Received: 24 January 2024 | Accepted: 30 May 2024

DOI: 10.1002/agm2.12327

Aging Medicine Open Access WILEY

ORIGINAL ARTICLE

Body composition characteristics and influencing factors of different parts of sarcopenia in elderly people: A community-based cross-sectional survey

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Funding information
Beijing High level Public Health Technical Talents Training Plan, Grant/Award Number: 2022-1-005, Key DisciplineMember-02-44

Abstract

Objectives: This study aims to describe the differences in body composition among different body parts of the elderly in the community and its relationship with sarcopenia.

Methods: Elderly people aged ≥65 underwent bioelectric impedance analysis testing and were categorized into a sarcopenia group, possible sarcopenia group, and control group. The characteristics of body composition indicators in different parts and their relationship with different stages of sarcopenia were analyzed.

Results: The sarcopenia group illustrated the lowest values of FFM, FFM%, BFM, BFM%, ICW, and limb PhA, along with higher ECW/TBW in the trunk and left leg compared to the control group. The possible sarcopenia group showed lower FFM% in limbs and trunk, and higher BFM% compared to the control group. Gender differences in elderly body composition were observed, with an increase in BFM% in various body parts posing a risk factor for possible sarcopenia in elderly males, whereas an increase in BFM% except in the left arm was a protective factor for sarcopenia in elderly females.

Conclusion: The body composition of the elderly in the community varied significantly in different stages of sarcopenia and genders, which correlated with sarcopenia.

KEYWORDS
aging, body composition, primary health care, sarcopenia

1 | INTRODUCTION

Sarcopenia is an age-related loss of muscle mass accompanied by a decline in muscle strength and/or physical function. The current global prevalence of sarcopenia varies between 10% and 27%.[1] The prevalence of possible sarcopenia and sarcopenia in China is 46.0% and 18.6%.[2,3] Aging is now a globally highlighted problem. Data from World Population Prospects: the 2019 revision shows that by 2050, one in six people worldwide will be aged 65 years (16%) or older.[4] China is facing significant challenges due to its rapidly aging population.[5] Sarcopenia increases the risk of falls, fractures, mortality, and the burden of disease in the elderly.[6] It is a significant public health concern to gain an in-depth understanding of sarcopenia in an aging society.[7,8]

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The development of sarcopenia is a gradual process, and the Asian Working Group for Sarcopenia, AWGS 2019,[9] first proposed the concept of possible sarcopenia based on previous studies: decreased muscle strength with/without reduced physical performance for primary care services. The population with possible sarcopenia may not have experienced a decrease in muscle mass. And the decline in muscle strength and function may be related to other body components. Understanding the body composition characteristics of possible sarcopenia in community screening will be a key step in preventing sarcopenia. Li[10] found an interaction effect between muscle and fat mass, and leg circumference measurements are affected by edema.[11] These factors confuse the classification of sarcopenia and possible sarcopenia during a physical examination. Body composition examination based on bioelectric impedance analysis (BIA) used in community preventive services helps to diagnose cases quickly. BIA is a low-radiation, inexpensive, and easy-to-perform test that can be used to screen for sarcopenia and possible sarcopenia in the community.

Body composition is significantly associated with possible sarcopenia and sarcopenia. In our previous study, we have already found PhA to be a good screening test for sarcopenia and probable sarcopenia.[12] Low extracellular water (ECW)/intracellular water (ICW) and ECW/total body water (TBW) were negatively correlated with skeletal muscle index (SMI).[13] Fat mass index (FMI) and fat-free mass index (FFMI) may be more accurate than BMI in predicting functional outcomes in pre-frail older adults.[14] Adverse changes in body composition not only reduce physical performance and grip strength but also lead to further adverse changes.[15] It has been found that different modes of intervention[16] for older adults produce major changes in different body composition indicators[17] and body parts.[18] Therefore, understanding changes in body composition in community-dwelling older adults is essential to carry out the prevention and treatment of sarcopenia.

Few reports were found to describe the characteristics of different body parts and body composition in sarcopenia, possible sarcopenia, and non-sarcopenia in the community-dwelling elderly, as well as the relationship with different stages of sarcopenia. This study aims to analyze the body composition characteristics of community elderly individuals with sarcopenia and possible sarcopenia through BIA detection, as well as their impact on different stages of sarcopenia, which will provide a reference for better understanding the effects of these physical characteristics on the development of sarcopenia in older adults.

2 | RESEARCH METHODS

2.1 | Participants

2.1.1 | Participants selection

A total number of 1018 elderly residents were recruited by the convenience sampling method, who enjoyed the free physical examination program for those over 65 years old in the National Basic Public Health Service in 2023 at the Fangzhuang Community Health Service Center in Beijing.

