Original Article

Possible sarcopenia and its risk factors in a home for seniors in Shanghai

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Background and Objectives: The Asian Working Group for Sarcopenia (AWGS) recommended various measures for identifying patients with possible sarcopenia in its 2019 consensus. The present survey aimed to assess older adults in a senior home to determine the prevalence and associated factors for possible sarcopenia and to compare the differences between various assessment pathways based on AWGS 2019 criteria. **Methods and Study Design:** This cross-sectional study examined 583 participants of a senior home. Patients with possible sarcopenia were determined through the following four pathways: [I] calf circumference (CC) + handgrip strength (HGS); [II] SARC-F+HGS; (III) SARC-CalF+HGS; and (IV) CC, SARC-F, and/or SARC-CalF+HGS. **Results:** The four assessment pathways revealed a high prevalence of possible sarcopenia in the older adults in the senior home ([I]=50.6%; [II]=46.8%; [III]=48.2%; [IV]=65.9%). There is significant difference in prevalence between pathway IV and the other pathways (p<0.001). A multivariate analysis revealed that advanced age, risk of malnutrition, malnutrition, high level of care, an exercise frequency of <3 times per week, and osteoporosis were correlated with a higher risk of possible sarcopenia. By contrast, oral nutritional supplements (ONS) reduced the risk of possible sarcopenia. **Conclusions:** This survey reported a high prevalence of possible sarcopenia in the older adults of the senior home and determined the associated influencing factors. Furthermore, our findings suggested that pathway IV is the most suitable pathway for the examined older adults which enabled the detection and early intervention of more possible sarcopenia.

Key Words: AWGS 2019, older adult, prevalence, risk factors, sarcopenia

INTRODUCTION

Sarcopenia is a progressive and systemic skeletal muscle disease involving the accelerated loss of muscle mass, strength, and physical function. It is associated with numerous adverse outcomes, such as falls, decreased immunity, frailty, and increased risk of chronic disease and mortality.[1,2] The etiology of sarcopenia is complex, and its specific pathological mechanism has yet to be elucidated. Among the numerous causes of sarcopenia, the primary one is aging. Studies have reported that the median loss of annual muscle quality throughout the lifespan of an individual is 0.37% for women and 0.47% for men, and among the population aged ≥75 years, the rate of annual muscle quality loss is 0.64%−0.70% for women and 0.80%−0.98% for men.[3] In addition to aging, sarcopenia can be secondary to decreased physical activity, malnutrition, and disease.[4] The risk factors faced by an individual increase with age; consequently, the risk of sarcopenia becomes higher, and the level of harm increases. Enhanced health benefits can be gained through early detection and intervention.

The concept of "possible sarcopenia" was introduced by the Asian Working Group for Sarcopenia in its 2019 consensus (AWGS 2019) for Asian populations, which provided primary institutions with a basis for the practical and feasible diagnosis of sarcopenia.[5] Decreased muscle strength is a key symptom of sarcopenia, which is central to the diagnosis of sarcopenia and advantageous in predicting adverse outcomes.[4] The AWGS 2019 consensus recommends the process of "case finding to assessment," that is, screening the population calf circumference (CC) measurements as well as SARC-F and (or) SARC-CalF questionnaires during the case identification stage, followed by a handgrip strength (HGS) test for the screen-

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positive population to identify patients with possible sarcopenia. However, the presence of differences between these pathways requires verification.

In the current study, a possible sarcopenia assessment based on the four aforementioned pathways was conducted for older adults aged ≥60 years from a senior home in Shanghai. The detection rates obtained through various pathways were compared, and the factors associated with possible sarcopenia were explored.

