ORIGINAL ARTICLE

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

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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) in2009–2011. 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 ≥90th percentile)
2- BP (Systolic and diastolicBP≥90th percentile CDC for age and sex, except for those 18 and 19 years old for whom the cut off values of ≥130 and ≥ 85mmHg respectively were used instead
3- HDL Cholesterol level ≤40 mg/dl
4- Triglyceride ≥ 110 mg/dl
5- FBS≥ 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), ≥85th to <95th percentile (at risk for overweight), ≥95th 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 ≥ 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 0.05and SPSS 19 statistical software was used.

Results

From total 2258 participants, 1920 (85%), 226 (10%), 18 (0.84%), and 93 (4.16%) were

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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.

The prevalence of M.S among girls in three weight groups: normal, at risk for overweight, and overweight weight was 5%, 11.9% and 23.4%, respectively, which showed significant increase of the prevalence of syndrome with increase weight in girls (*P*=0.0001).

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

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

Variable	Male	Female	*P* value
Age (year)	14.63±2.58	15.27±2.74	0.0001
Height (cm)	162.83±13.82	151.81±9.32	0.0001
Weight (kg)	52.39±14.69	50.99±12.39	0.015
BMI (kg/m^2)	19.75±4.43	20.83±4.20	0.0001
Waist Circumference (cm)	70.69±11.23	68.19±9.82	0.0001
HDL (mg/dl)	53.77±12.18	55.62±11.77	0.0001
TG (mg/dl)	111.62±67.07	100.52 ±57.66	0.0001
SBP (mmhg)	106.58±11.25	106.32±10.99	0.574
DPB (mmhg)	60.65±10.20	64.85±9.68	0.629
FBS (mg/dl)	91.85±12.45	89.16±12.45	0.012

TG: Serum Triglyceride
HDL-C: High density lipoprotein
SBP: systolic Blood Pressure
DBP: diastolic Blood Pressure
FBS: Fasting Blood Suger

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difference (*P*=0.0001). 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. There was no difference between two sexes in that study, and the most common M.S components were high triglycerides and HDL cholesterol. Other studies in different cities of Iran (10,11,12) have been conducted among a limited population. Population-based studies in other countries also have shown various prevalence rates. For example, in the U.S, the prevalence of M.S varied from 3.1% to 12.7% based on different definitions and cut off points of M.S (3). This example shows the importance of a similar and clear definition of M.S in children and adolescents.

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

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

BMI	Weight group	Waist circumference (%)	BP(%)	TG(%)	HDL(%)	FBS(%)
		Total				
85>	**Normal**	7.2	22.0	30.4	23.1	16.5
85-94.99	**At risk**	18.7	23.3	49.1	29.1	14.6
≥95	**Moderate overweight Z score=1.65-2**	31.3	16.7	55.6	27.8	5.6
	Severe overweight Z score≥2	54.9	18.3	54.8	31.2	19.4
		Boys				
85>	**Normal**	9	24.7	24.7	25.7	19.2
85-94.99	**At risk**	11	25	25	39.1	17.4
≥95	**Moderate overweight Z score=1.65-2**	44.4	33.3	33.3	44.4	11.1
	Severe overweight Z score≥2	58.8	24.0	24.0	36.0	28.0
		Girls				
85>	**Normal**	5.2	19.1	27	20.4	13.6
85-94.99	**At risk**	24.2	22.4	40.6	22.4	12.8
≥95	**Moderate overweight Z score=1.65-2**	14.3	0.0	55.6	11.1	0.0
	Severe overweight Z score≥2	53.8	16.2	48.5	29.4	16.2

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M.S in children and adolescents (3). We found in the three groups of normal, at risk for overweight, and overweigh, 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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