POLISH ANNALS OF MEDICINE 23 (2016) 87–91

Available online at www.sciencedirect.com

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journal homepage: http://www.elsevier.com/locate/poamed

Original research article

Risk related cardiovascular changes in metabolically healthy obese adolescents

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ARTICLE INFO

Article history:
Received 17 May 2015
Received in revised form
20 June 2015
Accepted 24 January 2016
Available online 28 February 2016

Keywords:
Cardiovascular risk
Metabolic syndrome
Metabolically healthy obese
Adolescents

ABSTRACT

Introduction: Pediatric obesity reflects a real crisis for public health as associated with cardiovascular risk in subjects with developed metabolic syndrome. Simultaneously the information concerning risk related cardiovascular changes in metabolically healthy obese adolescents is pretty insufficient.
Aim: This study is designed to determine the risk related cardiovascular changes in metabolically healthy obese adolescents.
Material and methods: 208 obese adolescents were grouped as metabolically healthy and metabolically unhealthy by International Diabetes Federation (IDF) criteria for pediatric metabolic syndrome. We analyzed the basic metabolic parameters, left ventricular geometry and function, 24-hours blood pressure monitoring and carotid intima-media thickness. Control group consisted of 23 lean healthy subjects.
Results and discussion: 69% of obese adolescents could be considered as metabolically healthy by pediatric IDF criteria. BMI in metabolically unhealthy was greater vs. metabolically healthy ($P = 0.019$) as well as dyslipidemia and dysglicemia. Cardiovascular parameters were deteriorated in all obese vs. lean healthy (myocardial hypertrophy and dysfunction, thickening of carotid vessels and systolic hypertension). It established low sensitivity (0.28) and low negative predictive value (0.29) of metabolic syndrome criteria to screen obesity associated cardiovascular problems.
Conclusions: Prognostic capability of pediatric metabolic syndrome criteria is pretty low due to its sensitivity. Therefore obese adolescents not met diagnostic level for metabolic syndrome by IDF criteria could be falsely excluded from the cardiovascular risk group. Thus, it is not possible to assert an existence of absolutely healthy metabolic profile in obese and more sensitive markers are necessary for the metabolically healthy obesity identification.

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http://dx.doi.org/10.1016/j.poamed.2016.01.006

1. Introduction

Pediatric obesity reflects a real crisis for public health[1] as it is associated with an increased occurrence of cardiovascular and metabolic disorders, orthopedic and psychiatric complaints together with a low self-esteem.[2]

Compared with lean healthy, obese individuals are at increased risk for adverse long-term outcomes[3,4] as each kg/m^2 of body mass index (BMI) gained is associated with an 18% increase in the risk of developing hypertension and a 26% increase in risk for the complete custer of metabolic syndrome[5] and dyslipidemia.[6] Thus, adiposity is associated directly with cardiovascular risk. Simultaneously, the majority of the risk criteria are metabolic with an only exception as blood pressure. However, very little is known regarding the impact of metabolic derangements at cardiovascular risk development in children. This is, probably, due to fact of low pediatric incidence of acute cardiovascular events, which are necessary for the risk stratification.[7]

The concept of 'metabolically healthy obesity' has become popular recently and is defined as healthy overweight and obese subjects with normal metabolic features despite increased adiposity.[8–10] Thus, it suggested that metabolically healthy obese have a decreased heart failure risk in a 6-year follow-up study in contrast to normal weight subjects.[11] However, others argue that obesity per se is not a benign condition and obese subjects are at risk in spite of normal metabolic profile.[4,12,13]

Obese children and adolescents tend to become an obese adults[14] and have a 16-fold higher risk of becoming severely obese adults with a BMI above 40 kg/m^2 as compared to normal weight adolescents.[15] Logically, some of obese adolescents could be considered as metabolically healthy. Understanding of acute events' risk in them is pretty uncertain due to insufficient data of their cardiovascular profile.

2. Aim

This study is designed to determine the risk related cardiovascular changes in metabolically healthy obese adolescents.

