Research Article

A comparison of six pediatric criteria of metabolic syndrome among Iranian girl adolescence in Northeast of Iran

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Abstract

Metabolic syndrome (MetS) is an important risk factor for diabetes and CVD, but there is no standard definition, particularly in pediatrics, and this is further complicated because of the effects of puberty and growth stage.

Subjects consisted of 995 girls aged between 12- 18 years old. After obtaining informed consent, anthropometric parameters were measured and biochemical measurements were performed by using commercial kits. Six different definitions for metabolic syndrome were used which that most relevant adopted criteria for adolescent.

The highest prevalence was obtained using the criteria defined by De Ferranti et al., 2004 (4.3%) and lowest using the criteria of Goodman et al., 2004 (0.1%). The frequency of normal/thin, overweight and obese was determined as 83.5%, 13.2% and 3.2%, respectively. A 43-fold difference in the prevalence of MetS was observed dependent on the definition used.

In conclusion, we need an adopted definition for Iranian adolescents especially in puberty and growth stage.

Keywords: Metabolic syndrome; Obesity; Metabolic syndrome definition; Pediatrics; Adolescents.

Introduction

Obesity and related complications such as cardiovascular disease (CVD), and type 2 diabetes are increasing in prevalence globally, metabolic syndrome (MetS) are related to CVD and insulin resistance disorders, it is more considered especially in children [1]. Alongside of increasing prevalence of obesity and sedentary lifestyle in childhood and adolescence, risk of metabolic syndrome have been increased, and subsequently risk of many chronic disease have been raised [2]. Metabolic syndrome is set of several abnormalities such as central obesity, hypertension, dyslipidemia and, hyperglycemia that are often associated with insulin resistance, therefore this syndrome so called insulin resistant syndrome [3,4].

MetS has been described in many ways which cause to lack of a gold standard diagnostic test [5], Due to physiological changes during growth and puberty, this issue is more problematic in pediatrics. Several definitions for metabolic syndrome have been proposed for adults by the WHO, the National Cholesterol Education Program's Adult Treatment Panel III, the European Group for the Study of Insulin Resistance and the International Diabetes Federation, which all agreed on the essential components (glucose intolerance, central obesity, hypertension and dyslipidemia) but differed in the detail and cutoff values.

In adults, cutoff measurements for various components of metabolic syndrome have been determined, but about children and adolescents cutoff vales are very controversial [6,7]. Metabolic syndrome prevalence in children and adolescents have been investigated by several investigators [2,5,8-12], however, there is no agreement on the pediatric diagnostic criteria for Metabolic Syndrome that lead to being incomparable results from different studies [7,13], because there are no reference values for various component of metabolic syndrome to be used during childhood and adolescence [14,15].

MetS has various definitions and its prevalence among children and young people differs by use of different definition for the components. The aim of study were comparison of prevalence metabolic syndrome based on different definition for adolescence and assess differences of prevalence rates of metabolic syndrome according used various definition.

Subjects and methods

Subjects

Subjects consisted of 995 girl children and adolescents aged between 12-18 years old. Exclusion criteria included medication for lipid metabolism and blood pressure. Parental informed consent and subject assent were obtained from all participants before participation.

Anthropometric measurements

Waist circumference was measured in 995 subjects at the midpoint between the lowest rib and the iliac crest. sex-and age-specific BMI percentiles were calculated based on persian populaton data obtained from the CASPIAN study [16]. Blood pressure was measured based on guildelines of the National High Blood Pressure Education Program (NHBPEP) and blood pressure percentile was caculated based on age and height [17].

Definition of the metabolic syndrome

We used six different crietria for determining the prevalence of MetS: IDF [18], NCEP-ATPIII [19], Cook et al. [8], De Ferranti et al. [5], Goodman et al. [9] and, Viner et al., [12].

Biochemical measurements

Serum fasting triglyceride, HDL-cholesterol, total cholesterol and glucose concentrations were measured using commercially available test kits (Pars Azmun Teb, Iran).

Statistical analyses

The recorded information was checked for missing values and data entry errors. All missing or doubtful data were checked once more by returning the questionnaire. The SPSS statistical software version 16 for Windows (SPSS Inc., Chicago, USA) were used for statistical analyses. The mean values of all factors were compared using paired Student's t test and Ch-squre test acording to distrbution type. The significance of differences was defined at $P<0.05$.

Results

The prevalence of metabolic syndrome and its components were calculated using six different diagnostic criteria. The highest prevalence was found using the criteria of De Ferranti et al., 2004 (4.3%) and lowest observed according Goodman et al., 2004 (0.1%). Table 1 shows the prevelance of MetS and its component, as well as MetS prevalence compared using the different definition based on obesity status in this sample. Frequency of normal/thin, overweight and obese was detemined as 83.5%, 13.2% and 3.2%, respectively. As expected, MetS was more frequent in obese and overweight girls. Table 2 illustrated these data by comparing several defifnition for metabolic syndrome. In all definition of metabolic syndrome seems to be obesity is related to syndrome prevalence and 41.4% prevalence was observed in obese girls based on De Ferranti definition. Age- based comparision of six different criteria was obeserved in Figure 1.

