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Original Article

Features of older community-dwelling adults with osteosarcopenia requiring support or care

Takahiro Shiba, RPT, MS[1], Yohei Sawaya, RPT, PhD[1, 2], Tamaki Hirose, RPT, MS[1, 2], Ryo Sato, RPT, MS[1], Masahiro Ishizaka, RPT, PhD[2], Akira Kubo, RPT, PhD[2], Tomohiko Urano, MD, PhD[1, 3]*

[1] *Nishinasuno General Home Care Center, Department of Day Rehabilitation, Care Facility for the Elderly "Maronie-en": 533-4 Iguchi, Nasushiobara-shi, Tochigi 329-2763, Japan*
[2] *Department of Physical Therapy, School of Health Sciences, International University of Health and Welfare, Japan*
[3] *Department of Geriatric Medicine, School of Medicine, International University of Health and Welfare, Japan*

Abstract. [Purpose] This study aimed to investigate the problems associated with osteosarcopenia and its effect on physical performance, nutritional status, and support or care required by older community-dwelling adults. [Participants and Methods] This study investigated 141 older community-dwelling adults requiring support or care using an ambulatory rehabilitation service. The patients were divided into a control, osteopenia only, sarcopenia only, and osteosarcopenia group. We investigated the associations of each condition with the baseline information, grip strength, gait speed, Mini Nutritional Assessment-Short Form score, and support or care level required. [Results] The osteosarcopenia group consisted of 43.3% of the total study participants. Osteosarcopenia was more closely associated with body mass index, support or care level, grip strength, gait speed, skeletal muscle mass index, and Mini Nutritional Assessment-Short Form score than osteopenia or sarcopenia alone. [Conclusion] Osteosarcopenia is highly prevalent in older community-dwelling adults requiring support or care, which may suggest a greater effect on physical performance, nutritional status, and support or care required than that exerted by osteopenia or sarcopenia alone.
Key words: Nutrition, Long-term care, Osteosarcopenia

INTRODUCTION

With the aging of the world population currently accelerating, the population aging rate as expressed by the rate of individuals aged 65 years or over was 9% in 2019, which is projected to increase to 16% in 2050[1]. The population aging rate in Japan was the highest in the world (28.7%), followed by Italy (23.3%), Portugal (22.8%), and Finland (22.6%) in 2020[2]. In Japan, the long-term care insurance (LTCI) system was introduced in 2000 to address the growing demand for health care and welfare in aging adults with disabilities[3]. The LTCI services are classified into support levels 1 and 2 and care levels 1 to 5, depending on the mind and body function of aging adults who have posed problems for their lives owing to advancing age or disabilities. Facility and in-home services necessary for their lives prevent the development of diseases and maintain life functions.

Preventing sarcopenia, the degenerative loss of skeletal muscle mass and strength due to increased age, lifestyle, nutrition, and disease, is essential to prevent morbidity and maintain life function. Sarcopenia reduces physical performance and ability

to perform activities of daily living (ADL) while increasing risk of swallowing disorders[4, 5] and depressive symptoms[5, 6]. Further, sarcopenia is associated with mortality in older, hospitalized patients[7]. Finally, an increase in fragility fractures due to osteoporosis in aging adults is predicted[8]. It is important to intervene in both sarcopenia and osteoporosis to prevent disabilities in elderly individuals. In recent years, osteosarcopenia a new syndrome describing the coexistence of sarcopenia and osteoporosis, has been proposed[9]. Studies on osteosarcopenia are underway around the world.

Previous studies have suggested that many older adults may have osteosarcopenia[10]. Patients with osteosarcopenia have shown lower grip strength, leg strength, and back muscle strength[11, 12] and higher mortality[13] than patients with sarcopenia or osteoporosis alone. Furthermore, poor nutritional status has been reported to be associated with osteosarcopenia[14]. Many surveys have been conducted on community-dwelling elderly who do not need care or support individuals. There are no reported older adults who continue to live at home despite having various diseases and disabilities. Older community-dwelling adults requiring support or care have a higher prevalence of osteosarcopenia than older adults who do not need care or support, suggesting that osteosarcopenia may have a greater effect not only on physical performance but also on nutrition, and support or care level.

