CORRELATION OF THE COMPONENTS OF THE METABOLIC SYNDROME IN CHILDREN WITH CORONARY ANGIOGRAPHY FINDINGS AND CARDIO-METABOLIC RISK FACTORS IN THEIR PARENTS

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Abstract

INTRODUCTION: Although coronary artery disease (CAD) becomes symptomatic late in life, early identification and modification of risk factors may reduce its future incidence.

METHODS: In this cross-sectional study, 108 subjects aged 6-18 years were randomly selected from among children of patients who underwent coronary angiography at Chamran Heart Center, Isfahan, Iran. The parents were assigned to two groups according to the presence or not of coronary stenosis in angiography. Each group was divided into two subgroups, with or without the metabolic syndrome. All of the subjects were aged below 55 years. In addition to anthropometric measurements, blood pressure, fasting serum glucose, and insulin level were measured and lipid profile was assessed in the children of the patients. The data were analyzed with SPSS using independent t-test, Kruskal-Wallis, chi-square and standard linear multiple regression tests.

RESULTS: In the group with stenosis in coronary angiography, the prevalence of the metabolic syndrome components was significantly higher in children of parents with the metabolic syndrome than in the other group (24 vs. 18; P=0.003). In the group without stenosis in coronary angiography, the children of parents with the metabolic syndrome had higher triglyceride (TG) levels and lower levels of high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, total cholesterol, and fasting blood glucose.

CONCLUSIONS: Our study emphasizes the importance of primordial and primary prevention of cardiovascular disease, especially in children of families with high risk of premature atherosclerosis.

Keywords: Metabolic syndrome, familial aggregation, cardiovascular disease.

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Introduction

The metabolic syndrome is a constellation of hypertension, impaired glucose tolerance, dyslipidemia and abdominal obesity. It is associated with an increased risk of total and cardiovascular mortality in adults.[1-6]

Risk factors for certain chronic disease, such as coronary artery disease (CAD) may be evident from childhood; these include risk factors which may be modifiable (e.g. serum lipid, obesity, physical inactivity, smoking) or not modifiable (e.g. heredity, race, age, sex). CAD risk factors are etiologically related to atherosclerosis and may contribute to CAD in adults. Therefore, preventive measures adopted in early life may help reduce the prevalence of the disease in childhood. The control of risk factors is an effective strategy for preventing atherosclerotic disease.[7]

Tracking of cardiovascular disease from childhood to adulthood suggests that early detection of the individual at risk, along with family-based intervention programs, may have long-term benefits for the prevention of CAD.[8-11]

This is especially important for those with a family history of premature CAD or cerebrovascular or occlusive peripheral vascular disease (defined as onset before the age of 55 years in a sibling or parent).

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A family history of premature CAD predicts cardiovascular risk in the next generation.
Early detection and treatment of youth at risk for premature CAD is shown to provide the greatest opportunity to decrease morbidity and mortality.[7]
The aim of the present study was to characterize the components of the metabolic syndrome in children and adolescents with a family history of premature CAD and assess the correlation of these components with status of parents in respect of the metabolic syndrome, as well as evidence of stenosis in the parents' coronary angiography.

