E-ISSN 2281-4612
ISSN 2281-3993

Academic Journal of Interdisciplinary Studies
MCSER Publishing, Rome-Italy

Vol 3 No 4
July 2014

Relationship of Anthropometric Measures with Cardiovascular Risk Factors in Children and Adolescents

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Doi:10.5901/ajis.2014.v3n4p145

Abstarct

This national study was performed to establish the relationship of anthropometric measures with cardiovascular risk factors and metabolic syndrome (MetS) in Albanian normal-weight children and adolescents. We examined the data of 3,548 children and adolescents (48.2% boys), aged 11-18 years, with a normal BMI (5th-84th percentile) achieved from a survey of 'Childhood and Adolescence Surveillance and Prevention of Adult Non-communicable Disease'. The diagnostic criteria for MetS were classified by the International Diabetes Federation agreement. The prevalence of MetS for 10- to 13.5-year-old boys, 14- to 18-year-old boys, 10- to 13.7-year-old girls, and 14- to 18-year-old girls were 1.3, 2.4, 2.1, and 3.2%, correspondingly. After adjustment for age and sex, each item increase in BMI (within normal range) and waist circumference enhanced the odds of MetS from 5 to 68 % and from 1 to 18 %, respectively. The principal model of dyslipidemia between the participants was high triglycerides and low high-density lipoprotein cholesterol. This study sets off current research about the high frequency of metabolic risk factors among normal-weight individuals in the pediatric age group.

Keywords: *anthropometric , cardiovascular , metabolic syndrome, childre, adolescents*

1. Introduction

Obesity has achieved a pandemic point and has been demostrated to have a considerable connection with metabolic syndrome (MetS), one of the main risk factors of type 2 diabetes mellitus (T2DM) and cardiovascular disease (CVD).

Current studies have certificated that the elevated prevalence of obesity among adults expands to the adolescent population too, and childhood obesity has turned into a new type of challenge for pediatric care [1] . Decreasing levels of physical activity and rising caloric intake have been recommended as a reason for the growing rate of obesity in children and adolescents [2–3]. Childhood obesity is correlated not only with significant inferences for the risk of childhood illnesses but also with amplified risk of chronic disease and reduced life expectancy in adult life [4] . The alliance among childhood obesity and MetS has been estimated in current years [5] . Several studies have compared the prevalence of cardio metabolic risk factors across weight groups amid children and it has been documented that the prevalence of risk factor bunching enhances among weight classes [6] . Nevertheless, in these articles, there is a cluster of normal-weight children and adolescents with metabolic risk factors affecting them to the expansion of the MetS [6–11] .

Three decades ago, the notion of a 'metabolically obese normal-weight'(MONW) phenotype was established in the adult population [12]. Since then, a lot of facts have proposed a high prevalence of this phenotype in the general population. It has been illustrated that these individuals have a higher percentage of visceral fat and a lower lean body mass and react positively to caloric constraint [12–13] .

The current study aimed to evaluate the relationship of anthropometric measures with risk factors of CVD as well as MetS in a national representative model of Albanian normal-weight children and adolescents.

2. Study Methods

The data for this study were obtained from the survey of 'Childhood and Adolescence Surveillance and Prevention of Adult Non-communicable Disease' (CASPIAN) study performed in 2011. The CASPIAN is a countrywide longitudinal school-based course for the examination of risk manners as a result of risk features of chronic sicknesses amid children and adolescents.

For the third investigation of the CASPIAN study [14] , nearly 5,024 students aged 11–18 years were selected by multistage random cluster sampling from urban and rural districts situated in different parts of the country. 3,548 subjects of them, who had fulfilled documentations and normal weight in relation to the BMI cutoffs (5th–84th percentile) of the Centers for Disease Control and Prevention (CDC) were comprised in this study.

We applied the cutoffs of the CDC [15] because the first inspection of the CASPIAN study, accomplished between 19,108 children and adolescents, exposed a big concurrence of cutoffs acquired for Albanian children and adolescents with cutoffs of the CDC, however not with those of the International Obesity Task Force (IOTF) [16]. The survey intentions and procedures were entirely clarified to the students and their parents. Written informed permission and oral approval were achieved from the parents and the students, correspondingly. The authorization for the study was allowed by the ethics committees.

