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Original Study

Exercise and Nutritional Supplementation on Community-Dwelling Elderly Japanese Women With Sarcopenic Obesity: A Randomized Controlled Trial

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ABSTRACT

Objectives: To investigate the effects of exercise and/or nutritional supplementation on body composition, blood components, and physical function in community-dwelling elderly Japanese women with sarcopenic obesity.
Design: Randomized controlled trial.
Setting: Urban community in Tokyo, Japan.
Participants: Among 1213 community-dwelling elderly women over 70 years of age, 307 were defined with sarcopenic obesity, and 139 women participated in the study.
Intervention: Participants were randomly assigned to one of four intervention groups. The exercise and nutrition (Ex + N) and exercise only (Ex) groups attended 60-minute exercise classes twice a week for 3 months. The Ex + N and nutrition only (N) groups were provided with essential amino acid supplementation and tea fortified with catechins to be taken daily for 3 months. Health education classes were provided to the control (HE) group every 2 weeks.
Measurements: Bioelectric impedance analysis was used to measure body composition. Skeletal muscle mass index was calculated using measures of muscle mass and height. Physical function measures included grip strength, knee extension strength, usual walking speed, and walking parameters (stride, step length, width, walking angles). Blood samples were obtained to analyze levels of albumin, triglycerides, cholesterol, hemoglobin A1c, leptin, cystatin C, vitamin D, interleukin-6, and high-sensitivity C-reactive protein.
Results: Significant between-group × time interactions were observed in usual walking speed ($P = .012$), stride ($P = .004$), right step length ($P = .003$), average number of steps ($P = .029$), and vitamin D ($P < .001$). Compared to the HE group, the Ex + N intervention significantly decreased total body fat mass ($P = .036$) and increased stride ($P = .038$) and vitamin D ($P < .001$). Significant reductions in trunk fat were observed in the Ex group compared with HE ($P = .014$). The Ex + N and Ex interventions were over four times as likely (odds ratio [95% confidence interval]) to reduce body fat mass than the HE group (4.42 [1.21-16.19]; 4.50 [1.13-17.9], respectively). Significant odds ratios of the Ex + N intervention improving walking speed (3.05 [1.01-9.19]), vitamin D (14.22 [1.64-123.02]), and leptin (3.86 [1.19-12.47]) were also observed.
Conclusion: Although exercise and nutrition have beneficial effects on individual variables of body composition, blood components, and physical function, improvements in muscle mass and variable

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Conflict of interest: Authors from Ajinomoto Co., Inc. and Kao Corporation assisted in the data collection but had no role in the development of the study design and interpretation of the data. Co-authors Hisamine Kobayashi and Shinji Somekawa are employed by Ajinomoto Co., Inc.; and Yoshifumi Niki and Yukari Yamashiro by Kao Corporation. Ajinomoto Co., Inc. provided the amino acid supplementation, and Kao Corporation provided the tea catechin supplementation. The authors included in this publication affiliated with either corporation assisted in the data collection and analysis. The terms of this arrangement have been reviewed and approved by the Tokyo Metropolitan Institute of Gerontology in accordance with its policy on objectivity in research.

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combinations such as percent fat + skeletal muscle mass index or percent fat + physical functions were not observed in this population. Further large-scale and long-term investigation is necessary.

The separate influences of sarcopenia and obesity on adverse health outcomes have been topics of interest within the research community. There has been an increased interest in the combination of both sarcopenia and obesity, or sarcopenic obesity, which has originally been characterized by reduced muscle mass and high body fat percentage.[1,2] More recently, research has shown that dynapenic obesity, the loss of muscle strength with age and high body fat, is associated with poor physical function and mobility.[3,4] Sarcopenic obesity has been found to be closely associated with knee osteoarthritis,[5] metabolic syndrome and arterial stiffness,[6] instrumental activities of daily living disability,[7] gait abnormalities, falls,[1] and all-cause mortality.[8,9]

The benefits of resistance exercise in older people has been well established. The literature clearly shows that resistance exercise is effective for improving muscle mass, strength, and walking ability in older adults.[10,11] Aerobic exercise is the optimal type of exercise for the reduction of fat mass, although the combination of aerobic and resistance exercise may have greater benefits for weight loss, fat loss, and cardiorespiratory fitness.[12,13] Recent studies have shown that nutrition is an important factor regarding sarcopenic obesity. Although solid evidence to recommend specific interventions for sarcopenia has yet to be established, nutritional supplementation in combination with exercise has been effective in the treatment of sarcopenia.[14] One review concluded that randomized controlled studies containing exercise programs including both strength and aerobic exercises combined with nutritional investigation was the most promising approach to sarcopenic obesity based on current evidence.[15]