2.1.2 | Diagnostic criteria for different stages of sarcopenia

The diagnostic criteria published by the Asian Working Group on Sarcopenia (AWGS) in 2019[9] were used to apply: (1) ASMI (BIA) of the limbs: $<7.0\,kg/m^2$ for men and $<5.7\,kg/m^2$ for women; (2) assessment of physical function: 6-meter stride $<1.0\,m/s$ or SPPB score ≤ 9 or standing test $\geq 12\,s$; and (3) grip strength: $<28\,kg$ for men and $<18\,kg$ for women; if (1) and (2) or (3) were satisfied, the diagnosis of sarcopenia was made; and if grip strength decreases, it is possible sarcopenia.

2.1.3 | Inclusion exclusion criteria

Inclusion criteria: (1) ≥65 years; (2) normal communication and exchangeability; and (3) able to cooperate to complete data collection and sign the informed consent.

Exclusion criteria: Those who had pacemakers implanted in their bodies or joint replacements and were unable to undergo the BIA measurement.

2.2 | Assessment

2.2.1 | Questionnaire survey

In this study, demographic data, including age, gender, pre-retirement occupation, marital status, etc., were obtained from all participants via a structured questionnaire. The nutritional status of participants was assessed utilizing the Mini Nutritional Assessment–Short-Form (MNA-SF) questionnaire.

2.2.2 | Physical examination

A height gauge was used to measure height. The baseline BIMS digital grip was used to measure grip strength, repeated twice, and the mean was recorded. The waist and hip circumference of the elderly were measured by using a tape measure, and the waist-to-hip ratio (WHR) was calculated as the waist circumference divided by the hip circumference. The elderly walk forward at a normal walking speed after the instructions by the investigator to evaluate the 6-m walk speed.

2.2.3 | The measurement of body composition

Body composition of the elderly was conducted by using Inbody 770 Device manufactured by Bysbys Medical Devices Trading (Shanghai) Co. The analysis provided various body composition metrics,

TABLE 1 Comparison of general characteristics and overall body composition indicators of the study population.

	Total (*n* = 1018)	Control (*n* = 648)	Possible sarcopenia (*n* = 206)	Sarcopenia (*n* = 128)	χ/F	P
Height	163.178 ± 7.949	163.446 ± 7.574	163.961 ± 8.714	160.484 ± 8.142	8.871	<0.001
Weight	65.940 ± 10.967	67.232 ± 10.157	68.424 ± 11.720	55.035 ± 6.904	85.497	<0.001
WHR	0.903 ± 0.069	0.907 ± 0.068	0.902 ± 0.069	0.885 ± 0.070	5.404	0.005
FFM	44.829 ± 7.955	45.601 ± 7.578	46.367 ± 8.436	38.224 ± 5.658	56.805	<0.001
BFM	21.111 ± 6.226	21.631 ± 6.142	22.057 ± 6.320	16.811 ± 4.642	37.847	<0.001
ECW/TBW	0.393 ± 0.007	0.393 ± 0.007	0.394 ± 0.008	0.395 ± 0.007	6.394	0.002
Low ECW/TBW	381 (37.43)	258 (37.72)	85 (41.26)	258 (37.72)	4.593	0.101
High ECW/TBW	637 (62.57)	426 (62.28)	121 (58.74)	426 (62.28)		
MNA-SF	12.390 ± 0.922	12.509 ± 0.807	12.451 ± 0.847	11.656 ± 1.232	51.304	<0.001
Pre-retirement occupation						
Clerical	526 (51.67)	341 (49.85)	115 (55.83)	70 (54.69)	4.458	0.348
Workers and peasants	156 (15.32)	108 (15.79)	33 (16.02)	15 (11.72)		
Other	336 (33.01)	235 (34.36)	58 (28.16)	43 (33.59)		
Literacy level						
Junior high school and below	305 (29.96)	192 (28.07)	67 (32.52)	46 (35.94)	3.989	0.136
High school and above	713 (70.04)	492 (71.93)	139 (67.48)	82 (64.06)		
Monthly salary						
≤6000	583 (57.27)	392 (57.31)	122 (59.22)	69 (53.91)	0.913	0.633
>6000	435 (42.73)	292 (42.69)	84 (40.78)	59 (46.09)		
Marital status						
Yes	897 (88.11)	614 (89.77)	180 (87.38)	103 (80.47)	9.032	0.011
No	121 (11.89)	70 (10.23)	26 (12.62)	25 (19.53)		
Smoking status						
Smoking	87 (8.55)	56 (8.19)	19 (9.22)	12 (9.38)	1.691	0.792
Nonsmoking	864 (84.87)	585 (85.53)	170 (82.52)	109 (85.16)		
Quit smoking	67 (6.58)	43 (6.29)	17 (8.25)	7 (5.47)		
Drinking status						
Drinking	101 (9.92)	63 (9.21)	26 (12.62)	12 (9.38)	8.193	0.085
No drinking	884 (86.84)	604 (88.30)	168 (81.55)	112 (87.50)		
Quit drinking	33 (3.24)	17 (2.49)	12 (5.83)	4 (3.13)		
Hypertension						
Yes	582 (57.17)	401 (58.63)	123 (59.71)	58 (45.31)	8.484	0.014
No	436 (42.83)	283 (41.37)	83 (40.29)	70 (54.69)		
Diabetes						
Yes	324 (31.83)	210 (30.70)	75 (36.41)	39 (30.47)	2.500	0.286
No	694 (68.17)	474 (69.30)	131 (63.59)	89 (69.53)		
Dyslipidemia						
Yes	485 (47.64)	315 (46.05)	105 (50.97)	65 (50.78)	2.114	0.348
No	533 (52.36)	369 (53.95)	101 (49.03)	63 (49.22)		

