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Prevalence and associated body composition factors of sarcopenia in community-dwelling older adults

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Abstract

Background The objective of this investigation was to examine the frequency and determinants related to body composition of sarcopenia among aging individuals residing in the Beijing community through implementation of the diagnostic criteria for sarcopenia outlined by the 2019 Asian Working Group for Sarcopenia (AWGS).

Methods A cross-sectional examination employing multistage cluster sampling was conducted on a sample consisting of 933 individuals aged 50 years or above. The study utilized the AWGS 2019 criteria for muscle mass, muscle strength, and physical function to gauge sarcopenia. In addition, data on demographic characteristics, anthropometry, and body composition were collected. Logistic regression analysis was carried out to ascertain the relationships between sarcopenia and correlated factors.

Results The study found that the overall prevalence of sarcopenia was 8.3%. Sex ($p<0.001$) and body mass index (BMI $p<0.001$) were determined to have a significant association with the occurrence of sarcopenia. The adjusted analyses demonstrated that with each standard deviation increase in fat-free mass index (OR = 0.02 (0.01–0.05), of 95%), skeletal muscle mass (OR = 0.17 (0.12–0.25), of 95%), and other body composition indicators (including total body water 0.26 (0.2–0.35), intracellular water 0.1 (0.06–0.17), protein 0.01 (0–0.02), soft lean mass 0.35 (0.28–0.44), BMI 0.58 (0.51–0.67), body cell mass 0.21 (0.15–0.29), OR < 0.60, of 95%), the risk of sarcopenia decreased by more than 40%. Certain straightforwardly accessible anthropometric indices such as upper arm circumference (correlation coefficient 0.94 (0.9–0.97), 0.97 (0.95–1), 1.01 (0.99–1.03), respectively, of 95%), waist circumference (0.94(0.92–0.96), 1.01 (0.99–1.03), 1.02 (1–1.03), of 95%), hip circumference (0.93 (0.9–0.96), 0.99 (0.97–1.02), 1.02 (1–1.04), of 95%), waist-to-hip ratio (0.93 (0.87–1), 1.04 (1–1.08), 1 (0.97–1.03), of 95%), body fat percentage (1 (0.98–1.02), 1.02(1–1.04), 1.01 (0.99–1.02), of 95%), and phase angle (0.91 (0.89–0.93), 0.96 (0.94–0.98), 0.99 (0.98–1), of 95%) exhibited substantial correlation with skeletal muscle index, muscle strength or physical performance. However, no noteworthy link between sarcopenia and most variables associated with physical function was discovered.

Conclusions The findings of the study highlight the prevalence of sarcopenia among the aging residents of Beijing. Certain easily measured anthropometric indices demonstrated strong correlation with muscle strength or physical performance, thereby providing an avenue for screening and diagnosing sarcopenia in older people who may not be able to undergo grip strength or physical function assessments. To investigate causal relationships, future studies employing longitudinal or interventional designs with a more comprehensive population are warranted.

Keywords Sarcopenia, Older adults, Prevalence, AWGS 2019 criteria, Body composition

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Introduction

Sarcopenia, which is defined by the gradual and generalized loss of skeletal muscle mass, strength, and function, represents a prevalent and substantial health concern that impacts the aging populace globally [1].The incidence of sarcopenia increases with age, subsequently resulting in unfavorable outcomes, such as falls, fractures, restricted mobility, impairment of independence, and escalated mortality rates [2–5]. As the global population continues to age, sarcopenia is expected to emerge as a considerable burden on a healthcare systems and societies around the world [6, 7]. Thus, a deeper understanding of the condition and effective interventions are critical.

Within Asia, the aging population has substantiated sarcopenia as an increasingly pertinent public health issue. To account for the particular demographic, cultural, and nutritional factors that could impact sarcopenia's prevalence and expression in the Asian population, the Asian Working Group for Sarcopenia (AWGS) has assembled diagnostic criteria [3, 8]. The AWGS stipulates that a diagnosis of sarcopenia requires the concurrent presence of reduced muscle mass along with low muscle strength or poor physical performance [8–10]. Despite the fact that the correlation between sarcopenia and various anthropometric, demographic, and body composition indicators in the Chinese population has yet to be extensively explored, comprehending these connections is of utmost importance for the development of targeted preventive strategies and interventions. It has been suggested that grip strength and physical performance are related to body composition. If this is proven true, then assessing body composition alone could facilitate the diagnosis of sarcopenia, potentially eliminating the need to evaluate grip strength and physical function. Hence, the aim of this study is to clarify the relationship between body composition factors, excluding the appendicular skeletal muscle index, and sarcopenia. The ultimate objective is to predict and diagnose sarcopenia solely through body composition metrics. The findings of this research will be invaluable for screening and diagnosing sarcopenia in elderly individuals who are unable to undergo assessments of grip strength or physical function. As a result, healthcare professionals, policymakers, and researchers striving to mitigate the harmful effects in sarcopenia on the health and quality of life in older adults will benefit immensely from this study.

Methods

Study design

The present investigation represents a cross-sectional analysis, with data collection concluded in July 2022. The study protocol was duly registered and approved by the Institutional Review Board (IRB) of the hospital. The primary subjects of this research were senior individuals residing in various communities across Beijing. The method of sampling was cluster sampling, and three communities were randomly selected for investigation. Enrollment was limited to participants aged 50 years and above, all of whom provided written informed consent. This study is financially supported by the National Key Research and Development Program of China.

Participants

The study included participants aged 50 and above from the three communities and excluded participants who (1) refused to sign the informed consent; (2) suffered from terminal disease; (3) had a major disability or mental illness; and (4) were unable to cooperate with investigators.

