RESEARCH ARTICLE

Comparison of anthropometric and physiological hemodynamic parameters in metabolic syndrome population

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ABSTRACT

Background: Metabolic syndrome (MS) is a cluster of interrelated metabolic risk factors consisting of obesity, high blood pressure (BP), disturbance in glucose metabolism and dyslipidemia. It has been reported that obesity and incidence of cardiovascular disease (CVD) along with cardio-metabolic risk factors are associated with each other. Aim and Objectives: The aim of the study was to compare anthropometric parameters such as height, weight, body mass index (BMI), waist circumference (WC), and hemodynamic parameters such as systolic BP (SBP), diastolic BP (DBP), and pulse rate with the severity of MS. Materials and Methods: A total of 195 participants who volunteered with the signs of MS were divided into three groups based on the presence of metabolic abnormalities as Group I (with <3 components of MS – control group), Group II (with any three components of MS - MS group), and Group III (with more than three components of MS-severe MS [SMS] group). Results: Result showed that BMI was found to be significantly more in SMS and MS with that of control and there was significant difference in BMI ($P < 0.001$) between the groups. WC also showed a significant increase in both MS and SMS with that of control and it was statistically different ($P < 0.001$) among the groups. SBP and DBP were higher in MS and showed significant difference ($P < 0.001$) between the groups. Conclusion: Importance should be given to each component of MS and by detecting the disease in the early stage itself, the burden of MS as well as CVD can be reduced.

KEY WORDS: Anthropometry; Body Mass Index; Hemodynamic; Metabolic Syndrome

INTRODUCTION

Metabolic syndrome (MS) is a cluster of interrelated metabolic risk factors consisting of obesity, high blood pressure (BP), disturbance in glucose metabolism, and dyslipidemia[1] that are associated with the genesis and progression of atherosclerotic cardiovascular diseases (CVD).[2] It has been reported that obesity and incidence of CVD along with cardio-metabolic risk factors are associated with each other.[3] Obesity becomes a growing problem in industrialized as well as developing countries.[4] It causes increased morbidity because of its association with type2 diabetes, hypertension, atherosclerosis, and CVDs.[5] Obesity can be identified easily by measuring body mass index (BMI) and waist circumference (WC) in clinics as well as in epidemiological research.[6]

Objective

The objective of the study was to compare anthropometric parameters such as height, weight, BMI, WC, and
hemodynamic parameters such as systolic BP (SBP), diastolic BP (DBP), and pulse rate with the severity of MS.

**MATERIALS AND METHODS**

This cross-sectional study consisting of 195 participants between the age of 30 and 60 years and was divided into three groups based on the presence of metabolic abnormalities as Group I or control (with <3 components of MS), Group II/MS group (with any three components of MS), and Group III/severe MS (SMS) (with more than three components of MS). The study commenced after obtaining the Institutional Ethical Committee clearance and the participants written informed consent. National Cholesterol Education Program Adult Treatment Panel III criteria were used to diagnose MS and grading the severity. According to this criterion, patients with any three out of five components as mentioned below can be considered as MS. Participants with WC ≥102 cm in men and ≥88 cm in women, systolic and DBP ≥130/85 mm Hg, low high-density lipoprotein (HDL) cholesterol, HDL ≤40 mg/dL in men and ≤50 mg/dL in women, triglycerides ≥150 mg/dL, and fasting blood glucose ≥100 mg/dL were included for the present study. Physiological parameters include height, weight, BMI, and WC, height were determined using a wall–mounted, non–extendable measuring tape with participants standing in an erect posture with barefoot, arms by side and feet together. Weight was measured using standard weighing machine, bare foot with minimum clothing. BMI was calculated as weight (kg) divided by height (m²). WC measurement was taken at the end of normal expiration, between the lower rib margin and the iliac crest, with the help of non-elastic measuring tape. Pulse was counted for 1 entire min. BP was recorded in participants seated using a sphygmomanometer.

**Statistical Analysis**

All the data were expressed as mean ± SE. The means were analyzed by one-way analysis of variance with multiple comparison test of Student Newman Keuls test. Statistical analysis as well as plotting of graphs was carried out using SigmaPlot 13.0 (Systat software, USA). P < 0.05 was considered as significant.

**RESULTS**

Among the physiological parameters of the study groups, the value of anthropometric parameters such as height, weight, WC, and BMI is given in Table 1. The mean height of control group 163.9 cm was significantly higher (F = 11.708, P < 0.001) than that of MS and SMS groups. Although the difference in weight among the participants were not statistically significant (P = 0.092) among the groups, the BMI calculated from height and weight was found to be significantly more (F = 27.377, P < 0.001) in SMS and MS with that of control (25.6) and there was significant difference in BMI between the groups. Similarly, WC also showed a significant increase (F = 29.362, P < 0.001) in both MS (97.4) and SMS (102.4) with that of control (90.8) and it was statistically different among the groups.

The results of hemodynamic physiological parameters, SBP, DBP, and pulse rate are depicted in Table 2. The statistical analysis showed that the BP values were significantly low in control than the MS and SMS groups. The SBP which showed higher value in mm of Hg (F=15.656; P < 0.001) in MS and SMS (136.2 and 138.8, respectively) in comparison to control (129.6). Similarly, the DBP in mm Hg was higher (P < 0.001) in MS (83.1) and SMS (88.1) than that of the control (80.0), which showed significant difference between all the groups. However, the values of the pulse rate did not differ among themselves significantly.

