



Original Article

Association between age and phase angle in “old” and “super-old” nursing home residents

AKIRA KUBO, RPT, PhD^{1)*}, MASAHIRO ISHIZAKA, RPT, PhD¹⁾, SHO TSUKAHARA, RPT²⁾, SHUNYA NUMAGUCHI, RPT²⁾

¹⁾ Department of Physical Therapy, School of Health Sciences, International University of Health and Welfare: 2600-1 Kitakanemaru, Otawara-shi, Tochigi 324-8501, Japan

²⁾ Division of Physical Therapy, Master Program in Health Sciences, Graduate School of Health and Welfare Sciences, International University of Health and Welfare, Japan

Abstract. [Purpose] We aimed to clarify the characteristics of age-related changes based on the body composition data of old and super-old nursing home residents. [Participants and Methods] This cross-sectional study included 53 female nursing home residents aged 75 years and above (mean age: 89.4 years; standard deviation: 5.6 years). They were divided into the old and super-old groups. The old group consisted of 24 participants aged between 75 and 89 years (mean age: 84.4 years; standard deviation: 3.7 years). The super-old group consisted of 29 participants aged 90 years and above (mean age: 93.5 years; standard deviation: 2.7 years). The parameters such as phase angle, skeletal muscle mass index, skeletal muscle mass, body fat percentage, body mass index, and Barthel index were examined in the two groups. The relationship between age and phase angle was determined, and the partial correlation coefficient was analyzed using the items for which a significant difference was found between the two groups as adjustment variables. [Results] The overall phase angle was 3.2 degrees, and that of the super-old group alone was 2.6 degrees. Age-related difference was observed in the phase angle and Barthel index. A significant correlation of -0.53 was observed between age and phase angle. The Barthel index-adjusted partial correlation coefficient between age and phase angle was -0.35 . [Conclusion] The results of this study indicated that phase angle is an indicator of physical condition associated with aging in female nursing home residents aged 75 to 100 years.

Key words: Phase angle, Super-old, Nursing home

(This article was submitted May 30, 2022, and was accepted Jun. 28, 2022)

INTRODUCTION

Recently, various physical functions, such as grip strength, gait speed¹⁾, and standing balance²⁾ have been rejuvenated in Japanese community-dwelling older individuals.

The joint committee of the Japan Gerontological Society and Japan Geriatrics Society recommended to propose a classification of people aged over 65 years as follows; 65 to 74 years: pre-old age, aged over 75 years as follows; 75 to 89 years: old age, and people aged over 90 years; oldest-old or super-old³⁾.

Studies are needed to examine the characteristics of aging based on the new classification. The target of the research should be conducted on individuals aged over 75 years. However, accurate measurement of physical function in super-aged nursing home residents is difficult in terms of reproducibility and validity; thus, simple measurement methods with less effort and risk are needed. Bioimpedance electrical analysis is a non-invasive, safe and fast methods, and validated assessment of body composition.

*Corresponding author. Akira Kubo (E-mail: akubo@iuhw.ac.jp)

©2022 The Society of Physical Therapy Science. Published by IPEC Inc.



This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial No Derivatives (by-nc-nd) License. (CC-BY-NC-ND 4.0: <https://creativecommons.org/licenses/by-nc-nd/4.0/>)

Therefore, we aimed to clarify the characteristics of aging changes from the body composition data for older and super-old nursing home residents using a safe and easy bioimpedance electrical analysis. In this study, we hypothesized that PhA has the characteristics of aging changes from body composition data of old and super-old female nursing home residents.

PARTICIPANTS AND METHODS

Participants in this cross-sectional study were nursing home residents located in the northern part of Tochigi prefecture as of March 24, 2022. The study was approved by the Ethics Committee of the International University of Health and Welfare (Approval No. 21-Io-13), in compliance with the Declaration of Helsinki. Written informed consent was obtained from the participants or their family members.

Figure 1 shows the flowchart of the participants in this study. The total number of nursing home residents was 77. Fifty-three females aged ≥ 75 years (age; 89.4 ± 5.6 years; mean \pm SD) were included in this study. The 24 excluded were 16 males (age; 77.4 ± 7.3 years), five females aged < 74 years, and three females who could not cooperate in the measurement. The oldest resident aged 100 years. They had no history of replacement arthroplasty or current use of an artificial pacemaker. The residents' required median degree of care was 4, the minimum was 3, and the maximum was 5.

