Research Article

Obesity indices comparison and its correlation with random blood sugar and blood pressure in adults in rural field practice area of a medical college

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ABSTRACT

Background: The prevalence of obesity has doubled in adults and children and tripled in adolescents over the past 2 decades. Body Mass Index (BMI) has gained international acceptance as a standard for recognition and classification of overweight and obesity. Measuring Waist Circumference (WC) alone is a simpler way of assessing for abdominal fat and has been shown by more recent research to be superior to WHR in determining health risks. This present study was conducted among the adults above 30 years adults in the rural field practice area of a medical college with the objectives to assess prevalence of obesity using BMI, WC, WHR and WHtR, to compare these indices and to correlate obesity indices with random blood sugar level and blood pressure.

Methods: It was a household survey in which 1150 participants were included as study subjects.

Results: It was observed that 16.8% study participants were obese as per International classification of BMI, 35% study participants were obese as per BMI National classification and WHR, 26.7% were obese as per WC classification and 66% study participants were obese as per WHtR. In the present study, it was observed that none of the obesity indices was found to be correlated with Systolic B.P, Diastolic B.P and Random blood sugar level.

Conclusions: WHtR greater than 0.5 is a simple and effective indicator of centralized obesity. It measures obesity in those individuals which are healthy according to BMI and WC. One can use a simple instrument such as measuring tape to assess obesity as it measures WC, WHtR, and WHR instead of using heavy and non-calibrated weighing machine.

Keywords: BMI, WC, WHR, WHtR, RHTC

INTRODUCTION

Obesity has become the public health issue of the day-and for good reason. The data outline a dismal picture and a more foreboding future. The prevalence of obesity has doubled in adults and children and tripled in adolescents over the past 2 decades.¹ Individuals from so called disadvantaged communities are not exempted from the epidemic. They are also at the risk of obesity and its complications.² Hypertension is common in newly diagnosed type 2 Diabetes Mellitus and is associated with obesity. The association between hypertension and higher

triglyceride and insulin levels may be secondary to obesity. An association between hypertension and cardiovascular complications is already apparent at the diagnosis of diabetes mellitus.³

A strong correlation has been established between a high BMI and the development of type 2 diabetes mellitus from a study of more than 7000 British men (mean follow up of 12 years).⁴ These observations were expected as obesity is known to induce insulin resistance due to decrease in insulin sensitive receptors as the weight increases.⁵ Positive correlations between BMI and

glucose levels (random and fasting), body lipid level and blood pressure have been documented.^{6,7} A positive correlation is thought to exist between random blood glucose and obesity. However, racial factors seem to be important in the relationship between BMI and glucose intolerance because large studies such as Scottish study did not demonstrate a correlation between causal blood sugar and BMI.⁸

Body Mass Index (BMI) has gained international acceptance as a standard for recognition and classification of overweight and obesity. It is used by various health care professionals as an initial screen to identify individuals at risk for problems related to being overweight or underweight. Measuring Waist Circumference (WC) alone is a simpler way of assessing for abdominal fat and has been shown by more recent research to be superior to WHR in determining health risks.⁹

There has been some conflicting data regarding the relative merits of WHR versus WC, but the current scientific consensus favors the use of WC. WHR is particularly inaccurate in women.¹⁰ World Health Organization has declared WHtR as the best indicator of cardiovascular risk. This index is age independent and sex independent. Cut off value of WHtR is 0.5.¹¹ By comparison with BMI, WC, WHR and WHtR, WHtR more than 0.5 may be best indicator for undiagnosed type 2 diabetes mellitus and impaired fasting glucose.¹²

In young children, WHtR is not superior to WC or BMI in estimating Body Fat%, nor is WHtR better correlated with cardio-metabolic risk factor than WC or BMI in overweight/ obese children. These data do not support the use of WHtR in young children.¹³ WHtR is a simple and practical anthropometric index to identify higher metabolic risk in normal and overweight Japanese men and women.¹⁴ So this present study was conducted among the adults above 30 years adults in the rural field practice area of a medical college with the objectives to assess prevalence of obesity using BMI, WC, WHR and WHtR, to compare these indices and to correlate obesity indices with random blood sugar level and blood pressure.

