

Metabolic Syndrome among Obese Kuwaiti Adolescents (11-17 Years)

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Abstract

Aim of work: To detect features and the prevalence of Metabolic Syndrome (MS) in obese adolescents (11-17 years) attending School Health Screening Center in Farwaniah governorate in Kuwait.

Research design and methods: A total 352 obese Kuwaiti adolescents attended the School Health Screening Center in Al-Farwaniah Governorate in Kuwait were assessed for criteria of Metabolic syndrome (MS). We defined the MS using the Criteria analogous to the Third Report of the Adults Treatment Panel (ATPIII) as having at least three of the following: fasting triglycerides ≥ 100 mg/dl; HDL < 50 gm/dl; fasting glucose ≥ 110 mg/dl; waist circumference $\geq 90^{\text{th}}$ percentile for age and gender and height. Weight status was assessed by using the age and gender specific body mass index (BMI) using the National Center for Health Statistics references standards.

Results: Metabolic syndrome was recorded among 27.8% of the studied obese Kuwait adolescents (having three or more criteria of Metabolic syndrome), 26.3% of the sample had one criteria of MS and 35.6% has two signs of MS.

Conclusion: The study suggests that prevalence of metabolic syndrome is high among obese Kuwaiti adolescents and since the childhood metabolic syndrome and obesity likely persist into adult hood, early identification is important to improve future cardio vascular, health and quality of life for adults.

Keywords: Metabolic syndrome; Adolescents; Obesity

Introduction

Metabolic syndrome i.e. insulin resistance or syndrome X is a condition that results from obesity and other several disorders like systemic inflammation, increased fibrinolysis, endothelial dysfunction and atherosclerosis. Insulin resistance has been defined as constellation of major risk factors, including obesity, high fasting triglycerides, low level of high-density lipoprotein cholesterol (HDL-C), elevated fasting plasma insulin, impaired glucose tolerance, and hypertension [1,2].

The Third National Cholesterol Education Program-Adult Treatment Panel (NCEP-ATP III) defines the metabolic syndrome as the presence of at least three of the following five risk factors in an individual: central or abdominal obesity, hypertriglyceridemia, hypertension, low HDL-C, high fasting glucose levels [3,4].

The metabolic syndrome is considered as a major risk factor for cardiovascular disease and type 2 diabetes. Components of metabolic syndrome are present in children and adolescents, as well as in adults [5]. However, the metabolic syndrome has not been well characterized in children or adolescents in terms of criteria, prevalence, or clinical implications, although studies have examined abnormalities caused by the metabolic syndrome [6,7].

The incidence of overweight children and adolescents has been increasing in Asia with urbanization and economic development [8]. Over the past 10 years, the rate of obesity and over weight has been increased in Kuwaiti children and adolescents [9]. Obesity is associated with dyslipidaemia, type 2 diabetes mellitus and long-term vascular complications [10-13].

The prevalence of metabolic syndrome among the adolescents in USA was estimated to be 6.8% among over weight adolescents and 28.7% among obese adolescents (1988-1994) increased up to 32.1% among obese between (1999-2000) [14].

Research Design and Methods

The sample of the study was 352 obese children, they were selected from the School Health Screening Center in Fwarwaniah governorate

in Kuwait, during the academic year 2009-2010 (first September 2009 to first May 2010), after being identified through the school health screening center as having a body mass index (BMI) score $\geq 95^{\text{th}}$ percentile. Informed consents were given and filled by the parents of the studied adolescents.

An anthropometric and general physical examinations were carried out. Height was measured in the upright position with a stadiometer. Weight was measured using zeroing scale. Obesity was defined as Body Mass Index i.e BMI $\geq 95^{\text{th}}$ percentile; according to age and sex NCHS/CDC 2000 BMI values [15]. Waist circumference was measured by metric strip at the midpoint between the lower rib and iliac crest after normal exhalation and compared by Fernandez JR percentiles used for the waist circumference [16]. Hip circumference was also measured at the greater trochanter of the femur using a non-stretchable measuring tape.

Blood pressure was measured 3 times after ten minutes of rest in supine position and the last two measurements were averaged for analysis. Hypertension was defined in accordance with the Second National Task Force on high blood pressure in children and adolescents as systolic or diastolic blood pressure $\geq 90^{\text{th}}$ percentile for age, height and gender [17].

After a 12-hours overnight fast, blood samples were drawn from an antecubital vein each adolescents for estimation of fasting blood glucose and serum lipids. Fasting blood glucose was measured by

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glucose oxidase methods and serum lipids were assessed by using the enzymatic kit method by standard automated analyzer (Vital Scientific Span Keren Netherlands). Fasting hyperglycemia was defined as fasting blood glucose ≥ 110 mg (≥ 6.1 mmol/l) according to American Diabetes Association Definition [18].