METHODS

Participants and general data collection

This survey was a cross-sectional study on all the residents of a senior home in Changning District, Shanghai (n = 585; Figure 1). Details and some results of this survey have been reported elsewhere.[6] Briefly, through a combination of questionnaires and face-to-face interviews, data on several aspects associated with the participants were collected, including demographics, exercise frequency per week, level of nursing care, medical history, type of diet, use of nutritional supplements, and use of medications. Taking five or more drugs per day was regarded as polypharmacy.[7] The nutritional status of the older adults was assessed using the Mini Nutritional Assessment Short Form (MNA-SF).[8] The study protocol was approved by the Research Ethics Committee of Huadong Hospital affiliated to Fudan University (approval number: 2020K178). All participants provided written informed consent for participation.

Case finding

SARC-F is a questionnaire for conducting a rapid assessment of sarcopenia. It comprises five items, including lifting and carrying a 10-lb weight, walking across a room, getting up from a bed or chair, climbing 10 stair steps, and the number of falls in the previous year.[9] It is scored from 0 to 10, with scores of ≥4 indicating an abnormal status.

The CC at the widest point of the calf was measured using a non-elastic tape measure while a participant is in a sitting position and their knee flexed at 90°. The SARC-CalF questionnaire incorporates CC into the SARC-F questionnaire to considerably improve the sensitivity and specificity of the SARC-F questionnaire.[10] SARC-CalF scores range from 0 to 20, and scores of ≥11 indicate an abnormal status. In accordance with the recommendations of the AWGS 2019 consensus, a CC of <34 cm for men, a CC of <33 cm for women, SARC-F score of ≥4, or SARC-CalF score ≥11 can be used to identify sarcopenia cases.[5]

Handgrip strength measurement

Handgrip strength (HGS) was measured using a digital hand dynamometer (CAMRY EH101, Guangdong, China).[11] During the testing process, an older adult participant was in a standing position with their arms drooping naturally and their elbows extended, and they are asked to use their dominant hand to squeeze the dynamometer handle with maximum strength. The test was performed at least twice, and the maximum reading was used. If the older adult participant could not stand independently, a sitting position was adopted for the measurement. In accordance with the AWGS 2019 consensus, low muscle strength is defined as a handgrip strength of <28 kg for men and <18 kg for women.[5]

Possible sarcopenia

In accordance with the AWGS 2019 consensus, patients with possible sarcopenia are identified through the following four pathways:

(I) CC+HGS (abnormal CC and HGS);

(II) SARC-F+HGS (SARC-F ≥4 and abnormal HGS);

