

## EVALUATION OF METABOLIC SYNDROME VARIABLES IN MORNING WALKERS

**Background:** Subtypes of obesity exist that appear to deviate from the standard relationship between increased body mass index (BMI) and its metabolic consequences, including metabolic syndrome. Physical activity is an important effect modifier in the relationships between obesity and metabolic status.

**Aims & Objective:** To evaluate metabolic syndrome variables in normal weight and overweight morning walkers.

**Materials and Methods:** The present cross-sectional study was conducted to evaluate metabolic syndrome variables in normal weight (Group I) and overweight/obese (Group II) morning walkers. Blood pressure and anthropometric measurements were recorded and after an overnight fast, blood samples taken were assessed for glucose and lipid profile. The joint interim statement criteria were applied for diagnosis of metabolic syndrome.

**Results:** In Group I, there were 43.5% of individuals who were metabolically obese in spite of their normal weight (MONW); while in Group II, there were 19% overweight/obese individuals without obesity related metabolic abnormalities (MHO).

**Conclusion:** Waist circumference and triglycerides were the strongest markers for metabolic syndrome in both the normal weight and overweight groups; 91.6% cases of metabolic syndrome among morning walkers were associated with elevated waist circumference values. Metabolic syndrome variables in both groups were similar. Majority of subjects had normal HDL-cholesterol, suggesting favorable effect of physical activity on HDL-cholesterol.

**Key Words:** Metabolic Syndrome; Body Mass Index; Waist Circumference; Physical Activity

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**Received Date:** 06.11.2013

**Accepted Date:** 04.12.2013

**DOI:**

10.5455/njppp.2014.4.041220133

### INTRODUCTION

It is commonly observed that probability of having metabolic abnormalities, including metabolic syndrome (MetS), increases with the level of obesity.<sup>[1]</sup> Metabolic syndrome is a multiplex risk factor for cardiovascular disease and type 2 diabetes. The variables that define MetS include central obesity, dyslipidemia, hypertension and altered glucose metabolism.<sup>[2]</sup> Obesity, defined as excess body fat (BF) has been evaluated in both clinical and epidemiological studies, using predominantly body mass index (BMI) (normal weight range is 18.5-24.9 kg/m<sup>2</sup>; overweight range is 25.0-29.9 kg/m<sup>2</sup>; and obese range is  $\geq 30.0$  kg/m<sup>2</sup>).<sup>[3]</sup>

A significant number of individuals have the metabolic syndrome despite having normal weight status (BMI  $\leq 25$  kg/m<sup>2</sup>). They are defined as metabolically obese normal weight individuals (MONW).<sup>[4-6]</sup> These individuals because of their abnormal metabolic status rather than high BMI are at increased risk of developing type 2 diabetes and major cardiovascular events.<sup>[7]</sup> On the other hand a significant number of obese individuals do not have obesity related metabolic abnormalities. They are designated as metabolic healthy obese (MHO) and appear to be at least partially protected from the development of the metabolic disturbances generally attributed to obesity. However, different researchers have defined

metabolic healthy obesity using different criteria.<sup>[4-6]</sup>

Low physical activity and increased adiposity often occur in combination, masking their independent effects on metabolic risk factors.<sup>[8]</sup> Physical activity is an important effect modifier in the relationships between obesity and metabolic status. In India, usually people adapt to morning walk to decrease the degree of obesity, blood glucose or blood pressure. The objective of this study was to evaluate metabolic syndrome variables in normal weight and overweight morning walkers.

### MATERIALS AND METHODS

The present cross-sectional study was conducted in the Postgraduate Department of Physiology, Government Medical College, Jammu from September 1, 2011 to April 30, 2012. A total of 110 men who were 20 to 69 years of age were studied. Subjects were recreationally active were enrolled from three different locations frequented by morning walkers in Jammu City. Informed written consent was obtained after explaining the nature of the study to the subjects and ethical clearance was obtained from Institutional Ethics Committee vide no. IEC/pharma/thesis/research/project/06/2011/2060, dated 20-10-2011.

