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Original article

Sarcopenia, but not sarcopenic obesity, predicts mortality for older old men: A 3-year prospective cohort study

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ABSTRACT

Background: The prognostic significance of sarcopenia and sarcopenic obesity (SO) among older people remains controversial. The main aim of this study was to evaluate the mortality risk of sarcopenia and SO among men aged 75 years and older in Taiwan.

Methods: This prospective cohort study recruited all residents of the Banciao Veterans Home, a veterans retirement community in Taipei City in northern Taiwan. For all study participants, the demographic profile, comorbid medical conditions, biochemical markers, handgrip strength and gait speed, sarcopenia, SO, and all-cause mortality were collected during a 3-year follow-up period.

Results: In the study, 680 residents participated. The prevalence of sarcopenia and SO was 60.3% and 19.7%, respectively. During the study period, 140 (20.6%) deaths were identified. The diseased individuals were older, more prone to having diabetes mellitus and sarcopenia, had lower serum levels of total cholesterol and triglycerides, but had no difference in SO. Comparisons between different statuses of SO showed that age; diabetes mellitus; metabolic syndrome; body mass index; waist circumference; handgrip strength; gait speed; systolic blood pressure; fasting plasma glucose; serum levels of total cholesterol, triglyceride, high-density lipoprotein; and mortality were all significantly different between the groups. Sarcopenia [odds ratio (OR), 2.64; 95% confidence interval (C.I.), 1.687–4.135; $p < 0.001$], diabetes mellitus (OR, 1.70; 95% CI, 1.083–2.267; $p = 0.021$) were independent risk factors for mortality; whereas the serum level of triglyceride was protective (OR, 0.99; 95% CI, 0.989–0.997; $p = 0.001$). The Cox proportional hazard model confirmed that sarcopenia was significantly associated with mortality with or without obesity.

Conclusion: The mortality risk of sarcopenia significantly outweighed the survival benefits of obesity in old age. The unfavorable impact of SO may eventually result from sarcopenia, but not obesity.

1. Introduction

Sarcopenia, the age-related loss of skeletal muscle and decline in muscle strength,[1,2] is reportedly associated with a number of adverse clinical outcomes such as physical disability, falls, fractures, frailty, extended hospitalization, infectious and noninfectious complications at hospital admissions, and all-cause mortality.[3–9] However, sarcopenia may sometimes coexist with an increase in fat mass [i.e., sarcopenic obesity (SO)], which suggests that the confluence of the two individual body composition phenotypes may potentiate the mutually adverse health impacts,[10,11] and that the prevalence of sarcopenia significantly increases with age.[12–14] Sarcopenic obesity has attracted extensive research attention; however, a standardized diagnostic strategy is still lacking. Despite the lack of standardized diagnostic strategy, various health risks of SO have been demonstrated such as higher cardiovascular disease,[15] lower physical function and cardiopulmonary fitness,[16] physical disability,[17] frailty and poorer quality of life,[6,18] longer hospitalization,[19] and higher mortality of patients with end-stage renal disease and tumor.[20,21]

Whether the abovementioned health impacts result from SO or sarcopenia *per se* nonetheless remains controversial. Among all

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adverse health outcomes, the association between SO and mortality in otherwise healthy older adults remains unclear because the effects of obesity and sarcopenia on the mortality of the elderly seem to develop in opposite directions. Evidence suggests that the relationship between the body mass index (BMI) and mortality in the elderly is a U-shaped curve, whereas the risk of mortality rises only at extreme BMI values over 35–40 kg/m^2.[22,23] Jassen[5] and colleagues moreover report that increased BMI was protective against mortality for people aged 65 years and older, after controlling for waist circumference (WC). However, increased WC was associated with mortality when controlling for BMI, which implied that BMI may represent lean body mass for individuals with an equivalent WC, and WC reflects fat mass for individuals with an equal BMI.[24] This discovery indicates that adiposity may still play an unfavorable role in mortality among older people. The double health burden model of SO concerning the health of older people seems reasonable; however, rarely do studies really examine the combined effect of obesity and muscle mass or strength on mortality in the elderly, and data from The Third National Health and Nutrition Examination Survey clearly showed that SO was not associated with poor functioning.[25,26] It has been hypothesized that obesity alone in old age may protect against mortality, but the risk of mortality may outweigh the protective effect if obesity is combined with low muscle strength.[27] Therefore, the main purpose of this study was to evaluate the mortality impact of SO among Chinese men aged 75 years and older in Taiwan.