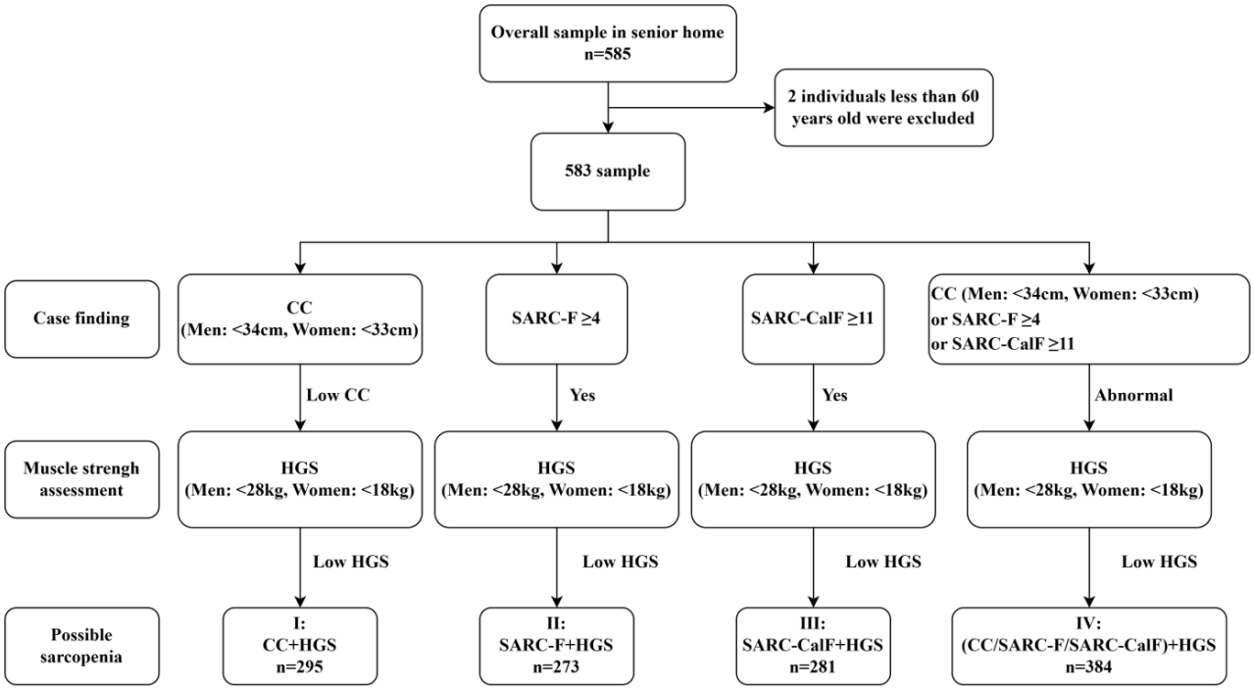

Figure 1. Flowchart for participant inclusion. CC: calf circumference; HGS: handgrip strength: CC+HGS: low CC and low HGS; SARC-F+HGS:SARC-F ≥4 and lowHGS; SARC-CalF+HGS: SARC-CalF ≥11 and low HGS; (CC/SARC-F/SARC-CalF)+HGS: (low CC or SARC-F ≥4 or SARC-CalF ≥11) and low HGS.

(III) SARC-CalF+HGS (SARC-CalF ≥11 and abnormal HGS);

(IV) CC, SARC-F, and/or SARC-CalF+HGS (abnormal HGS in any screen-positive individual who was identified through CC screening in combination with the SARC-F and SARC-CalF questionnaires in combination).

Statistical methods

Statistical analysis was performed using SPSS Statistics 26.0 (IBM, Armonk, New York, USA). Data were presented as means ± standard deviations or percentage values. Continuous variables were analyzed using Student's t-test or Mann-Whitney U test, and categorical variables were analyzed using Pearson's chi-square test or Fisher's exact test. The McNemar chi-square test was used to test for differences in the prevalence of possible sarcopenia obtained through different detection pathways. A two-tailed p value of <0.05 was regarded as statistically significant. The associated factors for possible sarcopenia were estimated using the OR for binary logistic regression and 95% CI. Variables that were revealed to have a p value of <0.1 through univariate analysis (Pearson's chi-square test) were included in a binary logistic regression model (Forward: LR).

RESULTS

Characteristics of the subjects and prevalence of possible sarcopenia

In total, 583 older adults (mean age=86.0±6.6 years) participated in the present study; they comprised 204 (35.0%) male participants with a mean age of 85.2±7.8 years and 333 (65.0%) female participants with a mean age of 86.4±5.8 years. On the basis of the four assessment pathways, the prevalence of possible sarcopenia in the participating older adults from the nursing home was high ([I]=50.6%; [II]=46.8%; [III]=48.2%; [IV]=65.9%; Figure 2). For all four pathways, the difference in prevalence between the two sexes was nonsignificant (p>0.05), and the difference in prevalence between pathway IV and the other pathways was significant (p<0.001).

