exclusion Criteria :
i) Patients with type 1 diabetes mellitus.
ii) Patients of type 2 diabetes mellitus having severe co-morbidities like stroke, chronic renal diseases and chronic lung diseases at the time of recruitment into the study.
iii) Pregnant and lactating women.

Sample Size Calculation:
Sample size was calculated to be 270 using the Cochran's formula considering p = 53.42. [9]

Sampling Technique: Simple random sampling

Study Tools:
(1) A pre-designed and pre tested questionnaire set
(2) Non stretchable measuring tape
(3)Hesley Digital weighing scale, Hesley Inc Germany
(4) Stadiometer

Consent: Written informed consent was obtained from all the study subjects.

Operational Definitions:
(1) Diabetes: Any subject with FBS value of ≥7mmol (≥126 mg/dl) or two-hour plasma glucose ≥11mmol (≥200mg/dl) or HbA1C ≥6.5 %(48mmol/mol) was considered as having diabetes (as per WHO criteria for diagnosis of diabetes).[10]

(2) Waist Circumference: It was measured at the midpoint between the tip of the iliac crest and the lower margin of last palpable rib, using a non stretchable tape, at the end of normal expiration, with the subject standing erect and arms relaxed in sides. Abdominal/central obesity was considered to be present when the waist circumference was ≥80 cm in women and ≥90 cm in men.[11]

(3) Hip Circumference: It was measured by a measuring tape and recorded in centimeters, to the nearest 0.1 cm, at the level of maximum circumference of the ischial tuberosity of the participant.

(4) Height: Height was measured by a stadiometer and recorded in centimeters to the nearest 0.1cm.

(5) WHR (Waist-hip ratio): It was calculated as waist circumference divided by hip circumference.

(6)Body Mass Index (BMI) : Defined as weight in kilograms divided by the square of the height in meters. Individuals are classified as underweight (BMI <18.5), normal (BMI 18.5 – 24.99) and overweight (BMI ≥25) in WHO criteria. [12]

In Asians, the cut-offs for overweight (≥23.0 kg/m^2) and obesity (≥25.0 kg/m^2) are lower than WHO criteria due to risk factors and morbidities. [13]

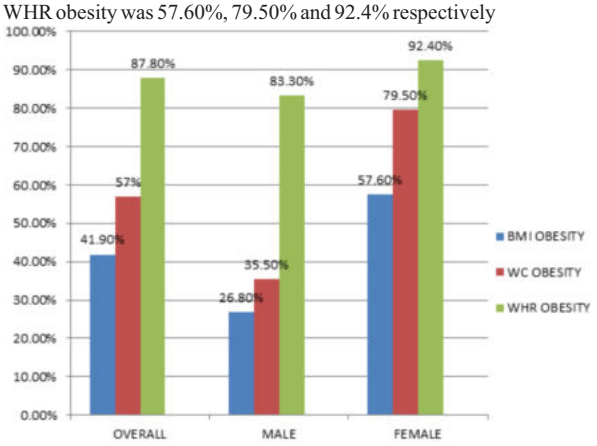
Criteria For Defining Obesity:
- BMI ≥ 23.0 kg/m^2 - overweight and BMI ≥25.0 kg/m^2– obese. [13]
- WC ≥ 90 cm in males and ≥ 80 cm in females (central/abdominal obesity).[6]
- WHR ≥0.95 for men and ≥0.85 for women. [4]

Data Management:
The data was subjected for statistical analysis using SPSS-26 software for windows. For categorical data comparison was done by Chi square test and for continuous data t-test or Z-test was applied. P-value <0.05 was considered to be significant.

Ethical Consideration:
The study was conducted after due approval from the committee for Ethical approval – AGMC & GBP Hospital.

RESULTS

In this study, 270 patients with type 2 diabetes mellitus (age>20 years) were studied out of which 138(51.1%) were male and 132(48.9%) were female. The overall prevalence of obesity and obesity in male and female patients according to BMI, WC and WHR are shown in Graph 1. The overall prevalence of obesity according to BMI, WC, WHR was 41.90%, 57% and 87.80% respectively. In male, the prevalence of BMI, WC and WHR obesity was 26.80%, 35.50% and 83.30% respectively. However, in females the prevalence of BMI, WC and WHR obesity was 57.60%, 79.50% and 92.4% respectively



Graph1: The Overall Prevalence Of Obesity And Obesity In Male And Female Patients According To BMI, WC And WHR

Table 1 shows distribution of the study participants according to the types of obesity. Considering BMI of the patients, 113(41.9%) were in obese category, 69(25.6%) were in overweight category, 78(28.9%) were in normal category while 10 (3.7%) were in underweight category. Based on WC obesity 154(57%) patients were found to be obese and 116(43%) were found to be non obese. WHR obesity was found to be present in 237(87.8%) of the subjects.

Table 1 : Distribution Of The Study Participants According To The Types Of Obesity.

Types of obesity	n (%)
BMI	
Underweight (<18.5)	10 (3.7)
Normal (18.5-22.9)	78 (28.9)
Overweight (23.0 – 24.9)	69 (25.6)
Obese (≥25)	113 (41.9)
WC Obesity	
Obese	154 (57.0)
Non Obese	116 (43.0)
WHR Obesity	
Obese	237 (87.8)
Non Obese	33 (12.2)

*BMI – Body Mass Index, WC – Waist circumference, WHR- Waist to hip ratio.