METHODS

It was a household survey conducted in the rural field practice area of a medical college among the adults above 30 years of age in the month of October 2015 to January 2016. In different settings, at different places in India, the prevalence of obesity was varied as per the results of different studies. Based on results from Pilot study, the prevalence of obesity was 25.8% among 150 adults above 30 years of age.

Taking 10% allowable error, the sample size will be 1150. The field practice area of RHTC covers 9 villages, out of them 3 villages were selected randomly using Lottery method. The population of these 3 villages was 9062 and the total households were 1639. Systematic random sampling was used to select household from the villages as per the house hold data available at RHTC. Every 2nd house hold was visited and the family members whose age was above 30 years were selected as study participants.

If the household was found locked during the survey, the right hand thumb rule was practiced. A total of 1150 participants were included as study subjects. The study participants were explained the purpose of the study. Written informed consent was obtained from all the participants and the study was approved by the Ethical Committee of a Medical College. The structured questionnaires were used to collect necessary information as per objectives of the study.

Preliminary information such as house no, religion, caste, ADHAR no. education, occupation and income was obtained. Each participant was asked about his family history of diabetes mellitus and hypertension and also his own past history of diabetes mellitus and hypertension with duration of treatment.

Weight and height were measured by trained nurses and interns. The measurement was carried out with a standard hospital weighing balance and height measure, in light clothing without shoes, jackets and heavy ornaments.

Table 1: Classification of adults according to BMI.¹¹

Classification	BMI		
	Global population	Asian population	Indian population
Underweight	<18.5	<18.5	<18.5
Normal	18.5-24.99	18.5-22.99	18.5-22.99
Overweight	25-29.99	23-26.99	23-24.99
Obese	≥30	≥27	≥25

Subjects were asked to stand erect on the scale with both arms at the sides. The weight was recorded to the nearest

0.1 kg and height to the nearest 0.1 cm. Height was measured as the distance from top of the head to the

bottom of the feet (no shoes). Waist circumference was measured using measuring tape at the level between lower border of costal margin and iliac crest. Hip circumference was measured at the level of greater trochanter. Blood pressure was measured using Sphygmomanometer. The systolic and diastolic pressure was measured three times over a period of three minutes. Accordingly relevant data was collected, compiled and analyzed using SPSS- V19.

Table 2: Cut-off for WC.¹¹

Population		
Indian	Male	90 cm
	Female	80 cm
Global	Male	102 cm
	Female	88 cm

Waist to Height Ratio (WHtR) Cut off for WHtR-0.5.¹¹
Cut off for Waist to Hip ratio (WHR) Male >1, Female > 0.85.¹¹

Statistical tools applied were mean, percentages, Chi-square Test, Co-relation Coefficient, Logistic Regression, ROC curve. In the assessment of obesity, International classification of BMI was taken as gold standard and compared with the other obesity indices.¹⁵

RESULTS

29.3% study participants were in the age group of 30-40yrs, 25.7% were in the age group of 41-50years, 21.7% were in 51-60years and 23.3% were geriatric age group. 48.5% study participants were males and 51.5% were females. 19% study participants were known diabetic and 24% were hypertensive.

As per socio-economic status according to modified BG-Prasad scale, 30% study participants were belonged to middle socio-economic status group, 25% belonged to upper middle, 21% belonged to lower middle, 17% lower and only 7% belonged to upper class.

Table 3: Comparison of different obesity indices with BMI international.