including body fat mass (BFM), fat-free mass (FFM), total body water (TBW), intracellular water (ICW), extracellular water (ECW), and phase angle (PhA).

BFM% and FFM% were calculated as the percentage of the measured value relative to the standard value. The ECW/TCW ratio represents the proportion of extracellular water to total body water, with values ≥0.390 indicative of high.[19]

2.2.4 | Statistical methods

All the survey data were entered by Epidata 3.1 with two-person entry method, and the final database was completed after error checking. SPSS 25.0 was utilized for statistical analysis of the survey data. The measurement data conforming to a normal distribution were described using mean ± standard deviation. Analysis of variance (ANOVA) employed intergroup comparisons, with post hoc pairwise comparisons conducted for significant results. Categorical data were presented as frequency (%) and compared among groups using chi-square test, with $P<0.05$, indicating statistical significance. Radar charts were used to visualize the distribution of body composition metrics across the limbs and trunk. Multiple logistic regression analysis was performed to assess the impact of different body components on the likelihood of possible sarcopenia and its incidence.

3 | RESULTS

3.1 | General characteristics of the study population and overall body composition indicators

A total of 1018 individuals were recruited in this study, with a possible sarcopenia prevalence of 20.24% and a sarcopenia prevalence of 12.57%. There were statistically significant differences in age, height, weight, WHR, FFM, BFM, ECW/TBW, MNA-SF scores, marital status, and hypertension among the groups, $P<0.05$. After pairwise comparison, it was found that there were significant age differences among the three groups. The height, weight, WHR, FFM, BFM, and MNA-SF scores of the sarcopenia group were significantly lower than those of the other two groups, and their ECW/TBW were higher than those of the control group (Table 1, $P<0.05$, respectively).

3.2 | Body composition characteristics of sarcopenia groups in different parts and stages

FFM%, BFM%, FFM, BFM, and ICW in various parts of the sarcopenia group were significantly lower than those in the possible sarcopenia group and the control group (Figure 1; Table 2, $P<0.05$, respectively); PhA of individuals with muscular dystrophy in the limbs was lower than the other two groups, but higher in the

