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Implications of Race and Ethnicity in Sarcopenia US National Prevalence of Sarcopenia by Muscle Mass, Strength, and Function Indices

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Abstract

Sarcopenia prevalence varies widely by definitions and populations, which led to the creation of new criteria by the Sarcopenia Definitions and Outcomes Consortium. Yet, the degree to which sarcopenia prevalence varies according to these criteria across race and ethnic groups in the U.S. population needs further investigation. We estimated the US national prevalence of sarcopenia using different indices among adults aged 50–80 years across race and ethnicity groups utilizing data from the National Health and Nutrition Examination Surveys (NHANES: 1999–2002 and 2011–2014). Sarcopenia was defined by appendicular lean mass divided by body mass index (ALM/BMI), grip strength, and gait speed. For each index the following samples were constructed: grip strength (NHANES 2011–2014: N=4,615), gait speed (NHANES 1999–2002: N=3,448) and ALM/BMI (NHANES 1999–2002: N=3,448) among adults aged 50–80 years. Sarcopenia prevalence varied by race/ethnicity: NH-Whites (11.2–24.3%), Hispanics (21.9–36.0%), NH-Blacks (4.4–27.7%), and Asians/others (18.5–35.7%). Based on the multivariable models, compared to NH-Whites, NH-Blacks were less likely to have sarcopenia by ALM/BMI (OR=0.26, 95%CI: 0.18–0.39), and more likely by gait speed (OR=3.90, 95% CI: 3.00–5.06) with no difference by grip strength (OR=0.96, 95%CI: 0.75–1.24). While, Hispanics and Asians/others were more likely to have sarcopenia by grip strength, gait speed, and ALM/BMI (ORs=2.15–3.21) compared to NH-Whites. This study suggests the need for inclusion of race/ethnicity related criteria in sarcopenia definitions. Future investigations could determine whether this discrepancy between race/ethnicity across sarcopenia indices, particularly in NH-Blacks, is partly due to either muscle mass or functional changes with aging.

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CONFLICT OF INTEREST

The authors have no conflicts.

Keywords

Sarcopenia; Race/Ethnicity; Gait speed; Grip strength; Appendicular lean mass

INTRODUCTION

Sarcopenia is associated with several adverse health outcomes and disabilities due to a marked decline of muscle mass and function with increasing age [1,2]. In the US, sarcopenia prevalence varies considerably depending on the studied populations [3], the methods of assessment, and cut-points being used [4–6]. Several methods to assess muscle mass and function include measurement of lean body mass and upper and lower body strength such as grip strength and gait speed, with or without adjustment for body size [5].

In 2016, the National Institute on Aging (NIA) initiated a panel of experts, the Sarcopenia Definitions and Outcomes Consortium (SDOC), to generate new evidence-based cut points of specifically reduced lean mass and low strength for a consistent definition of sarcopenia [7]. After analyzing a large body of data from various epidemiological studies followed by several conference meetings, the SDOC panel concluded that the standard definition of sarcopenia should be based on low grip strength or low gait speed since they independently predict falls, mobility limitation, hip fractures, and mortality when compared to the use of lean mass measures which were found to be less effective in predicting these adverse health outcomes [7]. As the conclusion was generated from population-based studies and surveys consisting mostly of healthy community-dwelling older adults, who were self-identified as Caucasians [8], this raises the question of whether these criteria for sarcopenia reflect the variation of muscle mass and function among diverse populations living in the US.

A review of previous studies shows disparities in lean body mass, muscle strength, and physical function between race and ethnic groups [9–12]. In the Health, Aging and Body Composition Study, Non-Hispanic (NH)-Black men had a 20% lower physical function score than NH-White men, despite a 5% higher body lean mass than NH-White men [10]. Asians, when compared to NH-Black people as well as to NH-White people, had lower muscle mass, weaker grip strength, and slower gait speed [11]. A study of the US populations found that Mexican Americans and NH-Whites had a higher physical performance score compared to NH-Blacks [9]. These race/ethnicity differences may have implications for the criteria and diagnosis of sarcopenia and on the ability to accurately estimate the prevalence of sarcopenia in different populations.

