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ORIGINAL ARTICLE

Association of visceral fat area with abdominal skeletal muscle distribution in overweight Japanese adults

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KEYWORDS
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Summary
Background: Quantitative evaluation of visceral fat mass and skeletal muscle mass is important for health promotion. Recently, some studies suggested the existence of adipocyte–myocyte negative crosstalk. If so, abdominal skeletal muscles may easily and negatively affected not only by the age but also the visceral fat because age-related reduction in abdominal region is greater compared with limbs.
Objective: We cross-sectionally examined the existence of quantitative associations between visceral fat area and abdominal skeletal muscle distribution in overweight people.

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Methods: A total of 230 Japanese males and females who aged 40—64 years and whose body mass index (BMI) was 28.0—44.8 kg/m^2 participated in this study. The cross-sectional area (CSA) of the visceral fat, subcutaneous fat, and abdominal skeletal muscles, namely, the rectus abdominis, abdominal oblique, erector spinae, and iliopsoas muscles were measured by the computed tomography images.
Results: Stepwise regression analyses revealed the existence of sex difference in the relation between visceral fat CSA and other morphological variables. In males, BMI was a positive, and the iliopsoas muscle group CSA was a negative contributor of the visceral fat CSA. In females, both age and BMI were selected as positive contributors.
Conclusion: These data suggested that the visceral fat CSA may negatively associated with iliopsoas muscle group CSA in males. In females, the visceral fat CSA was not significantly related to the distribution of the abdominal skeletal muscle groups.
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Introduction

Sarcopenic obesity, a condition in which skeletal muscle is lost while fat mass is preserved or even increased, was identified as a major risk factor for metabolic syndrome [1,2] and physical disabilities [3,4]. In addition, the ratio of the visceral fat area to thigh skeletal muscle mass had a significant relationship with metabolic syndrome [1,5]. Kim et al. [6] showed that visceral obesity was associated with the future loss of skeletal muscle mass. Quantity of skeletal muscle is one of the determinant factors of $\dot{V}O_{2\,max}$ [7] or 5-year decline in muscle strength [8]. Therefore, quantitative evaluation of the visceral fat and the skeletal muscle is important for health promotion.

Recently, adipocyte—myocyte crosstalk was focused because it closely related to obesity-related disorders such as metabolic syndromes, hypertension, cardiovascular diseases, and type 2 diabetes mellitus [9,10]. The loss of skeletal muscle with aging is generally more pronounced in certain muscle groups. Especially, relative reduction in skeletal muscle thickness with aging was previously shown to be greater in the abdomen compared with that in limbs [11]. Therefore, if the excess visceral fat accelerates the abdominal skeletal muscle atrophy, people with visceral obesity need to train abdominal skeletal muscle in a positive manner. However, there was limited information about the association of visceral fat with the abdominal skeletal muscle, except for Zhang et al. [12] which reported the significantly negative relation between visceral adipose tissue area and psoas muscle attenuation.

In general, the magnetic resonance imaging and/or computed tomography (CT) are the gold standard of the skeletal muscle mass measurement. Some previous studies reported the validity of estimating skeletal muscle volume from single cross-sectional image, i.e., Shen et al. [13] and Schweitzer et al. [14] for whole body skeletal muscle mass and Tanaka et al. [15] for segmental skeletal muscle mass. As for the trunk region, Tanaka et al. [15] reported the single image of skeletal muscle can estimate trunk skeletal muscle volume with standard error of estimate of ~6.5%. Anderson et al. [16] presented the accuracy of predicting thoracic and lumbar trunk muscle CSA at vertebral levels T6 to L5. These previous studies indicate that not only visceral fat mass but also skeletal muscle mass can be estimated by one cross-sectional image. Therefore, the aim of the present study is to examine the relationship between visceral fat mass and abdominal skeletal muscle distribution using CT imaging

Methods

Subjects

This study was a secondary analysis of a randomised controlled trial, the Saku Control Obesity Program (SCOP), which was examining the effects of behavioral treatments and exercise at the Saku Central Hospital Human Dock Center. The research plan was approved by the Ethical Committee of the National Institute of Health and Nutrition and Saku Hospital. The details and design of this study have been described previously [17]. Individuals who underwent health check-ups at the center were registered in the database, and 976 members between the ages of 40 and 64 years old who

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