The features of Metabolic syndrome were identified according to National Cholesterol Education Program's Adult treatment Panel III criteria modified by Cook et al. 2003 for use in young people [7]. Metabolic Syndrome was defined by this criterion including at least three features in the adolescents:

- Triglycerides level of ≥ 110 mg/dl.
- High Density Lipoprotein (HDL) level < 40 mg/dl.
- Abdominal obesity indicated by waist circumference $\geq 90^{\text{th}}$ percentile for age and gender.
- Fasting blood glucose level ≥ 110 mg/dl and
- Blood pressure of $\geq 90^{\text{th}}$ percentile for age and gender.

Statistical Methods

The data were expressed as frequencies with mean and standard deviations. Statistical analysis using statistical package SPSS 16 (IBM, New York, USA) Chi-Square and student t test were used to determine statistical differences in qualitative variables. P value less than 0.05 was considered statistically significant.

Results

The mean age and SD of the studied adolescents was 13.1 ± 3.1 years. The overall prevalence of metabolic syndrome in obese adolescents was 28.4% table 2. Metabolic syndrome was observed in the majority of adolescents with upper social class level (Family earning more than 1000 Kuwaiti Dinars), where one K.D. = 3.6 American Dollars.

Family history of hypertension was recorded among 16.2% of the studied adolescents and family history of diabetes mellitus was observed among 18.8% of 352 obese adolescents without significant statistical association between boys and girls in the studied adolescents. Of 352 of the obese adolescents, 26.3% had one criteria of the Metabolic Syndrome criteria (MS), 35.6% had two, while 27.8% (98 adolescents) were having the criteria for diagnosis of MS i.e. having three or more criteria.

In this study, central obesity was detected 167 obese adolescents 47.4%, 33.5% have had hypertiglyceridemia, 65.3% presented with low values of high density lipoprotein cholesterol 25.3% had high diastolic blood pressure and 14.8% had high systolic blood pressure and 5.7% had showed impaired fasting glucose.

Discussion

The prevalence of Metabolic Syndrome in the present study according to the modified ATP III criteria was 28.4% of the studied obese adolescents (11-17 years). Our findings can be compared with that of Cook et al 2003 who found the prevalence of MS was 23.7% among adolescents in general population, and was 31.2% in overweight and obese adolescents [7].

In Gulf area such as United Arab Emirates, Eapen et al. (2009) [19] has reported that 44% of 260 obese adolescents aged 14.5 ± 2.6 years (mean, SD) were having Metabolic Syndrome. In Oman, Al Lawati et al (2003) [20] reported that the rate of Metabolic Syndrome (MS) was

found to be 21% among Omanis adults ≥ 20 years of age according to the criteria of the US National Cholesterol Education Program (NCEP).

Childhood obesity is a major risk factor for insulin resistance and the metabolic syndrome in children and adolescents. As it is reported that about one-third of overweight or obese children and adolescents exhibit the features of the Metabolic Syndrome [21].

In Asian countries the prevalence of the Metabolic Syndrome in children increases with obesity and has been reported to be high as 22.5-52.8% in obese children and 10-25% in obese adolescents [22]. The prevalence of Metabolic Syndrome reaches as high as 50% in severely obese youngsters. Each half-unit increase in BMI stepwise increases the risk of Metabolic Syndrome in overweight persons [23]. Indians in Asia are a race who has more insulin resistant than white Caucasians and they have more components of Metabolic Syndrome [24]. In western countries like Australia, Torres Straight Islanders and Aborigines have been found to have higher rates of Metabolic Syndrome [25].

The mechanisms underlying the development of the metabolic derangements that occur in Metabolic Syndrome are not fully understood. The most widely accepted hypothesis involves a complex interaction between insulin resistance and obesity that is modified by social, environmental, and genetic factors [26,27]. Pediatric researchers have found that these criteria persist from childhood to adulthood, leading to the suspect that the metabolic syndrome continues into adulthood [28]. Also obese adolescents have a lower exercise capacity than normal weight adolescents [29]. Also obesity alone increases the risk of hypertension, cholecystitis, and psychological symptoms in obese children [30].

In this study, the constituent factors for Metabolic Syndrome were as follows, one factor is 26.3% of obese adolescents, two factors in 35.6%, while 98 adolescents (27.8%) of the sample of the study i.e 352 obese adolescents were having three or more criteria of Metabolic Syndrome. Our findings are in agreement with those of Cruz et al 2004 [31].

In this study metabolic syndrome was more prevalent in obese children with upper social class level where their families earning more ≥ 1000 Kuwaiti Dinars about 77% of boys and girls, and less common in obese adolescents with their paternal education with college level or more table 1. This finding coincides with Loucks and colleagues 2007 [32], they found an inverse association between parental education and metabolic syndrome.