Materials and methods

This cross-sectional study was conducted on 108 men and women aged less than 55 years, who were admitted for coronary angiography to Chamran Heart Center, the major referral heart center is Isfahan Province. They were assigned to two main groups: one with coronary stenosis in angiography and the other without coronary stenosis in angiography. Then each group was divided into two groups: with and without the metabolic syndrome.
The Ethics Committee of Isfahan Cardiovascular Research Center (ICRC) (NTH member) approved the study. We obtained oral assent from children and written consent from their parents.
The 6-18-year-old children of these patients were examined for components of the metabolic syndrome.
Social and demographic variables, as well as anthropometric indices were assessed during a detailed physical examination conducted by the same physician.
The age of each subject (accurate to 1 month) was recorded. Weight was measured to the nearest 100 g (Seca Beam Balance, Japan) with the subjects lightly dressed and barefoot. Standing height to the nearest 0.2 cm (Seca Stadiometer) was also measured and recorded.
A mercury sphygmomanometer with suitable cuff size for each subject was used to measure the sitting and supine blood pressure following standard criteria. The mean of two measurements of Korotkoff phase I and the mean of two values of phase IV were recorded as systolic blood pressure (SBP) and diastolic blood pressure (DBP), respectively.
Venous blood samples were taken from each subject following[7] an overnight fast (12 hours). An Hitachi 902 autoanalyzer (Roch, Japan) was used for the measurement of serum lipids, lipoproteins, and fasting blood sugar. Insulin level was measured by ELISA. All laboratory analyses were done at ICRC (World Health Organization collaborating center), which is under external quality control of the central laboratory of St. Rafael University, Department of epidemiology, Leuven, Belgium, and the laboratory of Centers for Disease Prevention and Control, USA.
The following criteria were used to define the metabolic syndrome in children. Children meeting at least three of the following criteria were considered to have the metabolic syndrome.[12]
1. Systolic or diastolic blood pressure greater than the 90 percentile for age and sex[7]
2. Waist circumference greater than the 75th percentile for age and sex of Iranian youths[12]
3. High-density lipoprotein (HDL) cholesterol <50 mg/dl
4. Triglyceride (TG) > 100 mg/dl
5. Fasting blood sugar (FBS) > 100 mg/dl[12]
Waist circumference greater than 102 cm in males and greater than 80 cm in females, and meeting at least two of the following criteria:
1. Blood pressure > than 130/80 mmHg
2. FBS >110 mg/dl
3. TG >150 mg/dl
4. HDL <40 mg/dl in males
5. HDL <50 mg/dl in females[13]
Statistical analyses were performed with SPSS statistical package, version 10.0 for windows, using chi-square and Kruskal-Wallis tests and independent t-test when appropriate. P value less than 0.05 were considered as significant.

Results

This study was conducted on 108 patients with premature CAD consisting of 11 women (10.1%) with a mean age of 48.2 years and 97 men (89.9%) with a mean age of 51.4 years, 108 children consisting of 49 girls (45.3%) with a mean age of 13.8 years and 69 boys (54.7%) with a mean age of 14.1 years. The metabolic syndrome components of offspring versus the status of parents in respect of the metabolic syndrome and stenosis in coronary angiography are presented in Table 1.
In the group with stenosis in coronary angiography, the children of patients who had the metabolic syndrome were heavier and had higher levels of FBS, cholesterol, low-density lipoprotein (LDL) cholesterol, TG, insulin and lower levels of HDL than children of patients who did not have the metabolic syndrome.

TABLE 1. comparison between metabolic syndrome components in children with the metabolic syndrome and stenosis in coronary angiography of their parents

Components of the metabolic syndrome in children	Parents with coronary angiography stenosis		Parents without coronary angiography stenosis		P value
	Parents metabolic syndrome		Parents metabolic syndrome		
	Positive	Negative	Positive	Negative	
	Mean±SD (Min, Max) frequency	Mean±SD (Min, Max) frequency	Mean±SD (Min, Max) frequency	Mean±SD (Min, Max) frequency	
Weight	57.88±9.82 (32.5-70) 26	53.06±15.14 (26-93) 27	53.12±12.89 (30-80) 26	51.09±15.13 (20-74) 27	0.31
Height	161.8±7.13 (140-169) 26	159.3±12.08 (130-176) 27	158.3±15.16 (135.5-186) 26	156.9±15.8 (116.8-186) 27	0.59
SBP	102.2±11.44 (70-120) 25	103.2±18.37 (80-130) 19	97.37±12.18 (80-130) 17	95.83±11.66 (80-115) 18	0.26
DBP	60.76±9.17 (40-80) 25	63.13±13.52 (40 - 80) 16	59.74±8.07 (45-80) 19	56.47±7.43 (50-70) 18	0.24
FBS	91.31±9.77 (72-107) 26	87.14±9.22 (73 ±105) 28	88.12±9.48 (70-107) 26	91.59±14.72 (74-151) 27	0.35
Cholesterol	162.2±42.94 (74-240) 26	159.3±35.48 (107-271) 28	139.6±38.9 (65-225) 26	151.8±18.79 (121-202) 27	0.09
LDL	99.84±33.6 30-166 25	96.93±31.7 (56-187) 28	81.54±29.33 (37-156) 26	92.37±16.6 (67-143) 27	0.11
HDL	39.54±13.79 13-70 26	42.39±9.29 (26-57) 28	37.69±12.56 (12-64) 26	42.63±7.02 (31-57) 27	0.30
TG	124.5±41.42 (78-205) 26	101.2±41.89 (55-200) 28	101.3±37.45 (60-243) 26	84.07±16.72 (42-126) 27	0.001*
Insulin	11.98±8.07 (3.9-40) 26	10.96±7.19 (1.7-25) 17	7.88±6.04 (1.9-30) 18	7.93±3.07 (3.7-13.3) 11	0.16

