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Original Article

Indicators predicting the development and improvement of sarcopenia in older adults requiring long-term care

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Abstract. [Purpose] This study aimed to identify factors associated with sarcopenia development and improvement among older adults requiring long-term care. [Participants and Methods] This prospective observational study included 118 older adults requiring long-term care in a single facility. Sarcopenia was assessed according to the 2019 diagnostic criteria of the Asian Working Group for Sarcopenia at baseline and after 6 months. Nutritional status was measured using calf circumference and the Mini Nutritional Assessment-Short Form to examine the association between sarcopenia onset and improvement. [Results] Risk of malnutrition and lower calf circumference at baseline were significantly associated with sarcopenia development. The study also showed that a non-risk of malnutrition, higher calf circumference, and higher skeletal muscle mass index were significantly associated with improved sarcopenia. [Conclusion] The Mini Nutritional Assessment-Short Form and calf circumference were able to predict sarcopenia development and improvement in older adults requiring long-term care.
Key words: Nutrition, Sarcopenia, Long term care

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INTRODUCTION

The world's population is aging rapidly, and the aging rate, or the percentage of the world's population aged 65 and over, has risen from 5.1% in 1950 to 9.3% in 2020. This trend is expected to increase further over the next 40 years to 17.8% by 2060[1)]. Sarcopenia is an extremely important concept in such an aging society. Sarcopenia is defined as loss of muscle strength and skeletal muscle mass[2)]. It is reportedly associated with decreased physical function, increased medical costs, and even increased mortality[3, 4)]. Its prevalence among older adults in Japan ranges from 7.5–8.2%[5, 6)], but increases to 41.7% in older adults with various diseases requiring long-term care[7)]. This means that the prevalence of sarcopenia is higher in older adults requiring long-term care than in the general older adult population, and early assessment and intervention to prevent or improve sarcopenia in older adults requiring long-term care is a crucial.

The World Health Organization (WHO) declared a COVID-19 pandemic in March 2020, and the COVID-19 pandemic is likely to negatively impact the nutrition and physical activity behaviors of many older adults[8)]. Nutrition is considered a

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modifiable factor in sarcopenia development, suggesting that nutrition-based interventions may be useful in the prevention of sarcopenia[9]. However, to the best of our knowledge, factors associated with the development and improvement of sarcopenia in older adults requiring long-term care are unknown. Therefore, we hypothesized that nutritional status is associated with the development and improvement of sarcopenia in older adults requiring long-term care. We aimed to explore and identify predictors of sarcopenia development and improvement using baseline data.

PARTICIPANTS AND METHODS

The participants of this study were 118 older adults who visited the daycare for adults between March 2020 and September 2022, who were eligible for Japan's long-term care insurance system[10], and who used daycare rehabilitation services. The inclusion criterion was the use of the facility on the measurement dates between March 2020 and September 2022. Exclusion criteria were (1) under 65 years of age, (2) those who had difficulty understanding test instructions, (3) those who had difficulty standing and walking, and (4) those who could not repeat test measurements 6 months after the initial measurements. This study was approved by the Ethics Review Committee of the International University of Health and Welfare (Approval No.: 21-Io-22,17-Io-189-7). Written informed consent was provided by all participants (or their family members).

This prospective cohort study included participants who completed a baseline assessment of nutrition and sarcopenia and a 6-month follow-up assessment of sarcopenia. Sarcopenia was defined according to the Asian Working Group for Sarcopenia 2019 (AWGS2019)[11], and the study participants were classified into two groups: sarcopenia (severe sarcopenia and sarcopenia) and non-sarcopenia groups. Skeletal muscle mass index was measured by the bioelectrical impedance method (hereafter, BIA method) using a body composition analyzer (InBody520, InBody, Seoul, South Korea). Grip strength was measured using a grip strength meter (Takei Kiki Kogyo, model TKK5401 Grip-D, Niigata, Japan). Measurements were taken twice in the sitting position, and the maximum value was taken as the representative value. Walking speed was calculated from the usual walking speed between 3 m and 8 m (5 m) while walking straight on an 11 m walking path. Walking aids were those that were normally used in daycare for adults. In this study, sarcopenia was assessed at baseline and after six months. participants whose condition progressed from non-sarcopenia to sarcopenia were defined as developing sarcopenia and those whose condition progressed from sarcopenia to non-sarcopenia were defined as improving sarcopenia.