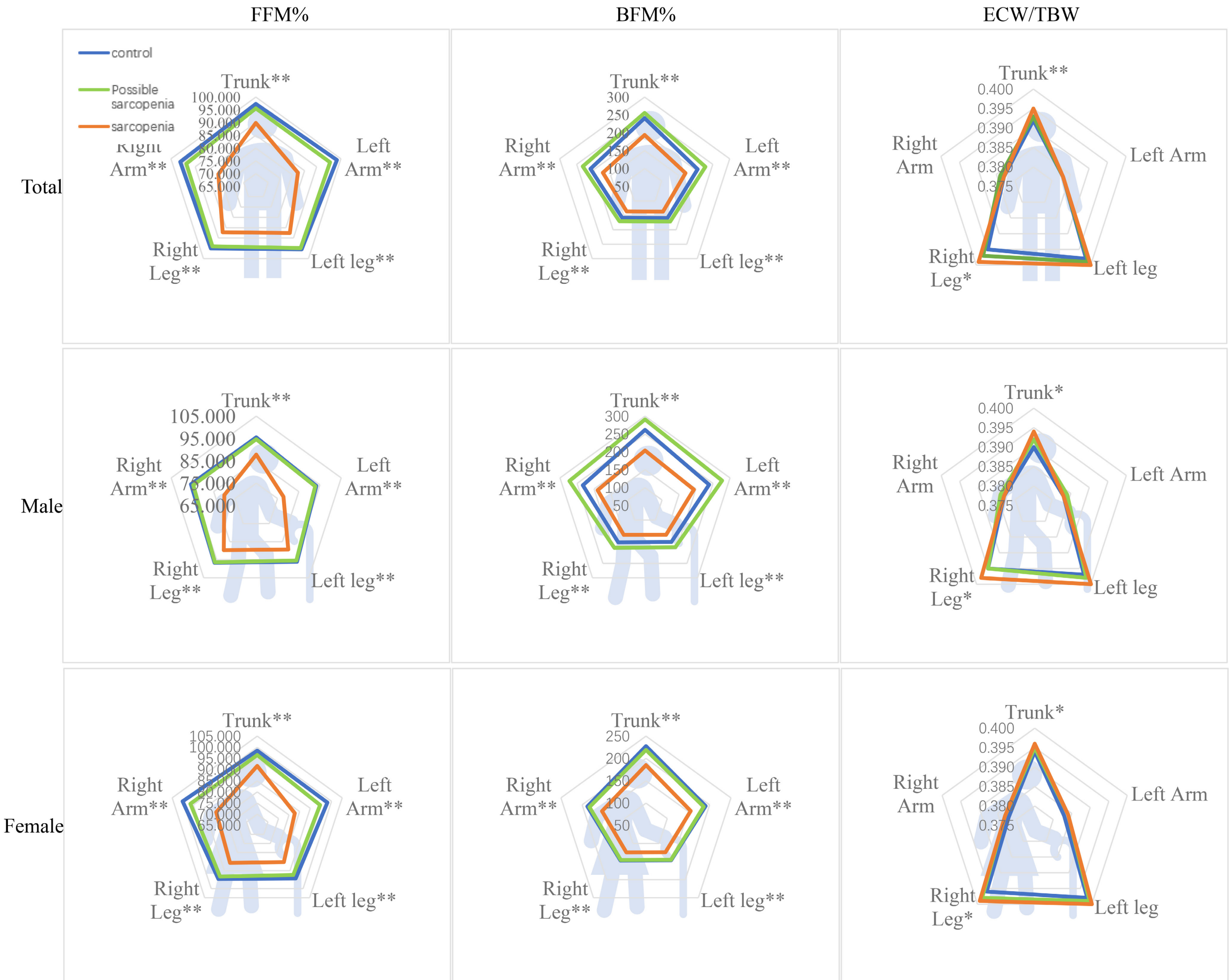

FIGURE 1 Comparison of different stages of sarcopenia at different parts of body composition in the elderly. FFM% represents fat-free body mass measurements divided by standard values. BFM% denotes body fat mass measurements divided by standard values. ECW/TBW is extracellular water/total body water. ANOVA **$P<0.001$; *$P<0.05$.

TABLE 2 Comparison of body composition in different stages of sarcopenia after site grouping.

	Stage	Trunk	Left arm	Left leg	Right leg	Right arm
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
FFM	Control	20.555 ± 3.490	2.442 ± 0.585	7.068 ± 1.412	7.035 ± 1.395	2.387 ± 0.572
	Possible sarcopenia	20.825 ± 4.004	2.487 ± 0.659	7.249 ± 1.593	7.186 ± 1.582	2.439 ± 0.647
	Sarcopenia	17.056 ± 2.672[a,b]	1.847 ± 0.426[a,b]	5.819 ± 1.189[a,b]	5.796 ± 1.186[a,b]	1.804 ± 0.409[a,b]
	F	50.031**	61.542**	46.571**	47.158**	60.773**
BFM	Control	11.057 ± 3.286	1.540 ± 0.608	3.175 ± 0.824	3.155 ± 0.820	1.570 ± 0.609
	Possible sarcopenia	11.251 ± 3.415	1.582 ± 0.627	3.237 ± 0.837	3.218 ± 0.835	1.609 ± 0.636
	Sarcopenia	8.348 ± 2.652[a,b]	1.179 ± 0.414[a,b]	2.545 ± 0.583[a,b]	2.537 ± 0.579[a,b]	1.196 ± 0.411[a,b]
	F	40.685**	23.604**	35.750**	36.640**	22.3901**
ICW	Control	9.769 ± 1.684	1.175 ± 0.280	3.344 ± 0.666	3.317 ± 0.653	1.148 ± 0.274
	Possible sarcopenia	9.883 ± 1.932	1.195 ± 0.316	3.426 ± 0.755	3.386 ± 0.746	1.172 ± 0.310
	Sarcopenia	8.075 ± 1.288[a,b]	0.889 ± 0.205[a,b]	2.744 ± 0.564[a,b]	2.726 ± 0.562[a,b]	0.867 ± 0.197[a,b]
	F	58.091**	61.818**	47.758**	48.421**	61.030**
PhA	Control	7.440 ± 1.236	4.530 ± 0.548	4.425 ± 0.686	4.351 ± 0.646	4.414 ± 0.573
	Possible sarcopenia	7.060 ± 1.287[a]	4.467 ± 0.625	4.405 ± 0.738	4.344 ± 0.734	4.354 ± 0.624
	Sarcopenia	7.493 ± 1.320	4.015 ± 0.477[a,b]	3.893 ± 0.663[a,b]	3.788 ± 0.680[a,b]	3.926 ± 0.464[a,b]
	F	7.918**	39.414**	39.489**	32.373**	46.363**