3. Anthropometric and Biochemical Measurements

Qualified research staff assessed the adolescents' height and weight in line with standardized practices. Weight and height were calculated to the closest 0.1 kg and 0.1 cm, correspondingly with the children wearing only underwear and no shoes. Height and weight dimensions were applied to calculate BMI (kg/m 2). Waist circumference (WC) was computed to the nearest 0.1 cm with a elastic string at a point halfway among the lower edge of the ribcage and the iliac crest at the end of normal expiration. We appraised blood pressure (BP) before blood sampling and in a quiet condition utilizing mercury sphygmomanometers after no less than 5 min of relax in the sitting location. The individuals were settled with the heart, cuff, and zero pointers on the manometer at the observer's eye stage. All readings were captured in duplicate in the right arm. Suitable size cuffs were applied with a cuff width 40% of the mid-arm perimeter as well as cuff bladders involving 80–100% of the arm circumference and around two-thirds of the extent of the upper arm without going beyond. The average of the two time measurements was documented and comprised in the analysis [17] . Venous blood samples were gathered from all study contributors and distributed to the laboratory on the day of blood gathering. The blood samples were centrifuged for 10 min at 3,000 rpm within 30 min of venipuncture and were instantly carried to the laboratory. Fasting blood sugar (FBS), total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), and triglycerides (TG) were measured enzymatically by auto-analyzers. HDL-C was determined after dextran sulphate-magnesium chloride precipitation of non-HDL-C. Consistent with the Friedewald equation, low-density lipoprotein cholesterol (LDL-C) was analyzed in serum samples with TG ≤ 400 mg/dl [18] .

4. Statistical Analyses

The records were offered as mean ± standard deviation (SD). Independent t-test was used to evaluate BMI and WC among the participants with and those without risk factors. Multiple logistic regression analyses were to estimate the relationship between measures of adiposity (BMI and WC) and probable risk factors, integrating age and gender in each model as potential confounders. All statistical analyses were executed appling programs available in the SPSS version 18.0 statistical package for Windows (SPSS Inc., Chicago, IL, USA).

5. Results

This countrywide study consisted of 3,548 participants (48.2 % boys) aged 11–18 years, with a mean age of 14.75 (2.58) years and with 51.8 % of the them were 10–13.9 years old.

Table 1 represents the demographic and metabolic features of the participants. The lipid reports of two age clusters of boys were analogous. On the other hand, there was a major refuse in TC and LDL-C with increasing age in girls. TC and LDL-C of 10-

Table 1. General characteristics of normal-weight participants according to gender and age group

	Boys		Girls	
	10–13.9 years (n = 772)	14–18 years n = 1,021	10–13.9 years (n = 843)	14–18 years (n = 929)
BMI, kg/m2	18.23 (2.15)	20.90 (2.08)	17.87 (2.21)	20.48 (1.90)
WC, cm	63.06 (7.60)	70.16 (7.69)	64.18 (8.62)	73.49 (7.25)
Height, cm	144.84 (10.75)	158.44 (6.60)	142.94 (10.36)	169.04 (8.99)
Weight, kg	38.74 (8.66)	52.60 (7.02)	36.98 (8.59)	58.78 (8.80)
SBP, mm Hg	97.80 (12.96)	104.40 (12.77)	101.22 (13.71)	109.16 (12.11)
DBP, mm Hg	62.86 (10.77)	66.08 (9.74)	64.56 (11.03)	69.46 (10.56)
FBS, mg/dl	87.08 (12.04) 86	72 (16.16)	88.27 (12.49)	87.85 (13.21)
TC, mg/dl	150.63 (30.85)	150.75 (32.33)	148.25 (31.02)	129.40 (29.75)
HDL-C, mg/dl	46.52 (14.21)	46.12 (14.35)	48.08 (14.75)	44.28 (14.12)
LDL-C, mg/dl	85.74 (27.91)	87.98 (28.05)	82.17 (27.85)	72.18 (24.42)
TG, mg/dl	92.90 (38.94)	93.38 (37.79)	86.89 (39.98)	90.77 (38.53)

to 13.9 -year-old girls were 148.25 and 82.17 and decreased to 129.40 and 72.18 in 14- to 18-year-old girls, respectively. The bunch of elements of dyslipidemia, MetS, and risk features of CVD in diverse age and sex groups is represented in table 2 . The sample of risk factor bunch was analogous for 10- to 14-year-old boys and girls. More than half of the 10- to 14-year-old boys had not any of the sections of MetS (54%); however, more than half of the girls at the identical age had as a minimum one atypical metabolic factor (53.4%).