The Mini Nutritional Assessment-Short Form (MNA-SF) was used to assess the nutritional status[12]. The MNA-SF is useful for nutritional screening of the older adults within a short period and comprises six questions. In this study, a score of less than 12 indicates malnutrition risk[13]. Calf circumference was measured once on each side using a measuring tape, and the maximum value was considered representative.

Age, gender, height, care level, and pre-existing conditions were obtained from the facility's medical records. Pre-existing conditions were diagnosed by a physician.

Comparison of baseline basic attributes between the group that developed sarcopenia and the group that did not (and comparison of baseline attributes between the groups with and without sarcopenia improvement) was performed using the χ^2 test and Mann–Whitney's U test. All statistical analyses were performed using Statistical Package for the Social Sciences Statistics (Version 25, International Business Machines Corporation, Armonk, NY, USA). Statistical significance was set at $p<0.05$.

RESULTS

Figure 1 illustrates a change in sarcopenia status after 6 months in eligible participants. Table 1 lists baseline factors associated with the development of sarcopenia (and baseline factors associated with sarcopenia improvement). Of 54 older adults requiring long-term care who used day rehabilitation and did not present with sarcopenia, 47 did not develop sarcopenia while 7 did. In a baseline group comparison between the non-sarcopenia and sarcopenia groups, the sarcopenia group

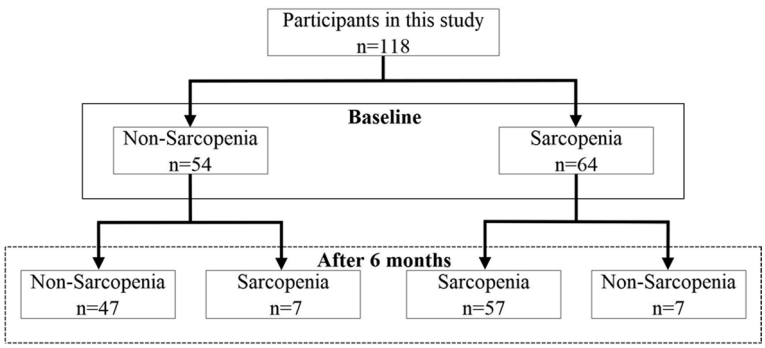

Fig. 1. Change in sarcopenia status after 6 months in eligible participants.

Table 1. Comparison of baseline attributes in the development and improvement of sarcopenia

	NonSar-NonSar (n=47)	NonSar-Sar (n=7)	p	Sar-Sar (n=57)	Sar-NonSar (n=7)	p
Gender female (%)	46.8	28.6		35.1	28.6	
Age (years)	78.4 ± 6.5	80.0 ± 7.9		80.1 ± 6.9	78.3 ± 9.6	
Height (cm)	160.2 ± 9.2	160.8 ± 7.2		158.0 ± 8.1	162.2 ± 8.0	
Weight (kg)	61.9 ± 10.1	54.4 ± 8.9		54.0 ± 7.9	59.3 ± 8.0	
BMI (kg/m^2)	24.1 ± 3.9	21.0 ± 2.9		21.7 ± 2.7	22.5 ± 2.5	
LTCI support level 1 (%)	38.3	28.6		28.1	14.3	
support level 2 (%)	12.8	42.9		10.5	14.3	
care level 1 (%)	34.0	14.3		31.6	57.1	
care level 2 (%)	12.8	14.3		22.8	14.3	
care level 3 (%)	2.1	0.0		7.0	0.0	
care level 4 (%)	0.0	0.0		0.0	0.0	
care level 5 (%)	0.0	0.0		0.0	0.0	
SMI (kg/m^2)	7.1 ± 0.9	6.7 ± 0.9		5.8 ± 0.7	6.3 ± 0.6	*
Grip strength (kg)	25.4 ± 9.6	21.4 ± 6.0		20.4 ± 6.4	24.7 ± 8.3	
Gait speed (m/s)	0.8 ± 0.3	0.9 ± 0.2		0.7 ± 0.2	0.7 ± 0.4	
Calf circumference (cm)	36.0 ± 2.9	32.5 ± 3.3	*	32.3 ± 2.8	34.7 ± 2.3	*
At risk and malnutrition (%)	29.8	71.4	*	57.9	14.3	*
Cardiovascular disease (%)	12.8	14.3		36.8	14.3	
Respiratory disease (%)	10.6	28.6		12.3	0.0	
Cerebrovascular disease (%)	57.4	28.6		52.6	42.9	
Orthopedic diseases (%)	48.9	57.1		50.9	28.6	
Malignant tumor (%)	12.8	14.3		19.3	42.9	
Intractable neurological disease (%)	12.8	14.3		10.5	0.0	
Osteoporosis (%)	6.4	14.3		10.5	28.6	
Diabetes mellitus (%)	21.3	14.3		29.8	28.6	
Hypertension (%)	40.4	28.6		47.4	42.9	