National estimates of sarcopenia prevalence among older adults using different indices among a representative sample of US diverse populations will further our understanding of the prevalence of sarcopenia in the US and to the extent it varies across race and ethnic groups. Therefore, the objectives of this study are, to estimate sarcopenia prevalence, overall and by race/ethnicity, in the US older adult populations using muscle mass and function indices. The findings of the study may indicate the need for including criteria related to race and ethnicity in a standardized definition of sarcopenia.

MATERIALS AND METHODS

Study population

This is a cross sectional study utilizing data from the National Health and Nutrition Examination Survey (NHANES) of the following cycles: 1999–2002 and 2011–2014. NHANES is a national survey with a stratified multistage probability design. Data on health and nutritional status of non-institutionalized civilians of the U.S. population were collected through a series of interviews, examinations, and laboratory measurements. The National Center for Health Statistics (NCHS) Research Ethics Review Board provided the following protocol approval numbers for the presented surveys years: Protocol #98–12 (NHANES 1999–2002), Protocol #2011–17(NHANES 2011–2012), and Continuation of Protocol #2011–17(NHANES 2013–2014). Further information on the NHANES database is obtainable at http://www.cdc.gov/nchs/nhanes.htm(accessed February 2021). The use of de-identified data exempted this study from review by the local Institutional Review Board.

Study sample

From the NHANES 1999–2002 and 2011–2014 surveys, only participants who had available data on physical functioning, body composition measures, and demographics were included. Participants with a height of >6’5” or a weight of >450 lb. or pregnant women were not eligible and were excluded from the sample based on the NHANES study protocol. Therefore, for each sarcopenia index three different samples were constructed: For grip strength index there were 4,615 eligible participants from survey 2011–2014; for gait speed index there were 3,448 eligible participants from survey 1999–2002, and for muscle mass index the final sample included 3,651 eligible participants from survey 1999–2002.

Measures

Muscle mass: Dual energy X-ray Absorptiometry (DXA), using a QDR-4500 Hologic Scanner (Bedford, MA), assessed body composition. Lean soft tissue assessed by DXA was composed of all fat-free mass components except for mineral content. Appendicular Lean Mass (ALM) was defined as the combined lean tissue mass for all four limbs (arms and legs). The NIA and Foundation for the National Institutes of Health criteria was used to classify sarcopenia as ALM adjusted for body mass index (BMI)(<0.789 for men, <0.512 for women) [13].

Muscle function

Grip strength: The grip strength test was taken in 2011–2014 surveys and the protocol is detailed in the NHANES 2011–2012 Muscle Strength Procedures Manual (https://wwwn.cdc.gov/nchs/data/nhanes/2011-2012/manuals/Muscle_Strength_Proc_Manual.pdf, accessed February 2021). Briefly, grip strength was measured in kilograms (kg) with the Takei Digital Grip Strength Dynamometer over three trials separated by 60 seconds and alternating hands. Similar to previous studies, the mean value achieved using all 6 -trials was used in the analysis. Sarcopenia was classified based on the grip strength criteria (<35.5 kg for men; <20 kg for women) [14].

Gait speed: Gait speed was measured in 1999–2002 surveys by staff certified health technicians that used a 20-foot (6.15 meters) timed walk test according the NHANES examination protocol and procedure. From a standing position, the participants were asked to walk at their usual walking pace, and their walking time was measured when the participant's first foot touched the starting line and ended when it crossed the finish line. Maximal gait speed was computed as the 20-foot distance divided by the walking time (m/s). European Working Group on Sarcopenia in Older People was used to classify sarcopenia based on the criteria of <0.8 m/s for gait speed for men and women [14].

Demographics: Study covariates included gender, age in years by groups (50–59, the reference category, 60–69, 70–80), race and ethnicity (Non-Hispanic Whites ((NH)-Whites reference category), NH-Blacks, Hispanic, Asians, and Other). Since Asians (5.2%) and 'Other' (2.0%) were the smallest categories, they were combined to 'one category' as Asians/Others in these analyses.

Body mass index: Body mass index (BMI) was measured as the weight in kilograms divided by the square of height in meters. The World Health Organization adult cut-off points for BMI were low to normal weight <25.0 kg/m^2, overweight 25.0–29.9 kg/m^2, and obesity ≥30.0 kg/m^2 [15].