Data collection

All data collectors were community hospital nurses trained in questionnaire data collection as well as in anthropometric and bioimpedance measurements. The baseline demographic information compiled encompasses several categories: (1) general personal data: chronological age, gender, educational level, occupation, spouse status, and financial status. (2) Anthropometrics and biological components: height, weight, handgrip strength of the dominant hand, gait speed over a distance of 6m, arm circumference, leg circumference, waist circumference, and hip circumference. (3) Assessment of body composition was conducted utilizing a multi-frequency bioelectrical impedance analyzer (Inbody770, BioSpace), with measured parameters, including total body water (liters), body fat mass (kilograms), skeletal muscle mass (kilograms), and total body minerals (kilograms).

Sarcopenia assessment

Sarcopenia was assessed using the diagnostic standards of the AWGS 2019, a widely recognized framework for diagnosing sarcopenia in Asia, which takes into account reductions in muscle mass, muscle strength, and physical performance [8]. In line with AWGS criteria, low muscle mass was defined as appendicular muscle mass of less than 7.0 kg/m2 for males and less than 5.7 kg/m2 for females as measured by bioelectrical impedance analysis (BIA). Low muscle strength was considered when handgrip strength was less than 28 kg for males and less than 18 kg for females. Physical ability was evaluated using the 6 m walking test, with a speed of less than 1.0 m/s indicating reduced physical performance, and the Short Physical Performance Battery

(SPPB) score of 9 or less indicating low physical function. Sarcopenia was diagnosed when low muscle mass and low muscle strength or low physical performance were observed. Severe sarcopenia was diagnosed when low muscle mass, low muscle strength, and low physical performance were all present. Individuals without any of these low measurements were classified as nonsarcopenic. For statistical purposes in this study, severe sarcopenia and sarcopenia were combined.

Muscle mass was evaluated through direct segmental multifrequency BIA utilizing the In-Body 770 device (Bio space Co., Ltd.). Participants were instructed to wear lightweight attire and to position themselves on the device's electrodes for a duration of 3–5 min in a barefoot state. The relative skeletal muscle mass index was derived by dividing the appendicular skeletal muscle mass (in kilograms) by the square of height (in meters).

Variables was evaluated through BIA included: total body water (TBW): total amount of water in the whole body; intracellular water (ICW): water distributed within the cell; extracellular water (ECW): water distributed outside the cell; body fat mass (BFM): total mass of fat in the whole body; soft lean mass (SLM): the weight of non-fat tissues in the body, mainly including muscle, bone and other soft tissues (It does not include the mineral content of bones); fat free mass (FFM): the weight of non-fat tissue in the body, consisting mainly of components, such as muscle, bone, internal organs, water and minerals; skeletal muscle mass (SMM): weight of skeletal muscle; body mass index (BMI): weight divided by height squared for calculation; percent body fat (PBF): body fat content as a percentage of body weight in humans; basal metabolic rate (BMR): the rate of energy metabolism of the human body in a state of wakefulness and extreme tranquility, unaffected by muscular activity, ambient temperature, food and mental stress, could be estimated by Harris–Benedict equation (Male: $66.47 + 13.75 * \text{weight} + 5.0033 * \text{height} - 6.775 * \text{age}$; Female: $655.1 + 9.563 * \text{weight} + 1.850 * \text{height} - 4.676 * \text{age}$); visceral fat area (VFA): amount of fat surrounding the organs in the abdominal cavity, could be used to diagnose abdominal obesity; body cell mass (BCM): the mass of cells in the body, including the sum of water, proteins, fats and other components within the cells; bone mineral content (BMC): the amount of minerals in bones, mainly including minerals, such as calcium and phosphorus; fat free mass index (FFMI): BMI after removing the effects of fat; fat mass index (FMI): weight of fat divided by height squared for calculation; 50 kHz—whole body phase angle (WBPA): Whole body phase angle measured at 50 kHz frequency. Phase Angle (PhA) is an impedance value calculated by passing a weak alternating current through the body and measuring the voltage at different segments of the body as a means of evaluating body composition. Impedance consists of resistance (R) and reactance (Xc), and the phase angle is the angle, in degrees, between the sum of resistance and reactance expressed on a vector diagram.

Handgrip strength (kg) was measured using an adjustable hydraulic hand-held dynamometer (EH101; CAMRY), calibrated before testing, with standardized verbal instructions given to the participants. They were instructed to stand upright with their arm vertical, holding the dynamometer beside, but not against, their body and then grip it as hard as they could. For each hand, handgrip strength was measured twice, and the maximal recorded value was considered.

Gait speed was assessed by measuring the time taken to walk 6 m at their regular speed, wearing flat, comfortable walking shoes. The measurement was taken once by trained evaluators using a stopwatch.

Statistical analysis

The baseline characteristics were delineated, with continuous variables reported as means ± standard deviations (SD) and categorical variables as frequencies with their respective percentages. Variables exhibiting a normal distribution were subjected to the independent two-sample *t* test, whereas those with a non-normal distribution were evaluated using the Mann–Whitney *U* test. Categorical data were analyzed employing Pearson's chi-squared test.

The correlation between multiple covariates and sarcopenia was analysed through binary regression commencing with univariate logistic regression models. This was followed by multivariate logistic regression, adjusted for confounders, including age, sex, economic status, and marital status. In addition, a multivariate logistic regression model, incorporating age and sex while normalizing the variables, was applied to ascertain the factors with the most robust association to sarcopenia, diminished skeletal muscle index (SMI), reduced physical performance, and weakened muscle strength. The outcomes were articulated as odds ratios (OR) alongside 95% confidence intervals (CI) and *P* values. Statistical significance was established at the threshold of $P < 0.05$. Data analysis was executed utilizing R software, version 4.1.3 (Academia Sinica, R Foundation for Statistical Computing; 2022-03-10).