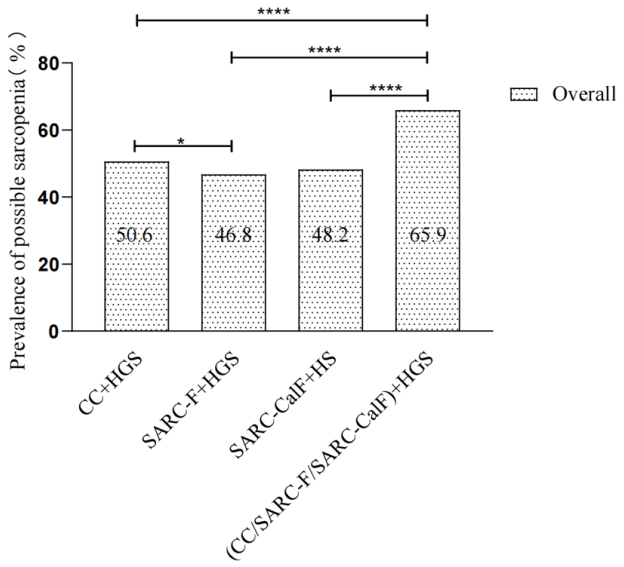

Figure 2. Prevalence of possible sarcopenia. CC: calf circumference; HGS: handgrip strength; CC+HGS: low CC and low HGS; SARC-F+HGS: SARC-F ≥4 and lowHGS; SARC-CalF+HGS: SARC-CalF ≥11 and low HGS; (CC/SARC-F/SARC-CalF)+HGS: (low CC or SARC-F ≥4 or SARC-CalF ≥11) and low HGS. $^{*}p$<0.05; $^{***}p$<0.001.

Risk factors for possible sarcopenia

The association between these characteristics and possible sarcopenia, as determined by pathway IV, was analysed in the subsequent steps. The participants with and without possible sarcopenia were aged 87.0±6.1 years and 83.9±7.0 years, respectively (Table 1). The prevalence of possible sarcopenia increased with age (60-69 years: 37.5%, 70-79 years: 51.4%, ≥80 years: 68.8%). Relative to the participants without possible sarcopenia, the mean age of the participants with possible sarcopenia was higher (p<0.001), and their mean MNA-SF score (p<0.01) was lower. The prevalence of possible sarcopenia increased with the deterioration of nutritional status (p<0.001). Significant differences were observed for level of care, exercise frequency, type of diet, use of protein powder, use of mineral and vitamin supplements, and use of oral nutritional supplemen (ONS) between the participants with possible sarcopenia and those without possible sarcopenia (p<0.05). Compared with the participants without possible sarcopenia, the prevalences of dysphagia, stroke, Alzheimer's disease, osteoporosis, and fractures in the participants with possible sarcopenia were higher (p<0.05).

Independent factors influencing possible sarcopenia risk

Variables that were revealed to have a p value of <0.10 through the univariate analysis were included in the multivariate analysis model. The p value of this model as obtained through the H−L test was 0.9. Table 2 reveals that the incidence of possible sarcopenia was associated with aging (OR=2.7; 95% CI=1.5–4.9). Malnutrition exacerbated the progression of sarcopenia. Compared with having a normal nutritional status, being at risk of malnutrition (OR=3.8; 95% CI=2.4–6.1) and having malnutrition (OR=24.4; 95% CI=3.1–188.7) enhanced the risk of possible sarcopenia. The likelihood of having possible sarcopenia (OR=2.1; 95% CI=1.2–3.6) was higher in participants who received a high level of nursing care. Moreover, the participants who exercised fewer than three times per week were at a higher risk of possible sarcopenia (OR=3.7; 95% CI=2.2–6.1) than those who exercised at least three times per week. Furthermore, osteoporosis was a risk factor for possible sarcopenia (OR=1.8; 95% CI=1.1–2.9). By contrast, ONS was a protective factor against sarcopenia (OR=0.5; 95% CI=0.3–0.9).

DISCUSSION

Sarcopenia is a progressive process, and early detection and intervention are key measures for delaying the development of sarcopenia. On the basis of the possible sarcopenia assessment process recommended by the AWGS 2019 consensus, the present survey was conducted with the primary aim of assessing muscle strength. On the basis of the four assessment pathways, the prevalence of possible sarcopenia was revealed to be high in the participating older adults from the senior home. For all exam-