Comorbidities: Medical history was obtained from the participants and included self reported history of physician diagnosis of arthritis, congestive heart failure, coronary heart disease, angina pectoris, heart attack, stroke, cancer, and diabetes. We categorized a '0' as self-report of no chronic disease, '1' as one chronic disease, and '2+' as two or more chronic diseases.

Statistical analysis

All analyses were performed using Stata 15 [16]. Responses coded as 'do not know,' 'refused,' or 'missing' in the original NHANES surveys was treated as missing. All analyses were performed using NHANES 1999–2002 and 2011–2014 sampling weights to account for stratification and clustering because of the complex sample design. Descriptive statistics (sample sizes and weighted proportions) were used to estimate national sarcopenia prevalence and to summarize the characteristics of the study samples by each sarcopenia index. Weighted Chi square test was used to examine the bivariate association between sarcopenia and each study covariate separately. In the multivariable analyses, weighted logistic regression models were used to examine the adjusted associations between race and ethnicity and sarcopenia by its indices while adjusting for age, gender, BMI and comorbidities. To account for nonrandom missing DXA data in NHANES 1999–2002, multiple imputation was performed by the NCHS creating five imputed data sets that were included in all the analyses to obtain more accurate variance estimates. Detailed information on the rationale and methods for multiple imputation has been described in the NHANES DXA data file documents. A type I error level of 0.05 was considered significant throughout the statistical tests.

RESULTS

National prevalence of sarcopenia

The sarcopenia indices: ALM/BMI, grip strength and gait speed yielded the following national sarcopenia prevalence (Table 1): ALM/BMI (15.6%), grip strength (25.6%) and gait speed (13.8%). Men had higher sarcopenia prevalence than women by ALM/BMI (17.6 vs. 13.7%, p<0.001) and by grip strength (30.9 vs. 20.8%, p<0.001), and lower sarcopenia prevalence by gait speed (10.3 vs. 17.0%, p<0.001). Participants with two or more comorbidities had higher prevalence of sarcopenia in all indices, for example, by grip strength (39.6 vs. 15.6%, p<0.001) and by gait speed (26.6 vs. 6.6%, p<0.001) than those who did not report any study comorbidity.

Sarcopenia prevalence by race/ethnicity

Sarcopenia prevalence significantly differed by race and ethnicity, which ranged from 11.2% to 24.3% in NH-Whites, 21.1% to 36.0% in Hispanics, 4.4% to 27.7% in NH-Blacks, and 18.5% to 35.7% in Asians/Others (Table 1). Compared to NH-Whites, the prevalence of sarcopenia by muscle mass index (ALM/BMI) was lower among NH-Blacks (4.4 vs. 15.0%, p<0.001) and higher in Hispanics (27.8 vs. 15.0%, p<0.001). Compared to NH-Whites, sarcopenia prevalence by grip strength was lower in NH-Blacks (20.8 vs. 24.3%), higher in Asians/Others (35.7% vs. 24.3%) and in Hispanics (36.0 vs. 24.3%). While sarcopenia prevalence by gait speed was higher in NH-Blacks vs. NH-Whites (27.7 vs.11.2%), higher in Hispanics vs. NH-Whites (21.1 vs. 11.2%), and in Asians/Others (18.5 vs. 11.2%).

Race/ethnicity and the associations with sarcopenia

Based on the multivariable models, NH-Blacks had significantly lower odds of developing sarcopenia by ALM/BMI (OR=0.26, 95% CI: 0.18–0.39, p<0.001) than NH-Whites, whereas Hispanics and Asians/Others had significantly higher odds of developing sarcopenia by ALM/BMI than NH-Whites (OR=2.70, 95% CI: 2.16–3.35, p<0.001; OR=3.02, 95% CI: 1.71–5.33, p<0.001), respectively (Table 2).