Results

Our investigation revealed that sarcopenia is significantly associated with age, gender, and BMI. Moreover, we discovered that the phase angle acts as a protective factor for both physical function and muscle strength.

In addition, we found that upper arm circumference is a risk-reducing factor for muscle strength, whereas lower leg circumference is a risk-increasing factor for physical function.

Baseline characteristics

Our investigation comprised 1059 community-dwelling older adults. However, only 1053 subjects were considered for inclusion (6 were unwilling to sign the informed consent form), and subsequently, 120 individuals were excluded from the analysis due to an incomplete evaluation of sarcopenia. Finally, a total of 933 participants were incorporated in the study. The selection process and the number of participants at each stage based on the exclusion criteria is demonstrated in Fig. 1A, while the prevalence of sarcopenia stratified by age and gender is illustrated in Fig. 1B.

Table 1 displays the baseline characteristics of the participants grouped by sarcopenia categories. The study population had a mean age of 67.9 years (±7.6 SD). Notably, the prevalence of sarcopenia was found to be 8.8% ($n=82$). Various parameters were identified to be significantly associated with sarcopenia, including arm circumference, leg circumference, waist circumference, hip circumference, TBW, ICW, ECW, protein, minerals, BFM, SLM, SMM, BMI, BMR, VFA, BCM, AMC, BMC, FFMI, FMI, and WBPA.

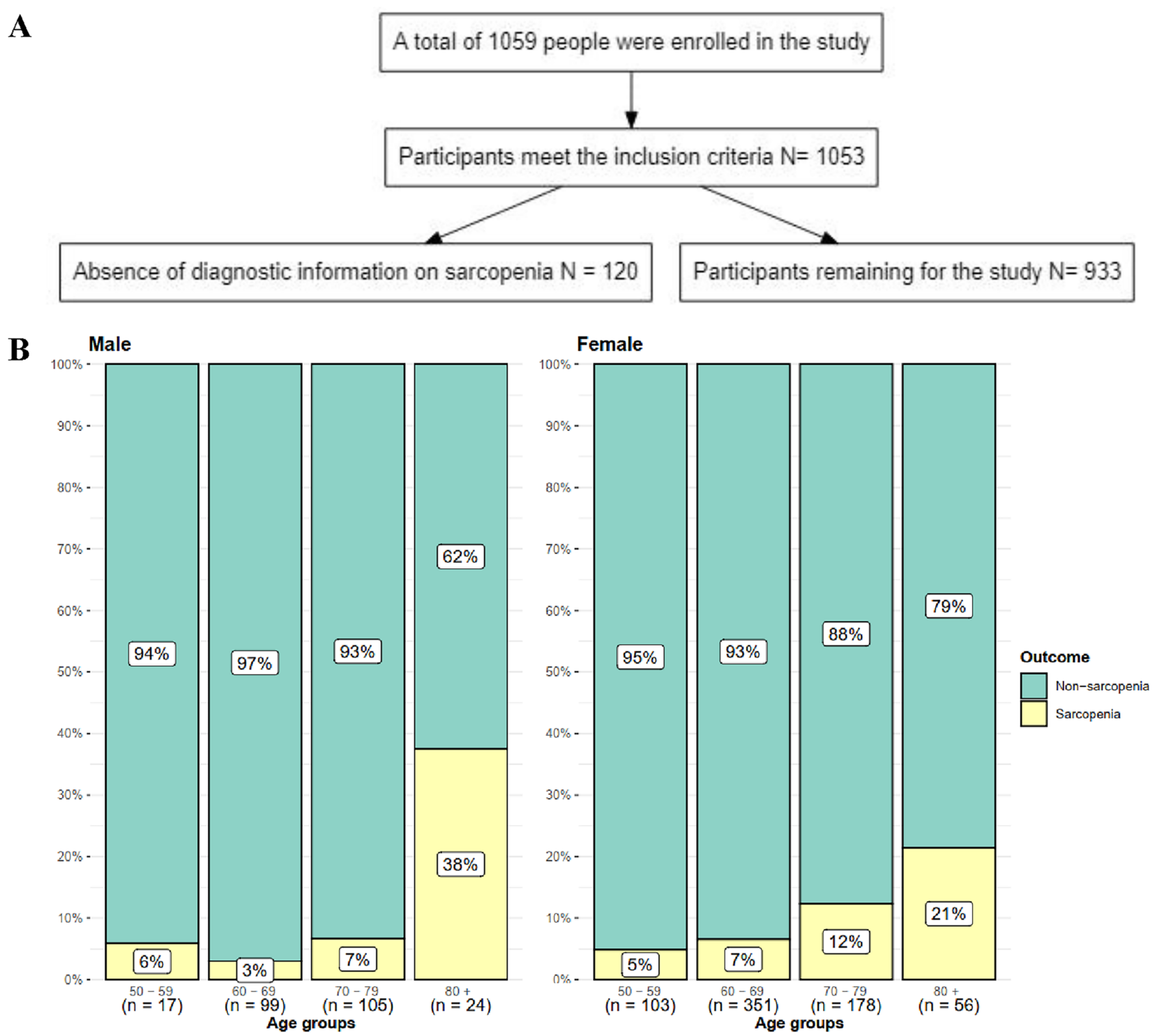

Fig. 1 Overview of study participants and sarcopenia prevalence. **A** Flowchart of the selection process. **B** Sarcopenia prevalence by age and gender

Table 1 Baseline characteristics of the participants stratified by sarcopenia status ($N=933$)