Table 1. Characteristics of participants†

Characteristic	Possible sarcopenia n=384	No sarcopenia n=199	*p* value
Age (year) (mean±sd)	87.0±6.1	83.9±7.0	<0.001
Age (year) (n [%])			
60~<80	42 (10.9%)	44 (22.1%)	<0.001
≥80	342 (89.1%)	155 (77.9%)	
MNA-SF, (mean±sd)	10.4±2.5	12.4±1.3	<0.001
Nutritional status (n [%])			
Normal nutritional status	145 (37.8%)	159 (79.9%)	<0.001
At risk of malnutrition	179 (46.6%)	39 (19.6%)	
Malnutrition	60 (15.6%)	1 (0.5%)	
High level of nursing care (n [%])	353 (91.9%)	140 (70.4%)	<0.001
Exercise frequency (number of times per week; n [%])			
≥3	164 (42.7%)	172 (86.4%)	<0.001
<3	220 (57.3%)	27 (13.6%)	
Polypharmacy (n [%])	192 (50.0%)	89 (44.7%)	0.227
General dietary (n [%])	245 (63.8%)	156 (78.4%)	<0.001
Protein powder (n [%])	48 (12.5%)	14 (7.0%)	0.042
Minerals and vitamin supplements (n [%])	42 (10.9%)	38 (19.1%)	0.007
ONS (n [%])	30 (7.8%)	37 (18.6%)	<0.001
History of tumors (n [%])	19 (4.9%)	16 (8.0%)	0.136
Dysphagia (n [%])	65 (16.9%)	7 (3.5%)	<0.001
Stroke (n [%])	196 (51.0%)	75 (37.7%)	0.002
Alzheimer's disease (n [%])	150 (39.1%)	34 (17.1%)	<0.001
Osteoporosis (n [%])	109 (28.4%)	32 (16.1%)	0.001
Chronic bronchitis (n [%])	48 (12.5%)	17 (8.5%)	0.150
Lumbar disease (n [%])	44 (11.5%)	13 (6.5%)	0.058
Parkinson's syndrome (n [%])	17 (4.4%)	3 (1.5%)	0.066
History of fractures (n [%])	31 (8.1%)	7 (3.5%)	0.035
COPD (n [%])	16 (4.2%)	5 (2.5%)	0.309
Renal insufficiency (n [%])	25 (6.5%)	7 (3.5%)	0.132

ONS: oral nutritional supplement; COPD: chronic obstructive pulmonary disease.
†Possible sarcopenia was determined by pathway IV.

Table 2. Results of multivariate logistic regression †

Variables	OR (95% CI)	*p* value
Age (year)		
<80	1	
≥80	2.7 (1.5-4.9)	0.001
Nutritional status		
Normal nutritional status	1	
At risk of malnutrition	3.8 (2.4-6.1)	
Malnutrition	24.4 (3.1-188.7)	0.002
High level of nursing care		
No	1	
Yes	2.1 (1.2-3.6)	0.006
Exercise frequency (number of times per week)		
≥3	1	
<3	3.7 (2.2-6.1)	<0.001
ONS		
No	1	
Yes	0.5 (0.3-0.9)	0.019
Osteoporosis		
No	1	
Yes	1.8 (1.1-2.9)	0.026

ONS: oral nutritional supplement
†Possible sarcopenia was determined by pathway IV.

ined pathways, the difference in prevalence between male and female participants was nonsignificant. Moreover, our findings revealed that a higher prevalence was obtained through pathway IV than through the other three pathways, demonstrating that the pathway IV could more adequately identify cases of possible sarcopenia than the other pathways did and facilitate the early intervention and referral of patients. However, this conclusion requires the support of further clinical evidence to verify the reproducibility and operability of the pathway.

The prevalence of possible sarcopenia varies among studies because of their differences in terms of partici-

pants and diagnostic criteria.[12] In a study conducted in Japan, 1792 residents aged 65–74 years were evaluated using pathway I; the results revealed to have a prevalence of possible sarcopenia of 2.9%.[13] The prevalence obtained through our survey is higher, which is probably related to the older age of the participants of the present study. Furthermore, our survey combined and applied three screening instruments for the case identification stage, which probably resulted in a higher prevalence of possible sarcopenia in our survey relative to other studies.