Compared to NH-Whites, NH-Blacks had significantly higher odds of developing sarcopenia by gait speed (OR=3.90, 95% CI: 3.00–5.06) but not by grip strength (OR=0.96, 95% CI: 0.75–1.24, p=0.761). Hispanics and Asians/Others had significantly higher odds of developing sarcopenia by grip strength, respectively (OR=2.60, 95% CI: 1.96–3.46, p<0.001; OR=2.15, 95% CI: 1.31–3.53, p<0.001) and by gait speed, respectively (OR=3.21, 95% CI: 2.37–4.33) OR=3.00, 95% CI: 1.71–5.14, p<0.001) than NH-Whites (Table 2).

DISCUSSION

In the present study, we analyzed three different sarcopenia indices measuring low muscle mass, strength, and function in the estimation of national sarcopenia prevalence in a representative sample of the older adult US population aged 50–80 years. The study highlighted the variability of sarcopenia prevalence by race and ethnicity.

Race and ethnic groups were associated differently with the various sarcopenia indices when compared to NH-Whites in the multivariable models. Thus, even after adjusting

for age, gender, body fat measures, and related medical conditions including arthritis, diabetes, and cardiovascular diseases, sarcopenia discrepancies across race and ethnicity remained. For example, risks for sarcopenia were consistently higher by gait speed, grip strength, and muscle mass indices for Asians/Others and Hispanics compared to NH-Whites. Whereas in NH-Blacks, their risks for sarcopenia by muscle mass index were consistently lower than NH-Whites. Yet, their risks for sarcopenia by gait speed were higher; only when sarcopenia was defined by grip strength was there no difference in sarcopenia to NH-Whites. Specifically, Hispanics and Asians/Others had up to 2.6 times higher odds of having sarcopenia by grip strength and up to 3.2 times higher odds of having sarcopenia by gait speed when comparing to NH-Whites. NH-Blacks had up to 74% lower odds of having sarcopenia by muscle mass index, which did not align with their 3.9 times higher odds of having sarcopenia by gait speed nor to their concordance of sarcopenia prevalence by grip strength when compared to NH-Whites. More studies are needed to determine whether the discrepancy in muscle function, particularly in gait speed, is partly attributed to either muscle mass loss or functional changes with aging that may vary also by race and ethnicity.

Previous studies report varying levels of muscle function, strength, and mass by race and ethnicity. For example, in the Health, Aging and Body Composition Study among participants aged 70–79 years, although NH-Blacks had greater muscle strength measured by grip strength and knee extension and muscle mass, their muscle quality (i.e. ratio of strength to muscle mass) in their lower limbs tended to be lower than in NH-Whites [17]. In the Chicago Health and Aging Project, after an average 6 years follow-up, NH-Blacks had higher disability levels measured by a basic daily function questionnaire and physical function assessments than NH-Whites after adjustment for age and gender [18]. Chinese adults living in China showed lower muscle function and mass than NH-Blacks and NH-Whites living in the US [11]. The Boston Area Community Health/Bone (BACH/Bone) survey, however, found that NH-Black and Hispanic men had lower physical function compared to NH-Whites despite their higher total lean mass [12]. Although this differs from our findings in Hispanics that showed higher muscle function than NH-Whites, one potential explanation for this discrepancy is our study sample included not only men but also approximately equal number of women.

In the current study, the greatest concordance of sarcopenia prevalence between race and ethnic groups was observed in sarcopenia by grip strength index, which suggests using this index in studies of diverse populations. This is in agreement with SDOC study populations and other studies where the participants were mostly aged 65 years or older [6,7]. In a study by Patel et al. [6], the authors examined three different indices of sarcopenia by grip strength following the SDOC cut points in older adults (≥65 years) found that sarcopenia defined by absolute grip strength, had similar prevalence between NH-White and NH-Black only in men, but not in women, whereas in this NHANES older population sarcopenia by grip strength was similar in NH-Black and NH-White regardless of sex [6]. Another explanation for the variation in sarcopenia by race and ethnicity in our study may originate from a non-specific criterion of muscle function. As opposed to grip strength and muscle mass indices, low gait speed's cut point is not gender-specific. In other words, men and women have the same threshold (0.8 m/s) for low gait speed [7]. In the NHANES 1999–2002 samples utilized here, a one SD below the average gait speed was approximately 0.84 m/s

in men, whereas it was lower (0.78 m/s) in women. With the use of gender-specific cut-off values, the national sarcopenia estimates in these NHANES surveys would have been higher in the total sample (13.8 vs. 14.3%), lower in women alone (17.0 vs. 15.0%) and higher in men alone (10.3 vs. 13.6%). Future studies may need to consider including a gender-specific cut-point for low gait speed to better reflect sarcopenia prevalence.