Characteristics	All $N=933$	Non-sarcopenia $N=851$	Sarcopenia $N=82$	*P* value
Sex *n* (%)				0.786
Male	245 (26.3%)	225 (91.8%)	20 (8.2%)	
Female	688 (73.7%)	626 (91%)	62 (9%)	
Age, mean (sd)/years	67.94 (7.61)	67.5 (7.32)	72.5 (9.07)	< 0.001
Age groups, n (%)				< 0.001
50–59	120 (12.9%)	114 (95%)	6 (5%)	
60–69	450 (48.2%)	424 (94.2%)	26 (5.8%)	
70–79	283 (30.3%)	254 (89.8%)	29 (10.2%)	
80+	80 (8.6%)	59 (73.8%)	21 (26.2%)	
Educational level, *n* (%)				0.053
Elementary school	40 (4.3%)	32 (80%)	8 (20%)	
Middle school	232 (24.9%)	215 (92.7%)	17 (7.3%)	
high school	339 (36.3%)	313 (92.3%)	26 (7.7%)	
College and above	322 (34.5%)	291 (90.4%)	31 (9.6%)	
Occupation group, *n* (%)				0.269
Professionals	151 (16.2%)	132 (87.4%)	19 (12.6%)	
Administrator	128 (13.7%)	118 (92.2%)	10 (7.8%)	
Unemployed	177 (19%)	160 (90.4%)	17 (9.6%)	
Others	477 (51.1%)	441 (92.5%)	36 (7.5%)	
Income status, n(%)/thousand				0.095
≤ 80	369 (39.5%)	329 (89.2%)	40 (10.8%)	
80–500	564 (60.5%)	522 (92.6%)	42 (7.4%)	
Spouse status, *n* (%)				0.246
Without spouse	198 (21.2%)	176 (88.9%)	22 (11.1%)	
With spouse	735 (78.8%)	675 (91.8%)	60 (8.2%)	
Arm circumference/cm, mean (sd)	27.92 (3.51)	28.07 (3.37)	26.34 (4.42)	0.0008
Leg circumference/cm, mean (sd)	34.47 (3.7)	34.7 (3.71)	32.06 (2.62)	< 0.001
Waist/cm, mean (sd)	85.35 (10.1)	85.86 (10.08)	80.04 (8.81)	< 0.001
Hip circumference/cm, mean (sd)	98.25 (8.72)	98.75 (8.72)	93.08 (6.82)	< 0.001
WHR, mean (sd)	0.87 (0.1)	0.87 (0.11)	0.86 (0.08)	0.2141
SMI/kg·m^{-2}, mean (sd)	6.83 (1.15)	6.95 (1.12)	5.61 (0.55)	< 0.001
TBW/kg, mean (sd)	32.51 (5.66)	33.09 (5.49)	26.51 (3.44)	< 0.001
ICW/kg, mean (sd)	19.85 (3.5)	20.22 (3.39)	16.05 (2.1)	< 0.001
ECW/kg, mean (sd)	12.66 (2.18)	12.88 (2.12)	10.46 (1.37)	< 0.001
Protein/kg, mean (sd)	8.58 (1.51)	8.74 (1.47)	6.95 (0.91)	< 0.001
Minerals/kg, mean (sd)	3 (0.78)	3.04 (0.8)	2.56 (0.3)	< 0.001
BFM/kg, mean (sd)	21.33 (6.39)	21.68 (6.42)	17.73 (4.83)	< 0.001
SLM/kg, mean (sd)	41.62 (7.26)	42.37 (7.05)	33.88 (4.4)	< 0.001
FFM/kg, mean (sd)	44.09 (7.51)	44.87 (7.28)	36.02 (4.6)	< 0.001
SMM/kg, mean (sd)	23.89 (4.57)	24.37 (4.42)	18.93 (2.74)	< 0.001
BMI/kg·m^{-2}, mean (sd)	25.2 (6.84)	25.51 (7.03)	22.01 (3.04)	< 0.001
PBF/%, mean (sd)	32.31 (6.82)	32.28 (6.79)	32.69 (7.07)	0.6128
BMR/kcal·d^{-1}, mean (sd)	1322.4 (162.2)	1339.2 (157.1)	1148.0 (99.4)	< 0.001
VFA/cm^2, mean (sd)	106.49 (37.34)	107.53 (37.6)	95.67 (32.9)	0.0027
BCM/kg, mean (sd)	28.43 (5.02)	28.96 (4.86)	22.99 (3)	< 0.001
AMC/cm, mean (sd)	26.33 (2.56)	26.59 (2.49)	23.64 (1.59)	< 0.001
BMC/g, mean (sd)	2.47 (0.74)	2.5 (0.76)	2.14 (0.25)	< 0.001
FFMI/kg·m^{-2}, mean (sd)	17 (6.39)	17.22 (6.64)	14.64 (0.99)	< 0.001
FMI/kg·m^{-2}, mean (sd)	8.21 (2.56)	8.29 (2.54)	7.36 (2.65)	0.0032
WBPA/°, mean (sd)	4.67 (0.6)	4.73 (0.57)	4.05 (0.55)	< 0.001

Table 1 (continued)

WHR: Waist–hip Ratio; TBW: Total Body Water; ICW: Intracellular Water; ECW: Extracellular Water; BFM: Body Fat Mass; SLM: Soft Lean Mass; FFM: Fat Free Mass; SMM: Skeletal Muscle Mass; BMI: Body Mass Index; PBF: Percent Body Fat; BMR: Basal Metabolic Rate; VFA: Visceral Fat Area; BCM: Body Cell Mass; AMC: Arm Muscle Circumference; BMC: Bone Mineral Content; FFMI: Fat Free Mass Index; FMI: Fat Mass Index; WBPA: 50kHz—Whole Body Phase Angle