Essential amino acid ingestion can induce muscle protein anabolism in elderly adults.[16,17] Furthermore, leucine-rich amino acids have improved aspects of functional status and increase lean body mass.[18,19] An investigation we conducted in 2011 revealed that a leucine-rich essential amino acid supplementation in congruence with exercise effectively improved muscle strength, as well as the combined variables of muscle mass and walking speed in sarcopenic women.[20]

Previous studies have reported that green tea containing catechins can reduce body fat,[21] systolic blood pressure, LDL cholesterol,[22] abdominal fat, and serum triglycerides.[23] Additionally, in combination with exercise, green tea catechins had beneficial effects on walking ability and muscle mass in Japanese sarcopenic women.[24] Whether such interventions are beneficial for elderly people with sarcopenic obesity is unknown.

We hypothesized that resistance training combined with amino acid supplementation would increase muscle mass, and aerobic exercise in combination with tea catechins may reduce body fat. No studies, to the best of our knowledge have examined the effects of exercise and nutrition, in combination and separately. The purpose of this study was to investigate the effects of exercise, amino acid and tea catechin supplementation on body composition, blood components, and physical function in community-dwelling elderly Japanese women with sarcopenic obesity.

Materials and Method

Subjects

A letter inviting elderly people over 70 years old in the community (Itabashi ward, Tokyo) to participate in a follow-up comprehensive geriatric health examination survey in 2012 was sent to 1289 elderly women who had completed an initial baseline survey in 2008. Among them, 575 women participated in the follow-up survey in 2012. Invitation letters were also sent to a separate cohort in 2013, to 957 people who had originally participated in a baseline survey in 2006. There were 638 people who participated in the follow-up survey in 2013. Detailed descriptions of the 2008 cohort[25] and 2006 cohorts[26] are available in previous publications. A total of 1213 people who had participated in both follow-up surveys in 2012 and 2013 were screened for sarcopenic obesity (Figure 1).

Sarcopenic obesity was operationally defined as body fat percent of 32% or greater, measured by dual x-ray energy absorptiometry (DXA, Hologic QDR 4500A), combined with skeletal muscle mass index less than 5.67 kg/m^2; body fat percent of 32% or greater and grip strength less than 17.0 kg; and body fat percent of 32% or greater and walking speed under 1.0 m/s. The exclusion criteria were: (1) severely impaired mobility; (2) impaired cognition (Mini-Mental State Examination score < 24); (3) missing baseline data; and (4) unstable cardiac conditions such as ventricular dysrhythmias, pulmonary edema, or other musculoskeletal conditions. Based on these criteria, 307 (25.3%) were operationally defined as having sarcopenic obesity, and information on "treatment strategy" was mailed to the potential patients. A total of 168 people were excluded from the study (Figure 1).

The study protocol was approved by the Clinical Research Ethics Committee of Tokyo Metropolitan Institute of Gerontology (ID2014-693). Procedures were fully explained to all participants, and written informed consent was obtained.

Randomization

Randomization was performed after the baseline assessment, and any variable that identified personal information was not included in the randomization process. Computer-generated random numbers were assigned to 139 participants (45.3%), who were then sorted and equally divided into four groups. These groups were then allocated to one of four intervention groups: (1) exercise and nutritional supplementation (Ex + N; n = 36), (2) exercise (Ex; n = 35), (3) nutritional supplementation (N; n = 34), and (4) health education (n = 34). All participants agreed to the group allocations. There was no attempt to equalize the size of the groups based on their characteristics or to recruit subjects with specific characteristics.

Outcome Measures

Interview

Face-to-face interviews were conducted to assess history of falls, fractures, pain, frequency of urination (daytime and nighttime), and chronic conditions such as history of heart disease, hyperlipidemia, dyslipidemia, diabetes, osteoporosis, osteoarthritis, OA and more.

Anthropometric and physical function measures

Measurements of height and weight were converted to BMI. Muscle mass, body fat mass, and body fat percent were determined using bioelectrical impedance analysis (InBody 720). Skeletal muscle mass index (SMI) was calculated using measures of muscle mass and height. Grip strength was measured using a handheld Smedley-type dynamometer in the dominant hand, and the better of two trials was used for analysis. Peak isometric force was measured to assess knee extension strength where the participants extended the knee with maximum power with their knee joint at 90°. A dynamometer was placed at the ankle joint to measure the force of extension. The greater measurement of two trials was recorded. Usual walking speed