ORIGINAL PAPER

Physiotherapy Quarterly (ISSN 2544-4395)
2022, 30(4), 65–71

Prevalence estimates of sarcopenia in community-dwelling older adults in Northern Nigeria according to revised European and Asian reference criteria

DOI: https://doi.org/10.5114/pq.2022.121148

Adedapo Wasiu Awotidebe[1], Abubakar Bala[2], Kassim Abdulkarim[3]
[1] Department of Physiotherapy, Faculty of Allied Health Sciences, Bayero University Kano, Kano, Nigeria
[2] Department of Physiotherapy, Federal Medical Centre, Azare, Nigeria
[3] Department of Physiotherapy, Ahmadu Bello University Teaching Hospital, Zaria, Nigeria

Abstract

Introduction. The study aim was to estimate the prevalence of sarcopenia in community-dwelling Nigerian older adults using the Asian Working Group for Sarcopenia (AWGS) and the revised European Working Group on Sarcopenia in Older People (EWGSOP2) references.
Methods. A total of 767 community-dwelling older adults aged ≥ 60 years were recruited for the study. Sarcopenia was defined in accordance with the AWGS and EWGSOP2 references.
Results. As for the AWGS reference, 24.4% (95% CI: 21.4–27.6) of older adults had sarcopenia and the prevalence was significantly similar between men and women ($p = 0.18$); whereas with the EWGSOP2 reference, 36.2% were classified as having sarcopenia and the prevalence was significantly higher in men ($p < 0.001$). The agreement between the AWGS and EWGSOP2 criteria in estimating the prevalence of sarcopenia was moderate ($\kappa = 0.591$), with EWGSOP2 showing higher sensitivity (0.882). In accordance with the 2 references, the multivariable logistic regression showed that age was consistently associated with increased odds of sarcopenia, whereas female gender, muscle strength, and physical performance were significantly associated with decreased odds of sarcopenia in older adults ($p < 0.001$).
Conclusions. The EWGSOP2 reference, compared with the AWGS reference, is more likely to identify older individuals with sarcopenia. Both references showed that muscle strength and physical performance were associated with a decreased risk of sarcopenia. Clinicians may use the EWGSOP2 reference criteria for early diagnosis and management of sarcopenia in older adults.
Key words: sarcopenia, elderly, prevalence, community-dwelling, Nigeria

Introduction

The prevalence of sarcopenia is on the increase and is becoming a public health concern [1]. Older people aged ≥ 65 years are more susceptible to sarcopenia, which causes severe geriatric syndromes, such as falls and fractures [2, 3], loss of functional independence [4], and long-term mortality [5]. The term 'sarcopenia' is used by the European Working Group on Sarcopenia in Older People (EWGSOP1) [6] and the 2014 Asian Working Group for Sarcopenia (AWGS) [7] to denote a progressive decline in muscle mass and muscle function (muscle strength or muscle performance). Prevalence estimates derived from these 2 references in older adults aged ≥ 60 years have been well described [8–10].

Data collected among Korean rural-dwelling older adults aged ≥ 70 years by using the AWGS reference indicated that 21.3% of men and 13.8% of women had sarcopenia [8]. Also, a recent systematic review of Japanese rural-dwelling older adults showed that about 10% (95% CI: 6.2–15.4%) of participants had sarcopenia [11]. Results from the Newcastle 85+ Study [12] and research by Lera et al. [10], which were based on EWGSOP1, indicated a prevalence of sarcopenia of 21% and 19.1%, respectively.

Given the burden of sarcopenia in older adults, there has been a call for early diagnosis and management [13]. However, the existence of different definitions and cut-off point values for sarcopenia in older adults remains a major constraint. For example, in the revised EWGSOP2 reference, sarcopenia is defined as low muscle strength and either low muscle mass or low physical performance [13], whereas in AWGS 2014 reference, sarcopenia is defined as low muscle mass and either low muscle strength or low physical performance [7]. From a cut-off values perspective, the values used to define sarcopenia vary depending on reference criteria and gender. According to the AWGS reference criteria, low muscle mass (defined as appendicular skeletal muscle mass index) is < 6.66 kg/m^2 for males and < 5.24 kg/m^2 for females [14]. In the same AWGS reference, low muscle strength is classified as handgrip strength of < 24.8 kg for males and < 15.0 kg for females and gait speed of < 0.8 m/s [14]. The EWGSOP2 reference, in contrast, used different cut-off values for sarcopenia in older adults. The cut-off values for low muscle mass are < 7.0 kg/m^2 for males and < 6.0 kg/m^2 for females. In the EWGSOP2 classification, low muscle strength (handgrip strength) is < 27 kg for males and < 16 kg for females, while low physical performance (gait speed) is classified as ≤ 0.8 m/s [13].

