The Prevalence of Metabolic Syndrome in Weight Groups among Children and Adolescents of Ahvaz

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Abstract

Objective: The present study was conducted to determine the prevalence of metabolic syndrome at different weight groups in children and adolescents of Ahvaz.

Materials and Methods: In this cross-sectional study 2258 children and adolescents 10-19 years old (1119 males and 1139 females) were assessed. Prevalence of metabolic syndrome (M.S) according to modified ATPIII criteria in children and adolescence of normal weight, at risk of overweight, and overweight were evaluated for both sexes. SPSS software 19 was used for statistical analysis.

Results: Prevalence of M.S was 9% and significantly higher in males (P=0.0001). The prevalence of M.S in three weight groups normal , at risk for overweight, and overweight was 7.6%, 13.7%, and 24.1%, respectively (P=0.0001). The prevalence of the syndrome in moderate and severe overweight was 5.6% and 26.9%, respectively.

Conclusion: The Prevalence of M.S increased with weight gain in both sexes and was higher in males.

Keywords: Metabolic syndrome, Weight, Adolescents, Prevalence.

Introduction

An association between obesity, high triglycerides (TG), low high density lipoprotein cholesterol (HDL-C), hyper-insulinemia, Glucose intolerance, high blood pressure (BP), and cardiovascular diseases (CVD) were considered since the early 60s, and first was described by Revan et al in 1988 as metabolic syndrome (M.S) (1). The M.S is a risk factor of cardiovascular mortality among adults with and without type 2 diabetes (2). Although the prevalence of M.S and associated risk factors have been extensively studied in adults, but limited reports are available about children and adolescents. There is no clear definition for the M.S in this age group. At present, the same risk factors in adults based on age and sexspecific percentiles from global or national
references are used to define thresholds (3). Early studies in the U.S showed that M.S in
children and adolescents is mostly restricted to
overweight subjects (3,4). Therefore, as the
prevalence of overweight in childhood and
adolescence increases, it is likely that the
prevalence of M.S increases in this age group
throughout the world (5). The prevalence of
overweight in Iranian children and adolescents
is significant, as it was reported to be 21% in
Tehran (6). On the other hand, in Iranian
children and adolescents the prevalence of
M.S based on modified ATPIII was reported
to be about 10%, which is significant (7,8).
Determining the prevalence of M.S in varying
weight groups can lead to screening of M.S
and appropriate intervention, and finally,
reducing Fatal cardiovascular complications
and diabetes in future. Therefore, the present
study was conducted to determine the
prevalence of this syndrome in different
weight groups among children and adolescents
of Ahvaz.

Materials and Methods
This analytic cross-sectional study performed
in Ahvaz, capital city of Khuzestan province
(South West of Iran) in 2009–2011. Of 25
health centers, 6 ones were selected randomly
by multi-steps cluster sampling method. A
total of 2258 individuals (1119 boys and 1139
girls) aged 10-19 were included in the study.
Informed written consent was obtained from
subjects or their parents. The subjects with
history of medication that would affect serum
lipid, Blood Pressure (BP) and carbohydrate
metabolism or history of chronic disease of
kidney, liver and heart, and chronic diarrhea
and hospitalization during three months ago
were excluded. BP was measured twice at
least 30 minutes apart by a standard and
appropriate mercury sphygmomanometer in a
sitting position after 15 minutes rest.
Waist circumference was measured by an
unstretchable tape measure at the midpoint of
the lowest rib and iliac crest over light
clothing at the end of exhalation. Heights and
weights were measured in a standing position