More than ever before, policies supporting the independence and preventing injury of community-dwelling elders is important, as evidenced by the 2017 revision to the LTCI system[15]. These changes call for 'independence support and prevention of serious conditions' in this population. In this study, we examined the presence of osteosarcopenia and measured its relationship with physical performance, nutritional status, and care level among older adults requiring supportive care and receiving ambulatory rehabilitation to improve their quality of life. The findings of this study will contribute to interventions for prevention of osteosarcopenia in this population.

PARTICIPANTS AND METHODS

This study was a cross-sectional study in which a survey was conducted in a single facility in March 2020 and March 2021. It was conducted in accordance with the principles of the Declaration of Helsinki. We thoroughly explained the objective of the study and measurements to all participants, and participation was voluntary. Written informed consent was obtained from the participants who agreed to participate in the study. The study was approved by the Ethics Committee of the International University of Health and Welfare (Approval number, 17-1o-189-7).

The inclusion criteria for this study were 209 older adults who were enrolled in ambulatory rehabilitation between March 2020 and March 2021; 141 participants who did not meet the exclusion criteria were included in this study. We excluded (1) 42 participants who had not used the ambulatory rehabilitation service during a 1-week measurement period in March 2020 and March 2021 for poor health conditions or personal reasons and (2) 26 participants who had not received a diagnosis of sarcopenia because of the difficulty in holding a standing position or walking. None of the participants refused to participate in the study. Most of them live in Nasushiobara City (a regional city with a population of about 100,000) in the northern region of Tochigi Prefecture.

For baseline participant characteristics, we examined gender, age, height, weight, body mass index (BMI), or support care level, and medical history (cerebrovascular disease, dementia, cancer, diabetes, orthopedic disease, and intractable neurological disease) based on medical records from the ambulatory rehabilitation service.

To test physical performance, we measured the grip strength and gait speed. A dynamometer (digital grip dynamometer D-TKK5401, Takei Scientific Instruments Co., Ltd., Niigata, Japan) was used to measure the grip strength. The maximum value of the two measurements taken twice on each side in the chair sitting position with both upper limbs hanging down to the body side was used as the representative value. The gait speed was measured with the participants walking at a comfortable speed on an 11-m straight walkway consisting of a 5-m measurement section and a 3-m preliminary section set at both ends of the measurement section to avoid the effects of acceleration and deceleration. The speed was calculated on the basis of the amount of time required for the 5-m section. We measured the gait speed twice and used the average as the representative value. The participants used their walking aids that were used daily for the measurement.

The Mini Nutritional Assessment-Short Form (MNA-sf) was used to assess nutritional status. It consists of six survey items: (1) food intake, (2) weight loss, (3) mobility, (4) psychological stress and acute disease, (5) neuropsychological problems, and (6) Calf circumference, making it useful for nutritional screening of aging adults, with higher scores indicating better nutritional status[16].

The Asian Working Group for Sarcopenia 2019 algorithm was used to diagnose sarcopenia[17]. In the diagnostic algorithm, the skeletal muscle mass index (SMI) was defined as <7.0 kg/m^2 in males and <5.7 kg/m^2 in females on bioelectrical independence analysis (BIA). Participants who met the criteria low muscle mass and both low grip strength (<28 kg in males and <18 kg in females) and/or low gait speed (<1.0 m/s in males and females) were considered to have sarcopenia. In this study, the SMI was calculated by measuring the skeletal muscle mass of the extremities via the BIA method using a body composition analyzer (InBody520, InBody Japan Inc., Seoul, South Korea) and dividing it by height squared in meters.

The bone density was measured using an ultrasound bone mass measurement device (Benus Evo, Nihon Kohden Corporation, Tokyo, Japan). The Benus Evo measures the calcaneal speed of sound and broadband ultrasound attenuation using quantitative ultrasound (QUS) and calculates the young adult mean and T-score as indicators of the bone density. The QUS method cannot be used for a confirmed diagnosis of osteoporosis because it does not measure the bone mineral density

J. Phys. Ther. Sci. Vol. 34, No. 5, 2022

342

(BMD) and bone mineral content (BMC) directly; however, its findings are highly associated with the BMD and BMC measured using dual energy X-ray absorptiometry (DXA)[18]. Therefore, the participants with a T-score of ≤-2.5 in the QUS method were classified as having osteopenia by the World Health Organization (WHO) diagnostic criteria for osteoporosis[19] and with reference to a previous study[20]. Meanwhile, those who were determined to have sarcopenia and osteopenia were defined as having osteosarcopenia (Fig. 1). All measurements were performed by physical or occupational therapists.