Furthermore, regarding the risk factors of sarcopenia in older adults, there are no specific patterns associated with sarcopenia with either the AWGS or EWGSOP reference criteria. Advancing age is a dominant factor related with an increased risk of sarcopenia in older adults [15–18]. In addition, education level has shown an inverse association with sarcopenia in older adults [19]. However, the influence of body mass index (BMI) on the risk of sarcopenia is not clear. For example, Landi et al. [20] and Yu et al. [16] observed that high BMI conferred a protective effect on the risk of sarcopenia. In contrast, Murphy et al. [17] and Foley et al. [15]

Correspondence address: Adedapo Wasiu Awotidebe, Department of Physiotherapy, Bayero University Kano, PMB 3011, Gwarzo Road, Kano, Nigeria, e-mail: awotidebe.adedapo@gmail.com, https://orcid.org/0000-0001-5666-8358

Received: 24.10.2020
Accepted: 23.11.2020

Citation: Awotidebe AW, Bala A, Abdulkarim K. Prevalence estimates of sarcopenia in community-dwelling older adults in Northern Nigeria according to revised European and Asian reference criteria. Physiother Quart. 2022;30(4):65–71; doi: https://doi.org/10.5114/pq.2022.121148.

found that overweight was associated with the risk of sarcopenia.

In consequence of the nonexistence of a harmonized definition of sarcopenia, each reference standard generates different estimates of the condition in older adults [8, 10]. The lack of a reference standard for and therefore different reference criteria for classifying sarcopenia may hamper the early screening of this condition in clinical practice. Unfortunately, the situation is much worse in Africa, where, in spite of the increasing proportions of older adults with sarcopenia [21, 22], there is no reference criterion specifically developed for the African population. Until an African reference criterion is developed, researchers and clinicians from Africa will continue to use the reference criteria developed elsewhere. Presently, there is limited information regarding which reference standard will generate more conservative estimates of sarcopenia among older adults in this region. Therefore, the present study was conducted to determine the prevalence of sarcopenia among older adults in Northern Nigeria using the AWGS and the revised EWGSOP2 references.

Subjects and methods

Study sample

This was a cross-sectional study of community-dwelling older adults aged ≥ 60 years in selected rural communities in the North-Western and North-Eastern regions of Nigeria. The study population was comprised of predominantly native Hausa older adults aged ≥ 60 years who had lived in the selected rural communities for at least 12 months and who were traditionally engaged in farming activities.

Sampling technique and recruitment

The elders in the selected communities were approached and informed about the study. The community elders facilitated the use of the community hall as a meeting point for recruitment and collection of data. Individuals living with stroke, physical disabilities, severe arthritis, hearing difficulties, or cognitive impairment were excluded from the study.

Sample size estimation

The sample size for the study was estimated by using the G*Power sample size estimation (version 3.1.9.4 for Mac). Fisher's exact test for proportions on 2 independent groups was selected. The required sample size inputs were computed *a priori* as follows: tail: 2 – proportions p1 (7.1%) and proportions p2 (2.8%) (based on previous prevalence of sarcopenia in Nigeria for men and women, respectively) [22], at type I error = 0.05, power = 0.80, critical $z = 1.959$, and allocation ratio (p1/p2) of 1. Therefore, a total sample size of 798 participants was projected for the study.

Data collection

Participants who met the inclusion criteria of age and geography were purposefully selected for the study. Strategies for recruitment into the study included free weight and blood pressure assessment. Those with high blood pressure on 2 consecutive days were referred to nearby community health centres for further assessment and management; participants who were overweight or obese were given weight reduction and diet education. In order to conform with the Islamic religious practice of non-mixing of women and unrelated men in a predominantly Muslim population, male and female participants were recruited on different days of the week. Trained research assistants and researchers stationed at the community hall collected data from 800 participants from September 2019 to January 2020.

Measurements

Anthropometry

Body weight and height were measured in accordance with the standards of the International Society for the Advancement of Kinanthropometry [23]. Prior to the assessments, all participants wore light clothing and remained barefoot. Height was evaluated to the nearest 0.1 cm by using a stadiometer in an upright position with the head in the Frankfort plane, and body weight to the nearest 0.1 kg on calibrated bathroom scales. BMI was estimated and categorized into: underweight: < 18.5 kg/m^2; normal weight: 18.5–24.9 kg/m^2; overweight: 25–29.9 kg/m^2; and obese: ≥ 30 kg/m^2.