In the group without stenosis in coronary angiography, the children of patients with the metabolic syndrome had lower levels of HDL, LDL, cholesterol, FBS, and insulin, and higher levels of TG than children of patients without the metabolic syndrome.

TG in the children of patients with stenosis in coronary angiography was significantly higher than in children of patients without stenosis in coronary angiography. Comparison of metabolic syndrome components in children according to the status of their parents in respect of the metabolic syndrome is presented in Table 2.

Comparison of metabolic syndrome components in children according to the status of their parents in respect of stenosis in coronary angiography is presented in Table 3.

Discussion

In this study, serum TG levels significantly correlated in children with the metabolic syndrome. Mean number of the metabolic syndrome components in children of parents with metabolic syndrome in the group with stenosis in coronary angiography was higher than in those without; furthermore the mean lipoprotein and insulin levels in children of parents without the metabolic syndrome in the group with stenosis in coronary angiography was higher than in those without.

Our findings demonstrated that the prevalence of the metabolic syndrome in the offspring of parents with coronary stenosis was significantly higher than in children whose parents did not have stenosis in coronary angiography.

A study in Korea showed that the risk of the metabolic syndrome in children highly correlated with the status of parents in respect of the metabolic syndrome; they also demonstrated that the metabolic syndrome has familial components, highlighting the influence of genes and shared environments in the etiology of the metabolic syndrome.

They suggested that familial aggregation is a risk factor for obesity.[1] It is therefore important to evaluate families and identify strategies for the prevention and management of the metabolic syndrome.

TABLE 2. Comparison of metabolic syndrome components in children with and without metabolic syndrome in their parents.

Components of the metabolic syndrome in children	Parents with metabolic syndrome	Parents without metabolic syndrome	P value
	Mean±SD frequency	Mean±SD frequency	
Weight	55.50±11.60 (52)	52.07±15.02 (54)	0.19
Height	160.04±11.86 (52)	158.09±13.99 (54)	0.44
SBP	100.09±11.87 (44)	99.43±15.52 (35)	0.83
DBP	60.32±8.62 (44)	59.59±11.09 (34)	0.75
FBS	89.71±9.67 (52)	89.33±12.33 (55)	0.86
Cholesterol	150.88±42.16 (52)	155.62±28.53 (55)	0.49
LDL	90.51±32.52 (51)	94.69±25.3 (55)	0.46
HDL	38.67±13.09 (52)	42.51±8.18 (55)	0.07
TG	112.92±40.81 (52)	92.78±32.96 (55)	0.006*
Insulin	10.30±7.5 (44)	9.77±6.03 (28)	0.75

TABLE 3. Comparison of metabolic syndrome components in children with and without stenosis in coronary angiography of their parents.

Components of the metabolic syndrome in children	Parents with coronary angiography stenosis	Parents without coronary angiography stenosis	P value
	Mean±SD frequency	Mean±SD frequency	
Weight	55.42±12.92 (53)	52.08±13.97 (53)	0.31
Height	160.48±9.94 (53)	157.62±15.37 (53)	0.59
SBP	102.59±14.44 (42)	96.62±11.78 (37)	0.049*
DBP	61.68±10.97 (41)	58.14±7.84 (37)	0.11
FBS	89.15±9.63 (54)	89.89±12.44 (53)	0.73
Cholesterol	160.70±38.90 (54)	145.79±30.71 (53)	0.03*
LDL	98.30±32.33 (53)	87.06±24.11 (53)	0.04*
HDL	41.07±11.65 (54)	40.21±10.32 (53)	0.68
TG	112.41±42.91 (54)	92.55±29.84 (53)	0.007*
Insulin	11.58±7.66 (43)	7.89±5.05 (29)	0.026*

