Obesity, Metabolic Syndrome and Physical Activity in Indian Adults
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Abstract
Background: Metabolic syndrome is a major health problem worldwide, increasing the risk of cardiovascular diseases and diabetes. Modern lifestyles have decreased physical activity which is a leading cause of obesity, a major determinant of metabolic syndrome. The present study was done to assess the association of obesity, metabolic syndrome and physical activity in 1500 urban adults.

Methods: Anthropometric measurements were taken and blood pressure was measured. Blood lipid profile and blood glucose levels were assessed. Physical activity assessment was done by a suitable structured questionnaire and Physical Activity Level (PAL) was calculated.

Results: By NCEP (ATP III) criteria, 750 subjects (44.9% males and 55.1% females) with metabolic syndrome (MS) and 750 non-metabolic syndrome (NMS) subjects were identified. The major components of MS were low HDL levels in 85% and elevated waist circumference in 80% of the MS subjects. Elevated blood glucose levels were found in 65%, elevated triglycerides in 50% and elevated blood pressure in 55% of the MS subjects. There was a significant difference (p<0.01) in the PAL value of MS and NMS subjects, indicative of MS subjects being less active as compared to NMS. The odds ratio indicated that physical inactivity can increase the risk of MS by 3.34 times.

Conclusion: Regular physical activity would help curb the growing menace of obesity and co-morbidities of metabolic syndrome.

Keywords: Metabolic syndrome; Obesity; Physical activity

Introduction
Metabolic syndrome (MS), characterized by central obesity, dyslipidemia, hyperglycemia and hypertension is currently a major global public health challenge because it involves a serious risk of cardiovascular disease and type 2 diabetes [1,2]. Asians have an unusual high tendency to develop type 2 diabetes mellitus and coronary heart disease; important determinants of both these non communicable diseases are insulin resistance and clustering of other proatherogenic factors [3,4].

Obesity is considered to be the link between insulin resistance and metabolic abnormalities inclusive of diabetes, hypertension and dyslipidemia, all of which are risk factors for coronary artery disease [5]. In the recent INTERHEART study, abdominal obesity assessed by waist-to-hip ratio showed a strong association with myocardial infarction [6]. Obesity is also considered to be a major risk factor for hypertension [7]. A study by Deshmukh et al. [8] in this issue suggests that there is a significant correlation between obesity indices and systolic and diastolic blood pressure.

Physical inactivity is an independent risk factor for chronic diseases and overall is estimated to cause 1.9 million deaths globally [9]. These diseases are escalating due to marked shift in life style in Asian countries caused by economic growth, affluence, urbanization and dietary westernization [3,4]. As a result of economic changes and increase mechanization, the prevalence of physical inactivity is increasing in India, particularly in urban areas, to levels compared with the West [10]. In order to understand the epidemiology of these chronic diseases, and plan effective interventions, it is necessary to assess physical activity patterns effectively.

The present study was, therefore, planned to determine the association between obesity, metabolic syndrome and physical activity in Indian adults.

Material and Methods
A hospital based study was conducted with 1500 subjects. The subjects comprised of middle aged men and women visiting the OPDs of 7 Delhi hospitals for medical problems related to the components of metabolic syndrome and/or for preventive health checkups.

NCEP (ATP III) criteria [11] were used to select freshly diagnosed cases of metabolic syndrome. The project was approved by the ethics committee of Delhi University, India and all participants signed an informed consent form.

The study consisted of collection of ground data and relevant literature for a statistical selection of probabilistic sample size of individuals with MS, aged 35 to 55 years (n=750) calculated at the 95% confidence interval with a 5% margin of error. An equal number of non metabolic syndrome (NMS) subjects matched for age and gender were selected.

Suitable questionnaires were formulated to collect demographic & baseline information; information on routine daily physical activity and exercise pattern, occupational and leisure time physical activity, physical activity during the last 3-4 years including occupation, recreation and exercise patterns.

Anthropometric measurements like height, weight and waist circumference were taken using standardized techniques and the subjects were examined for blood pressure. Data regarding biochemical parameters viz blood glucose and lipid profile was obtained from the hospital authorities. Obesity was measured in term of waist circumference and the BMI classification as given for Asians [12].

Physical activity assessment was done by a suitable structured...
questionnaire developed by Bharathi, Sandhya and Vaz [13] for the assessment of physical activity pattern in urban middle aged Indians. The physical activity questionnaire estimates 24 hour energy expenditure as well as components of occupational and discriminatory leisure time activity. In this questionnaire, information is collected for daily, weekly and monthly physical activity.