Note: ANOVA ***P* < 0.001; **P* < 0.05.

[a]Difference compared to the control group.

[b]Difference between the group with possible sarcopenia.

trunk than the group with possible muscular dystrophy (Table 2, $P < 0.05$); and ECW/TBW of its trunk and left leg was lower than that of the control group, while ECW/TBW of its left leg was lower than that of the population with possible sarcopenia (Figure 1). There was no statistically significant difference in ECW/TBW of the other three areas among the three groups. At any part, there may be no statistically significant difference in FFM, BFM, and ICW between the possible sarcopenia group and the control group (Table 2, $P < 0.05$, respectively), but FFM% was lower than that of the control group, and BFM% was higher than that of the control group (Figure 1; < 0.05, respectively). PhA of the possible sarcopenia group was lower than that of the control group in the trunk area (Table 2, $P < 0.05$, respectively).

3.3 | Characteristics of body composition distribution in different parts of the different stages of sarcopenia

FFM, FFM%, BFM, BFM%, ICW, and PhA in various parts of the body of elderly people with sarcopenia of different genders were lower than the other two groups (Figure 1; Table 3, $P < 0.05$, respectively). The distribution characteristics of trunk PhA in males with sarcopenia were similar to those in the general population, but there was no statistically significant difference in trunk PhA in females (Table 3, $P < 0.05$, respectively). There may be no statistically significant differences in FFM, FFM%, ICW, and PhA of the limbs, as well as ECW/TBW of the trunk and left leg between the male sarcopenia group and the control group (Figure 1; Table 3, $P < 0.05$, respectively), with higher BFM and BFM% compared to the control group (Figure 1; Table 3, $P < 0.05$, respectively). The characteristics of women were different. In the possible sarcopenia group, PhA of FFM, FFM%, ICW, and arms in five parts of women were significantly lower than those of the control group, and there were no significant statistical differences in other body composition indicators compared to the control group (Figure 1; Table 3, $P < 0.05$, respectively).

3.4 | Effect of body composition in different parts of the body of gender differences on sarcopenia

An increase in BFM% in various body sites in elderly males, as well as an increase in ECW/TBW in the left leg and a decrease in PhA in the trunk ($P < 0.05$, respectively), were potential risk factors for possible sarcopenia. Elevated ECW/TBW in the limbs and decreased PhA were both risk factors for possible sarcopenia in elderly females ($P < 0.05$, respectively), while an increase in BFM% in the trunk serves as a protective factor for elderly females. An increase in ECW/TBW in the right leg was a risk factor for sarcopenia in elderly males, OR = 0.446, 95% CI (0.218, 0.910). Increased ECW/TBW in the legs of elderly females and decreased PhA in the limbs were risk factors for sarcopenia, whereas an increase in BFM% except in the left arm was a protective factor for sarcopenia in elderly females ($P < 0.05$, respectively; Table 4).

TABLE 3 Comparison of body composition in different stages of sarcopenia after grouping male and female parts.

