ORIGINAL ARTICLE

Obesity markers and its association with end-organ dysfunctions among patients with metabolic syndrome in Western India

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ABSTRACT
BACKGROUND: Metabolic syndrome is a risk factor for subsequent cardiovascular and renal complications. Obesity and different markers of obesity can warn us for further development of end organ dysfunction. Here we tried to correlate importance of different obesity markers with development of cardiovascular, renal and cerebrovascular complications in patients with metabolic syndrome. **OBJECTIVES:** To study association of various obesity markers like body mass index, waist circumference and waist-hip-ratio with end organ dysfunctions in patients of metabolic syndrome. **MATERIALS AND METHODS:** Cross-sectional study was carried out with 75 patients having metabolic syndrome, diagnosed as per ATP III criteria (2005) at tertiary care center of western India. All patients underwent detailed history and examination including anthropometric measurements. **RESULT:** Anthropometric markers like waist circumference, body mass index and waist hip ratio have positive, linear and continuous association with ischemic heart disease and chronic kidney disease in patients of metabolic syndrome. Cardiovascular complications were more strongly associated with WHR and waist circumference.This association could not be established statistically in patients of cerebrovascular stroke due to paucity of patients in this group. **CONCLUSION:** In patients of metabolic syndrome risk of cardiovascular and renal complications is increasing with increasing obesity. Cardiovascular risk is more strongly associated with waist-hip-ratio and waist circumference than to body mass index.

Key words: Metabolic syndrome, body mass index, waist circumference, waist-hip-ratio

INTRODUCTION

Obesity is a leading worldwide public health problem. The prevalence of hypertension, diabetes mellitus and metabolic syndrome has significantly increased with prevalence of obesity. Obesity, hypertension and diabetes are high risk factors for subsequent cardiovascular and renal complications. Sympathetic nervous activation and insulin resistance frequently observed in obesity may play major roles in cardiovascular and renal complications in these patients. Further the metabolic syndrome is a constellation of interrelated abnormalities that increase the risk for cardiovascular disease and progression to type 2 diabetes. The prevalence of metabolic syndrome is increasing because of the 'obesity epidemic'. Different markers of obesity like body mass index, waist circumference and waist-hip ratio can warn us for further development of hypertension, diabetes, metabolic syndrome and so cardiovascular and renal complications. This study was carried out in patients of metabolic syndrome only, there is dearth of such kind of published studies to our knowledge.

Here we studied association of metabolic syndrome with Ischemic heart disease, chronic kidney disease and cerebrovascular stroke and tried to correlate importance of different obesity markers with development of cardiovascular, renal and cerebrovascular complications in patients with metabolic syndrome.

MATERIALS AND METHODS

Cross-sectional study was carried out with 75 patients having metabolic syndrome (ATP III criteria (2005) for metabolic syndrome were used for diagnosis of metabolic syndrome) who were admitted or were attending medical outpatient department at tertiary care center of

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western India over a period of 2 years. Current ATP III (2005)[1] criteria define the metabolic syndrome as the presence of any three of the following five traits:

1. Abdominal obesity, defined as a waist circumference in men >102 cm (40 in) and in women >88 cm (35 in);

2. Serum triglycerides ≥150 mg/dL (1.7 mmol/L) or drug treatment for elevated triglycerides;

3. Serum HDL cholesterol <40 mg/dL (1 mmol/L) in men and <50 mg/dL (1.3 mmol/L) in women or drug treatment for low HDL-C;

4. Blood pressure ≥130/85 mmHg or drug treatment for elevated blood pressure;

5. Fasting plasma glucose (FPG) ≥100 mg/dL (5.6 mmol/L) or drug treatment for elevated blood glucose.

A detailed history was taken. Anthropometric examination including height, weight, body mass index, hip circumference, waist hip ratio and waist circumference was carried out.

Waist circumference was measured as per National Health and Nutrition Survey (NHANES) Protocol: In upright position, the right iliac crest of the patient was palpated and a horizontal mark was drawn just above the lateral border of it. It was crossed with a vertical mark in the mid-axillary line. The measuring tape was placed around the abdomen at this level parallel to the floor and measurement of waist circumference was taken at normal minimal inspiration without compressing skin. Body mass index was calculated using the following formula: Weight in kilograms/ (height in meters) 2.Waist–hip ratio or waist-to-hip ratio (WHR) is the ratio of the circumference of the waist to that of the hips. Hip circumference should be measured around the widest portion of the buttocks, with the tape parallel to the floor. Routine blood and urine investigations including complete blood count, urine examination, fasting and postprandial blood sugar level, renal function test, lipid profile were done. Chest X-ray and ECG were done to diagnose ischemic heart disease, cardiomegaly and cardiac failure. Echocardiography, treadmill test, U.S.G.

abdomen, CT head were also done as and when indicated.From history, physical and systemic examination and investigations a profile of patients with metabolic syndrome was studied and correlation between metabolic syndrome and end-organ dysfunction including ischemic heart disease, chronic kidney disease, cerebrovascular accidents and retinopathy was studied. Association of different obesity markers like body mass index, waist circumference and waist hip ratio with end organ dysfunction was studied in these patients.

The data was entered and analyzed in Epi-info software.

RESULT

In our study maximum numbers of patients (40%) were in 51-60 years of age group. Most of the patients manifested metabolic syndrome in later part of their life. Prevalence of metabolic syndrome was higher in males (53%) as compared to females (47%).