To validate the questionnaire for assessment of physical activity, accelerometry was used as a gold standard. Accelerometry is a physical activity monitoring technique with the basic objective of measuring the free living physical activity pattern [14]. This was done using a calibrated water proof activity monitoring device (Actical). It was put on the wrists of 10 subjects of same age group as per the study design for three days after uploading the required information on age, height, weight. The data was then analyzed using Actical software. Information on the daily physical activity of the subjects for the same 3 days was also gathered by the questionnaire used for the study. The total energy expenditure as calculated by the two methods was then compared. The data indicated that PAL values as calculated for physical activity data collected by physical activity questionnaire and Actical method had similar results (within 10% of error). This validated the questionnaire and its applicability.

The data was statistically analyzed. Mean and Standard Deviation (SD) were calculated for parametric data. Odds ratio was calculated. Chi-square and f tests were used for comparison between the MS and NMS groups. The significance level used was α=0.01 for a two-tailed test. All statistical analyses were carried out using the SPSS 19 version statistical program.

Results
Distribution of subjects for prevalence of MS diagnostic components

By NCEP (ATPIII) criteria, 750 subjects (44.9% males and 55.1% females) were identified with metabolic syndrome (MS). An equal number of age and gender matched non metabolic syndrome subjects (NMS) were taken. Table 1 illustrates the percentage prevalence of individual metabolic syndrome diagnostic components in the MS and NMS groups, (Table 2) were those who had less than three components of MS as per NCEP (ATPIII) criteria. Even among the NMS subjects, a large number of both males and females had low HDL levels (53.41% and 64.64% respectively). Abdominal obesity was another component seen in a large number of NMS subjects, especially females (31.1%).

Distribution of subjects for obesity

Table 3 depicts the distribution of MS and NMS subjects by BMI classification as given for Asians [12]. The results showed that 81% of the MS subjects were obese as compared to 35.2% of the NMS subjects. All the differences in the categories of BMI between MS and NMS subjects were statistically significant by chi-square (p<0.01). Thus obesity was predominantly seen in MS subjects.

Distribution of subjects for physical activity

Physical Activity Level (PAL) of the subjects was determined on the basis of Basal Metabolic rate and 24 hour energy expenditure. The subjects were accordingly classified as sedentary, moderate and heavy as per WHO classification for PAL [15].

Table 4 revealed that a fairly large number of MS subjects (65.57% males and 70.9% females) were having sedentary physical activity levels as compared to NMS subjects (32.35% and 45.27% respectively) and the differences were significant (p<0.01). Further, in both MS and NMS groups, more of females were sedentary as compared to males. The Odds ratio indicated that physical inactivity increases the risk of metabolic syndrome by 3.34 times. Regular physical activity helps to curb the growing menace of obesity and comorbidities of metabolic syndrome.

Distribution of subjects for physical activity and obesity

Table 5 states the distribution of MS subjects for physical activity level and BMI. The result revealed that more of MS subjects (84.6%), who were sedentary as per PAL values were obese, as compared to...
Our findings are similar to a research conducted by Knowles et al. [17], on total of 1,518 Peruvian adults. Results concluded that Compared to individuals with low BMI and low WC, men and women with high BMI and high WC had higher odds of elevated fasting glucose, blood pressure, TG, and reduced HDL.

Our study also revealed that in relation to physical activity, MS subjects, who were sedentary both males and females, were having high waist circumference as compared to them with moderate physical activity. According to BMI classification also, obesity was more prevalent in subjects having sedentary physical activity as compared to moderate physically active MS subjects. Physical activity thus found to be associated with obesity, which in term increases the predisposition to occurrence of metabolic syndrome.

The strength of our study was a standardized and validated questionnaire; freshly diagnosed cases of MS subjects and a fairly large sample size.

Current findings suggest creating awareness among people to include at least 30 minutes of physical activity everyday as recommended by WHO. These minimal changes may result in increase in daily energy expenditure [19] or could provide direct effects on metabolic regulation [20].

In summary, low HDL levels and high blood glucose with high blood pressure are the main components of metabolic syndrome in most people. Abdominal obesity is another major component of metabolic syndrome especially in females. Physical inactivity as indicated by a sedentary lifestyle is associated with the occurrence of obesity and metabolic syndrome. Regular physical activity would help curb the growing menace of obesity and co morbidities of metabolic syndrome.

References


<table>
<thead>
<tr>
<th>Body Mass Index</th>
<th>Physical Activity Level</th>
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<tbody>
<tr>
<td></td>
<td>Sedentary n=514</td>
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<tr>
<td>&lt;18.5</td>
<td>0 (0)</td>
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<tr>
<td>18.5 – 22.9</td>
<td>45 (8.7)</td>
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<tr>
<td>23.0 – 24.9</td>
<td>43 (8.5)</td>
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<td>&gt;25.0</td>
<td>426 (82.8)</td>
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Legends: Underweight, BMI <18.5; normal weight, BMI 18.5 – 22.9; overweight, BMI 23.0 – 24.9; obese, BMI >25.0.

Table 6: Distribution of MS subjects by BMI classification and PAL.