with bare feet using an unstretchable tape
measure and SECA scale with minimum
possible clothing respectively.
After 12 hours overnight fasting, blood
samples were drowning for the measurement
of glucose and lipid concentrations. Fasting
Blood Sugar (FBS), TG, Cholesterol and
HDL- Cholesterol were measured by the
enzyme colorimetric method using
commercially available enzymetic reagents
(pars azmoon kit, Tehran Iran) adapted to a
biotechnical instruments autoanalyzer.
Subjects with three or more characteristics
of the following components were categorized as
having M.S according to ATPIII criteria:
1- Abdominal obesity (waist circumference
\(\geq 90^{th}\) percentile)
2- BP (Systolic and diastolic BP \(\geq 90^{th}\)
percentile CDC for age and sex, except for
those 18 and 19 years old for whom the cut off
values of \(\geq 130\) and \(\geq 85\)mmHg respectively
were used instead
3- HDL Cholesterol level \(\leq 40\) mg/dl
4- Triglyceride \(\geq 110\) mg/dl
5- FBS \(\geq 100\) mg/dl
Based on specific percentile curves of BMI
adjusted for age and sex, the subjects were
categorized into 3 groups: <85th percentile
(normal weight), \(\geq 85^{th}\) to <95th percentile (at
risk for overweight), \(\geq 95^{th}\) percentile
(overweight). Also based on normal
distribution curve overweight individuals were
categorized into two groups: moderate
overweight (Z score =1.65-2) and severe
overweight (Z score \(\geq 2\)).

Statistical Analysis:
Descriptive analysis was used to present
diagrams, s, and indices (mean, standard
deviation). Chi-square test and analysis of
variance (ANOVA) were used to assess
relationship and mean values comparison. The
significance level was 0.05 and SPSS 19
statistical software was used.

Results
From total 2258 participants, 1920 (85%), 226
(10%), 18 (0.84%), and 93 (4.16%) were
placed in normal-weight, at risk for overweight, moderate overweight, and severe overweight group, respectively. Table 1 shows the basic characteristics of the studied population.

The prevalence of M.S based on modified ATPIII criteria was 9% (11% in boys and 7% in girls) and its prevalence was significantly greater in boys ($P=0.0001$). The frequency of each M.S component in two sexes were compared, which showed no significant difference for waist circumference ($P=0.917$) but the other components were higher in boys.

The prevalence of M.S in normal weight, at risk for overweight and overweight group were 7.6%, 13.7% and 24.1% respectively ($P=0.0001$). Trend analysis showed increased prevalence of M.S with increasing weight in studied population and both genders. In moderate and severe overweight group the prevalence of the M.S were 5.6% and 26.9% respectively, which showed no significant difference ($P=0.067$).

The prevalence of M.S among boys in three weight groups: normal, at risk for overweight and overweight was 10%, 16.3%, and 25.7%, respectively ($P=0.001$), which showed significant increase of the prevalence syndrome with increase weight. In boys with moderate and severe overweight, the prevalence of syndrome was 11.1% and 28%, respectively ($P=0.003$), which showed a significant difference between the two groups.

In girls the prevalence of M.S in moderate and severe overweight groups were 0% and 26.5%, respectively ($P=0.07$), which showed no significant difference between two groups. Table 2 shows the prevalence of M.S components in different weight groups in total population and each sex.

The distribution of frequency of the syndrome in at risk for overweight and overweight groups was higher in girls than in boys ($P=0.0001$).

In correlation coefficients, BMI had significant correlation with TG ($r=0.16$), DBP ($r=0.17$), SBP ($r=0.21$), Weight ($r=0.83$) and Waist ($r=0.54$), and reverse significant correlation with HDL ($r=-0.15$) ($P=0.0001$). Weight had significant correlation with TG ($r=0.16$), DBP($r=0.22$), SBP($r=0.30$), BMI ($r=0.83$) and Waist ($r=0.67$) and reverse significant correlation with HDL($r=-0.20$) and FBS($r=-0.15$) ($P=0.0001$)

**Discussion**

In this study, the prevalence of M.S in children and adolescents of Ahvaz aged 10-19 was 9% based on modified ATPIII criteria. In boys and girls, the prevalence was 11% and 7%, respectively, which showed a significant increase of the prevalence syndrome with increase weight in girls ($P=0.0001$).