Associations between sarcopenia and demographic, anthropometric, and body composition variables

The outcomes of Model 1, as presented in Fig. 2, exhibit significant correlations between sarcopenia and various factors, including age, anthropometric measurements, such as arm circumference, leg circumference, waist, and hip circumference, and body composition parameters, including TBW, ICW, ECW, protein, minerals, BFM, SLM, SMM, BMI, BMR, VFA, BCM, AMC, BMC, FFMI, FMI, and WBPA. Notably, Model 2 revealed that arm circumference, leg circumference, waist, hip circumference, TBW, ICW, ECW, protein, minerals, BFM, SLM, SMM, BMI, BMR, VFA, BCM, AMC, BMC, TBW/FFM, FFMI, FMI, and WBPA remained significantly linked to sarcopenia when adjusted for age, while WHR was associated with sarcopenia after additionally adjusting for sex. Model 3 presented a reduction in the risk of sarcopenia by more than 40 for each standard deviation increase in FFMI, SMM, ICW, BCM, protein, SLM, BMI, and TBW.

As depicted in Fig. 3, standardized variables that showed significant associations with sarcopenia, including arm circumference, leg circumference, waist circumference, hip circumference, TBW, ICW, protein, minerals, BFM, SLM, FFM, SMM, BMI, BMR, VFA, BCM, AMC, BMC, FFMI, FMI, and WBPA, also exhibited significant associations with low SMI after adjusting for age and sex. However, after further adjusting for age and sex, arm circumference, leg circumference, waist circumference, hip circumference, minerals, BFM, BMI, VFA, AMC, BMC, FFMI, and FMI had non-significant

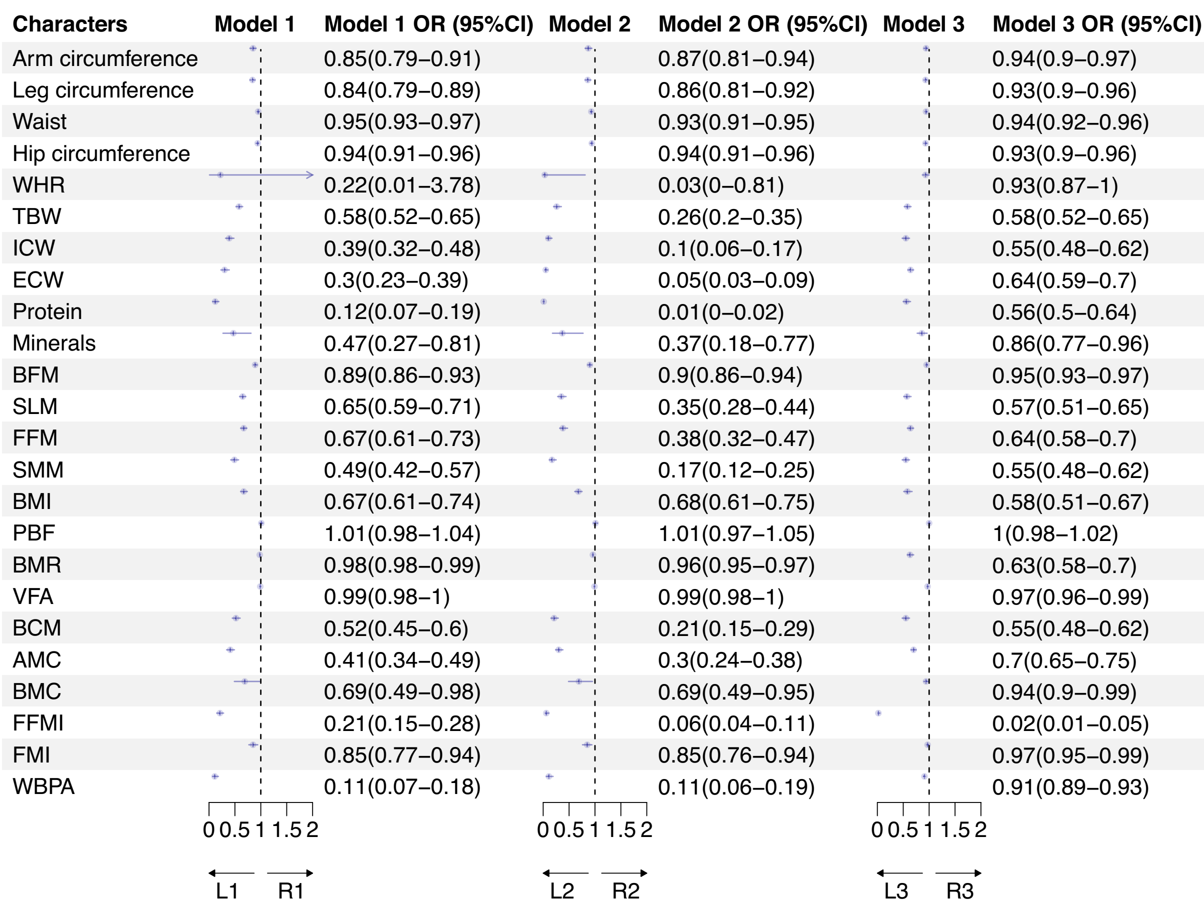

Fig. 2 Assessment of correlations between sarcopenia and various factors using different models

