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Body composition changes were related to nutrient intakes in elderly men but elderly women had a higher prevalence of sarcopenic obesity in a population of Korean adults

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ABSTRACT

In this study, we examined the relationship between sarcopenic obesity (SO) and nutrition status, according to sex in Korean adults who were 60 years or older. Body composition was categorized as SO, sarcopenic nonobesity, nonsarcopenic obesity, and nonsarcopenic nonobesity. Obesity was defined by body mass index. Sarcopenia was defined as an appendicular skeletal muscle mass divided by weight (Wt) of less than 1 SD below the sex-specific mean for young adults. Subjects included 1433 subjects (658 men and 775 women) who were 60 years or older and who participated in the fifth Korea National Health and Nutritional Examination Survey 2010. Sarcopenic obesity was more prevalent in women (31.3%) than in men (19.6%). Individuals with SO had significantly higher fasting insulin, homeostasis model assessment of insulin resistance (male: 3.2 ± 1.4, female: 3.4 ± 2.1), and triglycerides (male: 167.3 ± 90.6 mg/dL, female: 160.7 ± 85.0 mg/dL). High-density lipoprotein was under the normal criteria (50 mg/dL) in women. Intake of nutrients associated with muscle loss (protein, vitamin D, calcium, and vitamin C) was significantly different among the male but not the female groups. Although protein intake was normal, calcium and vitamin D intakes were insufficient in all groups. In conclusion, body composition changes were related to nutrient intakes in elderly (60 years or older) men but not elderly women. Women had a higher prevalence of SO than did men, suggesting that early nutritional intervention in elderly women may help them address age-associated body composition changes.

1. Introduction

Advanced medicine and industrial development throughout the world have increased the age and prevalence of obesity, both of which contribute to major health concerns [1]. Like other developed countries, the Korean population is rapidly aging and the proportion of the population 65 years and older is gradually increasing. In 2007, the average life expectancy was estimated to be 77.9 years [2]. Approximately 14.3% of the Korean population is expected to be 65 years or older in 2018; this

Abbreviations: ASM, appendicular skeletal muscle mass; BMI, Body mass index; HDL, high-density lipoprotein; KDRI, Korean Dietary Reference Intakes; KNHANES, Korean National Health and Nutrition Examinations Survey; NSNO, nonsarcopenic nonobesity; NSO, nonsarcopenic obesity; RDA, Recommended Daily Allowance; SNO, sarcopenic nonobesity; SO, sarcopenic obesity.

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percentage is expected to rise to 20.8% in 2026 [3]. Aging is accompanied by significant body composition changes that are often linked to sarcopenic obesity (SO), which is a progressive loss of muscle mass and increase of fat mass [4]. The loss of muscle mass and increase in fat mass deteriorate physical abilities and contribute to frailty, chronic disease, and body appearance.

Many previous studies also show that age-related body composition changes result in chronic inflammation and insulin resistance [5]. Inflammatory cytokines secreted from increased fat mass promote insulin resistance and infiltrate the muscle [6], thus leading to muscle cell loss and reduced ability of the muscle to repair damaged DNA [7]. Villareal et al [8] suggests that SO may lead to health conditions in the elderly such as insulin resistance and metabolic syndrome, cardiovascular disease risk factors, and even cancer induced by body composition changes [9]. Today, nutritional problems in the Korean elderly are no longer related to under-nutrition but to excessive energy intake, as indicated by unbalanced diets and physical activity patterns. Some of the most effective strategies for overcoming SO include the addition of muscle-strengthening physical activity and the use of dietary modifications, such as restricting calories and including nutrients that consist of high-quality protein, vitamin D, calcium, omega-3 polyunsaturated fatty acids, and antioxidants [7,10]. Studies have focused on the nutritional aspects of epigenetics and show that lifestyle, anti-inflammatory nutrients, and bioactive food factors may influence the DNA methylation regulating inflammation, perhaps even reducing the risk of developing metabolic disorders [11–13]. Calcium intake and vitamin D status may be associated with body weight, body composition, and insulin resistance [14,15]. This may be due to the essential role of calcium in insulin-mediated intracellular processes in skeletal muscle and adipose tissue, as well as vitamin D suppression of C-reactive protein, tumor necrosis factor, interleukin-6, and interleukin-8 [16]. Essential amino acids and antioxidants both stimulate protein synthesis by initiating the mammalian target of rapamycin signaling pathway and decreasing inflammatory cytokine production [17,18]. Increased vitamin C intake is positively associated with muscle strength and physical performance, possibly by reducing inflammation [19].