Assessment of sarcopenia components

A bioelectrical impedance analysis (BIA) machine (Tanita Ironman® Full Body Composition Monitor, model BC-549 plus) was used to measure the participants' weight (kg), body fat percent (%), total body water percent (%), muscle mass (kg), visceral fat (%), and resting basal metabolic rate (kcal). To ensure accuracy of the readings, all participants had to remove socks or stockings and be sure that their soles were clean. They then stood erect on the machine with the heels correctly positioned with the electrodes. All variables were measured twice and average values were used for analysis.

Muscle mass. We applied the Tanita muscle quality judgement chart to categorize muscle mass depending on age and sex (Figure 1). Muscle mass was then dichotomized into: 1 – normal muscle mass (for high and average) and 0 – low muscle mass (for low).

Muscle strength. Handgrip strength was used to evaluate muscle strength. Handgrip strength (dominant hand) was measured in accordance with the 2015 guidelines of the American Society of Hand Therapists [24] with a Jamar hand dynamometer (Sammons Preston Inc., Bolingbrook, USA). The participant was asked to sit on a chair with the elbow flexed at 90°, the forearm in the neutral position, and the wrist in 0–30° dorsiflexion. Three readings were taken of the dominant hand and the average was used for the analysis. On the basis of the AWGS reference, a handgrip strength of < 24.8 kg for men and < 15.0 kg for women was categorized as low muscle strength and values above these were categorized as normal muscle strength. In EWGSOP2, a grip strength of < 27 kg for men and < 16 kg for women is categorized as low handgrip strength.

Physical performance. The 4-m gait speed test was used to determine physical performance [25]. A 4-m walk test was performed indoors, with a 4-m long walking course with a concrete surface. The participants were instructed to walk at their usual pace while trained research assistants used a stopwatch to record the time it took to complete the 4-m walk. Subjects using a walking stick were allowed if it formed part of their daily life. According to the AWGS reference, gait speed values of < 0.8 m/s for both genders were categorized as low physical performance. The EWGSOP2 reference cate-

Muscle Quality Judgement Chart

Male	18 - 29	30s	40s	50s	60s	70s	80 and Over
High	74 and higher	73 and higher	70 and higher	64 and higher	56 and higher	46 and higher	39 and higher
Average	49-73	47-72	44-69	39-63	33-55	25-45	21-38
Low	48 or less	46 or less	43 or less	38 or less	32 or less	24 or less	20 or less

Female	18 - 29	30s	40s	50s	60s	70s	80 and Over
High	68 and higher	70 and higher	69 and higher	67 and higher	61 and higher	54 and higher	50 and higher
Average	48-67	48-69	45-68	41-66	34-60	26-53	22-49
Low	47 or less	47 or less	44 or less	40 or less	33 or less	25 or less	21 or less

*Muscle Quality Score may not be accurately evaluated if there are abnormalities in the state of body water, such as in the following conditions:
- If the body fatigued or swollen.
- If the person is dehydrated or suffering from reduced blood flow.

It is important to maintain a good balance between muscle mass and quality.
More ★ indicates a better state of muscle.
(Max. ★★★★)

Balance Between Muscle Mass and Muscle Quality

Muscle Quality Judgement	Low	Average	High
High	★★	★★★	★★★★
Average	★★	★★★	★★★
Low	★	★	★★
Muscle Mass Judgement	Low	Average	High

Figure 1. Tanita muscle quality judgement. Tanita BC-549 plus body composition monitor. Available from: https://www.tanita.com

gorized participants with gait speed ≤ 0.8 m/s as '0: low gait speed' and those with gait speeds > 0.8 m/s as '1: normal gait speed'.

Definition of sarcopenia

AWGS

Sarcopenia = low muscle mass + either low muscle strength or low physical performance.

EWGSOP2

Sarcopenia = low muscle strength + either low muscle mass or low physical performance.

Data analysis and statistics

Descriptive statistics for age, anthropometric variables, and sarcopenia components were presented as averages and standard deviations. Gender comparisons of these variables (anthropometric and sarcopenia components) were tested with the independent *t*-test. Sex- and age-specific prevalence of sarcopenia was presented as percentages and corresponding 95% confidence intervals. The receiver operating characteristic curve was determined to illustrate the sensitivity and specificity of the AWGS and EWGSOP2 references. The kappa statistic was applied to determine the strength of agreement between the AWGS and EWGSOP2 references. Multivariate logistic regression (stepwise forward selection method) served to determine the contribution of each of age, sex, BMI, handgrip strength, muscle mass, physical performance, body fat percent, resting basal metabolic rate, visceral fat, and total body water to the presence of sarcopenia. Assumptions for logistic regression for multicollinearity (variance inflation factor), model fit (omnibus test, Hosmer-Lemeshow test), and potential outliers were checked. Data were analysed with the Statistical Package for the Social Sciences (SPSS) version 22 and the significance level (alpha level) was set at 0.05.

