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ORIGINAL ARTICLE

Reduced serum total osteocalcin is associated with central obesity in Korean children

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KEYWORDS

Osteocalcin;
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Summary

Background: Recently, osteocalcin (OC), an osteoblast-derived hormone, has been suggested as a new link between obesity and insulin resistance in humans. However, few studies regarding the relationship between OC and obesity in Asian children have been published. We investigated the association of OC with adiposity, insulin resistance and metabolic syndrome (MetS) in Korean children.

Methods: Two hundred and nine (100 boys, 109 girls) children (age: 9.78 ± 1.05 years, body mass index (BMI): 22.27 ± 5.34 kg/m²) participated in this cross-sectional study. Anthropometric parameters, insulin resistance, lipid profiles, total OC, and an inflammatory marker, C-reactive protein (CRP), were measured. MetS phenotype was also determined.

Results: Serum total OC levels were significantly lower in overweight or obese children (76.96 ± 27.08 ng/ml vs. 66.91 ± 21.39 ng/ml, $p=0.020$) and it was negatively associated with body fat after controlling for age, gender and BMI. Serum total OC concentrations were significantly lower in participants with central obesity or

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at least two components of MetS driven by waist circumference than they were in those with none. Stepwise linear regression results also showed that serum total OC was partially explained by age, gender, waist-to-hip ratio, and fasting glucose.

Conclusions: This study supported a negative association between serum total OC and adiposity in children. OC may be associated with childhood central obesity; however, further research using more accurate measurements is needed to identify the association between these variables.

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Introduction

The epidemic of childhood obesity has been increasing worldwide during the last few decades. In Korea, the prevalence of obesity in children and adolescents increased from 5.8% in 1997 to 10.8% in 2008 as a global trend [1]. Childhood obesity has become one of the major concerns to health professionals in the world because it is associated with increased risk of development of cardiometabolic diseases in adulthood [2].

Metabolic syndrome (MetS) is a cluster of risk factors of cardiovascular diseases, such as central obesity, dyslipidemia, type 2 diabetes, and hypertension, that is based on a common root of insulin resistance (IR) [3]. Although diagnoses of central obesity and MetS in children are more complicated due to the need for age- and gender-specific references according to their growth, early identification and intervention of MetS in children is nevertheless important to prevent the morbidity and mortality related to cardiovascular disease later in life.

Osteocalcin (OC), an osteoblast-derived hormone, has recently been suggested as a link between the skeleton and IR or energy metabolism related to obesity in humans. In recent studies, key parameters of MetS, such as abdominal visceral fat accumulation, blood pressure and lipid profiles, were significantly correlated with low serum OC in various populations [4–6]. A low OC level is associated with MetS as well as a more severe phenotype of coronary atherosclerosis in adults [7]. Circulating OC levels were lower in obese children and were positively correlated with insulin sensitivity and negatively associated with leptin concentration [8]. Additionally, obese children with prediabetes had lower levels of uncarboxylated OC than those with normal glucose [9]. However, the relation between OC and MetS in overweight and obese Asian children has not been studied. Therefore, we investigated the association of serum total OC with obesity, IR and MetS in Korean children.

Research design and methods

Participants

The participants were recruited from a health camp for elementary students in a metropolitan city in Korea. Our exclusion criteria included (1) participation in a weight loss program during the past six months, (2) a personal history of diabetes and (3) any other acute or chronic illness such as heart diseases, asthma and severe infectious disease.

In all, 287 children aged from 7 to 12 volunteered for the study; of these children, 209 (100 boys and 109 girls) completed the anthropometric and biochemical measures. Thus, they were enrolled in the current study and classified into either the normal, overweight, or obese group according to their body mass index (BMI), age, gender, and percentile on the growth chart. The Korean Society for the Study of Obesity's guidelines for children define being overweight as a BMI between the 85th and 95th percentile and obese as the 95th percentile and above [10]. BMI was calculated based on the participants' height and weight. This BMI was then applied to the growth chart developed by the Centers for Disease Control to define specific gender- and age-specific BMIs to determine obesity.

All participants were also classified according to the criteria of MetS suggested by Ohzeki et al. [11] and diagnosed as a participant with MetS if they met the first criteria on central obesity and two or more of the following criteria among the other three: (1) waist circumference (WC) > height/2, (2) triglyceride \geq 120 mg/dl and/or high density lipoprotein cholesterol (HDL-C) < 40 mg/dl, (3) systolic blood pressure \geq 125 mmHg and/or diastolic pressure \geq 70 mmHg, and (4) fasting glucose \geq 100 mg/dl. Participant characteristics are summarized in Table 1. This study was approved by the Institutional Ethics Review Board at Yonsei University College of Nursing. Written informed consent was obtained from the parents of the participants before the study began.

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