BMI (calculated as weight in kilograms divided by the

square of height in meters), waist circumference, systolic and diastolic blood pressure were measured using standard methods. Laboratory assessments included venous blood samples in a fasted state for the determination of components of the lipid profile (high density lipoprotein cholesterol, and triglyceride) and blood glucose levels. The serum glucose was measured using the glucose-oxidase method and the lipid profile by the enzymatic-colorimetric method.

Subjects enrolled for the study were screened for metabolic syndrome according to joint interim statement guidelines. Metabolic syndrome was attributed in subjects if there was presence of three or more of the risk determinants: (i) increased waist circumference (> 90 cm in men, > 80 cm in women); (ii) elevated triglycerides ( $\geq 150$  mg/dl); (iii) low HDL cholesterol (< 40 mg/dl in men, <50 mg/dl in women); (iv) hypertension ( $\geq 130/ \geq 85$  mmHg); and (v) impaired fasting glucose ( $\geq 100$  mg/dl).<sup>[9]</sup>

The MONW phenotype was defined as individuals of normal weight (BMI<25 kg/m<sup>2</sup>) with the metabolic syndrome. The MHO phenotype was defined as overweight individuals (BMI  $\geq 25$  kg/m<sup>2</sup>) without the metabolic syndrome.<sup>[4]</sup>

The subjects were divided into two groups. Group-I included subjects who were normal weight (BMI <25kg/m<sup>2</sup>, n=46). While Group-II comprised of subjects who were overweight/obese (BMI  $\geq 25$ kg/m<sup>2</sup>, n=64). Both groups were further subdivided depending on the presence of metabolic syndrome. Metabolic syndrome variables in group-I and II were evaluated. Clinical characteristics of subjects with metabolic syndrome in Groups I and II were compared.

Data were analyzed using statistical software SPSS version 14 for Windows. Data reported as mean and standard deviation or percentages for variable. Differences in metabolic syndrome variables among the sub groups were assessed by  $\chi^2$  tests for categorical variables and Students' 't' test for continuous variables. A p-value of <0.05 was considered as statistically significant.

## RESULTS

Out of total 110 subjects, 46 subjects were in Group I with normal weight BMI out of which 26 subjects were without MetS while 20 had MetS (MNOW). 64 subjects comprised Group II with overweight BMI out of these 52 subjects

had MetS and remaining 12 had no MetS (MHO). Overall in present study total of 72 subjects (65%) had MetS in both groups, whereas 38 subjects were without MetS (Table 1). Increased waist circumference and elevated triglycerides were most common variables in both normal weight and overweight groups. Except HDL-cholesterol, prevalence of all other variables comprising metabolic syndrome were higher among overweight/obese subjects than normal weight subject (Figure 1). Comparison of both groups revealed that BMI was significantly higher in Group-II (27.94  $\pm$  2.81) than Group-I (23.52 $\pm$ 1.07) with p-value of 0.0001. Waist circumference was also higher in Group-II (27.94  $\pm$  2.81) compared to Group-I (94.15  $\pm$  7.11) with p-value of 0.001. Rest of the variables were not significantly different (p>0.05) among both groups (Table 2).

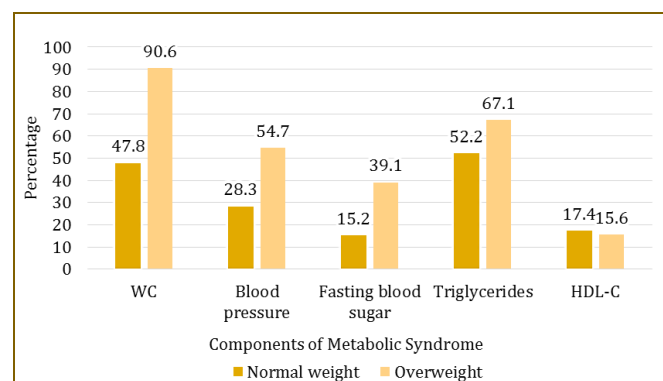
**Table-1:** Relationship of BMI with metabolic syndrome