The participants were divided into four groups: a control group (CO group: without sarcopenia and T-score of >-2.5), an only osteopenia group (OP group: without sarcopenia and T-score of ≤-2.5), an only sarcopenia group (SP group: with sarcopenia and T-score of >-2.5), and an osteosarcopenia group (OS group: with sarcopenia and T-score of ≤-2.5). The Kruskal–Wallis test or the χ^2 test was used to determine whether there were significant differences among the four groups in the collected data (gender, age, height, weight, BMI, support or care level, grip strength, gait speed, MNA-sf score, SMI, and T-score). Bonferroni's multiple comparison test or residual analysis was used to determine whether there were significant between-group differences in the collected data. A multiple regression analysis was also performed. The dependent variables were the BMI, support or care level, grip strength, gait speed, SMI, T-score, and MNA-sf score; the independent variables were the presence of osteopenia, sarcopenia, and osteosarcopenia. The multiple regression analysis was adjusted for age, gender, and medical history. All statistical analyses were performed using the SPSS software (version 23.0; IBM Corp., Tokyo, Japan). Statistical significance was set at p<0.05.

RESULTS

Of the 141 participants, 24 (17.0%) were included in the CO group, 35 (24.8%) in the OP group, 21 (14.9%) in the SP group, and 61 (43.3%) in the OS group. The prevalence of osteopenia and sarcopenia was 68.1% and 58.2%, respectively. The prevalence of osteopenia accompanied by osteosarcopenia was 63.5%, and the prevalence of sarcopenia accompanied by osteosarcopenia was 74.4%.

Significant differences were found in age, BMI, support or care level, grip strength, MNA-sf score, SMI, T-score, and medical history of diabetes among the four groups. Bonferroni's multiple comparison test showed between-group differences in age, BMI, support or care level, T-score, grip strength, MNA-sf score, and SMI with the OS group having significant differences in all the collected data compared with the CO group (Table 1).

In the multiple regression analysis of the adjusted model, osteosarcopenia was found to be significantly related to the BMI, support or care level, grip strength, gait speed, SMI, T-score, and MNA-sf score, resulting in a stronger association than osteopenia and sarcopenia (Table 2).

DISCUSSION

The prevalence of osteosarcopenia in older community-dwelling adults who do not need care or support aged 65 years and over in Japan ranges from 6.2% to 19.6%[21, 22]. The percentage of aging community-dwelling adults who do not need care or support with sarcopenia accompanied by osteosarcopenia was 58.5%[21]. In this study, the prevalence of osteosarcopenia was 43.3% among the older community-dwelling adults requiring support or care, and the prevalence of sarcopenia accompanied by osteosarcopenia was 74.4%, which was higher than that among aging adults who do not need care or support. As one of the occurrence factors of sarcopenia, daytime physical activity has been described previously to have an association[23, 24].
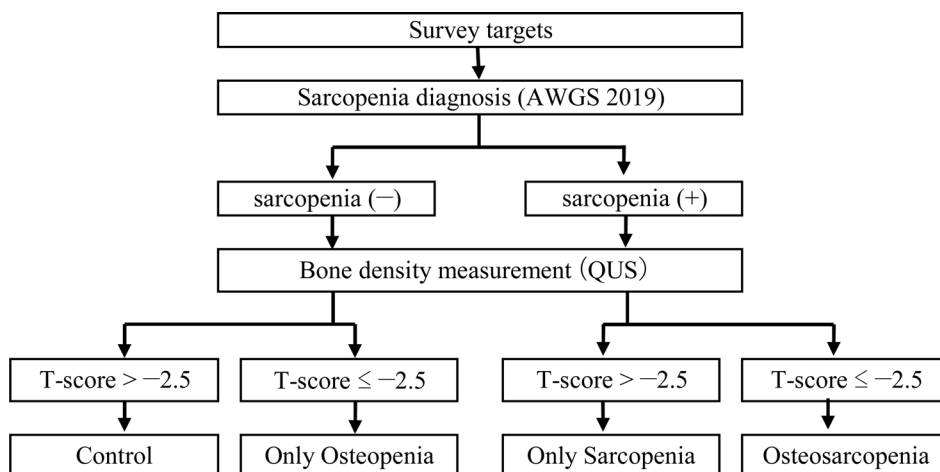

Fig. 1. Flow diagram depicting the study's participants selection.
AWGS 2019: Asian working group for sarcopenia 2019; QUS: Quantitative ultrasound.