	Stage	Trunk Mean ± SD	Left arm Mean ± SD	Left leg Mean ± SD	Right leg Mean ± SD	Right arm Mean ± SD
Male						
FFM	Control	24.006 ± 2.226	2.945 ± 0.377	8.429 ± 0.900	8.479 ± 0.901	3.021 ± 0.377
	Possible sarcopenia	24.130 ± 2.594	2.970 ± 0.432	8.498 ± 0.975	8.576 ± 0.972	3.030 ± 0.440
	Sarcopenia	19.444 ± 1.847[a,b]	2.166 ± 0.292[a,b]	6.885 ± 0.683[a,b]	6.908 ± 0.689[a,b]	2.226 ± 0.305[a,b]
	F	104.256**	108.424**	78.365**	82.025**	109.530**
BFM	Control	10.561 ± 3.228	1.368 ± 0.558	2.895 ± 0.747	2.918 ± 0.754	1.335 ± 0.551
	Possible sarcopenia	11.775 ± 3.431[a]	1.596 ± 0.631[a]	3.213 ± 0.778[a]	3.234 ± 0.776[a]	1.572 ± 0.627[a]
	Sarcopenia	7.922 ± 2.622[a,b]	1.066 ± 0.352[a,b]	2.386 ± 0.524[a,b]	2.397 ± 0.534[a,b]	1.047 ± 0.359[a,b]
	F	27.448**	17.495**	24.350**	24.606**	17.671**
ICW	Control	11.439 ± 1.069	1.416 ± 0.179	3.976 ± 0.410	4.015 ± 0.414	1.452 ± 0.179
	Possible sarcopenia	11.470 ± 1.266	1.427 ± 0.206	4.008 ± 0.453	4.058 ± 0.453	1.455 ± 0.209
	Sarcopenia	9.217 ± 0.904[a,b]	1.042 ± 0.141[a,b]	3.239 ± 0.330[a,b]	3.258 ± 0.332[a,b]	1.072 ± 0.147[a,b]
	F	104.932**	110.384**	84.236**	88.510**	110.645**
PhA	Control	7.629 ± 1.195	4.766 ± 0.538	4.599 ± 0.642	4.661 ± 0.656	4.864 ± 0.499
	Possible sarcopenia	6.834 ± 1.044[a]	4.667 ± 0.585	4.586 ± 0.749	4.630 ± 0.743	4.750 ± 0.611
	Sarcopenia	7.692 ± 1.168[b]	4.139 ± 0.510[a,b]	3.927 ± 0.756[a,b]	3.983 ± 0.770[a,b]	4.210 ± 0.509[a,b]
	F	19.409**	31.964**	24.261**	23.789**	37.063**
Female						
FFM	Control	18.277 ± 1.973	2.018 ± 0.327	6.115 ± 0.750	6.136 ± 0.767	2.060 ± 0.326
	Possible sarcopenia	17.388 ± 1.569[a]	1.886 ± 0.245[a]	5.821 ± 0.671[a]	5.869 ± 0.669[a]	1.923 ± 0.244[a]
	Sarcopenia	15.014 ± 1.117[a,b]	1.494 ± 0.165[a,b]	4.864 ± 0.566[a,b]	4.889 ± 0.571[a,b]	1.522 ± 0.165[a,b]
	F	96.529**	92.385**	90.941**	86.834**	97.720**
BFM	Control	11.385 ± 3.286	1.703 ± 0.605	3.326 ± 0.822	3.344 ± 0.826	1.676 ± 0.607
	Possible sarcopenia	10.706 ± 3.329	1.622 ± 0.644	3.224 ± 0.895	3.240 ± 0.900	1.591 ± 0.631
	Sarcopenia	8.713 ± 2.643[a,b]	1.307 ± 0.428[a,b]	2.665 ± 0.596[a,b]	2.672 ± 0.596[a,b]	1.291 ± 0.427[a,b]
	F	20.642**	13.185**	19.576**	20.059**	12.508**
ICW	Control	8.667 ± 0.946	0.971 ± 0.157	2.882 ± 0.349	2.901 ± 0.360	0.992 ± 0.157
	Possible sarcopenia	8.235 ± 0.775[a]	0.907 ± 0.117[a]	2.740 ± 0.316[a]	2.768 ± 0.315[a]	0.925 ± 0.118[a]
	Sarcopenia	7.099 ± 0.549[a,b]	0.718 ± 0.080[a,b]	2.288 ± 0.271[a,b]	2.304 ± 0.273[a,b]	0.732 ± 0.079[a,b]
	F	96.230**	92.997**	94.094**	89.838**	98.601**
PhA	Control	7.315 ± 1.249	4.182 ± 0.468	4.188 ± 0.596	4.270 ± 0.662	4.310 ± 0.461
	Possible sarcopenia	7.295 ± 1.466	4.030 ± 0.483[a]	4.092 ± 0.629	4.171 ± 0.659	4.172 ± 0.491[a]
	Sarcopenia	7.323 ± 1.424	3.743 ± 0.327[a,b]	3.668 ± 0.586[a,b]	3.816 ± 0.548[a,b]	3.848 ± 0.379[a,b]
	F	0.012	28.843**	22.190**	14.548**	31.143**

Note: ANOVA $^{**}P < 0.001$; $^{*}P < 0.05$.

[a]Difference compared to the control group.

[b]Difference between the group with possible sarcopenia.