Moreover, our survey analyzed the factors associated with possible sarcopenia. Sarcopenia is known as a disease that involves the age-related loss of muscle mass, strength, and physical function. Our survey results revealed that the prevalence of possible sarcopenia increased with age (Figure 2), and that the risk of possible sarcopenia in the participants aged ≥80 years was 2.7 times that in the participants aged <80 years. Our results are similar to those obtained by a cross-sectional study in China that examined 4866 residents aged ≥60 years; it reported aging as a risk factor for probable sarcopenia and compared residents aged 60–69 years, 70–80 years (OR = 1.8; 95% CI = 1.4–2.5), and >80 years (OR = 3.7; 95% CI = 1.9–7.5).[14] Senescence-induced muscle loss has a negative effect on the function of the swallowing-related muscle groups, which leads to sarcopenic dysphagia;[15] individuals who are affected by this condition exhibit reduced oral intake and an increased risk of malnutrition, leading to weight loss and the disruption of skeletal muscle synthesis, which further promote the development of sarcopenia.[16] The univariate analysis conducted for our survey revealed the association of possible sarcopenia with dysphagia, but the multivariate analysis did not reveal a significant difference. Further clinical evidence is required to clarify the complex relationship between sarcopenia and dysphagia.

Adequate nutrition is a foundation of healthy aging. It should be pointed out that sarcopenia and malnutrition share some of the same pathophysiological basis, such as low-inflammatory state and negative nitrogen balance. Sarcopenia can be induced many factors such as energy or protein malnutrition, and it is commonly observed in individuals with anorexia, malabsorption, lacking dietary supplements, and limited food intake ability.[4] On the other hand, muscle mass decreasing a component of sarcopenia is also a component in the definition of malnutrition.[17] Sarcopenia and malnutrition are more common in the elderly. These two diseases are two intertwined conditions that interact with each other, and eventually fall into a vicious circle (Figure 3). Our previously reported findings show that possible sarcopenia is an independent risk factor for malnutrition.6 In this study, compared with the participants with a normal nutritional status, those with malnutrition or at the risk of malnutrition may have possible sarcopenia. There are high overlap rates of malnutrition risk and malnutrition with possible sarcopenia, with the prevalence of sarcopenia among the participants at malnutritional risk or with malnutrition reaching 82.1% and 98.4%, respectively. Similarly, a study conducted in Turkey surveyed 909 community-dwelling older adults aged ≥65 years by using the European Working Group on Sarcopenia in Older People 1 (EWGSOP1) and MNA-SF models.[18] Its results revealed that the risk of sarcopenia among the participants who had nutritional risk or malnutrition was increased by 8 times.[18] Active nutritional intervention is essential for alleviating sarcopenia. Our survey identified ONS use as a beneficial factor for possible sarcopenia in older adults. Clinical studies have indicated