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**Table 1. Basic characteristics of the study population according to sex**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Male</th>
<th>Female</th>
<th>$P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>14.63±2.58</td>
<td>15.27±2.74</td>
<td>0.0001</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>162.83±13.82</td>
<td>151.81±9.32</td>
<td>0.0001</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>52.39±14.69</td>
<td>50.99±12.39</td>
<td>0.015</td>
</tr>
<tr>
<td>BMI (kg/m$^2$)</td>
<td>19.75±4.43</td>
<td>20.83±4.20</td>
<td>0.0001</td>
</tr>
<tr>
<td>Waist Circumference (cm)</td>
<td>70.69±11.23</td>
<td>68.19±9.82</td>
<td>0.0001</td>
</tr>
<tr>
<td>HDL (mg/dl)</td>
<td>53.77±12.18</td>
<td>55.62±11.77</td>
<td>0.0001</td>
</tr>
<tr>
<td>TG (mg/dl)</td>
<td>111.62±67.07</td>
<td>100.52±57.66</td>
<td>0.0001</td>
</tr>
<tr>
<td>SBP (mmhg)</td>
<td>106.58±11.25</td>
<td>106.32±10.99</td>
<td>0.574</td>
</tr>
<tr>
<td>DBP (mmhg)</td>
<td>106.58±11.25</td>
<td>106.32±10.99</td>
<td>0.574</td>
</tr>
<tr>
<td>FBS (mg/dl)</td>
<td>60.65±10.20</td>
<td>64.85±9.68</td>
<td>0.629</td>
</tr>
</tbody>
</table>

TG: Serum Triglyceride
HDL-C: High density lipoprotein
SBP: systolic Blood Pressure
DBP: diastolic Blood Pressure
FBS: Fasting Blood Sugar
Esmaeelzadeh et al (7) conducted a study based on the same criteria in Tehran, and used the percentiles of the studied population. The prevalence of M.S was reported 10.1% and no difference was observed between two sexes ($P=0.76$). In another study in Tehran by Chiti et al (8), the prevalence of M.S in adolescents aged 10-19 was obtained 9.5% based on the noted criteria. The prevalence of M.S was higher in boys than girls which is consistent with our study. In another study conducted in Isfahan by Kelishadi et al (9), the prevalence of M.S in students aged 6-10 was reported as 14% based on the noted criteria that is not consistent with ours and the previous cited studies.

Table 2. Prevalence of metabolic syndrome component according to varying degrees of body weight

<table>
<thead>
<tr>
<th>BMI</th>
<th>Weight group</th>
<th>Total</th>
<th>Waist circumference (%)</th>
<th>BP (%)</th>
<th>TG(%)</th>
<th>HDL(%)</th>
<th>FBS(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Normal</td>
<td>At risk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>85&gt;</td>
<td>Normal</td>
<td>7.2</td>
<td>22.0</td>
<td>30.4</td>
<td>23.1</td>
<td>16.5</td>
<td></td>
</tr>
<tr>
<td>85-94.99</td>
<td>At risk</td>
<td>18.7</td>
<td>23.3</td>
<td>49.1</td>
<td>29.1</td>
<td>14.6</td>
<td></td>
</tr>
<tr>
<td>≥95</td>
<td>Moderate overweight</td>
<td>31.3</td>
<td>16.7</td>
<td>55.6</td>
<td>27.8</td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Severe overweight</td>
<td>54.9</td>
<td>18.3</td>
<td>54.8</td>
<td>31.2</td>
<td>19.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Boys</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>85&gt;</td>
<td>Normal</td>
<td>9</td>
<td>24.7</td>
<td>24.7</td>
<td>25.7</td>
<td>19.2</td>
<td></td>
</tr>
<tr>
<td>85-94.99</td>
<td>At risk</td>
<td>11</td>
<td>25.0</td>
<td>25</td>
<td>39.1</td>
<td>17.4</td>
<td></td>
</tr>
<tr>
<td>≥95</td>
<td>Moderate overweight</td>
<td>44.4</td>
<td>33.3</td>
<td>33.3</td>
<td>44.4</td>
<td>11.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Severe overweight</td>
<td>58.8</td>
<td>24.0</td>
<td>24.0</td>
<td>36.0</td>
<td>28.0</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Girls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>85&gt;</td>
<td>Normal</td>
<td>5.2</td>
<td>19.1</td>
<td>27</td>
<td>20.4</td>
<td>13.6</td>
<td></td>
</tr>
<tr>
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<td>22.4</td>
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<td>12.8</td>
<td></td>
</tr>
<tr>
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<td>0.0</td>
<td>55.6</td>
<td>11.1</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Severe overweight</td>
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<td>16.2</td>
<td>48.5</td>
<td>29.4</td>
<td>16.2</td>
<td></td>
</tr>
</tbody>
</table>