In the individuals aged 14–18 years, normal-weight teenager boys were more expected to have no risk factors than were girls. Whereas more than half of the boys in this series of age (51.2%) had not any of the elements of MetS, 64.9% of the girls had one or more elements of MetS.

Table 2. Prevalence of dyslipidemia, metabolic syndrome components and cardiovascular risk factors of normal-weight participants according to gender and age group

Number of components	DLP	MetS	Risk factors CVD
Boys			
10–13.9 years (n = 772)			
0	61.4	54.0	53.0
1	30.8	35.5	40.3
2	6.4	9.1	6.7
3	1.1	1.4	0.0
4	0.2	0.0	–
14–18 years (n = 1,021)			
0	57.7	51.2	51.1
1	33.3	37.2	40.9
2	6.9	8.8	7.7
3	1.9	2.6	0.2
4	0.2	0.2	–
Girls			
10–13.9 years (n = 843)			
0	61.0	46.6	50.5
1	30.2	39.6	42.1
2	7.3	11.5	7.4
3	1.1	1.7	0.0
4	0.4	0.6	–
14–18 years (n = 929)			
0	52.6	35.1	37.3
1	42.0	46.3	48.0
2	4.8	15.3	14.1
3	0.4	3.0	0.6
4	0.2	0.3	–

6. Discussion

This study shows the prevalence of metabolic risk factors in Albanian children and adolescents with normal weight. Along with a few studies in the past, the outcomes of the present study demonstrated that there are children and adolescents with MetS and risk factors of CVD who are not obese in proportion to the BMI percentiles. Although individuals with normal BMI were chosen for this survey, the adiposity indices (BMI and WC) were significantly dissimilar in subjects with and not including metabolic risk factors. Resembling our preceding study, the prevalence of high TG and low HDL-C levels was elevated in this survey. This looks like to be the leading model of dyslipidemia between normal-weight children of our population.

Although the acknowledgment of the MetS can be dated to some decades ago, it has drawn more awareness in current years. The rising outbreak of T2DM and CVD drew a lot of attention to the MetS as a main issue in the management of these illnesses. The affiliation amid obesity and increasing metabolic risk factors has been recognized for many years. Adipose tissue has been proven to play an essential role concerning the impact on insulin resistance, which is the fundamental reason and important element of MetS. Conversely, more studies certificated that adipose tissue can also play a negative role in participants who are not obese regarding typical weight tables.

This notion expanded the meaning of MetS beyond the edges of obesity. Actually, metabolic risk factors correlated with adipose tissue can increase in people with normal weight, and concerning the global pandemic of these risk factors, we should enlarge the screening programs to comprise the normal-weight population.

While for a long time there has been the conception of MONW in adults, such understanding is limited in population-based studies performed among youngsters. Nevertheless, studies launching a prevalence of metabolic risk factor grouping within children and adolescent weight clusters proposed that the model of MONW can be extended to pediatrics.

In recent years, several studies have focused on childhood obesity as a new test for pediatric care and individual health in the future. There is evidence that obese adolescents are more expected to have irregular metabolic risk factors than their normal-weight matching parts.

However, this does not signify that normal-weight children and adolescents are inevitably on the secure side. Cook et al. [7] stated that the prevalence of MetS in US normal-weight children and adolescents was 0.1% from 1988 to 1994. A similar study, which was performed from 1999 to 2002, reported a prevalence of 1% for the similar group [8].

Camhi et al. [6] estimated the prevalence of cardio-metabolic risk factors within US adolescent BMI groups using the data from 2001-2008 studies. They confirmed the prevalence of cardiometabolic risk factor clustering to be around 9% amongst US normal-weight children and adolescents.