4 | DISCUSSION

This study has found that the muscle mass, fat mass, intracellular water content, and cellular function of the elderly people in the community were significantly different among the control group, possible sarcopenia group, and sarcopenia group. The body compositions of different parts of the body varied significantly between the male and female, which were associated with sarcopenia.

People with sarcopenia show a decrease trend not only in muscle mass but also in fat mass, water, and cellular function, which may be related to the mechanisms of both that and cachexia, such as increased oxidative stress and inflammation, imbalance in muscle protein homeostasis, and decreased rate of muscle cell renewal.[20] Malnutrition is also associated with sarcopenia, with human nutritional deficiencies leading to a highly pronounced decrease in muscle mass and body fat mass.[21] PhA was reported to link with gender-specific differences in

TABLE 4 Multivariate logistic regression analysis of the effects of body composition in different parts.

	Variables	Right arm		Left arm		Trunk		Right leg		Left leg	
		OR (95% OR)	*P*	OR (95% OR)	*P*	OR (95% OR)	*P*	OR (95%OR)	*P*	OR (95% OR)	*P*
Male											
Possible sarcopenia	High E/T	1.480 (0.562, 3.901)	0.427	1.100 (0.418, 2.891)	0.847	0.759 (0.424, 1.358)	0.352	0.606 (0.296, 1.242)	0.171	0.457 (0.217, 0.962)	0.039
	BFM%	1.006 (1.003, 1.008)	<0.001	1.006 (1.003, 1.008)	<0.001	1.005 (1.002, 1.008)	0.001	1.013 (1.008, 1.019)	<0.001	1.014 (1.008, 1.020)	<0.001
	PhA	0.702 (0.417, 1.179)	0.181	0.736 (0.442, 1.225)	0.238	0.538 (0.414, 0.698)	<0.001	0.729 (0.432, 1.228)	0.235	0.722 (0.434, 1.202)	0.211
Sarcopenia	High E/T	0.114 (0.015, 0.847)	0.034	0.202 (0.043, 0.942)	0.042	0.755 (0.331, 1.719)	0.503	0.280 (0.093, 0.840)	0.023	0.176 (0.058, 0.538)	0.002
	BFM%	0.997 (0.993, 1.002)	0.250	0.998 (0.993, 1.002)	0.380	0.995 (0.990, 1.000)	0.036	0.994 (0.985, 1.003)	0.163	0.994 (0.985, 1.003)	0.220
	PhA	0.089 (0.039, 0.204)	<0.001	0.109 (0.049, 0.243)	<0.001	1.186 (0.862, 1.633)	0.295	0.261 (0.130, 0.527)	<0.001	0.234 (0.119, 0.462)	<0.001
Female											
Possible sarcopenia	High E/T	1.711 (0.395, 7.407)	0.472	1.745 (0.536, 5.687)	0.355	0.740 (0.441, 1.240)	0.253	0.446 (0.218, 0.910)	0.026	0.778 (0.351, 1.724)	0.536
	BFM%	0.998 (0.994, 1.002)	0.338	0.998 (0.994, 1.002)	0.329	0.997 (0.993, 1.001)	0.155	1.000 (0.993, 1.007)	0.920	0.999 (0.992, 1.006)	0.756
	PhA	0.688 (0.401, 1.180)	0.174	0.637 (0.371, 1.094)	0.102	1.000 (0.839, 1.191)	0.999	0.729 (0.437, 1.215)	0.226	0.950 (0.566, 1.594)	0.846
Sarcopenia	High E/T	0.876 (0.147, 5.234)	0.885	0.259 (0.039, 1.730)	0.163	1.305 (0.631, 2.700)	0.472	0.256 (0.092, 0.713)	0.009	0.178 (0.058, 0.544)	0.002
	BFM%	0.994 (0.988, 1.000)	0.042	0.994 (0.988, 1.000)	0.054	0.992 (0.987, 0.998)	0.007	0.986 (0.976, 0.997)	0.011	0.988 (0.977, 0.999)	0.026
	PhA	0.120 (0.052, 0.277)	<0.001	0.121 (0.053, 0.276)	<0.001	1.068 (0.849, 1.344)	0.575	0.251 (0.126, 0.501)	<0.001	0.184 (0.090, 0.376)	<0.001

Note: The control group was used as the reference group, and age, marital status, hypertension, diabetes, and dyslipidemia were adjusted.

Abbreviation: E/T, ECW/TBW (extracellular water/total body water).

age, skeletal muscle mass index, and muscle mass independently.[22] The decrease in PhA can be attributed to a decrease in electrical resistance due to loss of muscle mass and/or an increase in resistance due to an increase in fat mass.[23] The body's physiological response to electrical currents is considered to be a manifestation of cellular function[24]; therefore, the decrease in PhA in limb of individuals with sarcopenia may be related to a decrease in cellular function.

