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Original article

Higher free thyroxine levels are associated with sarcopenia in elderly Koreans

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Abstract

Background: Skeletal muscle is a major target of thyroid hormone action. Although sarcopenia is associated with adverse health outcomes in the elderly, few studies have examined the association between sarcopenia and thyroid hormone levels in elderly Asians. We investigated the relationship between thyroid hormone levels and sarcopenia in elderly Koreans.
Methods: 658 individuals (324 males and 334 females) ≥60 years old who visited the Health Screening and Promotion Center at Ajou University Hospital were recruited for the study. Whole-body dual-energy X-ray absorptiometry was performed, and gait speed and hand grip strength were measured. The rate and odds ratios for sarcopenia were calculated for free thyroxine (fT4) and thyroid stimulating hormone (TSH) levels.
Results: The fT4 concentration was negatively associated with muscle mass in males ($r^2 = 0.031$, $p = 0.001$) and females ($r^2 = 0.019$, $ps = 0.011$). The highest rate of sarcopenia occurred in the highest fT4 quartile in males and females. However, no significant differences were found among TSH quartiles in either sex. TSH was not significantly associated with the risk of sarcopenia in males or females, whereas the fT4 concentration was associated with the risk of sarcopenia in both sexes.
Conclusions: Higher fT4 levels, not lower TSH levels might have an adverse effect on sarcopenia especially in elderly people.

Keywords: Free thyroxine; TSH; Sarcopenia; Muscle

1. Introduction

Ageing is a global phenomenon. The advanced-age population within the Organisation for Economic Co-operation and Development (OECD) region outnumbered the youngest population (0–19 years old) in 2010 and is expected to surpass all other population age groups by 2020. South Korea is ageing faster than any other country in the OECD. In 2010, ~10% of the population was >65 years of age, and that proportion is estimated to be ~40% by 2050 [1].

Hypothyroidism and hyperthyroidism are common among the general population and are more prevalent in individuals aged >60 years [2,3]. Early diagnosis and treatment of overt thyroid dysfunction is crucial for this population in view of the marked effects of abnormal circulating thyroid hormone levels on a number of organ systems, including the heart, skeleton, and neurological systems [4]. Hypothyroidism is associated with impaired cognitive function [5] and medical conditions, such as hyperlipidemia, congestive heart failure, and macrocytic anemia, in the elderly population [6,7]. Furthermore,

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overt hyperthyroidism is associated with significantly increased risks of cardiovascular disease, osteoporosis, and mortality, particularly among elderly individuals [4,7].

Sarcopenia is the age-associated loss of skeletal muscle mass resulting in decreased strength and aerobic capacity, leading to reduced functional capacity [8]. Previous studies have shown an association between sarcopenia and adverse health outcomes, such as falls, disability, hospital admission, long-term care placement, poor quality of life, and mortality, which highlights the importance of detecting and treating sarcopenia in older individuals [9].

Skeletal muscle is a major target of thyroid hormone action as demonstrated by the myopathic symptoms observed in patients with thyroid function disorders [10]. Hyperthyroidism can affect limb muscle mass and strength [11]. However, few studies have investigated the association of sarcopenia with thyroid hormone concentrations in the elderly Asian population. We investigated the relationship between thyroid hormone levels and the rate of sarcopenia in healthy Korean males and females ≥60 years old.

2. Materials and methods

2.1. Subjects

We recruited individuals aged ≥60 years who visited the Health Screening and Promotion Center at Ajou University Hospital (Suwon, Republic of Korea) for a routine medical examination between April 2011 and July 2014. Whole-body dual-energy X-ray absorptiometry (DXA) was performed, and gait speed and hand grip strength were measured in 666 of 747 participants. We excluded five individuals who were diagnosed with thyroid disease and currently taking thyroid hormone or anti-thyroid drugs and three individuals without thyroid hormone concentration measurements. Thus, 658 subjects (324 males, 334 females) were included in the study. Informed consent was obtained from all participants. Our study was approved by the Institutional Review Board of Ajou University Hospital (IRB number: AJIRB-MED-MDB-11-034).

2.2. Anthropometric parameters, grip strength, and gait speed measurements

Height and body weight were measured using standard methods, with subjects wearing light clothing. Body mass index (BMI) was calculated as weight divided by height squared (kg/m^2). Waist circumference was measured midway between the lower rib margin and the iliac crest in a standing position. Blood pressure was measured after resting for 10 min in a sitting position using an automatic sphygmomanometer (TM-2655P; P.M.S (Instruments) Ltd., Berkshire, UK). Appendicular skeletal muscle masses (ASM) were acquired using DXA (Lunar iDXA, the GE Healthcare Lunar, Madison, WI, USA). ASM was calculated as the sum of muscle mass in arms and legs, assuming that all non-fat and non-bone tissue is skeletal muscle. Daily quality control scans were performed during the study period. Subjects were scanned using standard imaging and positioning protocols. Muscle strength was assessed by grip strength, which was measured using a Jamar® Plus Digital Hand Dynamometer (Sammons, Preston, IL, USA). Testing was performed with the participant in the sitting position with the elbow flexed at 90°. Measurements were taken for each hand, and the participant was encouraged to exert the greatest force possible. The strongest hand-grip strength was used in the analyses. Physical performance was assessed by usual walking speed. Participants were asked to walk straight for 8 feet (2.4 m) at their usual speed.

2.3. Laboratory measurements

Fasting blood samples were drawn at the antecubital area between 08.00 and 11.00 h. Serum samples were stored at 4 °C and analyzed within 1 day after sampling. Blood urea nitrogen, fasting glucose, liver enzymes, and lipid profiles were measured using an automatic analyzer (Toshiba TBA 200FR; Toshiba Medical System Co. Ltd, Tochigi-ken, Japan). Low-density lipoprotein cholesterol levels were calculated from the levels of total cholesterol, triglycerides (TG) and high-density lipoprotein cholesterol. The concentration of 25-hydroxyl vitamin D was assayed using a radioimmunoassay kit (DiaSorin, Stillwater, MN, USA). Thyroid stimulating hormone (TSH) and free thyroxine (fT4) levels were measured using enzyme immunoassays (Advia Centaur Immunodiagnostic system, Siemens Healthcare Diagnostics, Tarrytown, NY, USA). The reference ranges were 0.55−4.78 uIU/mL for TSH and 0.89−1.76 ng/dL for fT4.

2.4. Covariates

The participants completed standardized questionnaires on smoking and drinking status, medication history, and medical histories of hypertension, type 2 diabetes, and cardiovascular and cerebrovascular diseases. Smoking history was categorized as current smoker or non-smoker. Drinking was categorized as current drinker or non-drinker.

2.5. Definition of sarcopenia

The height adjusted ASM (ASM/height^2) was used to define the sarcopenia cases according to the recommendation of the Asian Working Group for Sarcopenia (AWGS) [9]. Low muscle mass was defined as 1 standard deviation below the mean muscle mass of the young reference group [12] instead of 2 standard deviation as recommended by AWGS because too small number of subjects were classified as sarcopenia cases with this criteria. From these data, ASM/height^2 (m^2) was determined to be < 7.50 kg/m^2 in males and <5.38 kg/m^2 in females. The lowest grip strength or gait speed quartile was classified as low muscle strength or gait speed, respectively, because no reference cut-off values are available for the diagnosis of sarcopenia in Korean individuals.

The diagnosis of sarcopenia was based on the European Working Group on Sarcopenia in Older People (EWGSOP)