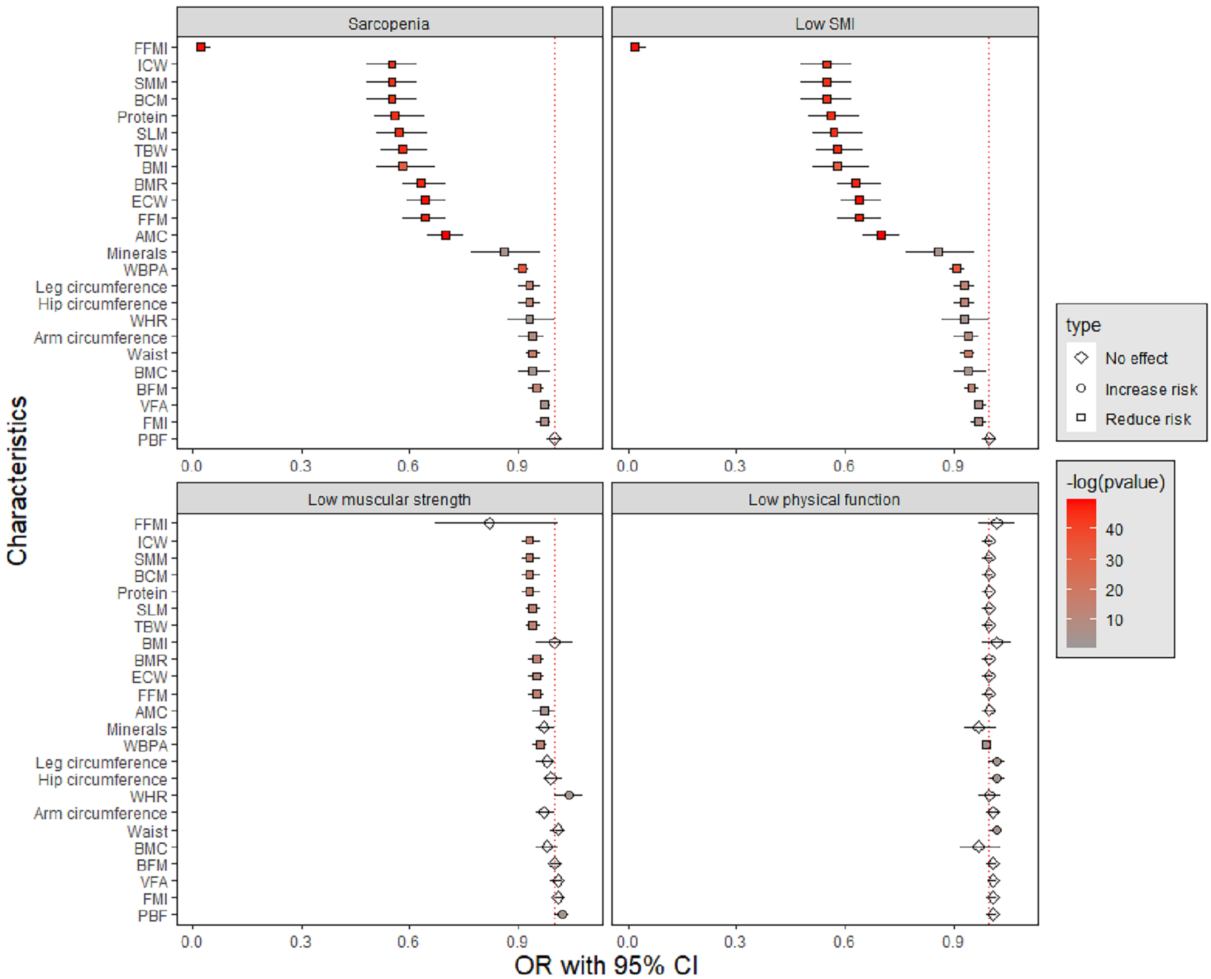

Fig. 3 Factors associated with low SMI, low muscle strength and low physical function

associations with low muscle strength. Supplementary Table 1 displays the values of factors that were associated with low SMI, low muscle strength, and low physical function, as shown in Fig. 3. Figure 4 displays the correlation matrix between different factors. Risk factors for decreased muscle strength: WHR, PBF. Protective factors: TBW, ICW, ECW, SLM, FFM, BMR, BCM, AMC, and WBPA. Risk factors for decreased physical performance: Calf Circumference, Hip Circumference, Waist Circumference. Protective factors: Phase Angle.

Discussion

The objective of our investigation was to assess the occurrence of sarcopenia and its related factors in the aging population residing in Beijing. This study disclosed that 8.8% of the study participants were affected by sarcopenia. This rate is consistent with findings from prior research conducted in China and other Asian nations, which have reported sarcopenia prevalence rates ranging from 6 to 30% in diverse populations [2–4, 8]. These outcomes underscore the significant public health impact of sarcopenia on the older population, as it is linked with unfavorable health consequences, such as an increased likelihood of falls, functional impairment, and reduced quality of life [7, 11].

This study reveals that gender is a significant contributor to the development of sarcopenia, with female individuals displaying a higher propensity for this condition than their male counterparts. This finding corroborates earlier research, which showed a greater frequency of sarcopenia in older women than in men [1, 5].The discerned dissimilarity in sarcopenia occurrence between genders is likely due to hormonal discrepancies, primarily the decline in estrogen levels among postmenopausal women, as well as the generally lower magnitude of muscle mass and strength in women compared to men. To prevent and treat sarcopenia in the aging population, it is imperative to implement interventions that are

