Assessment of left ventricular mass index could predict metabolic syndrome in obese children

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Background: Childhood obesity is a major risk factor for cardiovascular diseases in children and adults.

Objectives: The purpose of this study was to evaluate the serum leptin level and the cardiac changes in normotensive obese children and to study the relationship between left ventricular mass index (LVMI) and serum leptin with the parameters of metabolic syndrome (MS) in obese children.

Methods: This study was conducted in al Jeddani Hospital and Ibn Sina College Hospital in Saudi Arabia in the period from July 2012 to December 2013, and included 82 obese children. Their mean age was 10.2 ± 2.8 years; they were divided into 25 obese children with MS and 57 obese children without MS, and 40 healthy age- and sex-matched children were also included in the study as a control group. All children were subjected to clinical assessment including standing height, body weight, body mass index (BMI), waist circumference (WC), and blood pressure measurements. All children received an echocardiographic examination (2-dimensional, M-mode, Doppler, and tissue Doppler echocardiograpy) and laboratory assessment of serum leptin level, fasting glucose, fasting insulin, the homeostatic model assessment for insulin resistance (HOMA) index, total cholesterol, triglycerides, and high- and low-density lipoprotein profile.

Results: BMI, BMI standard deviation score, WC, fasting glucose, fasting insulin, HOMA index and the serum leptin level were significantly higher in obese children compared to control group ($p < 0.05$). The LVMI were increased in the obese compared to the control group ($p < 0.001$) while left ventricle systolic and diastolic functions did not differ in obese versus control group ($p > 0.05$). There was a significant positive correlation between both LVMI and serum leptin level in comparison to BMI, WC, fasting glucose, fasting insulin, HOMA, triglycerides, and low-density lipoprotein in all obese children, especially the MS group. However, there was a significant negative correlation between both LVMI and serum leptin level in comparison to high-density lipoprotein.

Conclusion: Assessment of LVMI as routine echocardiographic examinations and serum leptin level might be a feasible and reliable method for the evaluation of obesity and its related cardiovascular risks during childhood that can predict metabolic syndrome and insulin resistance.

Keywords: Left ventricular mass index, Metabolic syndrome, Obese children, Serum leptin

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Introduction

Obesity is currently regarded as a public health problem that affects both children and adults [1]. It has been shown that obesity is associated with the development of early myocardial and coronary artery changes in children and adolescent [2]. Therefore, prior to the onset of left ventricular systolic dysfunction, emergence of diastolic dysfunction in obese children might lead to diagnosis in a very early stage of the disease [3]. Obesity affects cardiovascular parameters such as left ventricular mass (LVM) and cardiac function as well as metabolic parameters such as insulin levels and glucose tolerance [4]. Tissue Doppler echocardiography (TDE) is a recent echocardiographic imaging technique that allows evaluation of regional myocardial systolic and diastolic function [5]. Metabolic syndrome (MS) is characterized by central obesity, insulin resistance, hyperglycemia, dyslipidemia, and hypertension [6]. Adipose tissue serves not only as an energy storage organ, but also as an endocrine organ by releasing factors into the circulation that have sites of action [7]. Leptin is a peptide hormone that is predominantly produced in adipose tissue [8]. In addition to its effect on neuroendocrine, immune, and reproductive systems, leptin regulates food intake, body weight, and energy homeostasis [9]. Increased adiposity was shown to be associated with hyperleptinemia, which subsequently causes endothelial dysfunction, hypertension, and cardiovascular diseases [10]. Leptin is proposed as biomarker in children for predicting MS, Type 2 diabetes, or cardiovascular disease [11]. This study aimed to assess the LVM index (LVMI) and serum leptin level in obese nonhypertensive children and their prediction to metabolic syndrome.

Patients and methods

A cross-sectional study that comprised 82 obese children and 40 healthy children was conducted in al Jeddani Hospital and Ibn Sina College Hospital in Saudi Arabia from July 2012 to December 2013. The obese group consisted of 82 children (47 boys and 35 girls) aged 6–14 years. Their mean ± standard deviation age was 10.2 ± 2.8 years and mean body mass index (BMI) 32.8 ± 4.6 kg/m^2. The obese children had BMI $\geqslant$95th percentile for age and sex based on the standards of the Centers for Disease Control and Prevention.

Abbreviations

LVMI	left ventricular mass index
BMI	body mass index
WC	waist circumference
HOMA	homeostatic model assessment
TDE	tissue Doppler echocardiography
LVM	left ventricular mass
MS	metabolic syndrome
HOMA-IR	homeostatic model assessment for insulin resistance
LV	left ventricle
FGIR	fasting glucose insulin ratio
HDL	high density lipoprotein
SDS	standard deviation score
EM	early diastolic myocardial velocity

The control group consisted of 40 children (22 boys and 18 girls) aged 6–14 years. Their mean age was 10.6 ± 2.7 years and their mean BMI was 18.7 ± 2.9 kg/m^2. The control participants were recruited from a population of nonobese healthy children who presented to the hospital for minor illnesses. The obese patients were divided into the MS group (n = 25) and non-MS group (n = 57) according to the International Diabetes Federation consensus definition of MS in children and adolescents [12]. A local ethical committee was approved from our hospital (al Jeddani Hospital). Informed consent was obtained from parents of patients and controls. Children were excluded if they had: previous cardiac disease or taken medication known to affect cardiac function (antihypertensive drugs); an earlier major illness, including type 1 diabetes; taken medications; had a condition that is known to influence their growth, insulin action, or insulin secretion (e.g., glucocorticoid therapy, hypothyroidism, and Cushing's disease); or liver disease or impaired liver functions (see Figs. 1 and 2).

Anthropometric measures

For each child, the height and weight were measured. The height was measured to the nearest 0.1 cm using a Holtain portable anthropometer (manufacturer, address), and the weight was determined to the nearest 0.01 kg using a Seca scale balance (manufacturer, address) with the patient dressed in minimal clothes and without shoes. The BMI was calculated as weight (in kg) divided by height (in m) squared. Waist circumference (WC) was measured at the level of the umbilicus with the child standing and breathing normally. Each measurement was taken as the mean of three consecutive measurements, using standardized equipment and following the