Comparing the relative risks of MetS in overweight and obese Chinese children with their normal-weight counterparts, Li et al [10] reported the prevalence for MetS as 15.5% between normal-weight boys versus 18.8% in girls. In our previous study, which was accomplished to assess the prevalence and delivery of the MetS in children with dissimilar sorts of obesity, the prevalence of MetS was less than 2% between normal-weight subjects. In this study, generally more than half of the study population had as a minimum one risk factor of MetS [11]. A latest study [18] illustrated that lipids, lipoproteins, the indicators of inflammation and oxidative pressure were similar to obese children.

In the study mentioned, children with the equal BMI class, but high cardio-respiratory strength, had notably lower WC compared with individuals with low cardio-respiratory fitness. The authors claimed on the preventive role of cardio-respiratory health along with fatness and obesity in developing MetS [18].

The outcomes of this study present undeniable evidence that WC joined with BMI does not expect an increase in obesity-associated health risk better than does BMI or WC by itself. The high co-linearity among these two measures is accountable. Consequently, there is no key benefit of using both measures of obesity for population observing as their autonomous involvement is only secondary [19] .

In our study, the principal structure of atypical lipid profile was high TG and low HDL-C. This outline, which is the central prototype of dyslipidemia among Albanians compared with Western countries, has been noted in other studies on adults and children [11] .Lower average HDL-C and hypertriglyceridemia is the chief model detected in South Asians in British cities [20] .

Furthermore, Asian Indians reveal an unfavorable lipid pattern consisting of low HDL-C and high TG [21]. An equivalent pattern has been monitored in pediatric studies. Comparing the prevalence of cardio-metabolic risk factors regarding the weight status among children and adolescents from Quebec, Lambert et al. [22] noticed the percentage of high levels of TC, LDL-C, HDL-C, and TG to be 16.9, 18.0, 11.4, and 1.0% for boys, correspondingly.

The relevant values for girls were 31.0, 31.2, 5.5, and 3.7%. In their assessment of cardiovascular risk factors among French children, Botton et al. [23] stated the percentage of children with high levels of TC, LDL-C, HDL-C, and TG to be 10, 5.9, 0.5, and 3.7% between normal-weight participants, correspondingly. In a study on children in a rural Georgia district, 26% demonstrated high TC, 20% had elevated LDL-C, 13% had high TG, and 43% had low HDL-C [24].

In contrast, the lipid profile of youths in Eastern countries is different. Serum HDL-C levels of Turkish post-pubertal adolescents, as in the adult population, are profoundly lower than in Europeans and North Americans [25] . A high level of hepatic lipase activity and protein mass has been proposed to explain the low HDL-C levels among Turkish people [25] . In a study which was designed to evaluate serum lipid profiles and the prevalence of dyslipidemia in school children in Eastern Iran, the most common form of dyslipidemia was a low HDL-C level and hypertriglyceridemia [26] .

In the preceding article of this series, the age- and sex-accustomed prevalence of high TC, LDL-C, low HDL-C, and high TG levels were 3.4, 3.2, 22.1, and 22.6% in participants with normal BMI and WC, respectively [11] . High TG and low HDL, which is an attribute of the insulin resistance lipid phenotype, is the leading prototype of dyslipidemia among normal-weight children of our population. This can be a cause for apprehension about a re-assessment of cardiovascular risk inference in our community.

The large model dimension of this study permitted us to recognize the metabolic risk factors among normal-weight children and adolescents. The cross-sectional nature of the study and the absence of establishing the pubertal condition of the participants were the main restrictions of this survey.

The results of this study revealed that metabolic risk factors are recurrent among normal-weight children and adolescents, and normal BMI does not inevitably eliminate children from screening programs for MetS. We found that small raises in adipose tissue, still within normal BMI values, can situate children at an augmented risk of developing MetS.

The significant prevalence of high TG and low HDL-C in normal-weight children may be attributable to lifestyle factors. Consequently, in addition to an prominence on controlling childhood overweight for the primary prevention of non-communicable diseases, the significance of a healthy lifestyle and fitness in normal-weight children and adolescents should be underscored.

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