Obesity has been associated with increased plasma levels of insulin, this denotes insulin resistance that resulting in diminished ability of insulin to stimulate glucose uptake by the skeletal muscles and adipose tissue, in addition to reducing insulin's ability to suppress hepatic glucose

Production and output [31,33,34]. Central obesity was reported in nearly half of obese adolescents in our study. Also hypertension is recognized as an important component of metabolic syndrome where 25.3% of obese adolescents in this study have had high diastolic blood pressure and 14.8% have had high systolic blood pressure, some investigators has found a positive association between insulin levels and blood pressure [35,36,37] whereas others have not [38,39]

Impaired glucose tolerance or high fasting blood glucose are now called prediabetes [40] which was reported among 5.7% of the studied obese adolescents. However, in several studies, overweight adolescents had low HDL cholesterol, and high triglycerides and insulin but they

	Boys N=180		Girls N=172		Total	X ²	P Value
	No	%	No	%			
Parental educational level:							
Primary school	61	33.9	58	33.7	119	0.275	P>0.05
Middle School	43	23.9	46	26.7	89		
High School	51	28.3	48	27.9	99		
College +	25	13.9	20	11.6	45		
Socio-economic status:							
Upper ≥ 1000KD	140	77.8	132	76.7	272	0.250	P>0.05
Middle (500- < 1000)	23	12.8	21	12.2	44		
Lower (< 500)	17	9.4	19	11.0	36		
Family history of diseases:							
Hypertension (+)	28	15.6	29	16.9	57	0.469	P>0.05
Cardiovascular accident (+)	11	6.1	10	5.8	21		
Heart disease (+)	13	7.2	15	8.7	28		
Diabetes Mellitus (+)	35	19.4	31	18.0	66		

Table 1: Distribution of general characteristics of the studied adolescents (11-17 years).

	Metabolic syndrome	Without metabolic syndrome	Total No = 352
Sex n(%)			
Female	51 (29.7)	121 (70.3)	172 (48.9)
Male	47 (27.2)	131 (72.8)	180 (51.1)
Age (Years)	13.4 ± 3.4	12.9 ± 2.8	13.1 ± 3.1
BMI (Kg/m ²) ^{**}	31.2 ± 4.3	22.3 ± 4.6	27.3 ± 4.5
Waist circumference (cm)	68.7 ± 9.8	68.4 ± 8.9	67.2 ± 8.9
Hip circumference (cm)	85.4 ± 8.3	86.7 ± 7.9	85.7 ± 7.7
SBP (mmHg) [*]	118 ± 14.9	104 ± 12.2	109.9 ± 14.1
DBP (mmHg) [*]	81.3 ± 10 ± 1	69 ± 8.3	76.5 ± 8.9
Total cholesterol (mg/dl) [*]	195 ± 4 ± 30.1	170.9 ± 19.1	180.8 ± 25.2
HDL-C (mg/dl) [*]	49.5 ± 7.1	51.2 ± 7.2	51.1 ± 6.7
LDL-C (mg/dl) [*]	119.1 ± 24.8	107.4 ± 17.9	111.9 ± 22.1
Triglycerides (mg/dl) ^{***}	181.2 ± 47.8	148.1 ± 41.9	164 ± 43.9
Glucose (mg/dl) ^{**}	103.9 ± 9.5	93.1 ± 8.2	96.9 ± 8.5

SBP= Systolic Blood Pressure; DBP = Diastolic Blood Pressure; BMI = Body Mass Index;
LDL-C = Low Density Lipoprotein-Cholesterol; Values are expressed in mean ± SD
* P < 0.05 ** P < 0.001

Table 2: Metabolic characteristics of studied adolescents (11-17 years).

have normal glucose levels [33,34], suggesting that glucose intolerance may develop later on than other metabolic syndrome abnormalities.

Several longitudinal studies of adults demonstrated that hyperinsulinaemia can precede the development of type 2 diabetes mellitus by more than 10 years [31,41]. Beck Neilsen and Groop [42] have proposed three stages model for development of type 2 diabetes mellitus. Stage 1 includes fasting hyperinsulinaemia with normal or slightly increased blood glucose. Stage 2 is characterized by prediabetic glucose intolerance with insulin resistance and stage 3 is the development of type 2 diabetes mellitus. Many of macro vascular changes associated with diabetes mellitus and cardiovascular complications begin in stage 1 and 2 before diagnosis of diabetes.

Dyslipidaemia especially low HDL cholesterol and triglycerides levels was observed in 65.3% and 33.5% of obese adolescents respectively, this result coincide with many studies [33,36,43,44]. In several studies, overweight in adults had serum insulin (with normal glucose), higher triglycerides and high blood pressure and low HDL cholesterol than normal weight adults [33,34].

Some limitations in this study should be considered. Our adolescents (11-17 years) was from one governorate (Al Farwaniyah) where six governorates are present in Kuwait. Therefore caution should be considered on generalizing these results and data to Kuwaiti adolescents. Also insulin level in the blood was not done so that the study will more accurate in presence of insulin resistance.

Therefore, there is a necessity to apply a preventive strategy for metabolic syndrome in children; we should encourage increased physical activity such as decreasing time spent for watching TV, walking to schools, decreasing sedentary activities. Any management plan for over weight and obese children should include 3 major components: diet, exercise, and family-based behavior and they not be placed on restrictive diets because adequate calories are needed for proper growth.

Screening for metabolic syndrome in obese children should be carried out for early identification of MS, and thus obese children can change their life style behavior that can prevent incidence of diabetes mellitus and cardiovascular complications.

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