Metabolic Syndrome	Group I (Normal Weight) n=46 (%)	Group II (Over Weight) n=64 (%)	Total (%)	p- value
Present	20 ( 43.5)	52 (81)	72 (65)	<b>&lt;0.005</b>
Absent	26 (56.5)	12 (19)	38 (35)	
<b>Total</b>	<b>46 (100)</b>	<b>64 (100)</b>	<b>110 (100)</b>	

**Table-2:** Comparison of overweight subjects with metabolic syndrome and normal weight subjects with metabolic syndrome

Variables	Group I (Normal Weight)	Group II (Over Weight)	p- value
Age (years)	49.7 $\pm$ 7.02	50.36 $\pm$ 10.52	0.7966 NS
BMI (kg/m <sup>2</sup> )	23.52 $\pm$ 1.07	27.94 $\pm$ 2.81	0.0001 HS
Waist circumference (cm)	94.15 $\pm$ 7.11	100.32 $\pm$ 7.19	0.0017 HS
SBP (mmHg)	130.75 $\pm$ 15.86	136.80 $\pm$ 15.61	0.1470 NS
DBP (mmHg)	87.5 $\pm$ 7.75	88.5 $\pm$ 11.00	0.7111 NS
Fasting blood sugar (mg/dL)	118 $\pm$ 21.27	122.61 $\pm$ 42.09	0.6427 NS
Serum HDL-C (mg/dL)	44.95 $\pm$ 6.63	45.51 $\pm$ 6.21	0.7376 NS
S. triglycerides (mg/dL)	199.15 $\pm$ 73.78	198.55 $\pm$ 79.70	0.9768 NS
Total serum cholesterol	188.7 $\pm$ 42.79	196.71 $\pm$ 36.84	0.4323 NS
Serum LDL	103.92 $\pm$ 38.89	112 $\pm$ 33.08	0.3799 NS

HS = highly significant (p<0.001); NS = Not significant (p>0.05)



**Figure-1:** Comparison of metabolic syndrome variables in group I and group II

## DISCUSSION

Within the two BMI categories, the prevalence of metabolic syndrome was significantly higher among

overweight/obese subjects. Our results are partially in agreement with the National Health and Nutrition Examination Survey (NHANES) 2003–2006 report.<sup>[10]</sup> In this study, the prevalence of metabolic syndrome increased with increasing BMI for both sexes. However, only about 7% of underweight and normal weight NHANES male participants met the criteria for metabolic syndrome. Whereas in our study, MetS was observed in 43% (20/46) of normal weight subjects.

In a study comprising of 5267 participants (2227 men, 3040 women) from the 3rd Korean National Health and Nutrition Examination Survey, the MONW phenotype was observed in 8.7% of total subjects and 12.7% of normal-weight subjects.<sup>[11]</sup> However, in the current study high prevalence of MONW was observed (43.8%, 20/46) and this may be attributed to variations in total number of participants and high prevalence of abdominal obesity which was observed in 91.6% (66/72) subjects with metabolic syndrome in both groups and 70% (14/20) of MONW subjects.

Most studies support the view that the metabolic syndrome is largely initiated by abdominal obesity. Our results are consistent with the National Institute of Health assumption that within the normal-weight, overweight, and class-I obese BMI categories, patients with high WC values have a greater health risk than patients with normal WC values.<sup>[12]</sup> Ian Janssen and co-workers grouped 14,924 adult participants of the Third National Health and Nutrition Examination Survey by BMI and WC in accordance with the National Institute of Health cutoff points. They observed that the prevalence of hypertension, type 2 diabetes mellitus, dyslipidemia and the metabolic syndrome was greater in individuals with high WC compared with normal WC values within the same BMI category.<sup>[13]</sup> However, the cutoff waist circumference value used to define central obesity in the NIH guidelines is 102 cm whereas we have used ethnicity specific waist circumference value of  $\geq 90$  cm.