Table 1: Relationship of Body Mass Index with End Organ Dysfunction

Body Mass Index	Total Number of Patients	IHD (%)	CKD (%)	STROKE (%)*
20-25 Normal	16	4(25)	5(31.25)	0(0)
26-30 Overweight	47	17(36)	20(42.55)	3(6.38)
31-35 Obese	12	8(66)	7(58.33)	0(0)
Chi square for trend		4.669,p=0.0307	2.021,p=0.1551	

*statistical test can't be applied

Table 1 shows that prevalence of IHD and CKD increases as body mass index increases with maximum prevalence being in obese patients. In patients with normal BMI prevalence of IHD and CKD was 25% and 31.25% respectively. BMI was found to be significantly associated with IHD only. For patients having stroke, sample size was less so no statistical test could be applied.

Table 2: Relationship of Waist Circumference with End Organ Disease

Waist Circumference	Total Number of Patients	IHD (%)	CKD (%)	STROKE (%)
<40	2	0(0)	0(0)	0(0)
40-45	10	2(20)	4(40)	0(0)
46-50	33	10(30)	14(42)	0(0)
51-55	11	6(54)	5(45)	0(0)
>56	19	11(57)	9(47)	3(15)
Chi square for trend		6.894, p=0.0086	0.523, p = 0.4697	p=0.0125*

*Fisher's exact test

Table 2 shows increasing trend in prevalence of end organ diseases like IHD, CKD and CV stroke as waist circumference increases, with maximum prevalence being in patients with waist circumference greater than 56 inches. This increasing trend in waist circumference was found to be significantly associated with IHD and CV stroke (p<0.05).

Table 3: Relationship of Waist Hip Ratio with End Organ Dysfunction

Waist-Hip Ratio	Total Number Of Patients	IHD(%)	CKD(%)	STROKE(%)*
<1	9	1(11)	2(33.33)	0(0)
1-1.1	50	17(34)	25(50)	0(0)
>1.1	17	11(64.7)	5(29.41)	3(17.64)
Chi square for trend		8.130, p = 0.0044	0.621, p = 0.8817	

*statistical test can't be applied

Table 3 shows that there is a linear increase in IHD as waist hip ratio increases. Patients with waist hip ratio between 1-1.1 had a highest prevalence of CKD. So there was no linear relationship between waist hip ratio and incidence of CKD in our patients.CV Stroke was seen in patients with waist hip ratio >1.1.

So patients with waist hip ratio greater than 1 are at higher risk of developing IHD, CKD and CVA.

DISCUSSION

In this study we tried to compare the strength of association of different obesity markers like waist circumference, body mass index and waist hip ratio with end organ dysfunction in patients of metabolic syndrome. We observed that anthropometric markers like waist circumference, body mass index and waist hip ratio have positive, linear and continuous association with ischemic heart disease and chronic kidney disease in patients of metabolic syndrome. This association could not be established statistically in patients of cerebrovascular stroke due to paucity of patients in this group. The relative magnitudes of the associations for cardiovascular disease were systematically higher when WHR was considered, then was waist circumference and lastly body mass index. Many studies in populations without diabetes have indicated a positive association between markers of abdominal obesity, either WHR or WC, and cardiovascular disease events[2,3]. Studies of association on different anthropometric markers in diabetic patients showed that waist hip ratio was the best predictor of cardiovascular events[4,5]. Investigators of the European Prospective Investigation into Cancer in Norfolk (EPIC-Norfolk) study reported the respective relationships of waist and hip circumferences to incidence of coronary artery disease (CAD)[6]. The authors reported that an increased waist circumference was associated with an elevated CAD risk.

In our study 65 patients were diabetic with two other metabolic traits and rest had three of the metabolic traits other than diabetes. Metabolic syndrome is itself a high risk condition for development of ischemic heart disease. In these patients also risk is increasing with increasing obesity. High BMI alone is not an accurate predictor of subsequent vascular pathology; high BMI can be due to large muscle mass also. It doesn't necessarily mean high fat content of body. Visceral fat is more closely related to WHR or even WC than to BMI[5]. and as a consequence may have a stronger influence on cardiovascular disease risk[7].

In our study association for chronic kidney disease was higher with body mass index then with waist circumference and then with waist hip ratio in patients of metabolic syndrome. Study done by HyunjuOh,Shan Ai Quan showed that Central obesity, but not BMI, is associated with faster renal function decline in Korean population[8]. Several epidemiologic studies, mainly conducted in Western countries, suggest that BMI[9,10] is a strong risk factor for CKD, as well as central obesity[9,11,12]. In Hong Kong study, central obesity increased risk for CKD among patients with diabetes13. In Japanese cohort studies , BMI was associated with reduced glomerular filtration rate[14,15].

Proposed criteria for identifying patients with metabolic syndrome have contributed greatly to preventive medicine. The presence of metabolic syndrome alone cannot predict global cardiovascular disease risk. But abdominal obesity - the most prevalent manifestation of metabolic

syndrome - is a marker of 'dysfunctional adipose tissue', and is of central importance in clinical diagnosis[16].

So amongst patients with metabolic syndrome, patients having increasing waist circumference and waist hip ratio should undergo vigorous life style modification and pharmacological measures. These can improve their metabolic parameters and so reduce the risk of end organ dysfunction.

CONCLUSION

Metabolic syndrome is a risk factor for subsequent development of cardiovascular and renal complications. In patients of metabolic syndrome risk of cardiovascular and renal complications increases in a linear way as obesity advances and cardiovascular complications are more strongly associated with advancing central obesity, suggested by waist circumference and waist-hip-ratio.

Therefore in these patients, vigorous lifestyle modification is advised to control weight that can improve metabolic parameters and reduce risk of subsequent end-organ dysfunction.

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