Table 1. Comparison of patient characteristics among four groups: control, only osteopenia, only sarcopenia, and osteosarcopenia

	a) CO (n=24)	b) OP (n=35)	c) SP (n=21)	d) OS (n=61)	Multiple comparison
Female, n (%)[*]	8 (33.3)	22 (62.9)[**]	2 (9.5)[**]	25 (42.0)	
Age (years)[*]	71.8 ± 9.2	77.9 ± 8.4	77.6 ± 8.1	80.0 ± 8.2	a<d
BMI (kg/m^2)[*]	24.8 ± 3.4	23.9 ± 5.0	21.5 ± 2.4	21.4 ± 2.9	a>d
Support or care level (1−7)[†*]	1.5 (1.0−3.0)	3.0 (1.0−3.0)	3.0 (2.0−3.0)	3.0 (2.0−4.0)	a<d
Physical performance					
T-score[*]	−1.5 ± 1.0	−3.2 ± 0.5	−1.7 ± 0.6	−3.2 ± 0.5	a>b, a>d, c>b, c>d
Grip strength (kg)[*]	29.1 ± 9.4	22.2 ± 7.5	23.7 ± 7.3	19.6 ± 7.7	a>d
Gait speed (m/s)	0.9 ± 0.3	0.7 ± 0.4	0.7 ± 0.3	0.6 ± 0.3	
SMI (kg/m^2)[*]	7.6 ± 1.2	6.7 ± 0.8	6.1 ± 0.7	5.7 ± 0.7	a>c, a>d, b>d
MNA-sf (scores)[*]	13.0 ± 1.5	12.2 ± 1.2	12.0 ± 1.5	11.0 ± 2.5	a>d
Medical history, n (%)					
Cerebrovascular disease	17 (70.8)	18 (51.4)	14 (66.7)	31 (50.8)	
Dementia	2 (8.3)	5 (14.3)	1 (4.8)	6 (9.8)	
Cancer	3 (12.5)	5 (14.3)	4 (19.0)	13 (21.3)	
Diabetes[*]	5 (20.8)	7 (20.0)	10 (47.6)[**]	8 (13.1)[**]	
Orthopedic disease	10 (41.7)	21 (60.0)	8 (38.1)	31 (50.8)	
Intractable neurological disease	1 (4.2)	6 (17.1)	4 (19.0)	6 (9.8)	

[*]$p<0.05$. [**]Significant for residual analysis.
†: Median (25th percentile–75th percentile).
CO: control; OP: only osteopenia; SP: only sarcopenia; OS: osteosarcopenia; BMI: Body Mass Index; SMI: Skeletal Muscle Mass Index; MNA-sf: Mini Nutritional Assessment-Short Form.
Kruskal–Wallis test: age, height, weight, BMI, support or care level, T-score, grip strength, gait speed, SMI, MNA-sf score.
χ^2 test: gender, cerebrovascular disease, dementia, cancer, diabetes, orthopedic disease, intractable neurological disease.
Multiple comparison: Bonferroni's multiple comparison test.

Table 2. Multiple regression analysis (adjusted model) with the study item as the dependent variable and the presence or absence of only osteopenia, only sarcopenia, and osteosarcopenia as independent variables