As illustrated in Figure 1, various criteria have differences in values because difference of cutoff values which that have been used in each definition for either criteria. Cutoff values in De Ferranti definition are more different with another. In obesity criterium, there is high agreement between definition except De Ferranti criteria, which have lower cutoff value and so, more prevalence in this sample. Viner and Goodman definition have been used BMI for assessment of obesity and have high agreement in value detail. In general, alterations in this criteria seems to be related to physiological changes during maturation and growth stage. Highest agreement among different criteria of six definition, there were in FBG values by exption IDF definition. In FBG cutoff values often definintion used same value. Lowest agreement have been observed in BP criterium, measured BP values revealed high rates of reduction in 13-15 aged girls and in 18 age. Most prevalence of high BP observed in 16 and 17 aged girls. Triglyceride values indicated good agreement between different definitions and illustrated descending rate during Increasing of age. Prevalence of HDL criterium in this sample was high. Based on De Ferranti definition more than half of measured people in different ages have agreed amounts for metabolic syndrome. Prevalence of metabolic syndrome was many varied based on age grouping, often definitions were not
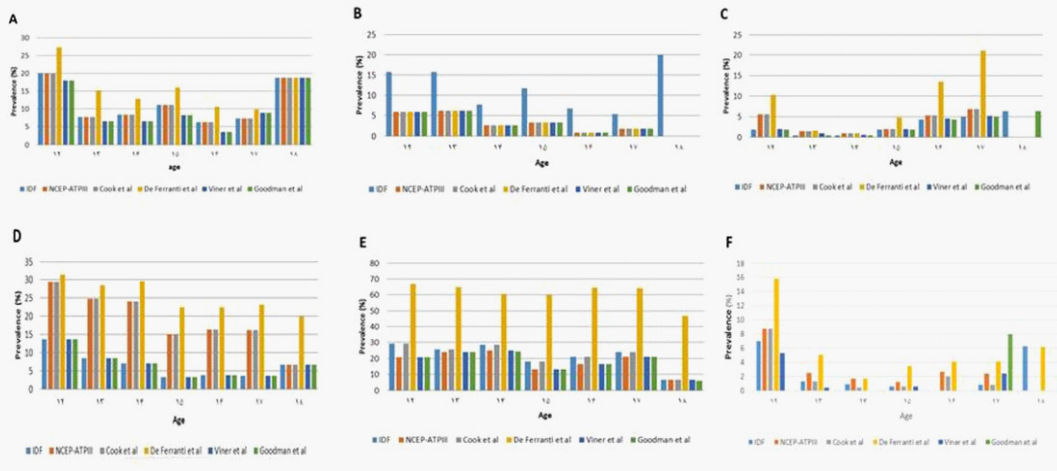
Figure 1: comparision of metabolic syndrome component in different age of subjects according six different ciriteria adopted for children and adolescents.

A: obesity; B: hyperglycemia; C: blood pressure; D: hypertriglyceridemia; E: HDL, and F: Metabolic syndrome. Each color showes one definition; blue: IDF; orange: NCEP-ATPIII; grey: Cook et al 2003.; yellow: DeFerranti et al 2004.; dark blue: Viner et al 2005.; green: Goodman et al 2004.

Table 1: prevalence of metabolic syndrome and its components according to the six definitions of MetS

IDF		NCEP-ATPIII		Cook et al., 2003		De Ferranti et al., 2004		Goodman et al., 2004		Viner et al., 2005	
WC ≥ 95th	9.1%	WC ≥ 95th	9.1%	WC ≥ 90th	9.1%	WC > 75th	14.1%	BMI ≥ 95th	7.6%	BMI ≥ 95th	7.6%
FBG ≥ 100 mg/dL	10.6%	FBG ≥ 110 mg/dL	3.3%	FBG ≥ 110 mg/dL	3.3%	FBG ≥ 110 mg/dL	3.3%	FBG ≥ 110 mg/dL	3.3%	FBG ≥ 110 mg/dL	3.3%
SBP ≥ 130 mmHg	2.0%	SBP ≥ 90th %ile	2.9%	SBP ≥ 90th %ile	2.9%	SBP > 90th %ile	5.4%	SBP ≥ 130 mmHg	2.0%	SBP ≥ 95th	2.1%
DBP ≥ 85 mmHg	3.1%	DBP ≥ 90th %ile	12.3%					DBP ≥ 85 mmHg	3.1%		
TG ≥ 150 mg/dl	6.3%	TG ≥ 136 mg/dl	20.6%	TG ≥ 110 mg/dl	20.6%	TG ≥ 100 mg/dl	26.1%	TG ≥ 130 mg/dl	6.3%	TG ≥ 150 mg/dl	6.3%
HDL < 40 mg/dl	24.2%	HDL < 35 mg/dl	20.7%	40 mg/dl ≥ HDL	24.2%	50 mg/dl < HDL	62.8%	39 mg/dl ≥ HDL	20.7%	HDL < 35 mg/dl	20.7%
MetS prevalence	1.2%		2.4%		1.4%		4.3%		0.1%		0.8%

NCEP-ATPIII: National Cholesterol Education Program's Adult Treatment Panel III; IDF: International Diabetes Federation; WC: Waist circumference; FBG: fasting blood glucose; TG: triglyceride; HDL: high-density lipoprotein; LDL: low-density lipoprotein; MetS: metabolic syndrome; DBP: dyastolic blood pressure; SBP: systolic blood pressure. Same cutoff of each componets illustrated by same color.