**DISCUSSION**

In this study, age-matched, sex-matched participants were recruited and their anthropometric parameters such as BMI and WC were recorded. These parameters were compared between the groups divided based on the severity of the MS as control, MS, and SMS groups. The result showed that these

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**Table 1:** Comparison of anthropometric parameters in control, MS and SMS

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control Group I</th>
<th>MS Group II</th>
<th>SMS Group III</th>
<th>Statistical information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (cm)</td>
<td>163.9±1.0</td>
<td>159.7±1.1</td>
<td>156.8±1.0</td>
<td>F=11.70, P&lt;0.001*</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>68.8±0.9</td>
<td>70.4±1.2</td>
<td>72.4±1.2</td>
<td>F=2.41, P=0.092</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>25.6±0.3</td>
<td>27.6±0.4</td>
<td>29.4±0.3</td>
<td>F=27.07, P&lt;0.001*</td>
</tr>
<tr>
<td>WC (cm)</td>
<td>90.8±0.9</td>
<td>97.4±1.1</td>
<td>102.4±1.1</td>
<td>F=29.36, P&lt;0.001*</td>
</tr>
</tbody>
</table>

Values expressed as mean±SE. BMI: Body mass index, WC: Waist circumference, MS: Metabolic syndrome, SMS: Severe metabolic syndrome,

*Significant

**Table 2:** Comparison of anthropometric parameters in control, MS and SMS

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control Group I</th>
<th>MS Group II</th>
<th>SMS Group III</th>
<th>Statistical information</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP (mmHg)</td>
<td>129.6±1.4</td>
<td>136.2±0.9</td>
<td>138.8±1.2</td>
<td>F=15.65, P&lt;0.001*</td>
</tr>
<tr>
<td>DBP (mmHg)</td>
<td>80.0±0.8</td>
<td>83.1±0.8</td>
<td>88.1±0.8</td>
<td>F=24.54, P&lt;0.001*</td>
</tr>
<tr>
<td>PR (/min)</td>
<td>70.7±1.2</td>
<td>71.6±1.1</td>
<td>74.2±1.8</td>
<td>F=1.74, P=0.177</td>
</tr>
</tbody>
</table>

Values expressed as mean±SE. BMI: Body mass index, WC: Waist circumference, SBP: Systolic blood pressure, DBP: diastolic blood pressure, PR: Pulse rate, *Significant
parameters significantly varied among groups [Table 1]. Obesity observed in the present study might be because of altered lifestyle with reduced physical activity, availability of fast food and changes in socioeconomic status. The studies have reported that BMI and WC were increased in MS which were significant when compared with non-MS group[7] and it is in agreement with the result of the present study. BMI and WC are the most commonly used measures for obesity. Obesity is considered as health disaster in both developed and developing countries.[8] Especially in developing countries such as India and other Asian countries, abrupt changes in the economic and social environments due to the increasing sedentary lifestyle and easy availability of rich in fat fast food all that have contributed to the rapid increase in the incidence of obesity and its comorbid conditions.[9] The results from prospective studies suggest that the abdominal obesity can predict the future MS and cardiovascular events.[10,11] In addition, several other prospective studies done on elderly individuals have shown that intra-abdominal fat as an independent risk factor for myocardial infarction[12] and increased WC for mortality.[13] Thus, this study indicates that obesity may be one of the results of MS.

The present study result showed that SBP was significantly different in MS and SMS group in comparison with that of control group. However, DBP showed significant difference in all three groups [Table 2]. Hypertension recorded in this study might be due to obesity, insulin resistance or stress. The studies showed that both SBP and DBP were significantly different in MS group in comparison with that of non-MS group[7] supports the result of the present study. SBP is associated with death from cardiovascular and other causes and the occurrence of stroke and coronary disease.[14] Recent study has shown that contribution of components of MS related mortality is mainly due to BP along with glucose abnormalities, without any contribution from other MS components.[15] Hypertension is an important risk factor for development of CVD.[16] Insulin resistance considered as one of the factors for development of hypertension. Insulin increases renal sodium retention while increasing free water clearance. Insulin resistance is also associated with increased sympathetic nervous system (SNS) activity and stimulation of vascular smooth muscle growth.[17] Stress becomes another possible factor for hypertension. Mechanisms by which hypertension occurs in patients with the MS include oxidative stress leading to altered bioavailability of nitric oxide, adipocyte-induced increased angiotensinogen production leading to increased sodium reabsorption, hyperinsulinemia leading to increased sympathetic activity and increased sodium intake.[18] The SNS can influence the BP by augmenting the cardiac output (increased cardiac contractility and heart rate), by increasing cardiopulmonary blood volume (constriction of the great veins), by directly vasoconstricting resistant vessels and by enhancing kidney sodium reabsorption (direct stimulation of renal tubular sodium reabsorption, renal vasoconstriction, and stimulation of renin secretion) with expansion of the extracellular fluid volume.[19]

Major strength of the study is that the sample size and limitation of the study are that biomarkers for each component of MS were not able to study.

CONCLUSION

In spite of advanced treatment, incidence and prevalence of CVD increase every year. Hence, importance should be given to each component of MS and by detecting the disease in the early stage itself, the burden of MS as well as CVD can be reduced.

REFERENCES


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