Body composition was measured using a portable, noninvasive, multifrequency bioimpedance device (In Body S10; In Body, Tokyo, Japan). The device can be measured while the resident is supine and sitting, which is useful for residents who cannot stand or sit due to serious dysfunction or are bedridden. Body weight was measured 1–2 days before body composition measurement. Height was calculated using an estimation formula⁴. The body mass index (BMI) was calculated from this weight and height.

Body composition assessment included the phase angle (PhA), body fat percentage (%BF), skeletal muscle mass (SMM), and skeletal muscle mass index (SMI). The PhA was calculated using the equation: $\text{PhA} = \arctangent(Xc/R) \times (180/\pi)$, where R is the resistance of the right half of the body and Xc is the reactance measured at 50 kHz.

The residents were divided into two groups; the old group aged 75–89 years ($n=24$, 84.4 ± 3.7 years) and super-old group aged ≥ 90 years ($n=29$, 93.5 ± 2.7 years).

The main disease and Barthel index (BI) score were investigated from the medical records.

In the two groups, PhA, SMI, SMM, %BF, and BMI were analyzed using the t-test, and BI was analyzed using the Mann–Whitney U test. The relationship between age and PhA was determined using Pearson's correlation coefficient. The partial correlation coefficient was analyzed using the items for which a significant difference was found between the two groups as adjustment variables.

All statistical analyses were performed using IBM SPSS Statistics 25 (IBM, Tokyo, Japan). Statistically significant was set at $p < 0.05$.

RESULTS

Table 1 shows the characteristics of the study participants. Table 2 shows the body composition and BI score between the two groups. The PhA of the aged ≥ 75 years was 3.2° , and that of the super-old group alone was 2.6° . The age-related difference was observed in the PhA and BI ($p < 0.01$), but not in SMI, SMM, %BF, and BMI. Age significantly correlated with PhA ($r = -0.53$, $p < 0.01$). The BI-adjusted partial correlation coefficient between age and PhA was $r = -0.35$ ($p < 0.01$).

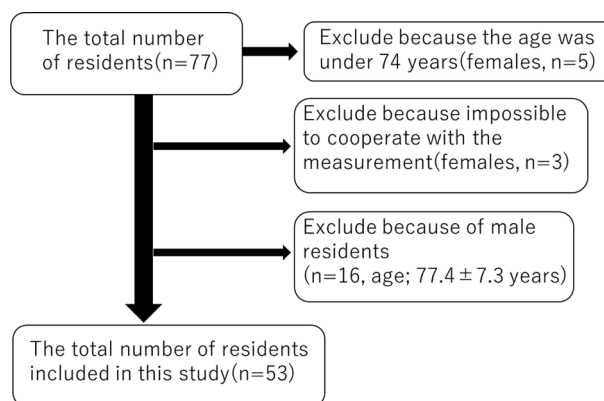


Fig. 1. Flow chart of participant selection.

Table 1. Participant characteristics between the two groups

	Old (n=24)	Super-old (n=29)	Total (n=53)
Age (years)*	84.4 ± 3.7	93.5 ± 2.7	89.4 ± 5.6
Height (cm)	158.5 ± 4.4	156.7 ± 4.7	157.5 ± 4.6
Body weight (kg)	43.9 ± 8.3	44.2 ± 8.4	44.1 ± 8.3
Morbidity			
Brain/nervous system disorders	12	12	24
Bone and joint disorders	2	2	4
Malignancy and cardiopulmonary disorders	1	1	2
Dementia and disuse syndrome	9	14	23

Mean ± SD, median (min–max).

* Significant for un-paired t-test.

Table 2. Body composition, Barthel index score, and morbidity between the two groups

	Old (n=24)	Super-old (n=29)	Total (n=53)
Phase Angle (°)*	3.2 ± 0.6	2.6 ± 0.7	2.9 ± 0.7
Skeletal Muscle Mass Index (kg/m ²)	4.9 ± 1.0	4.7 ± 1.0	4.8 ± 1.0
Skeletal muscle mass (kg)	16.9 ± 2.8	16.2 ± 2.8	16.5 ± 2.8
Percent body fat (%)	22.9 ± 9.1	25.1 ± 10.3	24.1 ± 9.8
Body Mass Index (kg/m ²)	17.4 ± 3.2	18.1 ± 3.8	17.8 ± 3.5
Barthel index score (point)**	30 (0–85)	10 (0–55)	10 (0–85)

Mean ± SD, median (min–max).