In the present study, we included medical conditions such as arthritis, diabetes, and cardiovascular diseases in our multivariable models and found that having one or more of these comorbidities was associated with sarcopenia. Due to the study design, a bidirectional relationship may exist where sarcopenia may increase the risk of developing a chronic disease [19,20], or vice versa wherein some chronic diseases may lead to a reduction in muscle function such as arthritis and diabetes that limit mobility and physical activity [19,20].

A major strength of this study was the use of data from a large, representative, diverse sample of the US population; thus, providing some degree of generalizability. Moreover, this sample is comprised from middle-aged and older adults, and adds to the literature in sarcopenia, which is mainly conducted in adults aged 60 years or older [7,8,21] or includes fewer adults across the lifespan [19]. The analysis was broad and included several sarcopenia indices comprising muscle mass index acquired using DXA technology, and two additional measures for muscle function (gait speed and grip strength) using the SDOC most recent updated criteria. In this analysis, we included the average of six trials of handgrip strength, which reduces measurement variability as opposed to other studies that used few trials [6,7]. Furthermore, the NHANES is a comprehensive dataset that allowed us to control for well-established risk factors associated with race/ethnicity and sarcopenia such as comorbidities (e.g. diabetes, arthritis, and cardiovascular diseases), obesity, age, and gender. This current study utilized data from the NHANES, which employed standardized protocols and rigorous quality control in data collection and reporting consistently among all participants.

The current study has limitations worth mentioning. First, the NHANES data are cross-sectional and only confirm associations between sarcopenia and study covariates such as body fat measures and comorbidities and not causality. Also, the NHANES survey included participants who were non-institutionalized adults, and not those with a higher tendency for muscle weakness, such as nursing home residents. Therefore, the sarcopenia prevalence might be an under-representation of the specific prevalence of this segment of the population. The analysis included participants with comorbidities that may affect their mobility and muscle mass and function. Other potential confounders associated with race and ethnicity and sarcopenia such as socioeconomic status [22], occupation [23], lifestyle habits including physical activity [24], diet [25], and smoking [26] were not analyzed since this study focused on the biology factors associated with race/ethnicity and sarcopenia.

CONCLUSION

Sarcopenia prevalence varies between race and ethnic groups within different measures of sarcopenia including grip strength, gait speed and ALM/BMI indices. The greatest

concordance between NH-Blacks and NH-Whites, however, was observed using grip strength to define sarcopenia. The inclusion of race and ethnicity related criteria could be developed for sarcopenia definitions. Future investigations could determine whether the discrepancies between race and ethnicity is partly due to either muscle mass or functional reduction with increasing age and ideally utilize a longitudinal study design.

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ABBREVIATIONS

SDOC	Sarcopenia Definitions and Outcomes Consortium
NIA	National Institute on Aging
NHANES	National Health and Nutrition Examination Survey
NCHS	The National Center for Health Statistics
DXA	Dual energy x-ray Absorptiometry
ALM	Appendicular Lean Mass
NH	Non-Hispanic
BMI	Body Mass Index

