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A COMPARATIVE STUDY OF VARIOUS ANTHROPOMETRIC INDICES AS PREDICTORS OF METABOLIC SYNDROME AT A TERTIARY HOSPITAL

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Abstract

Background: The recognition of the existence of the metabolic syndrome has developed over the last two decades following the description of an insulin resistance syndrome. The metabolic syndrome affects 10% to 25% of adult population worldwide. Present study was aimed to compare various anthropometric indices as predictors of metabolic syndrome at a tertiary hospital. **Material and Methods:** Present study was single-center, prospective, analytical study, conducted adults of age > 15 years, males and females patients, whose BMI ≥ 30 Kg/ m^2. **Results:** In this study most common age group involved was 40 to 60 years age group (58 %). 54 % patients were male and 46 % patients were female. Mean age was 51 ± 12 years. In this study there was high prevalence of metabolic syndrome among male of 52% compared to female its 30 % but among non-metabolic syndrome patient female has high prevalence of 16 % compared to male of 2%. In this study patient having metabolic syndrome defined according NCEP /ATPIII, 70 % shows positive waist circumference, 72 % shows positive Waist Hip Ratio, 52% show positive significance with raised Blood pressure. In this study the most common pre-existing disease is diabetes mellitus. Whose prevalence is 24%. The area under the ROC curve (AURC) for WC (0.705,) WHR (0.772), BP (0.706), FBS (0.527), TG (0.793) and HDL (0.421). So among all above parameter WHR better discrimination than WC and other parameter. **Conclusion:** The metabolic syndrome has a high prevalence in South Indian population. WHR has shown to have the best predictive power to identify metabolic syndrome. The metabolic syndrome is more common among 40 to 60-year age group. Metabolic syndrome more common in males. Diabetes mellitus is the most common pre-existing disease in patients of metabolic syndrome.

Keywords: metabolic syndrome, Waist Hip Ratio, body mass index, Diabetes mellitus

Introduction

The recognition of the existence of the metabolic syndrome has developed over the last two decades following the description of an insulin resistance syndrome or Syndrome X in 1988.[1] Definitions of the metabolic syndrome that also include a measure of central obesity have been developed between 1999 and 2001 by the WHO (38), the European Group for the study

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for insulin Resistance and the National Cholesterol Education Program (NCEP) Expert panel on Detection, Evaluation and Treatment of high blood Cholesterol in Adults (ATP III).[2,3]

The metabolic syndrome affects 10% to 25% of adult population worldwide. Resistance to the action of insulin is a central feature of the metabolic syndrome. The metabolic syndrome is associated increased risk of a variety of disease outcome including diabetes, peripheral arterial diseases, fatty liver, and non-alcoholic steatohepatosis, PCOS, gall stones, asthma, sleep apnea and selected malignant diseases.[4,5]

Although, the majority of studies recommend waist circumference (WC) as a better indicator of abdominal obesity and a better predictor for cardiovascular disease (CVD) than either BMI or waist-to-hip ratio (WHR), such findings have not been confirmed in Asian and Ocean countries and the best index of obesity that is predictive for CVD risk still remains as a controversial subject.[6,7,8,9]. Present study was aimed to compare various anthropometric indices as predictors of metabolic syndrome at a tertiary hospital.

Material And Methods

Present study was single-center, prospective, analytical study, conducted in department of general medicine, at K.G. Hospital Coimbatore, Tamil Nadu, India. Study duration was of 1 year (July 2008 to July 2009). Study approval was obtained from institutional ethical committee.

Inclusion criteria

- Adults of age > 15 years, males and females patients, whose BMI ≥ 30 Kg/ m^2, willing to participate in present study

Exclusion criteria

- Patients ≤ 15 years of age.
- Pregnant females whose BMI ≥ 30Kg/m^2.
- Patients suffering from CHF.
- Patients suffering from CRF.
- Patients having anasarca and ascites.
- Polytrauma cases

Study was explained to patients in local language & written consent was taken for participation & study. In this study, NCEP ATP III CRITERIA was used to define metabolic syndrome. Subjects had their height, weight, BMI, waist circumference, hip circumference, waist hip ratio, plasma glucose, fasting total cholesterol, HDL cholesterol measured.

1. Height: measured with subject standing erect posture without shoes to nearest 0.5cm
2. Weight: measured without shoes to nearest 0.5kg.
3. Waist circumference: was measured between iliac crest and lowest rib to nearest to 0.5 cm during expiration.
4. BMI: was calculated as weight in kilogram divided by square of the height in meters.
5. Plasma glucose: was measured in fresh sample using Roche automated clinical chemistry analyzer that is based on modified GOD-PAP method.
6. Fasting total cholesterol: values were determined using cholesterol CHOD-PAP Roche/ Hitachi 912 automated clinical chemistry analyzer that uses the Roceschlau and allains enzymatic method of cholesterol determination.