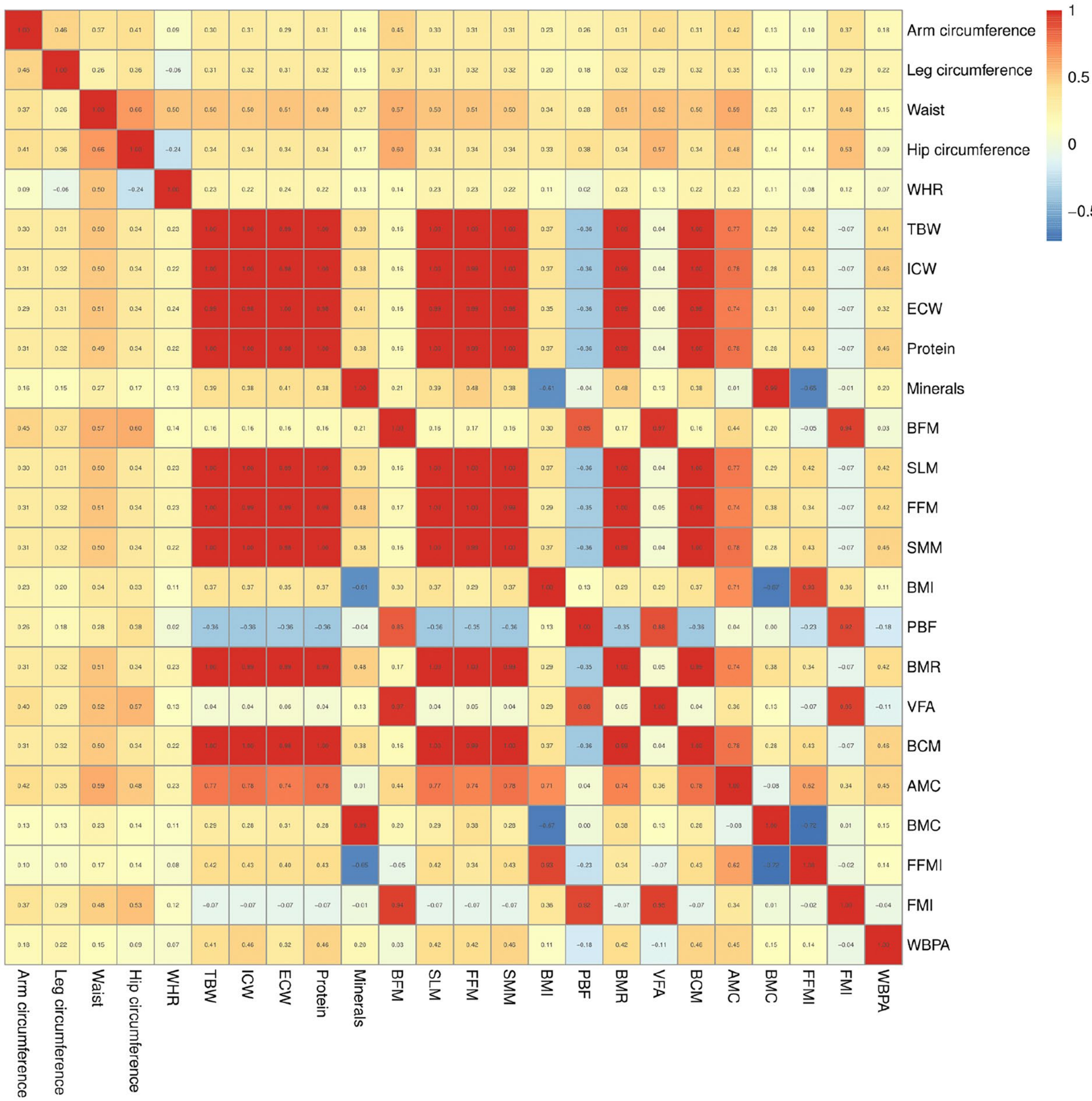

Fig. 4 Correlation matrix showing correlations between multiple factors

customized to meet the gender-specific requirements of each individual [9, 12, 13].

Our investigation has identified a significant association between whole-body phase angle (WBPA) and sarcopenia. Phase angle (PhA) functions as a safeguard against physical dysfunction and muscular weakness, with greater PhA values decreasing the probability of deterioration in physical function and muscle strength. Derived from BIA, PhA denotes a relevant parameter that highlights cellular soundness and function, particularly concerning cell membrane viability. Generally, higher phase angles indicate superior cellular structures and improved cellular function [14]. As a result, a reduction in phase angle may be linked to the deterioration and functional impairment of muscular cells, which are indicative traits of sarcopenia. Research has examined the connection between chronic disease comorbidities, phase angle, and the decline of age-related muscle mass linked to sarcopenia, revealing a negative correlation between phase angle and muscle mass decrease, with lower phase angle values signifying an elevated likelihood of muscle mass reduction [15, 16]. Our findings indicate that phase angle is correlated with sarcopenia, and that the incidence of sarcopenia increases with age and decreasing phase angle [17]. Furthermore, we found that phase angle is a simple and accessible measure, making it a valuable early predictor for sarcopenia in older individuals who are unable to participate in functional tests [18]. With further research, phase angle may become an important indicator for assessing the muscle health status of older people, aiding in early identification and intervention of sarcopenia.

Measuring the dimensions of the limbs is a straightforward procedure that can even be performed by patients at home, including those who are confined to bed. This study revealed that upper arm circumference is a protective factor for muscle strength, while lower leg circumference is a risk factor for physical function. Interestingly, our finding regarding upper arm circumference aligns with previous research, while our observation regarding lower leg circumference contradicts previous research. In addition, upper arm circumference was found to be positively correlated with ASM and ASMI, implying that greater muscle mass is generally associated with a larger upper arm circumference [19, 20]. Consequently, upper arm circumference can be utilized as a viable indicator for the evaluation of muscle mass. Further research should aim to corroborate these findings and investigate the potential applications of upper arm circumference in diverse populations and clinical contexts.