Ethical approval

The research related to human use has complied with all the relevant national regulations and institutional policies, has followed the tenets of the Declaration of Helsinki, and has been approved by the Kano State Ministry of Health (approval No.: AKTH/MAC/SUB/12A/P-3/VI/2110) and Bauchi State Ministry of Health (approval No.: NREC/12/05/2013/2019/50).

Informed consent

Informed consent has been obtained from all individuals included in this study.

Results

Participant's characteristics

Data of 767 participants, representing about 96% of the response rate, were used for analysis. Demographic, anthropometric, and sarcopenia components data of the 767 older adults aged ≥ 60 years and the proportion of men and women who participated in the study are presented in Table 1. The mean age of the participants was 68.53 ± 8.40 years. Men were taller and heavier, as well as presented significantly higher mean values for handgrip strength, muscle mass, and gait speed, but women had higher mean values for body fat ($p < 0.05$).

Prevalence of sarcopenia

Overall, on the basis of the AWGS reference, the prevalence of sarcopenia was 24.4% (95% CI: 21.4–27.6), similar in men (26.4%) and women (22.2%). In turn, as defined by the EWGSOP2 reference, it varied between 32.8% and 39.7% (Table 2). The prevalence in accordance with the EWGSOP2 criteria was significantly higher in men (49.2%) compared with women (22.3%) ($p < 0.001$). When comparing the accuracy of AWGS and EWGSOP2 in detecting the presence or absence of sarcopenia, AWGS had a sensitivity of 59.4% and specificity of 95.5%, whereas EWGSOP2 presented a sensitivity of 88.2% and specificity of 80.6% (Figure 2). The consistency of AWGS and EWGSOP2, which was presented as kappa coefficient (κ), indicated a moderate agreement ($r = 0.59$) between the 2 references in estimating the prevalence of sarcopenia ($p = 0.001$) (Table 2).

Table 1. Demographic, anthropometric, and sarcopenia components data of the community-dwelling older adults

Characteristics	Total mean ± *SD*	Men mean ± *SD*	Women mean ± *SD*
n	767	394 (51.4%)	373 (48.6%)
Age (years)	68.53 ± 8.40	68.73 ± 8.44	68.32 ± 8.36
Height (m)	1.61 ± 0.09	1.67 ± 0.08*	1.55 ± 0.06
Weight (kg)	58.93 ± 12.12	61.59 ± 11.39*	56.13 ± 12.25
Body mass index (kg/m^2)	22.71 ± 4.32	22.32 ± 3.90*	23.13 ± 4.70
Handgrip (kg)	21.60 ± 7.37	24.02 ± 8.13*	19.03 ± 5.38
Muscle mass (kg)	39.75 ± 7.87	43.91 ± 7.56*	35.34 ± 5.41
Gait speed (m/s)	0.74 ± 0.21	0.75 ± 0.21	0.72 ± 0.22
Body fat (%)	24.07 ± 9.7	18.57 ± 7.15*	29.82 ± 8.63
Resting metabolic rate (kcal)	1329.7 ± 211.04	1436.69 ± 180.49*	1217.86 ± 180.63
Visceral fat (%)	8.83 ± 3.30	9.69 ± 3.55*	7.93 ± 2.75
Total body water (%)	52.35 ± 8.08	56.51 ± 6.26*	48.40 ± 7.62

* $p < 0.05$

Table 2. Age- and sex-standardized prevalence of sarcopenia and comparison of agreement between the AWGS and EWGSOP2 criteria in the community-dwelling older adults

Variable	AWGS % (95% CI)	EWGSOP2 % (95% CI)
Overall	24.4 (21.4–27.6)	36.2 (32.8–39.7)
Sex		
Male	26.4 (22.1–31.0)	49.2 (44.2–54.3)
Female	22.2 (18.1–26.8)	22.3 (18.1–26.9)
p for difference	0.180	0.001
Age (years)		
60–74	17.9 (14.8–21.3)	28.6 (24.9–32.5)
75–84	42.7 (34.6–51.0)	57.7 (49.4–65.8)
> 84	47.6 (32.0–63.6)	64.3 (48.0–78.4)
p for difference	0.001	0.001
Diagnostic property		
Sensitivity (%)	59.4	88.2
Specificity (%)	95.5	80.6
Kappa statistic, *p* for difference	(*r* = 0.591)	(*p* = 0.001)

AWGS – Asian Working Group for Sarcopenia, EWGSOP2 – European Working Group on Sarcopenia in Older People