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7. The fasting triglycerides: were measured using Roche/ hitachi 912-917 modular analyzer that use GPO-PAP assay based on Wahlefelds reaction.
8. HDL cholesterol: was determined using the Roche second generation.
9. A person's hip circumference measured at the level of maximum posterior extension of the buttocks

Metabolic syndrome was defined using National Cholesterol Education Program Adult Treatment Panel III (2001), which requires at least three of the following criteria to define metabolic syndrome.

- Central obesity: waist circumference ≥ 102 cm or 40 inches (male), ≥ 88 cm or 36 inches (female)
- Dyslipidemia: TG ≥ 1.695 mmol/L (150 mg/dl)
- Dyslipidemia: HDL-C < 40 mg/dL (male), < 50 mg/dL (female)
- Blood pressure ≥ 130/85 mmHg
- Fasting plasma glucose ≥ 6.1 mmol/L (110 mg/dl).\
- Waist-to-hip ratio: Men with a WHR of 0.95 or more and women with a WHR of 0.85 or more

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Frequency, percentage, means and standard deviations (SD) was calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Difference of proportions between qualitative variables were tested using chi-square test or Fisher exact test as applicable. P value less than 0.5 was considered as statistically significant.

Results

In this study most common age group involved was 40 to 60 years age group (58 %). 54 % patients were male and 46 % patients were female. Mean age was 51 ± 12 years.

Table 1- General characteristics

Age	**Male**	**Female**	**Total**
Below 40	6 (12 %)	7 (14 %)	13 (12 %)
40 - 60	16 (32 %)	13 (26 %)	29 (58 %)
Above 60	5 (10 %)	3 (6 %)	8 (16 %)
Total	27 (54 %)	23 (46 %)	50
Mean age	51 ± 11	51 ± 14	51 ± 12

In this study there was high prevalence of metabolic syndrome among male of 52% compared to female its 30 % but among non-metabolic syndrome patient female has high prevalence of 16 % compared to male of 2%.

Table 2: Prevalence of Metabolic Syndrome

Sex	**Metabolic Syndrome**		**Total**
	Positive	**Negative**	
Male	26 (52 %)	1 (2 %)	27 (54 %)

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Female	15 (30 %)	8 (16 %)	23 (46 %)
Total	41 (82 %)	9 (18 %)	50

In this study patient having metabolic syndrome defined according NCEP /ATPIII, 70 % shows positive WAIST CIRCUMFERANCE statistically significant association with metabolic syndrome and 12% show negative significance. Patients those not having metabolic syndrome till 8% shows positive Waist circumference statistically significant association with metabolic syndrome and 10% show negative significance.

Table 3: Waist Circumference vs. Metabolic Syndrome

Waist Circumference	**Metabolic Syndrome**		**Total**
	Positive	**Negative**	
Positive	35 (70 %)	4 (8 %)	39 (78 %)
Negative	6 (12 %)	5 (10 %)	11 (22 %)
Total	41 (82 %)	9 (18 %)	50

In this study patient having metabolic syndrome defined according NCEP /ATPIII, 72 % shows positive Waist Hip Ratio.

Table 4: Waist Hip Ratio vs. Metabolic Syndrome

Waist Hip Ratio	**Metabolic Syndrome**		
	Positive	**Negative**	**Total**
Positive	36 (72 %)	3 (6 %)	39 (78 %)
Negative	5 (10 %)	6 (12 %)	11 (22 %)
Total	41 (82 %)	9 (18 %)	50

In this study patient having metabolic syndrome defined according NCEP /ATPIII, 52% show positive significance. Blood pressure statistically significant association with metabolic syndrome and 30% show negative significance. Among patients not having metabolic syndrome, 4% show positive blood pressure significance and 14 % show negative significance.

Table 5: Blood pressure vs. Metabolic Syndrome

Blood pressure	**Metabolic Syndrome**		
	Positive	**Negative**	**Total**
Positive	26 (52 %)	2 (4 %)	28 (56 %)
Negative	15 (30 %)	7 (14 %)	22 (44 %)
Total	41 (82 %)	9 (18 %)	50

In this study patient having metabolic syndrome defined according NCEP /ATPIII, 50 % shows positive raised fasting blood glucose.

Table 6: FBS vs. Metabolic Syndrome

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	MS		
FBS	**Positive**	**Negative**	**Total**
Positive	25 (50 %)	5 (10 %)	30 (60 %)
Negative	16 (32 %)	4 (8 %)	20 (40 %)
Total	41 (82 %)	9 (18 %)	50

In this study patient having metabolic syndrome defined according NCEP /ATPIII, 48% shows positive triglycerides statistically significant association with metabolic syndrome and 34% show negative significance.

Table 7: Triglycerides vs. Metabolic Syndrome

TG	**Metabolic Syndrome**		**Total**
	Positive	**Negative**	
Positive	24	0	24
Negative	17	9	26
Total	41	9	50

In this study patient having metabolic syndrome defined according NCEP /ATPIII, 60% shows positive HDL statistically significant association with metabolic syndrome and 22% show negative significance. Patients those not having metabolic syndrome till 16% shows positive HDL statistically significant association with metabolic syndrome and 2% show negative significance.