Association of types of obesity with various other factors in the study population are showed in Table :2. Considering different age groups of the patients, no significant association was found between the different types of obesity and age. The association between BMI obesity with gender and glycemic status was statistically significant in our study. The association between WC obesity with gender and socioeconomic status was statistically significant in our study (P value = 0.013).The association between WHR obesity with gender was statistically significant in our study. No significant association was however seen in patients with different obesity indices and duration of diabetes or physical activity.

Table 2 : Association Of Types Of Obesity With Various Factors In The Study Population.

Risk factors	n	BMI Obesity	WC Obesity	WHR Obesity
Age Category				
20-30	7	5 (71.4)	5(71.4)	6(85.7)
31-40	38	18 (47.4)	20(52.6)	31(81.6)
41-50	74	24 (32.4)	35(47.3)	62(83.8)
51-60	97	37 (38.1)	56(57.7)	89(91.8)
61-70	40	20 (50.0)	27(67.5)	37(92.5)
>70	14	09 (64.3)	11(78.6)	12(85.7)
P- value		0.128	0.145	0.440
Sex				
Male	138	37(26.8)	49(35.5)	115(83.3)

Female	132	76(57.6)	105(79.5)	122(92.4)
P-value		0.000	0.000	0.023
Socioeconomic Status				
Upper class	45	15(33.3)	27(60.0)	41(91.1)
Upper middle class	39	18(46.2)	27(69.2)	33(84.6)
Middle class	61	30(49.2)	40(65.6)	56(91.8)
Lower middle class	78	31 (39.7)	32(41.0)	66(84.6)
Lower class	47	19 (40.4)	28(59.6)	41(87.2)
P-value		0.344	0.013	0.646
Glycemic Status				
Euglycemic	44	29(65.9)	26(59.1)	36(81.8)
Hyperglycemic	226	84(37.2)	128(56.6)	201(88.9)
P-value		0.003	0.764	0.187
Duration of diabetes(in years)				
<1	32	14(43.8)	12(37.5)	31(96.9)
1-5	90	40(44.4)	53(58.9)	81(90.0)
6-10	68	28(41.2)	44(64.7)	57(83.8)
>10	80	31(38.8)	45(56.3)	68(85.0)
P-value		0.207	0.080	0.217
Physical activity				
Sedentary	181	80(44.2)	108(59.7)	162 (89.5)
Active	89	33(37.1)	46(51.7)	75(84.3)
P-value		0.485	0.213	0.217

DISCUSSION

Diabetes is one of the first diseases described with an Egyptian manuscript from 1500 BCE mentioning "too great emptying of the urine". The term "diabetes" or "to pass through" was first used in 250 BC by the Greek Apollonius of Memphis. Type 1 and Type 2 diabetes were identified as separate conditions for the first time by the Indian physicians Sushruta and Charaka in 400-500 CE with type 1 associated with youth and type 2 with obesity. The term "mellitus" or "from honey" was added by Thomas Willis in the late 1600s to separate the condition from diabetes insipidus which is also associated with frequent urination).[14]

Our study concluded that obesity is a highly prevalent co-morbidity in diabetic patients. "Asian Indian phenotype" is characterized by less of generalized obesity (measured by BMI) and greater central body obesity as shown by Waist Circumference (WC) & Waist-Hip Ratio (WHR). Our study supports this hypothesis. Another study showed that the change in waist was better predictor of the change in visceral adipose tissue. First line intervention for weight loss should be stressed for the effective management of T2DM.

Hadaegh et al. conducted a prospective study in 2008 among 2801 Iranian women and found that Body Mass Index (BMI), Waist circumference (WC), Waist-hip ratio (WHR), waist-to-height ratio (WHtR) were predictive of development of type 2 diabetes, but WHtR was a better predictor than BMI. Our study concluded that WHR obesity was a better predictor of diabetes.[15]

Our study agrees with the findings of Patro et al. who concluded that a waist hip ratio of >0.85 among females and >1.0 in males reflect central obesity. Central obesity with respondents carrying excess body fat cases pose a higher risk towards diabetes.[5]

Lotfi et al conducted a case control study in Iran in 2014 and found that waist circumference is the strongest anthropometric index that associates with type 2 diabetes in both sexes whereas our study says WHR obesity is highly associated with diabetes.[4]

• Awasthi et al. (2017) concluded that a strong association exists between obesity indices and diabetes and BMI and WC could be used in clinical practice for suggesting life style modifications. Our study finds WHR to be a stronger predictor of diabetes.[6]

Limitations

• The present study was an effort to identify the discriminatory power of various anthropometric measures and its association with T2DM, using hospital cases. Despite the small sample size, undisputedly waist hip ratio may be endorsed as the single most convenient, feasible measure that could be used across communities for its significant association with T2DM. Generalizability of the results is a limitation of the study because of the smaller sample size and due to disparities in various cut-offs used to define obesity in the available literature. Assessment of glycaemic control was intended to be assessed using investigation reports available from patient's files, but could not be done satisfactorily due to discrepancies in data records. A cohort study with a larger sample size is recommended to determine the optimal cut-off points for the various anthropometric measurements specific for the Indian population.

CONCLUSION

Among the various anthropometric measurements, WHR was found to have the best discriminatory power both in male and females. WC and BMI were also found to be sensitive markers. So, waist hip ratio as a single measure could be advocated due to simplicity of measurement and usage either in hospital or community settings.

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