REFERENCES

1. Beaudart C, Zaaria M, Pasleau F, Reginster JY, Bruyere O. (2017). Health Outcomes of Sarcopenia: A Systematic Review and Meta-Analysis. PLoS One 12: e0169548. [PubMed: 28095426]
2. Goodpaster BH, Park SW, Harris TB, Kritchevsky SB, Nevitt M, et al. (2006). The loss of skeletal muscle strength, mass, and quality in older adults: the health, aging and body composition study. J Gerontol A Biol Sci Med Sci 61: 1059–1064. [PubMed: 17077199]
3. Dam TT, Peters KW, Fragala M, Cawthon PM, Harris TB, et al. (2014). An evidence-based comparison of operational criteria for the presence of sarcopenia. J Gerontol A Biol Sci Med Sci 69: 584–590. [PubMed: 24737561]
4. Cruz-Jentoft AJ, Bahat G, Bauer J, Boirie Y, Bruyere O, et al. (2019). Sarcopenia: revised European consensus on definition and diagnosis. Age Ageing 48: 601.
5. Du K, Goates S, Arensberg M, Pereira S, Gaillard T. (2018). Prevalence of Sarcopenia and Sarcopenic Obesity Vary with Race/Ethnicity and Advancing Age. Divers Equal Health Care 15: 175–178.
6. Patel SM, Duchowny KA, Kiel DP, Correa-de-Araujo R, Fielding RA, et al. (2020). Sarcopenia Definition & Outcomes Consortium Defined Low Grip Strength in Two Cross-Sectional, Population-Based Cohorts. J Am Geriatr Soc 68: 1438–1444. [PubMed: 32633830]
7. Bhasin S, Travison TG, Manini TM, Patel S, Pencina KM, et al. (2020). Sarcopenia Definition: The Position Statements of the Sarcopenia Definition and Outcomes Consortium. J Am Geriatr Soc 68: 1410–1418. [PubMed: 32150289]

8. Cawthon PM, Manini T, Patel SM, Newman A, Travison T, et al. (2020). Putative Cut-Points in Sarcopenia Components and Incident Adverse Health Outcomes: An SDOC Analysis. J Am Geriatr Soc 68: 1429–1437. [PubMed: 32633824]
9. Al Snih S, Kaushik V, Eschbach K, Markides K. (2008). Ethnic differences in physical performance in older Americans: data from the Third National Health and Nutrition Examination Survey (1988–1994). Aging Clin Exp Res 20: 139–144. [PubMed: 18431081]
10. Araujo AB, Chiu GR, Kupelian V, Hall SA, Williams RE, et al. (2010). Lean mass, muscle strength, and physical function in a diverse population of men: a population-based cross-sectional study. BMC Public Health 10: 508. [PubMed: 20727198]
11. Auyeung TW, Lee SW, Leung J, Kwok T, Woo J. (2014). Age-associated decline of muscle mass, grip strength and gait speed: a 4-year longitudinal study of 3018 community-dwelling older Chinese. Geriatr Gerontol Int 14: 76–84. [PubMed: 24450564]
12. Shaw SC, Dennison EM, Cooper C. (2017). Epidemiology of Sarcopenia: Determinants Throughout the Life course. Calcif Tissue Int 101: 229–247. [PubMed: 28421264]
13. Cawthon PM, Peters KW, Shardell MD, McLean RR, Dam TT, et al. (2014). Cutpoints for low appendicular lean mass that identify older adults with clinically significant weakness. J Gerontol A Biol Sci Med Sci 69: 567–575. [PubMed: 24737559]
14. Cruz-Jentoft AJ, Landi F, Schneider SM, Zuniga C, Arai H, et al. (2014). Prevalence of and interventions for sarcopenia in ageing adults: a systematic review. Report of the International Sarcopenia Initiative (EWGSOP and IWGS). Age Ageing 43: 748–759. [PubMed: 25241753]
15. (1998). Executive Summary. Obes Res 6: S51–S179.
16. Stata Corp LP. College Station, TX, USA.
17. Newman AB, Haggerty CL, Goodpaster B, Harris T, Kritchevsky S, et al. (2003). Strength and muscle quality in a well-functioning cohort of older adults: the Health, Aging and Body Composition Study. J Am Geriatr Soc 51: 323–330. [PubMed: 12588575]
18. Mendes de Leon CF, Barnes LL, Bienias JL, Skarupski KA, Evans DA. (2005). Racial disparities in disability: recent evidence from self-reported and performance-based disability measures in a population-based study of older adults. J Gerontol B Psychol Sci Soc Sci 60: S263–S271. [PubMed: 16131627]
19. Lim HS, Park YH, Suh K, Yoo MH, Park HK, et al. (2018). Association between Sarcopenia, Sarcopenic Obesity, and Chronic Disease in Korean Elderly. J Bone Metab 25: 187–193. [PubMed: 30237999]
20. Mesinovic J, Zengin A, De Courten B, Ebeling PR, Scott D. (2019). Sarcopenia and type 2 diabetes mellitus: a bidirectional relationship. Diabetes Metab Syndr Obes 12: 1057–1072. [PubMed: 31372016]
21. Grosicki GJ, Travison TG, Zhu H, Magaziner J, Binder EF, et al. (2020). Application of Cut-Points for Low Muscle Strength and Lean Mass in Mobility-Limited Older Adults. J Am Geriatr Soc 68: 1445–1453. [PubMed: 32633836]
22. Confortin SC, Ono LM, Barbosa AR, d'Orsi E. (2018). Sarcopenia and its association with changes in socioeconomic, behavioral, and health factors: the EpiFloripa Elderly Study. Cad Saude Publica 34: e00164917. [PubMed: 30517315]
23. Brennan-Olsen SL, Vogrin S, Balogun S, Wu F, Scott D, et al. (2020). Education, occupation and operational measures of sarcopenia: Six years of Australian data. Australas J Ageing 39: e498–e505. [PubMed: 32969133]
24. Steffl M, Bohannon RW, Sontakova L, Tufano JJ, Shiells K, et al. (2017). Relationship between sarcopenia and physical activity in older people: a systematic review and meta-analysis. Clin Interv Aging 12: 835–845. [PubMed: 28553092]
25. Granic A, Sayer AA, Robinson SM. (2019). Dietary Patterns, Skeletal Muscle Health, and Sarcopenia in Older Adults. Nutrients 11: 745.
26. Steffl M, Bohannon RW, Petr M, Kohlikova E, Holmerova I. (2015). Relation between cigarette smoking and sarcopenia: meta-analysis. Physiol Res 64: 419–426. [PubMed: 25536323]