3. Material and method

In total, 208 obese adolescents (Caucasian) aged 10 to 17 were examined. All subjects were classified into two groups: metabolically healthy obese (MHO) and metabolically unhealthy obese (MUO) according to the pediatric International Diabetes Federation (IDF) criteria for metabolic syndrome evaluation.[16] Control group consisted of 23 lean healthy (LH) subjects.

Anthropometric measurements were performed by using standardized devices: Harpenden stadiometer, SECA weight scale. BMI was calculated as body weight (kg) divided by squared standing height (m^2). Obesity estimated by WHO cut-offs when BMI was greater than or equal to +2 SD. BMI z-scores used to compare between group means. Abdominal adiposity assessed by waist to height ratio (WHR)[17] and result greater than or equal to 0.5 was considered as positive for the central obesity.

The laboratory assessment of metabolic profile included fasting lipids, glucose, insulin and HOMA-IR,[18] oral glucose tolerance test.

Left ventricular (LV) geometry assessed by Khoury et al.[19] and LV function according to European Association of Echocardiography and American Society of Echocardiography recommendations.[20]

Hypertension was defined as office systolic blood pressure or diastolic blood pressure greater than the 95th percentile for age and gender by The Fourth Report on the diagnosis, evaluation and treatment of high blood pressure in children and adolescents,[21] ambulatory blood pressure monitoring results were interpreted by Lurbe et al.[22] Carotid intima-media thickness assessed by using Toshiba/Nemio XG/istyle and interpreted by Dawson et al.[23]

Written informed consent was obtained from the patients and their parents.

The results were analyzed using StatSoft Statistica 10. Quantitative variables were described as means $\pm$ SD, qualitative variables were described as percentages. Differences between groups were established by ANOVA and Mann–Whitney *U*-test. Reported *P*-values are two-tailed and *P*-values more than 0.05 were considered to be statistically metabolic syndrome criteria to predict obesity associated cardiovascular problems. Binary classification used for estimation sensitivity, specificity, negative predictive value and positive predictive value.

4. Results

There were no age and gender differences between groups (Table 1). BMI was greater in MUO than in MHO in both absolute values ($P = 0.019$) and z-scores ($P < 0.0001$) with no difference in degree of abdominal adiposity by WHR ($P = 0.744$).

Analysis of basic metabolic parameters shown the fasting total cholesterol, triglycerides were higher in MUO and HDL level lower respectively. Fasting blood glucose was higher in MHO and MUO vs. LH ($P < 0.001$ for both), but no difference MHO vs. MUO ($P = 0.583$) as well as fasting insulin level ($P = 0.431$) and HOMA-IR ($P = 0.364$). It was established that 91% of MHO and 100% of MUO were insulin resistant ($P = 0.014$). Oral glucose tolerance test revealed type 2 diabetes in 4.8% of MUO children, impaired fasting glucose in 6.89% MHO and in 19.35% MUO ($P = 0.008$), impaired glucose tolerance in 1.38% MHO and in 11.29% MUO ($P < 0.001$).

Normal blood pressure was registered in 25.00% $\pm$ 8.66% of MHO and 5.13% $\pm$ 5.69% MUO ($P = 0.01$ for both). First degree of hypertension was predominant in MHO ($P = 0.04$) and by contrast the second degree of hypertension was common for MUO ($P < 0.001$).

Analysis ambulatory blood pressure monitoring results shown the mean systolic blood pressure in MHO and MUO higher than in LH ($P < 0.001$) as well as in MUO is greater vs. MHO ($P = 0.014$). Simultaneously average blood pressure in MHO looks abnormal as the results above 120/80 mmHg should be considered as prehypertension for the adolescents.[21] Diastolic blood pressure didn't reveal any difference in groups. Systolic blood pressure load in MUO almost two times more significant than in MHO (39.57% $\pm$ 5.19% vs. 23.89% $\pm$ 2.81%; $P = 0.005$).