Measurement	Obese		Comparison with International classification of BMI				
	n	%	Sensitivity	Specificity	Area under ROC	LL	UL
BMI International	193	16.8	-	-	-	-	-
BMI National	400	34.8	100	78.4	0.89	0.87	0.91
WC	307	26.7	94.8	87	0.91	0.89	0.93
WC by Height	762	66.3	99.5	40.4	0.7	0.67	0.73
WC by Hip	401	34.9	94.8	77.2	0.86	0.84	0.89

In the present study, it was observed that 16.8% study participants were obese as per International classification of BMI, 35% study participants were obese as per BMI National classification and WHR, 26.7% were obese as per WC classification and 66% study participants were obese as per WHtR.

Maximum prevalence was found in cases of WHtR which measures abdominal obesity. In assessment of obesity, International classification of BMI was taken as Gold standard and compared with other obesity indices. It was found that 100% sensitivity was found in case of BMI national and 99.5% sensitivity was observed in case of WHtR.

But in case of WHtR, it lacks the specificity (40.4%). After comparison with Gold standard, area under ROC was less in case of WHtR.

In assessment of obesity by WHtR, 58% overweight and 63% normal individuals were also detected as obese. The relation between WHtR and categories of BMI International was found to be statistically significant.

Table 4: Correlation of Obesity indices with BP and RBS.

Relation with BMI	r	P
SBP	0.08	0.01
DBP	0.04	0.14
RBS	0.03	0.3
Relation with WC	r	P
SBP	0.08	0.01
DBP	0.06	0.04
RBS	0.02	0.60
Relation with WHR	r	P
SBP	0.04	0.15
DBP	0.03	0.40
RBS	0.001	0.97
Relation with WHtR	r	P
SBP	0.06	0.03
DBP	0.04	0.15
RBS	0.02	0.53

In the assessment of obesity by WHR, 32% overweight and 21% normal individual were also deemed as obese. The relation between WHR and categories of BMI International was found to be statistically significant. In assessment of obesity by WC, 53% overweight and 2% normal individuals were also deemed as obese. The relation between WC and categories of BMI International was found to be statistically significant. In the present study, it was observed that obesity was more common

among females (19%) as compared to males (14%) but was found to be statistically significant.

In the present study, it was observed that none of the obesity indices was found to be correlated with Systolic B.P, Diastolic B.P and Random blood sugar level. But association between Systolic B.P with obesity indices such as International BMI, WC and WHR was found to be statistical significant.

Table 5: Association between BMI International categories with SBP.

BMI Internation	SBP		Total	χ^2	P-value
	≤140 mmHg	>140 mmHg			
Under weight	27	8	35	10.64	0.014
	77.14%	22.86%	100.00%		
Normal	524	191	715		
	73.30%	26.70%	100.00%		
Over weight	146	61	207		
	70.50%	29.50%	100.00%		
Obese	119	74	193		
	61.70%	38.30%	100.00%		
Total	816	334	1150		
	70.96%	29.04%	100.00%		

The association between categories of BMI International and systolic BP (hypertensive/ non hypertensive's) was found to be statistically significant as 38% obese and 30% overweight were found hypertensive. Same was found in case of diastolic BP and categories of BMI International as 46% obese and 37% overweight were hypertensive.

But the relation between categories of BMI International and sugar level <140 mg% and >140 mg% was found to be statistically non-significant. Obesity was found to be associated with patients having only hypertension, with patients having only diabetes but was more associated with patients having both hypertension and diabetes. This association was not found to be statistically significant.

DISCUSSION

This study was conducted among the adults above 30 years adults in the rural field practice area of a medical college with the objectives to assess prevalence of obesity using BMI, WC, WHR and WHtR, to compare these indices and to correlate obesity indices with random blood sugar level and blood pressure.