In the study of familial aggregation of the metabolic syndrome in Korean families with adolescents, a highly significant correlation was seen between siblings for all metabolic syndrome variables (in our study too, a significant correlation was seen between children and parents with the metabolic syndrome).[14]

In the study of Cuencea et al., a correlation was reported between the weight indices of adopted children and their biological parents.[8] They found that the father-daughter and mother-daughter coefficients of correlation for BMI were significant.[8]

A father-daughter and mother-daughter association was found between total cholesterol and LDL concentrations and a mother-daughter association was found for TG levels.

In almost all subjects, the coefficients of correlation for blood pressure in patients and children were low for both systolic and diastolic blood pressure.[8]

In our study, this correlation was not statistically significant. We should acknowledge that the main limitation of our study was its cross-sectional nature.

Our main finding was a significant correlation between the components of the metabolic syndrome in children and their parents and a higher prevalence of cardiovascular risk factors in children of parents with stenosis in coronary angiography. This study emphasizes the importance of primordial and primary prevention of cardiovascular disease, especially in children of families with high risk of premature atherosclerosis.

References

1. Park HS, Park JY, Cho SI. Familial aggregation of the metabolic syndrome in Korean families with adolescents. Atherosclerosis 2005; Aug 25.

2. Haffner SM. The Metabolic Syndrome: Inflammation, Diabetes Mellitus, and Cardiovascular Disease. Am J Cardiol 2006;97:3-11.

3. Butte NF, Comuzzie AG, Mehta NR, et al. Quantitative genetic analysis of the metabolic syndrome in Hispanic children. Pediatr Res 2005;58(6):1243-8.

4. Isomaa B, Almgren P, Tuomi T, et al. Cardiovascular morbidity and mortality associated with the metabolic syndrome. Diab Care 2001;24:683-9.

5. Lakka HM, Laaksonen DE, Lakka TA, et al. The metabolic syndrome and total and cardiovascular disease mortality in middle-aged men. JAMA 2002;288:2709-16.

6. Ozanne SE, Hales CN. Early programming of glucose-insulin metabolism. Trends Endocrinol Metab 2002;13:368-73.

7. Kelishadi R, Sarraf Zadegan N, Naderi Gh, et al. Atherosclerosis risk factors in children and adolescents with or without family history of premature coronary artery disease.

8. Mayer EJ, Newman B, Austin MA, et al. Genetic and environmental influences on insulin levels and the insulin resistance syndrome: an analysis of women twins. Am J Epidemiol 1996;143:323-32.

9. Austin MA, King MC, Bawol RD, Hulley SB, Friedman GD. Risk factor for coronary heart disease in adult female twins Genetic heritability and shared environmental influences. AM J Epidemiol 1987;125:308-18.

10. Cook S, Weitzman M, Auinger P, Nguyen M, Dietz WH. Prevalence of a metabolic syndrome phenotype in adolescents: findings from the third National Health and Nutrition Examination Survey. Arch Pediatr Adolesc Med 2003;157:821-7.

11. Weiss R, Dziura J, Burgert TS, et al. Obesity and the metabolic syndrome in children and adolescents. N Engl J Med 2004;350:2362-74.

12. Kelishadi R, Ardalan G, Gheratmand R, et al. Pediatric Metabolic Syndrome and Associated Anthropometric Indices CASPIAN Study. Acta Paediatrica, 2006;95:1625-1634.

13 Braunwald's heart disease: a textbook of cardiovascular medicine/[edited by] Dougias P. Zipes;et al-7th edition 2005,(1014).

14. Vizcaino VM, Aguilar FS, Gutierrez RF, Crespo YJ, Navalon PG, Rojas VD, Familial aggregation of cardiovascular disease risk factors: the Cuenca study preventive medicine 1999;28:31-137.