Moreover in industrial societies, the prevalence of M.S increases over time in this age group (3). M.S is more prevalent in obese children and adolescents, and the prevalence of obesity increases in these societies over time (3), this trend is justifiable. The prevalence of obesity in developing countries, such as Iran, has increased over the past two decades (13). The improvement in nutritional status, weight gain, and decreased physical activity in Iranian children (14) can increase the prevalence of obesity which is related to lifestyle change. In our study, 10% of the subjects were at risk of overweight and 5% were overweight (0.84% with average overweight and 4.16% with severe overweight). Therefore, the prevalence of these two weight groups in the studied children and adolescents were remarkable. It can show the high prevalence of obesity in the societies like Iran. However, unexpectedly, the prevalence of M.S was higher in boys than in girls ($P=0.0001$). By comparing the criteria used in this study, it was found all aspect of criteria except waist circumference ($P=0.917$) were significantly higher in boys. This finding could explain the higher prevalence of M.S in boys.

Obesity is recognized as a major risk factor for
M.S in children and adolescents (3). We found in the three groups of normal, at risk for overweight, and overweight, 7.6%, 13.7%, and 24.1% had M.S, respectively. Statistically, there is a significant difference between the three main groups ($P=0.0001$), while there was no significant difference between the two groups with average overweight and severe overweight ($P=0.067$). This lack of significance could be due to the small number of subject in overweight group as well as the slight weight difference between the two groups. Therefore, apart from the severity of overweight, children with overweight are at greater risk of developing M.S.

This study showed the prevalence of M.S increases by weight gain. Other studies conducted in Iran, including in Tehran (8), Tabriz (11), and Mashhad (12) also showed that the prevalence of the syndrome increases by weight gain and progressive BMI. In addition in other parts of the world, higher prevalence of M.S by weight gain and progressive BMI has been reported (3,15-18). Moreover, previous longitudinal and cross-sectional studies showed according with increase of BMI, the possibility of more than one risk factor for M.S increases (3). Our results confirmed the results of previous studies. Some longitudinal studies showed more syndrome components at the beginning of the study, make risk of CVD in future higher (19).

The significance of high prevalence of M.S and obesity in children and adolescents is due to the fact that obesity is an independent risk factor of mortality caused by CVD. In Framingham’s study, it was estimated that M.S was the cause of 25% of new cases of CVD (20).

This study was a population based study with relatively large sample size. But the small number of subjects in the groups with moderate and severe overweight, and comparing them in terms of the prevalence of M.S is one of the weaknesses of this study.

**Conclusion**

The prevalence of overweight, obesity and M.S in children and adolescents of Ahvaz were significant and the prevalence of this syndrome increased with weight gain and progressive BMI. Therefore, in order to determine and follow up the risk factors of M.S in adulthood, children and adolescents with overweight should be given more attention.

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**References**