In the present study, it was observed that 16.8% study participants were obese as per International classification of BMI, 35% study participants were obese as per BMI National classification and WHR, 26.7% were obese as per WC classification and 66% study participants were

obese as per WHtR. Maximum prevalence was found in cases of WHtR which measures abdominal obesity. A study done by Sachin H et al in aged 20 and over years old males living in 11 towns in Kayseri, Turkey, according to BMI, overweight and obesity prevalence were 39.6% and 16.9%, respectively. Obesity prevalence was 29.9% (50-59 years) according to WHR, 50.4% (60-69 years) according to Waist Circumference (WC) and 24.8% (40-49 years) according to WHtR.¹⁶

In 1994, ICMR task force carried out a study involving more than 5000 individuals (3050 urban residents and 2487 rural residents) demonstrated 43% prevalence of overweight in urban Delhi and 12% in rural Haryana.¹⁷ Prevalence in the rural areas of Tamil Nadu rose sharply from 2% in 1989 to 17% in 2003.¹⁸ Kutty VR carried out a study in rural Kerala during 1991 using criteria of BMI >27, and the prevalence was found to be 5.8%.¹⁹

Later studies in Kerala reported 49% prevalence of overweight among 30-64 age group in 1998 and 41% among 40-60 age group during 2000.^{20,21} ICMR Task force study (1994) reported a higher prevalence in urban Delhi (31%) and a lower prevalence in rural Haryana(8%) using the criteria (WC >94 cm among men and >88 cm among women).¹⁷ The Sentinel surveillance on CVD in Indian industrial population (2001-03), using modified ATP III criteria for Asian (WC >90 cm among men and >80 cm among women) reported an overall prevalence of abdominal obesity at 32%. Dibrugarh in

Assam had the lowest prevalence (0.7%) while Hyderabad in Andhra Pradesh had the highest (52%).²² The ICMR Task force project reported 65% prevalence of high waist hip ratio in urban Delhi and 52% in rural Haryana in 1994 using the criteria (WHR: M->0.9, F->0.8).¹⁷

A study done by Wen Cheng Li et.al among Taiwanese adults, it was concluded that a WHtR greater than 0.5 is a simple and yet effective indicator of centralized obesity and associated cardio-metabolic risk, even among individuals deemed healthy according to BMI and WC.

In the same study, it was observed that the area under curve of WHtR was significantly greater than that of BMI or WC in the prediction of high total cholesterol, high triglyceride and low HDL-cholesterol.²³ In the present study also, it was found that individuals who were normal and overweight according to BMI, found to be obese according to WHtR greater than 0.5.

A strong correlation has been established between a high BMI and the development of type 2 diabetes mellitus from a study of more than 7000 British men (mean follow up of 12 years).⁴ In the present study, it was observed that none of the obesity indices was found to be correlated with Systolic B.P, Diastolic B.P and Random blood sugar level. But association between Systolic B.P and International BMI, WC and WHR was found to be statistical significant.

Positive correlations between BMI and glucose levels (random and fasting), body lipid level and blood pressure have been documented.^{6,7} A positive correlation is thought to exist between random blood glucose and obesity. However, racial factors seem to be important in the relationship between BMI and glucose intolerance because large studies such as Scottish study did not demonstrate a correlation between causal blood sugar and BMI.⁸

“Central obesity” indicated by an increased WHR, has been positively correlated with high blood pressure in several populations.²⁴ In the present study, it was observed that none of the obesity indices was found to be correlated with Systolic B.P, Diastolic B.P and Random blood sugar level. But association between Systolic B.P and International BMI, WC and WHR was found to be statistical significant.

The relation between categories of BMI International and systolic BP (hypertensive/ non hypertensive’s) was found to be statistically significant as 38% obese and 30% overweight were found hypertensive.

Strength of the study was that larger sample size was employed and standard procedure was used to classify study participants as per guidelines i.e. cut off values. Limitation was that causal association between obesity and diabetes and hypertension could not be determined.

CONCLUSION

WHtR greater than 0.5 is a simple and effective indicator of centralized obesity. It measures obesity in those individuals which are healthy according to BMI and WC. One can use a simple instrument such as measuring tape to assess obesity as it measures WC, WHtR, and WHR instead of using heavy and non-calibrated weighing machine.

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