In the present study, one third of MONW individuals had normal waist circumference values. One possible explanation for this is that classification of weight status by measurement of waist circumference does not quantify the magnitude of visceral and subcutaneous abdominal fat in a given individual.<sup>[14]</sup> Visceral adipose tissue (VAT) is a stronger predictor of the MetS and its component risk factors than is abdominal subcutaneous abdominal tissue (SAT).<sup>[15]</sup> VAT produces a number of adipokines (adiponectin, plasminogen activator inhibitor-1, and

interleukin-6) in greater concentration than does SAT.<sup>[16]</sup> We do not know whether our subjects with normal WC and the metabolic syndrome had relatively high levels of visceral fat. Measurement of visceral fat depot requires imaging techniques such as CT or magnetic resonance imaging that are not practical screening tools for the general population due to cost and radiation exposure. There is also the possibility that some lean individuals may have small amounts of visceral fat that happens to be intensely metabolically active, which results in insulin resistance and metabolic syndrome.

Results of the current study reveal that HDL-cholesterol was the least common metabolic syndrome variable in both subgroups. This may be due to favorable effect of physical activity on HDL-cholesterol. The Pawtucket Heart Study group has reported that physical activity was significantly associated with higher HDL-cholesterol levels.<sup>[17]</sup> Another study conducted in 3,000 adult Japanese men revealed that frequency of physical activity was independently and positively related to HDL-cholesterol.<sup>[18]</sup> Similarly, a pooled analysis among three European cohorts consisting of elderly men demonstrated a significant relation between physical activity and HDL-cholesterol.<sup>[19]</sup>

Elevated triglycerides and central adiposity were the two most common MetS variables observed among subjects with metabolic syndrome in both groups. Evidence from epidemiological and controlled clinical trials has demonstrated that triglyceride levels are markedly affected by body weight status and body fat distribution. Data obtained from 5610 participants  $\geq 20$  years of age from NHANES between 1999 and 2004 reported a relationship between body mass index (BMI) and triglyceride concentration.<sup>[20]</sup> Approximately 80% of participants classified as overweight (BMI 25 to 30  $\text{kg}/\text{m}^2$ ) and obese (BMI  $\geq 30$   $\text{kg}/\text{m}^2$ ) had triglyceride levels  $\geq 150$   $\text{mg}/\text{dL}$ . In addition to the association between triglyceride levels and BMI. Framingham Heart Study has found a strong association of triglyceride levels with both subcutaneous abdominal adipose tissue and visceral adipose tissue in men and women.<sup>[21]</sup>

## CONCLUSION

In Group-I, there were 43.5% of individuals who were metabolically obese (MONW). While in Group-II, there were 19% obese individuals who did not had obesity related metabolic abnormalities (MHO). Waist circumference and triglycerides were the strongest

markers for metabolic syndrome in both the normal weight and overweight groups. 91.6% cases of metabolic syndrome among morning walkers were associated with elevated waist circumference values. Metabolic syndrome variables in both groups were similar because mean waist circumference value was in the obese range in both subgroups. Majority of subjects had normal HDL-cholesterol, suggesting favorable effect of physical activity on HDL-cholesterol. Therefore, while defining obesity, waist circumference is of utmost value and a better indicator than BMI. Morning walk appears to be effective medium to improve atherogenic lipid profile especially HDL-cholesterol.

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**Cite this article as:** Singh O, Gupta M, Khajuria V. Evaluation of metabolic syndrome variables in morning walkers. *Natl J Physiol Pharm Pharmacol* 2014; 4:161-164.

**Source of Support:** Nil

**Conflict of interest:** None declared