Several nutrients likely play a role in the prevention of SO. This study investigated the relationship between nutritional status and health risk factors with the presence of SO in women and men who were 60 years or older from the Korean National Health and Nutrition Examination (KNHANES) 2010 data. Because sex differences exist in age-associated body composition changes, this study was conducted in both sexes. Our findings may help provide data for nutritional interventions that could improve the health of the aging population.

2. Methods and materials

2.1. Subjects

This study was based on data obtained from the KNHANES 2010, a nationally representative survey conducted by the Korean Ministry of Health and Welfare. The survey's target population included noninstitutionalized Korean civilians. Using household registries, sampling units consisted of households selected through a stratified, multistage, probability-sampling design that was based on geographic area, sex, and age group [20]. Korean National Health and Nutrition Examinations Survey 2010 consisted of 4 components: a health interview survey, a health behaviors survey, a health examination survey, and a nutrition survey. These surveys were completed by 8473 (77.5% of the total target population of 10938) participants in 2010 [20]. A total of 1433 individuals (658 men, 775 women) who were 60 years or older and participated in the health examination and nutrition surveys were included in this study. We excluded those who had not performed dual-energy x-ray absorptiometry, did not have data on oral daily nutrition intake, and had not undergone blood tests.

2.2. Data collection

Details of the KNHANES performed in 2010 have been previously described [20]. In brief, health examination, dietary measurement, height, and weight were obtained using standardized techniques and calibrated equipment. Body mass index was calculated by dividing weight (in kilograms) by height (in meter squared). Blood pressure was measured using a sphygmomanometer, with the subject in a sitting position. Three measurements were taken at 5-minute intervals in the morning after having fasted for at least 8 hours, and the average of the second and third measurements was used. Fasting glucose, fasting insulin, homeostasis model assessment of insulin resistance (HOMA-IR), total cholesterol, triglycerides (TGs), and high-density lipoprotein (HDL) were analyzed in a central, certified laboratory. A dual-energy x-ray absorptiometry scan was performed to measure total body fat mass, total body fat percentage, and lean mass, using fan-beam technology (Lunar Corp, Madison, WI, USA). A general questionnaire was administered to assess basic demographic and health-related information. Dietary intake was measured by the single 24-hour dietary recall method and compared with the Recommended Daily Allowance (RDA). Trained staff instructed the respondents to recall and describe all of the foods and beverages they had consumed the previous day. Food models and measuring bowls, cups, and spoons were used to assist in estimating portion sizes.

2.3. Definition of appendicular skeletal muscle mass and obesity

Appendicular skeletal muscle mass (ASM; in kilograms) was defined as the sum of lean soft tissue mass in the arms and legs, following the method of Heymsfield et al [21]. We calculated ASM as a percentage of body weight (Wt), modifying methods published by Janssen et al [22] and Lim et al [23]. Sarcopenia was defined as an ASM that was divided by Wt (ASM/Wt) and was less than 1 SD below the mean of a reference sample of 1746 healthy adults between 20 and 39 years of age (748 men, 998 women), taken from the fifth KNHANES database. The cutoff value (32.4 ± 2.8 for men, 25.7 ± 2.3 for women) for sarcopenia was 44% for men and 52% for women. Obesity classification was determined according to the body mass index (BMI) criteria established by the Obesity Task Force, World Health Organization, and the Korean Society for the Study of Obesity [24]. Subjects were further classified into