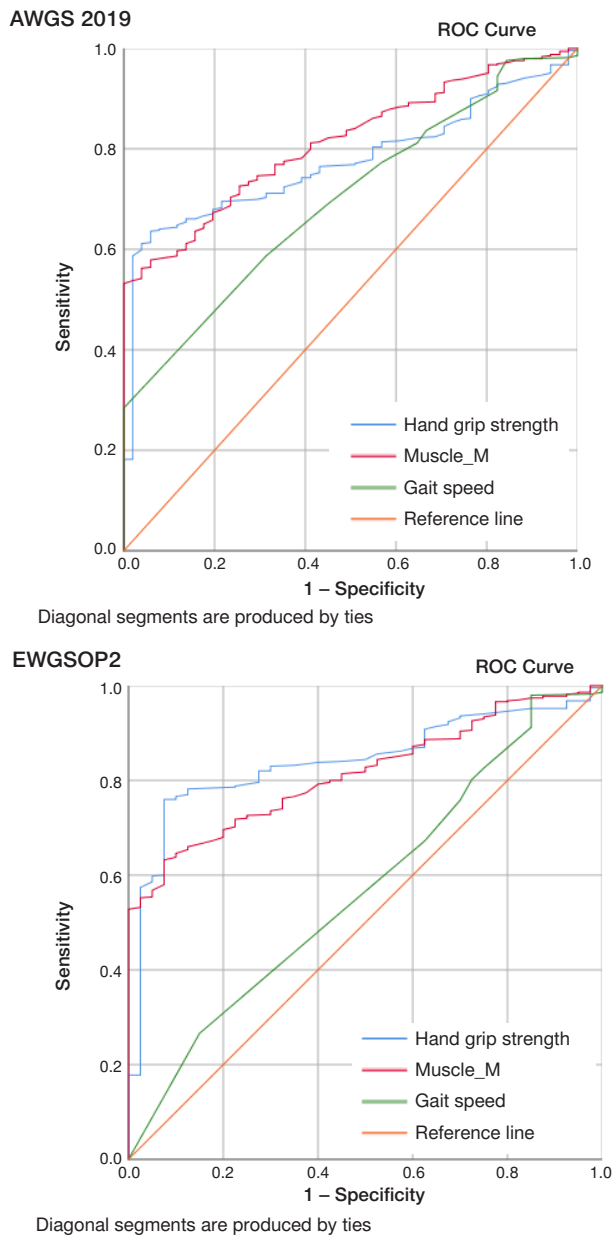

Figure 2. Receiver operating characteristic (ROC) curve for Asian Working Group for Sarcopenia (AWGS 2019) vs. European Working Group on Sarcopenia in Older People (EWGSOP2)

Table 3. Results of binary logistic regression model of risk factors for sarcopenia in older adults (≥ 60 years)

Variable	AWGS		EWGSOP2	
	Odds ratio (95% CI)	*p*	Odds ratio (95% CI)	*p*
Age	1.05 (1.01–1.10)	0.025*	1.05 (1.00–1.09)	0.023*
Sex (female)	0.22 (0.07–0.66)	0.007*	0.03 (0.01–0.10)	0.001*
Education (primary)	2.96 (1.12–7.84)	0.03*	1.7 (0.69–4.21)	0.25
Education (secondary)	2.14 (0.54–8.55)	0.28	2.97 (0.78–11.28)	0.11
Education (tertiary)	0.65 (0.13–3.35)	0.61	0.75 (0.14–4.06)	0.73
Body mass index	1.02 (0.91–1.16)	0.72	0.98 (0.88–1.09)	0.77
Handgrip strength	0.74 (0.70–0.80)	0.001*	0.7 (0.66–0.75)	0.001*
Physical performance	0.002 (0.001–0.006)	0.001*	0.03 (0.01–0.07)	0.001*
Muscle mass	1.01 (0.94–1.09)	0.71	1.00 (0.96–1.09)	0.53
Body fat	1.01 (0.95–1.07)	0.71	1.02 (0.97–1.08)	0.42
Resting metabolic rate	1.00 (0.99–1.00)	0.26	1.002 (1.000–1.005)	0.04*
Visceral fat	0.95 (0.81–1.11)	0.49	1.00 (0.86–1.16)	0.96
Total body water	0.99 (0.95–1.05)	0.89	0.98 (0.94–1.03)	0.48

AWGS – Asian Working Group for Sarcopenia, EWGSOP2 – European Working Group on Sarcopenia in Older People
* significant values
AWGS: omnibus (chi-square) = 393.27, $p < 0.001$; Cox-Snell R^2 = 45.4%, Nagelkerke R^2 = 66.3%
EWGSOP2: omnibus (chi-square) = 460.48, $p < 0.001$; Cox-Snell R^2 = 50.9%, Nagelkerke R^2 = 68.9%