The changes in human body composition may be the one of causes of sarcopenia. The occurrence of sarcopenia in high-ECW/TBW group is 2.17 times than that in the robust group,[25] which may be due to the fact that cell dehydration can lead to muscular catabolism, anabolic resistance, and muscle atrophy, as well as damage to muscle contractility. When ECW/TBW is high, the elderly are prone to swelling, and studies have reported that leg swelling in the elderly is secondary to aging.[26] Edema in the elderly is related to the diseases of the heart, kidney, liver, and endocrine system, and a considerable part is idiopathic senile edema. This type of edema is often caused by the enlargement of extracellular spaces with age, and the looseness of subcutaneous tissue spaces in elderly people, which makes it easy for water to be seeped into tissue spaces and form subcutaneous edema.[27] The sedentary lifestyle is also related to leg swelling. Four-hour-sitting was reported to increase 4.0% of the volume of interstitial fluid in the feet, and 1.9% of the volume of the feet.[28] This swelling can be improved through activity intervention.

This study found that in the control group and the possible sarcopenia group, BFM% in all parts of the body is higher than the control group, and FFM% is lower than the control group, indicating that the elderly with possible sarcopenia may struggle to maintain their ideal fat-free weight and are more prone to excessive fat content compared to other groups. Even if the muscle mass is not lower than the diagnostic criteria for sarcopenia, functional decline occurs in people with high-fat content, idoate F[29] found that one of the signs of modern aging is fat redistribution, and the infiltration of lipids in skeletal muscles can affect muscle function. Other studies suggest that ROS-FoxO pathway crosstalk can lead these elderly individuals to enter a state of sarcopenia.[10] In addition, blood lipids may also be a risk factor influencing the occurrence of sarcopenia.[30] This suggests that in the process of discovering and intervening in sarcopenia, we should not neglect elderly people who are not physically thin, as they are potential population for sarcopenia. As the decline in function is correlated with trunk muscles,[31] individuals who have difficulty maintaining trunk muscle mass may also become less functional, leading to a diagnosis of possible sarcopenia.

In this study, it was observed that an increase in body fat weight in males is a risk factor for possible sarcopenia, while a reduction in fat-free weight is evident in female sarcopenia patients. The higher body fat weight observed in elderly males in the possible sarcopenia group compared to the control group may be attributed to lipid infiltration. While, the decline in blood estrogen and estrogen receptors α and β in the muscles could explain the reason for female muscle loss. The protein content decreases, and the muscle mass of postmenopausal women decreases by 0.6% annually.[32] The fat distribution difference in genders may also be related to the following factors: (1) different sensitivity of subcutaneous fat lipolysis, (2) inhibiting adrenaline receptor α varies in different parts of the body,[33] and (3) different choices of physical exercise among older adults of different gender.[34]

Admittedly, this study has following limitations: the convenience sampling method used in this study may result in random bias. This study was a cross-sectional study in a community, which makes it difficult to verify the cause and effect, influencing factors and potential mechanisms. As the survey was conducted in a community health service center, the representativeness of the elderly is limited.

Our results illustrated that the muscle mass, fat mass, intracellular water content, and cellular function of the upper and lower limbs and trunk of elderly people in the community varied significantly in different stages of sarcopenia and genders. The body composition of the elderly significantly correlated with sarcopenia.

AUTHOR CONTRIBUTIONS

Xinying Dong conducted data collection and performed statistical analysis. Bingqing Bi conducted data collection and analysis revisions. Field investigation was assisted by Xinying Liu, Li Wang, Wentao Li, Mingyue Li, and Tong Xiang. Shugang Li provided guidance in research design, data analysis, and revised the manuscript. Hao Wu facilitated the establishment of field sample collection protocols and provided practical guidance.

ACKNOWLEDGMENTS

We thank all our participants for their contributions to this study.

FUNDING INFORMATION

This work was supported by the Beijing High Level Public Health Technical Talents Training Plan (2022-1-005, Key DisciplineMember-02-44).

CONFLICT OF INTEREST STATEMENT

All authors state that there is no conflict of interest.

ETHICS STATEMENT

The Ethics Committee of Capital Medical University reviewed and approved the study protocol (Z2023SY074). All participants gave their written informed consent after receiving explanation about the study protocol.

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How to cite this article: Dong X, Bi B, Hu Y, et al. Body composition characteristics and influencing factors of different parts of sarcopenia in elderly people: A community-based cross-sectional survey. *Aging Med*. 2024;7:384-392. doi:10.1002/agm2.12327