	BMI (kg/m^2)	Support or care level	Grip strength (kg)
	β (SE)	β (SE)	β (SE)
OP	0.000 (0.984)	0.126 (0.358)	−0.098 (1.631)
SP	−0.234 (1.118)[*]	0.159 (0.407)	−0.226 (1.853)[*]
OS	−0.327 (0.899)[*]	0.424 (0.327)[*]	−0.406 (1.490)[*]
	R^2=0.166	R^2=0.086	R^2=0.536
	Gait speed (m/s)	SMI (kg/m^2)	T-score (score)
	β (SE)	β (SE)	β (SE)
OP	−0.197 (0.092)	−0.182 (0.173)	−0.744 (0.171)[*]
SP	−0.189 (0.104)	−0.574 (0.197)[*]	−0.077 (0.194)
OS	−0.393 (0.084)[*]	−0.802 (0.158)[*]	−0.842 (0.156)[*]
	R^2=0.089	R^2=0.674	R^2=0.607
	MNA-sf (score)		
	β (SE)		
OP	−0.118 (0.524)		
SP	−0.143 (0.595)		
OS	−0.461 (0.479)[*]		
	R^2=0.190		

[*]$p<0.05$.
OP: only osteopenia; SP: only sarcopenia; OS: osteosarcopenia; BMI: Body Mass Index; SMI: Skeletal Muscle Mass Index; MNA-sf: Mini Nutritional Assessment-Short Form; SE: standard error.
Adjusted: gender, age, cerebrovascular disease, dementia, cancer, diabetes, orthopedic disease, intractable neurological disease.

J. Phys. Ther. Sci. Vol. 34, No. 5, 2022

344

Older community-dwelling adults requiring support or care have diseases or disabilities and lower physical performance and ADL performance than aging adults who do not need care or support[25]. The prevalence of sarcopenia ranges from 1% to 29% in community-dwelling populations and from 14% to 33% in long-term care populations[26]. Older adults requiring long-term care are at a high risk for fragility fractures and are not treated for osteoporosis[27]. Some previous studies showed that osteoporosis strongly increases the risk of sarcopenia and vice versa[28–30]. Therefore, older community-dwelling adults requiring support or care are more likely to be at a risk for osteosarcopenia than older adults who do not need care or support.

In the four-group comparison and the multiple comparison test, T-score of the OP group were significantly lower than those of the CO group. The SMI of the SP group were significantly lower than those of the CO group. This is expected because the T-score in the OP group and SMI in the SP group were used as criteria for grouping. The OS group had not only significantly lower SMI and T-score but also higher age and support or care level and lower BMI, grip strength, and MNA-sf score than the CO group. In addition, a multiple regression analysis was performed to understand the association of the collected data with osteopenia, sarcopenia, and osteosarcopenia. As a result, only osteosarcopenia was related to the support or care level, gait speed, and MNA-sf score. These results show that osteopenia in the older adults requiring support or care, which has not been investigated before, is more tightly associated with lower physical function and nutritional status than only sarcopenia or osteopenia. This is similar to previous studies of older adults who did not need care or support. In addition, a new finding of this study suggested an association with the care level.

Limited participation owing to the conduct of the study in a single facility with an ambulatory rehabilitation program is a limitation of our study. The LTCI system provides various services, including daycare, home-visit care, and home-visit rehabilitation, for livelihood support to older adults requiring support or care. As the target users for these various services may have different care levels, physical performance, and ADL performance, the results of the study may not often be the case with older community-dwelling adults requiring support or care who use other services. We used the QUS method, which cannot diagnose osteoporosis, instead of the DXA method, which is the standard for bone densitometry. Moreover, the study had a cross-sectional design, which could not allow an explanation of the causal connection between osteosarcopenia and physical performance, nutritional status, and support or care level. Moreover, there are two possible pathways: from osteoporosis to osteosarcopenia and from sarcopenia to osteosarcopenia. A longitudinal survey is necessary to clarify this. With many aspects of osteosarcopenia being as yet uncertain, the findings of osteosarcopenia targeted at older community-dwelling adults requiring support or care are valuable. Assessment of osteosarcopenia is important to prevent the onset of diseases and to maintain life functions in older community-dwelling adults requiring support or care. Further longitudinal studies are needed to examine the associations with negative health outcomes, such as death and a higher level of care. It is necessary to explore the factors that are important to prevent ambulatory rehabilitation users from progressing from only sarcopenia or only osteopenia to osteosarcopenia. In conclusion, the prevalence of osteosarcopenia in older community-dwelling adults requiring support or care is high, suggesting a possible greater effect not only on physical performance but also on nutritional status, and support or care level than that of only sarcopenia or only osteopenia.

Conflict of interest

The author declares no conflict of interest.

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J. Phys. Ther. Sci. Vol. 34, No. 5, 2022

346