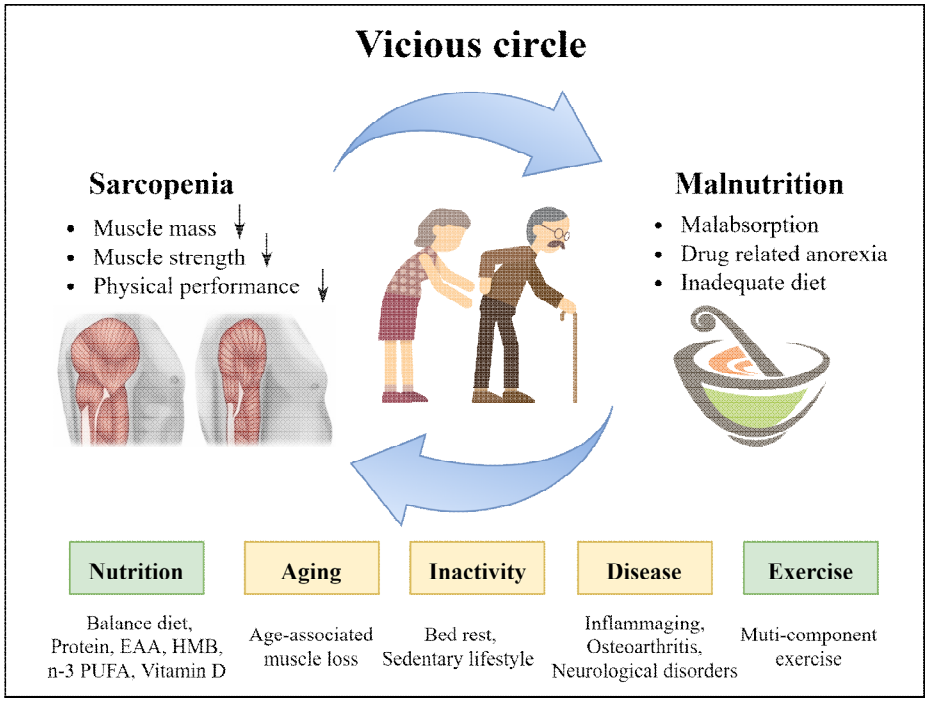

Figure 3. The relationship between sarcopenia and malnutrition. Sarcopenia and malnutrition are common problems in older people. Under the influence of aging, inactivity and diseases, sarcopenia and malnutrition fall into a vicious circle, increasing the susceptibility to diseases and mortality of patients. Whereas, appropriate nutrition and exercise intervention can delay the development of negative situations.

that ONS use can influence the musculoskeletal health of older patients with sarcopenia by improving their physical function; increasing the bone density, skeletal muscle mass, and strength in their extremities; and alleviating their chronic low-grade inflammation.[19-22]

Whether it is due to a sedentary lifestyle or disease-related bed rest or disability, the lack of physical inactivity contributes to the incidence of sarcopenia.[23] Our results suggest that exercising fewer than three times per week increases the risk of possible sarcopenia; this finding is consistent with that reported by a cross-sectional study conducted by Miura et al., who reported that exercise reduces the risk of possible sarcopenia.[13]

After confounding factors were removed, our survey results indicated that a high level of nursing care was associated with a 2.1 times increase in the risk of possible sarcopenia; this finding was probably due to the poor self-care ability of the older adults who received high-level nursing care because of their diseases, which reduced their quality of life and in turn exacerbated their muscle loss. Similarly, our survey indicated that osteoporosis caused the risk of possible sarcopenia to increase by 1.8 times. Muscle health and bone health are closely related. Both involve an underlying pathologic basis and interact in terms of genealogical regulation, endocrine, and mechanical action. The presence of osteoporosis leads to declined muscle health and initiates a vicious circle of health deterioration.[24]

Our survey has several contributions. First, in accordance with the AWGS 2019 consensus, a possible sarcopenia survey of older adults in a senior home was conducted, and the differences in the results obtained through different assessment pathways were analyzed. Multiple screening instruments were combined and used to assess the older adult population, and a further HGS assessment of the screen-positive population was conducted; this model allowed for more possible sarcopenia cases to be identified, thereby facilitating early interventions and referrals. Second, our survey revealed several factors associated with possible sarcopenia; these factors can be considered in the prevention and treatment of possible sarcopenia among older adults.

Nevertheless, our survey has some limitations. Although the combined use of multiple screening instruments and further assessment of the HGS of the screen-positive population allowed for more possible sarcopenia cases to be identified, further clinical evidence is required to verify the generalizability of the results and the operability of the method. Second, because the participants examined in our survey were individuals aged ≥60 years from a senior home, further research is required to determine whether the findings are applicable to community-dwelling populations or other types of populations. Third, our survey is a cross-sectional study with a small sample size, thus prospective studies and clinical trials with larger sample sizes are required to verify the causes of possible sarcopenia.

In conclusion, this survey reported a high prevalence of possible sarcopenia in the older adults of the senior home and determined the associated influencing factors. Furthermore, our findings suggested that pathway IV is the most suitable pathway for the examined older adults. It enabled the detection of more possible sarcopenia cases as well as early intervention and referral cases relative to the other pathways. Further clinical evidence is required to support this viewpoint.

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AUTHOR DISCLOSURES

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