Data are denoted as mean ± SD. Mann–Whitney U test, and χ^2 test were used to examine differences in baseline basic attributes in the development and improvement of sarcopenia.
NonSar-NonSar: non-sarcopenia-onset group; NonSar-Sar: Sarcopenia-onset group; Sar-Sar: non-sarcopenia-improvement group; Sar-NonSar: Sarcopenia improvement group; BMI: Body Mass Index; LTCI: long-term care insurance; SMI: Skeletal Muscle Mass Index.
*p<0.05.

had a significantly higher rate of the risk of malnutrition and a significantly lower calf circumference. Of 64 older adults requiring long-term care who used day rehabilitation and presented with sarcopenia, 54 did not show improvement, while 7 did. Comparison of baseline characteristics between the non-improved and improved sarcopenia groups showed that the improved sarcopenia group had significantly lower rates of the risk of malnutrition and significantly higher calf circumference and skeletal muscle mass index.

DISCUSSION

The study showed that the risk of malnutrition and low calf circumference at baseline were significantly associated with the development of sarcopenia. The study also showed that non-risk of malnutrition, higher calf circumference, and higher skeletal muscle mass index were significantly associated with improved sarcopenia. To the best of our knowledge, this is the first study to identify predictive indices for the development and improvement of sarcopenia in older adults requiring long-term care.

Malnutrition is a strong predictor of sarcopenia development in older adults, and many reports have indicated that nutritional status is a modifiable factor in sarcopenia[14–16]. There is a strong association between muscle health and malnutrition, and early detection of older adults at risk of malnutrition can prevent the development of sarcopenia, and closer observation in at-risk groups is required[17]. A controlled study of older adults requiring long-term care who presented with sarcopenia reported a 5% increase in muscle mass after three months in the group that received nutritional support, while the group that did not receive nutritional support remained unchanged[18]. These findings suggest that assessment interventions for nutrition may prevent or improve sarcopenia in older adults requiring long-term care.

In nutrition assessment and diagnosis, international surveys report that the Mini Nutritional Assessment and MNA-SF are the most frequently used tools for nutrition screening and diagnosis of malnutrition in older adults. These tools have also been reported as simple and useful nutrition screening tools[19, 20]. Tan et al. reported that being at risk of undernutrition and malnutrition, as assessed by the MNA-SF, increases the risk of sarcopenia by 2–3 times[21].

Calf circumference is also considered a simple and useful nutritional assessment for older adults[22]. It is also used as a sarcopenia screening tool in the AWGS2019 and is considered a simple indicator of muscle mass for diagnosing sarcopenia because of its positive correlation with muscle mass, as measured by BIA, regardless of obesity or age[23]. Ren et al. reported that calf circumference was significantly positively associated with albumin level, hemoglobin level, BMI, and abdominal circumference. Furthermore, they reported that a decrease in lower calf circumference predicts mortality as well as the risk of malnutrition[24]. The results of this study support previous studies and demonstrate that nutritional status is associated with sarcopenia prognosis even in a population of older adults requiring long-term care, suggesting that MNA-SF and calf circumference may be predictors of the development and improvement of sarcopenia.

Moreover, this study found that the group that improved from sarcopenia to non-sarcopenia had a higher skeletal muscle mass index at baseline. This suggests that sarcopenia may hardly improve in older adults with low muscle mass. Therefore, it is important to identify low muscle mass early and begin interventions in older adults requiring long-term care. In the future, we believe that it is important to identify cut-off values of skeletal muscle mass that can indicate sarcopenia improvement.

A limitation of this study is the small sample size. The study did not include potential confounders such as age and comorbidities in the multiple logistic analysis. In the future, it will be necessary to increase the number of participants and conduct a multicenter study to identify factors associated with the development and improvement of sarcopenia.

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Conflict of interest

The authors declare no conñicts of interest.

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