Risk factors

In the multivariate logistic regression defined by the AWGS reference criteria, age (β = 1.05; 95% CI: 1.01–1.10) and primary education (β = 2.96; 95% CI: 1.12–7.84) were significantly associated with increased odds of sarcopenia. In contrast, female gender (β = 0.22; 95% CI: 0.07–0.66), handgrip strength (β = 0.74; 95% CI: 0.7–0.8), and physical performance (β = 0.002; 95% CI: 0.001–0.006) were all significantly associated with a decreased risk of sarcopenia. For the EWGSOP2 reference, age (β = 1.05; 95% CI: 1.00–1.09) and resting metabolic rate (β = 1.002; 95% CI: 1.00–1.005) were associated with sarcopenia. However, similar to the AWGS reference, female gender (β = 0.03; 95% CI: 0.01–0.10), handgrip strength (β = 0.7; 95% CI: 0.66–0.75), and physical performance (β = 0.03; 95% CI: 0.01–0.07) were associated with a decreased risk of sarcopenia (Table 3).

Discussion

The present study provided cross-sectional data on community-dwelling older adults (aged ≥ 60 years) in Northern Nigeria. Prevalence estimates and factors associated with sarcopenia according to 2 reference criteria were compared. The research showed that the prevalence estimates for sarcopenia in the community-dwelling older adults were high, with higher values for the EWGSOP2 reference compared with AWGS. This finding is inconsistent with Asian studies, which found that EWGSOP2 identified fewer individuals with sarcopenia compared with AWGS [19, 26]. A difference in sarcopenia prevalence is expected if different tools are employed to estimate muscle mass. For instance, Pang et al. [26] used dual-energy X-ray absorptiometry (DEXA), while BIA was applied in the present study. Previous studies have highlighted that the prevalence of sarcopenia is lower when DEXA is used to measure muscle mass [1, 27]. Compared with BIA, DEXA is considered to be a more accurate measure of muscle mass but is not widely used in large community-based research because of lack of accessibility and affordability; BIA is generally preferable [13].

In addition, prevalence estimates based on the 2014 AWGS criteria did not differ by gender, whereas prevalence estimates based on EWGSOP2 were higher in men compared with women. Regardless of the reference criteria used, men have been consistently shown to have higher prevalence of sarcopenia than women [8, 14, 19]. A primary mechanism explaining the higher prevalence of sarcopenia in men is that the levels of insulin-like growth factor 1 and testosterone decrease rapidly, resulting in loss of lean mass, strength, and function – factors associated with sarcopenia [28].

It was also identified that the EWGSOP2 reference was more likely to identify older adults with sarcopenia than the AWGS reference (88.2% vs. 59.2%). In the present study, we observed a moderate agreement (κ = 0.59) between AWGS and EWGSOP2 in identifying adults with sarcopenia. In comparison, Yang et al. [19] found that the agreement between EWGSOP2 and AWGS in identifying older adults with sarcopenia ranged 0.16–0.60 in men and 0.19–0.51 in women. This observation highlights the need to exercise caution when comparing the prevalence estimates obtained with the EWGSOP2 and AWGS reference criteria. Moreover, the revised EWGSOP2 considers muscle strength to be diagnostically more important than muscle mass in assessing sarcopenia in older adults. The observed high sensitivity and specificity of EWGSOP2 in identifying older adults with sarcopenia could support its widespread use among clinicians and researchers in this population.

This study also assessed factors associated with increased risk of sarcopenia in older adults, for both the AWGS and EWGSOP2 references. Our analysis showed that advancing age, female gender, handgrip strength, and physical performance might explain the difference in sarcopenia prevalence in older adults. A study has revealed that poor muscle strength and physical performance are diagnostic

components of sarcopenia; however, maintenance of good muscle strength and physical performance through resistance and aerobic exercises can mitigate the impact of sarcopenia in older adults [29].

Limitations

The findings in this study should be interpreted in the light of the following limitations. First, in this population, it was difficult to establish the actual date of birth of the participants. Dates of birth had to be estimated on the basis of some past notable events in the community; thus, the accurate average age of the subjects could not be ascertained. Second, there are no known muscle mass prediction models for sub-Saharan Africans, and therefore we were unable to estimate the skeletal muscle index using the BIA-predicted skeletal muscle mass equation developed for European populations. We therefore estimated the muscle mass from the guidelines provided by the Tanita muscle quality judgement chart (Figure 1).