* Significant for un-paired t-test.

** Significant for Mann–Whitney U test.

DISCUSSION

In this study, we reported the characteristics of aging changes from body composition data of old and super-old female nursing home residents. The results showed two new findings on PhA in these residents; the degree of PhA is low and associated with aging.

Recently, the cutoff points of the PhA for malnutrition have been reported by sex. For females, the points for discriminating malnutrition were 4.0° in acute stroke patients⁵⁾ and 3.7° in older inpatient of the convalescent unit⁶⁾. In this study, the PhA of the aged ≥75 years was 3.2°, and that of the super-old group alone was 2.6°. The result was below the cutoff points of previous studies. Our study participants were limited to older and super-old female nurse home residents, and did not include under 75 years old residents; this factor may account for our results, which differed from previously reported results on PhA^{5, 6)}.

The age significantly correlated with PhA. Furthermore, we showed a significant partial correlation coefficient, which was adjusted for the degree of independence in daily life between age and PhA. Therefore, although this is a cross-sectional study, PhA is useful indicator of aging for nursing home residents.

This study has some limitations. First, our findings are limited to a relatively small number of residents at a single nursing home. Second, PhA is associated with inflammation⁷⁾ and osteoporosis⁸⁾. However, many residents in this study are predicted to have advanced osteoporosis and inflammation. Further research is required because the factors may affect the results.

In conclusion, the results of this study indicated that PhA is an indicator of physical condition associated with aging in female nursing home residents aged 75 to 100 years.

Conflict of interest

The authors declare no conflicts of interest in this work.

REFERENCES

- 1) Suzuki T, Nishita Y, Jeong S, et al.: Are Japanese older adults rejuvenating? Changes in health-related measures among older community dwellers in the last decade. *Rejuvenation Res*, 2021, 24: 37–48. [[Medline](#)] [[CrossRef](#)]
- 2) Watanabe M, Ishizaka M, Yakabi A, et al.: Rejuvenation of standing and gait balance in community-dwelling older individuals: a comparative study between 2006 and 2019. *Geriatr Gerontol Int*, 2021, 21: 975–980. [[Medline](#)] [[CrossRef](#)]
- 3) Ouchi Y, Rakugi H, Arai H, et al. Joint Committee of Japan Gerontological Society (JGLS) and Japan Geriatrics Society (JGS) on the definition and classification of the elderly: Redefining the elderly as aged 75 years and older: proposal from the Joint Committee of Japan Gerontological Society and the Japan Geriatrics Society. *Geriatr Gerontol Int*, 2017, 17: 1045–1047. [[Medline](#)] [[CrossRef](#)]
- 4) Kubo A, Keiri H: Estimating height from forearm and lower leg lengths of elderly persons. *Rigakuryoho Kagaku*, 2007, 22: 115–118 (in Japanese). [[CrossRef](#)]
- 5) Sato Y, Yoshimura Y, Abe T: Phase angle as an indicator of baseline nutritional status and sarcopenia in acute stroke. *J Stroke Cerebrovasc Dis*, 2022, 31: 106220. [[Medline](#)] [[CrossRef](#)]
- 6) Kubo Y, Noritake K, Nakashima D, et al.: Relationship between nutritional status and phase angle as a noninvasive method to predict malnutrition by sex in older inpatients. *Nagoya J Med Sci*, 2021, 83: 31–40. [[Medline](#)]
- 7) Tomeleri CM, Cavaglieri CR, de Souza MF, et al.: Phase angle is related with inflammatory and oxidative stress biomarkers in older women. *Exp Gerontol*, 2018, 102: 12–18. [[Medline](#)] [[CrossRef](#)]
- 8) Tanaka S, Ando K, Kobayashi K, et al.: A low phase angle measured with bioelectrical impedance analysis is associated with osteoporosis and is a risk factor for osteoporosis in community-dwelling people: the Yakumo study. *Arch Osteoporos*, 2018, 13: 39. [[Medline](#)] [[CrossRef](#)]