Table 2: metabolic syndrome prevalence based on obesity state in six different definition.

	IDF	NCEP-ATPIII	Cook et al., 2003	De Ferranti et al., 2004	Goodman et al., 2004	Viner et al., 2005
Normal/Thin	0.3%	1.0%	0.4%	1.3%	2.9%	0.1%
Overweight	6.0%	9.4%	6.8%	15.4%	17.1%	2.6%
Obese	10.3%	10.3%	10.3%	41.4%	31.0%	10.3%

NCEP-ATPIII: National Cholesterol Education Program's Adult Treatment Panel III; IDF: International Diabetes Federation

able to explaination of metabolic syndrome prevalence in age groups, these ages coincided with pubery changes and growth stage. None definition that adopted for children and adolescents pointed to physiological changes during growth stage and puberty.

Discussion

In the past, several definitions of the Metabolic Syndrome have been used for children.

However, many researcher have used the NCEP criteria as basic for development of similar definition which adopted to local condition. The definition presented by Cook et al. was used most commonly [20-24]. Core varibles such as obesity especialy central obesity, lipid concentrations, blood pressure and glucose were used in several definitions, but thresholds for some of these variables differed substantially.

The lack of a standard definition raised the problems in comparisons of prevalence among many studies, especially when study design and inclusion criteria are considered. Namely, results of two studies acording used definition ranged from 0.8% to 10.2% [25] and from 0-59% [26].

Our study has revealed that the prevalence of MetS was related to weight status, and had a wide range (0.1–4.3%) using the different proposed definitions.

In our population of 995 adolescents, we applied and compared six different metabolic syndrome criteria adopted for pediatrics.

Regardless of the criteria used, metabolic syndrome prevalence was higher in overweight and obese participants compared with non-obese one similar to previous studies [8,27]. In addition, the obesity component, whether measured by BMI percentile or waist circumference, was the most common feature of the metabolic syndrome in age groups.

Standard definition are available for overweight and obesity in pediatrics [28], and many attempts have been performed to define thresholds for large waist circumferences in pediatrics [29-32]. Given the obesity epidemiology in pediatrics and its important in human health [33-35], our study suggest that a measure of obesity could be needed to metabolic syndrome criteria adopted for adolescents to determine children and adolescents at risk for obesity-related disorder development. There are many evidences for importance of central obesity and overall obesity to estimate pediatric health risks. Central obesity markers should be considered as major component in pediatric metabolic syndrome definition. Moreover, in developing metabolic syndrome criteria that can be used worldwide, a marker of abdominal obesity would be more useful than BMI, because 12 aged girls have high prevalence of metabolic syndrome by each definition, but based on BMI, this group have not obese indivitial. the cut-offs of the waist circumference percentiles for Iranian children do not seem to be very specific since the majority of our overweight children had waist circumferences above the proposed thresholds.

Perhaps waist circumference cutoffs in conjunction with BMI percentile could be developed and included in the criteria to define the pediatric metabolic syndrome. Given the increasing prevalence of childhood obesity (particularly abdominal obesity) and related comorbid conditions, obesity index (preferably a combination of both waist circumference and BMI percentile) should be recognized as an essential component of the definition of pediatric metabolic syndrome.

As well as, cutoff values to define elevated blood pressure are available, [17] but this values may be not clear for Iranian girls. prevalence of elevated blood pressure in this sample is low. The metabolic syndrome is currently a very controversial issue in the medical and research communities [36,37]. The development of a standard definition required to increasing the understanding of the metabolic syndrome in pediatrics.

Moreover metabolic syndrome prevalence are varied widely between the different definitions, as well the puberty effects on the prevalence of the metabolic syndrome varied. Metabolic syndrome prevalence were higher 3-5 times in pubertal adolescents that were reported in De Ferranti and Cook literature [5,8]. We also found differences in metabolic syndrome prevalence in pubertal adolescents. Conversely, the other definitions of the metabolic syndrome suggested for pediatrics illustrated no influence of pubertal stage on the metabolic syndrome.

The entire concept of the metabolic syndrome is controversial. A major concern in the definition of the metabolic syndrome refers to the use of cut-off points for the various risk factors. Metabolic syndrome assessment used for prediction of cardiovascular disease and diabetes, so with different in definition which that lead to high different in prevalence, making decision for control and management of metabolic syndrome and related events faced with difficulty. As result, we need to closer definitions in pediatrics to determine the metabolic syndrme in childhood for prevention of subsequent outcomes in adulthood. High difference between several definition in Iranian adolescents proposed need to the new criteria or adaptation of exist criteria for Iranian girls.

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