Conclusions

This study indicates that the EWGSOP2 reference is more likely to identify sarcopenia in older adults than the AWGS reference; however, both references showed that muscle strength and physical performance were associated with a decreased risk of sarcopenia. Clinicians from this region may therefore use the EWGSOP2 reference criteria for early diagnosis of sarcopenia in older adults.

Acknowledgements

The authors would like to thank Mrs Serifat Oladokun for providing language editing services.

Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflict of interest

The authors state no conflict of interest.

References

1. Shafiee G, Keshtkar A, Soltani A, Ahadi Z, Larijani B, Heshmat R. Prevalence of sarcopenia in the world: a systematic review and meta-analysis of general population studies. J Diabetes Metab Disord. 2017;16:21; doi: 10.1186/s40200-017-0302-x.
2. Schaap LA, van Schoor NM, Lips P, Visser M. Associations of sarcopenia definitions, and their components, with the incidence of recurrent falling and fractures: the longitudinal aging study Amsterdam. J Gerontol A Biol Sci Med Sci. 2018;73(9):1199–1204; doi: 10.1093/gerona/glx245.
3. Bischoff-Ferrari HA, Orav JE, Kanis JA, Rizzoli R, Schlögl M, Staehelin HB, et al. Comparative performance of current definitions of sarcopenia against the prospective incidence of falls among community-dwelling seniors age 65 and older. Osteoporos Int. 2015;26(12):2793–2802; doi: 10.1007/s00198-015-3194-y.
4. Dos Santos L, Cyrino ES, Antunes M, Santos DA, Sardinha LB. Sarcopenia and physical independence in older adults: the independent and synergic role of muscle mass and muscle function. J Cachexia Sarcopenia Muscle. 2017;8(2):245–250; doi: 10.1002/jcsm.12160.
5. De Buyser SL, Petrovic M, Taes YE, Toye KRC, Kaufman J-M, Lapauw B, et al. Validation of the FNIH sarcopenia criteria and SOF frailty index as predictors of long-term mortality in ambulatory older men. Age Ageing. 2016; 45(5):602–608; doi: 10.1093/ageing/afw071.
6. Cruz-Jentoft AJ, Baeyens JP, Bauer JM, Boirie Y, Cederholm T, Landi F, et al. Sarcopenia: European consensus on definition and diagnosis: report of the European Working Group on Sarcopenia in Older People. Age Ageing. 2010;39(4):412–423; doi: 10.1093/ageing/afq034.
7. Chen L-K, Liu L-K, Woo J, Assantachai P, Auyeung T-W, Bahyah KS, et al. Sarcopenia in Asia: consensus report of the Asian Working Group for Sarcopenia. J Am Med Dir Assoc. 2014;15(2):95–101; doi: 10.1016/j.jamda.2013.11.025.
8. Kim M, Won CW. Sarcopenia in Korean community-dwelling adults aged 70 years and older: application of screening and diagnostic tools from the Asian Working Group for Sarcopenia 2019 update. J Am Med Dir Assoc. 2020;21(6):752–758; doi: 10.1016/j.jamda.2020.03.018.
9. Makizako H, Nakai Y, Tomioka K, Taniguchi Y. Prevalence of sarcopenia defined using the Asia Working Group for Sarcopenia criteria in Japanese community-dwelling older adults: a systematic review and meta-analysis. Phys Ther Res. 2019;22(2):53–57; doi: 10.1298/ptr.R0005.
10. Lera L, Albala C, Sánchez H, Angel B, Hormazabal MJ, Márquez C, et al. Prevalence of sarcopenia in community-dwelling Chilean elders according to an adapted version of the European Working Group on Sarcopenia in Older People (EWGSOP) criteria. J Frailty Aging. 2017; 6(1):12–17; doi: 10.14283/jfa.2016.117.
11. Su Y, Hirayama K, Han T-F, Izutsu M, Yuki M. Sarcopenia prevalence and risk factors among Japanese community dwelling older adults living in a snow-covered city according to EWGSOP2. J Clin Med. 2019;8(3):291; doi: 10.3390/jcm8030291.
12. Dodds RM, Granic A, Davies K, Kirkwood TBL, Jagger C, Sayer AA. Prevalence and incidence of sarcopenia in the very old: findings from the Newcastle 85+ Study. J Cachexia Sarcopenia Muscle. 2017;8(2):229–237; doi: 10.1002/jcsm.12157.
13. Cruz-Jentoft AJ, Bahat G, Bauer J, Boirie Y, Bruyère O, Cederholm T, et al. Sarcopenia: revised European consensus on definition and diagnosis. Age Ageing. 2019; 48(1):16–31; doi: 10.1093/ageing/afy169.
14. Du Y, Wang X, Xie H, Zheng S, Wu X, Zhu X, et al. Sex differences in the prevalence and adverse outcomes of sarcopenia and sarcopenic obesity in community dwelling elderly in East China using the AWGS criteria. BMC Endocr Disord. 2019;19(1):109; doi: 10.1186/s12902-019-0432-x.
15. Foley RN, Wang C, Ishani A, Collins AJ, Murray AM. Kidney function and sarcopenia in the United States general population: NHANES III. Am J Nephrol. 2007;27(3): 279–286; doi: 10.1159/000101827.
16. Yu R, Wong M, Leung J, Lee J, Auyeung TW, Woo J. Incidence, reversibility, risk factors and the protective effect of high body mass index against sarcopenia in community-dwelling older Chinese adults. Geriatr Gerontol Int. 2014;14(Suppl. 1):15–28; doi: 10.1111/ggi.12220.
17. Murphy RA, Ip EH, Zhang Q, Boudreau RM, Cawthon PM, Newman AB, et al. Transition to sarcopenia and determinants of transitions in older adults: a population-based study. J Gerontol A Biol Sci Med Sci. 2014;69(6):751–758; doi: 10.1093/gerona/glt131.