2. Methods

2.1. Participants

This study invited all people to participate who were aged 75 years or older living in the Banciao Veterans Home (Taipei, Taiwan), a veterans retirement community that is similar to assisted living residences in the United States. Most Banciao Veterans Home residents were physically fit and cognitively intact.[28–32] From March 2008 through July 2008, all residents who consented to participate in this study were enrolled, and then followed for 3 years. For all participants, the survival status was determined through personal interviews conducted by research nurses or obtained from the Veterans Affairs Welfare Registry, which is linked to the National Death Registry (Taipei, Taiwan) in a real-time manner. This study was approved by the Institutional Review Board of the National Yang Ming University (Taipei, Taiwan).

2.2. Data collection

For all participants, demographic profile, medical history, smoking, physical activities, and alcohol consumption were collected by a self-administrated questionnaire. Health behaviors were also collected such as smoking, habitual alcohol use, and physical activities.[31] Research nurses performed anthropometric measurements of all participants, including sitting blood pressure, body height and weight, WC, handgrip strength, and a 6-m walk. Handgrip strength was measured by a digital dynamometer (T.K.K.5401; Takei Scientific Instruments Co., Ltd., Niigata, Japan) when patients were placed in an upright position with the unsupported, dominant arm parallel to the body. The highest value of three repeated trials was recorded for further data analysis. Moreover, the usual gait speed was measured by a 6-m walk.[32] For each participant, venous blood sampling was performed after a 10-hour overnight fast. Serum levels of total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), serum triglyceride (TG), and fasting blood glucose (FPG) were measured by an automated clinical analyzers (XE-2100; Sysmex, Kobe, Japan and ADVIA 1800; Siemens).

Table 1
Demographic characteristics of older men aged 75 years or older living in the Banciao Veterans Home in Taipei, Taiwan.

	Overall ($N = 680$)
Age (y)	82.5 ± 4.7
Height (cm)	162.8 ± 6.4
Weight (kg)	62.6 ± 9.8
Body mass index (kg/m^2)	23.7 ± 3.3
Hypertension	56.2
Diabetes mellitus	22.2
Metabolic syndrome	31.6
Current smoker	34.3
Alcohol drinker	20.3
Physically active	67.0
Handgrip strength (kg)	18.9 ± 9.6
Gait speed (m/s)	0.88 ± 0.34
Sarcopenic obesity status	
Sarcopenia (−), central obesity (−)	24.7
Sarcopenia (−), central obesity (+)	15.0
Sarcopenia (+), central obesity (−)	40.6
Sarcopenia (+), central obesity (+)	19.7
All-cause mortality	20.6
Cancer	2.9
Cardiovascular disease	5.4
Infectious disease	9.1
Other	3.1

Data are presented as mean ± SD or %.

2.3. Definition of metabolic syndrome and sarcopenic obesity

Metabolic syndrome (MS) was defined by the National Cholesterol Education Program Adult Treatment Panel III Guideline (ATPIII) criteria, which was modified by the International Diabetes Federation for Chinese males. The diagnostic criteria included: (1) fasting glucose level of 100 mg/dL or greater or drug treatment for an elevated glucose level; (2) serum triglyceride level of 150 mg/dL or greater or drug treatment for an elevated triglyceride level; (3) HDL-C level less than 40 mg/dL or drug treatment for a reduced HDL-C level; (4) systolic blood pressure 130 mmHg or greater or a diastolic blood pressure of 85 mmHg or greater, or drug treatment for hypertension; and (5) waist circumference of 90 cm or greater or a BMI of 25 kg/m^2 or greater.

In this study, SO was defined when patients concomitantly demonstrated central obesity (WC of 90 cm or greater) and sarcopenia (surrogated by low handgrip strength).[27,33] Because WC is reportedly more associated with adverse outcomes than with BMI in this age group,[24] we selected WC rather than BMI to surrogate adiposity in this study. However, the cutoff for handgrip strength was modified in accordance with data from a Taiwanese norm.[34] Wu et al[34] report that the handgrip strength was approximately 25% lower in men aged 65 years and older than in Caucasians of the same age and sex; therefore, the cutoff for low handgrip strength in this study was defined as less than 22.5 kg, according to the European consensus[33] with modification for ethnic considerations. All patients were categorized into four groups, according to their SO status: (1) sarcopenia-negative and central obesity-negative; (2) sarcopenia-negative and central obesity-positive; (3) sarcopenia-positive and central obesity-negative; and (4) sarcopenia-positive and central obesity-positive (i.e., SO by our definition).

2.4. Data analysis

In this study, continuous variables were expressed as the mean and the standard deviation, and categorical variables were