Table 8: HDL vs. Metabolic Syndrome

	Metabolic Syndrome		
HDL	**Positive**	**Negative**	**Total**
Positive	30	8	38
Negative	11	1	12
Total	41	9	50

In this study the most common pre-existing disease is diabetes mellitus. Whose prevalence is 24%

Table 9: Pre Existing Diseases

Pre Existing Diseases	**No. of patients**	**(%)**
DM	12	24%
DM, Dyslipidemia	2	4%
DM, SHT	6	12%
DM, Dyslipidemia, SHT	2	4%
DM, SHT, IHD	2	4%
SHT	3	6%
Total	27	54%

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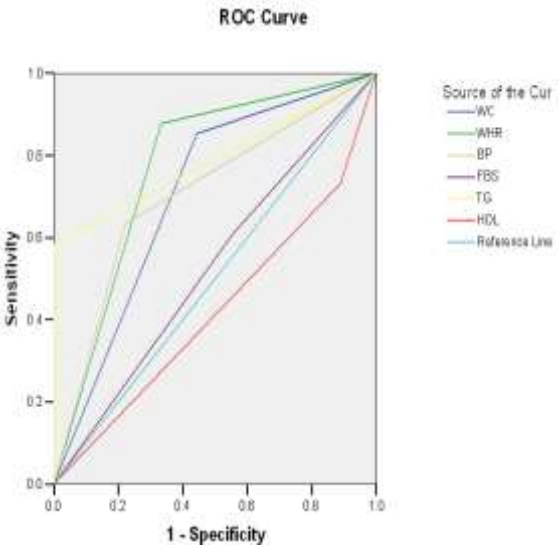

Figure

The area under the ROC curve (AURC) for WC (0.705,) WHR (0.772), BP (0.706), FBS (0.527), TG (0.793) and HDL (0.421). So among all above parameter WHR better discrimination than WC and other parameter.

Discussion

In 2001 the American National cholesterol education programme issued its Adult treatment panel III guidelines outlining criteria for diagnosis of the metabolic syndrome and management. ATP III definition was based on simple clinical Criteria and can be carried out in any general practice setting. The APT III has also updated recommendation for management of dyslipidemia.

The prevalence of obesity has increased dramatically in industrialized and developed countries, such that the World Health Organization reported overweight and obesity to be an escalating epidemic, worldwide.[10,11,12,13] Obese people are susceptible to other chronic diseases such as diabetes, cardiovascular disease (CVD) and some cancers. [13]

South Asian populations show lower muscle mass and high body fat at non-obese body mass index and there is selective increase in central obesity. As a result, at a BMI of 24 Kg/m2, 75% of individuals from such ethnic groups display insulin resistance. This explains their increased risk of diabetes and CHD. There is evidence that tendency to central deposition of fat is present in South Asians from childhood.[14]

Although, body mass index (BMI) as a recommended index of obesity by World Health Organization is related to disease risk, some studies suggest that the pattern of body fat distribution is a more important determinant of disease risk and individuals with a high proportion of abdominal fat have higher risks for developing diabetes, hypertension and CVD.[14,15,16] Unfortunately, there is no standard measure of abdominal obesity that is widely accepted.

Considering our study, overall prevalence of metabolic syndrome in our study as defined by NCEP/ ATP III criteria is 82%. This is quite high compared to two studies conducted in India by Gupta *et al.*,[17] which showed a rate of 12.8% and Ramchandran *et al.*,[1] which the overall prevalence was 41.1% using NCEP/ATPIII CRITERIA. Obesity has been given the

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highest importance among the other components of metabolic syndrome. Among the indices of obesity commonly used are BMI, waist circumference and waist hip ratio.

In an Australian study published in journal of internal medicines the WHR has been found to highly concordant with cardiovascular risk, development of Type 2 Diabetes Mellitus, hypertension and dyslipidaemia.[18] Similarly study conducted in Tehran published in international journal of obesity and related metabolic disorder WHR found to have high sensitivity, specificity and accuracy in predicting cardiovascular risk factor.

In our study we found that 78% of population has satisfactory fulfilled the criteria of NCEP/ATP III for waist circumference and out of them 70% of population has metabolic syndrome. 78% of population has satisfied criteria of NCEP/ATP III for waist hip ratio and out of them 72% of population have metabolic syndrome. WHR is the most sensitive and specific tool to predict metabolic syndrome. Again the ROC curve (AURC) for WHR (0.772) is more specific than any other component of metabolic syndrome.

In this study correlation significant is highly significant for WHR (0.000). In our study 56% of population had high BP according to NCEP/ATP III criteria. In our study 60% of population have high fasting blood sugar level. In our study 48% of population have high TG level. And lastly 70% has significant low HDL level.

Conclusion

The metabolic syndrome has a high prevalence in South Indian population. WHR has shown to have the best predictive power to identify metabolic syndrome. The metabolic syndrome is more common among 40 to 60-year age group. Metabolic syndrome more common in males. Diabetes mellitus is the most common pre-existing disease in patients of metabolic syndrome.

Conflict of Interest: None to declare
Source of funding: Nil

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