Gait speed is a simple and effective parameter for assessing physical function, representing an individual's walking proficiency and overall mobility. Evidence suggests a direct association between calf circumference and gait speed, indicating that individuals with greater calf circumference typically exhibit enhanced walking speeds signaling superior lower limb muscle conditions and walking aptitude [21, 22]. However, some studies have not found a significant correlation between calf circumference and gait speed, which may be influenced by other factors, such as height, weight, muscle strength, etc. [23].

Our research has established that calf circumference, hip circumference, and waist circumference are potential risk factors that affect physical function. Physical function involves multiple aspects beyond gait speed, such as balance, coordination, and strength. Elevated calf circumference, hip circumference, and waist circumference in older individuals may result in impaired balance and coordination, thereby reducing their overall physical function. This could, in turn, be linked to sarcopenia associated with obesity [24]. To gain a deeper insight into the correlation between calf circumference and various physical function indicators, future investigations must probe further and verify their feasibility in different populations and clinical scenarios. This study also revealed that WHR and PBF are some of the significant contributors to decreased muscle strength. WHR is a commonly employed metric to gauge body fat distribution, assessing the extent of central obesity by comparing waist and hip circumference dimensions. Research suggests that there is an inverse association between WHR and muscle strength, with higher WHR values often linked to reduced muscle strength. This could be attributed to increased abdominal fat, potentially leading to inflammation and metabolic disturbances, which may subsequently impact the growth and maintenance of muscles [25, 26]. In addition, abdominal fat may directly impact muscle fiber function, resulting in decreased muscle strength.

Recent studies have highlighted the intricate relationship between BFP and muscle strength. Elevated BFP, particularly associated with visceral fat, has been demonstrated to have an adverse effect on muscle strength by influencing metabolic health and evoking inflammation [27]. Conversely, a certain level of body fat is necessary for optimal hormone production, which can support muscle growth and strength [28].

The utilization of standardized diagnostic criteria for sarcopenia, as suggested by the AWGS, comparability with other studies conducted in Asia, thus augmenting the robustness of our results. In addition, our study's robustness is bolstered by the large sample size, which enhances the reliability of our findings.

However, our research on sarcopenia should be acknowledged for its limitations. First and foremost, the cross-sectional methodology of this study limits our capacity to infer causality between sarcopenia and its correlated factors, given that the observed associations could be attributed to reverse causality or the influence of confounding variables. Future research can employ longitudinal or interventional study designs to establish more robust evidence on causal relationships. Second, the gold standards for body composition measurement include Computed Tomography (CT) and Dual-Energy X-ray Absorptiometry (DXA). However, Given that the objective of this study was to identify the correlation between readily accessible anthropometric indicators and muscle strength or physical performance, a diagnosis of sarcopenia was not conducted using CT or DXA methodologies. Finally, this study participants were limited to older adults residing in Beijing, which may limit the generalizability of our findings to other populations or geographical regions. Therefore, further studies with diverse populations are necessary to confirm the prevalence of sarcopenia and explore potential disparities in risk factors between different settings and populations.

Conclusion

Our investigation offers significant insights into the epidemiology of sarcopenia and its contributing factors among the geriatric population residing in Beijing. Our study findings revealed that some conveniently accessible anthropometric indicators such as upper arm circumference, waist circumference, hip circumference, waist-to-hip ratio, body fat percentage, and phase angle were strongly correlated with muscle strength or physical performance. This will provide a means for screening and diagnosing sarcopenia in older individuals who are unable to undergo grip strength or physical function assessments.

Further research with diverse populations and geographical locations is needed to confirm and expand our understanding of the prevalence and risk factors for sarcopenia in different settings. Ultimately, an exhaustive understanding of sarcopenia and its correlated factors can guide the formulation of tailored prevention and intervention initiatives aimed at fostering healthy aging processes.

Abbreviations

AWGS	Asian working group of sarcopenia
SPPB	Short physical performance battery
BIA	Bioelectrical impedance analysis
SD	Standard deviations
CI	Confidence interval
WHR	Waist–hip ratio
TBW	Total body water
ICW	Intracellular water
ECW	Extracellular water
BFM	Body fat mass
SLM	Soft lean mass
FFM	Fat free mass
SMM	Skeletal muscle mass
SMI	Skeletal muscle index
BMI	Body mass index
PBF	Percent body fat
BMR	Basal metabolic rate
VFA	Visceral fat area
BCM	Body cell mass
AMC	Arm muscle circumference
BMC	Bone mineral content
FFMI	Fat free mass index
FMI	Fat mass index
WBPA	50 KHz whole body phase angle

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s40001-024-02185-9.

Additional file 1.

Additional file 2.

Additional file 3.

Additional file 4.

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Author contributions

Boshi Wang and Peng Liu designed the study and wrote the paper. Xue Zhang and Jiayu Zhang participated in interpretation of the data. Boshi Wang, Lihua Deng and Peng Liu were responsible for data analysis and interpretation. Boshi Wang, Peng Liu, Wei Li, Xue Zhang and Chenyu Nong reviewed and edited the manuscript. All authors have read and approved the manuscript.

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Availability of data and materials

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

All procedures conducted within the scope of this study, which involved human participants, were in full accordance with the ethical standards prescribed by the institutional and/or national research committee, and were aligned with the 1964 Helsinki Declaration and its subsequent amendments, or with equivalent ethical guidelines. This manuscript does not include any research involving animals carried out by the contributing authors. Informed consent was obtained in writing from all individual participants included in the study. The study protocol was duly registered with the Ethical Review Committee.

Consent for publication

All the authors have been fully informed about the study and the use of the data for publication purposes.

Competing interests

The authors declare no competing interests.

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