18. Kim H, Suzuki T, Kim M, Kojima N, Yoshida Y, Hirano H, et al. Incidence and predictors of sarcopenia onset in community-dwelling elderly Japanese women: 4-year follow-up study. J Am Med Dir Assoc. 2015;16(1):85.e1–85.e8; doi: 10.1016/j.jamda.2014.10.006.
19. Yang L, Yao X, Shen J, Sun G, Sun Q, Tian X, et al. Comparison of revised EWGSOP criteria and four other diagnostic criteria of sarcopenia in Chinese community-dwelling elderly residents. Exp Gerontol. 2020;130:110798; doi: 10.1016/j.exger.2019.110798.
20. Landi F, Liperoti R, Fusco D, Mastropaolo S, Quattrociocchi D, Proia A, et al. Prevalence and risk factors of sarcopenia among nursing home older residents. J Gerontol A Biol Sci Med Sci. 2012;67(1):48–55; doi: 10.1093/gerona/glr035.
21. Zengin A, Jarjou LM, Prentice A, Cooper C, Ebeling PR, Ward KA. The prevalence of sarcopenia and relationships between muscle and bone in ageing West-African Gambian men and women. J Cachexia Sarcopenia Muscle. 2018;9(5):920–928; doi: 10.1002/jcsm.12341.
22. Adebusoye LA, Ogunbode AM, Olowookere OO, Ajayi SA, Ladipo MM. Factors associated with sarcopenia among older patients attending a geriatric clinic in Nigeria. Niger J Clin Pract. 2018;21(4):443–450; doi: 10.4103/njcp.njcp_374_17.
23. Stewart A, Marfell-Jones M, Olds T, De Ridder H. International standards for anthropometric assessment. Lower Hutt: International Society for the Advancement of Kinanthropometry; 2011.
24. MacDermid J, Solomon G, Fedorczyk J, Valdes K. Clinical assessment recommendations, 3rd ed. Impairment-based conditions. Mount Laurel: American Society of Hand Therapists; 2015.
25. Bohannon RW, Wang Y-C. Four-meter gait speed: normative values and reliability determined for adults participating in the NIH Toolbox study. Arch Phys Med Rehabil. 2019;100(3):509–513; doi: 10.1016/j.apmr.2018.06.031.
26. Pang BWJ, Wee S-L, Lau LK, Jabbar KA, Seah WT, Ng DHM, et al. Prevalence and associated factors of sarcopenia in Singaporean adults – the Yishun study. J Am Med Dir Assoc. 2021;22(4):885.e1–885.e10; doi: 10.1016/j.jamda.2020.05.029.
27. Lee JSW, Auyeung T-W, Kwok T, Lau EMC, Leung P-C, Woo J. Associated factors and health impact of sarcopenia in older Chinese men and women: a cross-sectional study. Gerontology. 2007;53(6):404–410; doi: 10.1159/000107355.
28. Yamada M, Nishiguchi S, Fukutani N, Tanigawa T, Yukutake T, Kayama H, et al. Prevalence of sarcopenia in community-dwelling Japanese older adults. J Am Med Dir Assoc. 2013;14(12):911–915; doi: 10.1016/j.jamda.2013.08.015.
29. Yoo S-Z, No M-H, Heo J-W, Park D-H, Kang J-H, Kim SH, et al. Role of exercise in age-related sarcopenia. J Exerc Rehabil. 2018;14(4):551–558; doi: 10.12965/jer.1836268.134.