Table 1:

Prevalence of sarcopenia indices by gender, age, race and ethnicity, BMI, and comorbidities. Among Adults aged 50–80 years.

	Grip Strength** **N = 4,615**		**Gait Speed index*** **N = 3,448**		**ALM/BMI index*** **N = 3,651**	
	25.6% N=1,521	***p*-value**	**13.8% N=698**	***p*-value**	**15.6% N=755**	***p*-value**
	% (95%CI)		**%(95%CI)**		**%(95%CI)**	
Gender		<0.001		<0.001		<0.001
Men	30.9(27.1–34.9)		10.3(8.9–11.9)		17.6(15.7–19.6)	
Women	20.8(18.1–23.8)		17.0(14.7–19.5)		13.7(11.8–16.0)	
Age (years)		<0.001				<0.001
50–59	13.5(10.7–16.9)		6.0 (4.8–7.6)	<0.001	9.9(8.0–12.2)	
60–69	19.9(16.9–23.2)		14.5(12.4–17.0)		17.1(14.7–19.8)	
70–80	52.4(48.8–56.0)		29.5(26.4.5–32.7)		26.3(22.5–30.4)	
Race /Ethnicity		0.001		<0.001		<0.001
NH-White	24.3(21.3–27.6)		11.2(9.7–12.9)		15.0(13.2–17.1)	
Hispanic	36.0(31.4–40.9)		21.1(16.7–26.4)		27.8(22.3–33.9)	
NH-Black	20.8(17.7–24.4)		27.7(24.5–31.1)		4.4(2.6–7.3)	
Asian/others	35.7(27.2–45.2)		18.5(11.1–29.4)		22.3(15.0–32.0)	
BMI (kg/m^2)		0.035		<0.001		<0.001
<25.0	29.2(25.4–33.2)		11.1(8.8–13.8)		5.9(4.6–7.5)	
25.0–29.9	25.4(21.9–29.2)		10.3(8.5–12.3)		13.4(11.5–15.7)	
30.0≤	23.3(18.9–27.2)		17.5(14.7–20.8)		25.5(22.4–29.0)	
Comorbidities		<0.001		<0.001		<0.001
None	15.6(12.8–18.8)		6.6(5.0–8.6)		12.8(10.1–16.2)	
One	25.9(22.4–29.6)		14.2(12.4–16.3)		14.2(11.2–17.2)	
Two/more	39.6(35.6–43.8)		26.6(23.1–30.4)		23.1(20.3–26.3)	

*NHANES: 1999–2002

**NHANES: 2011–2014

NH-Non Hispanic; BMI-Body Mass Index; ALM-Lean Mass Appendicular

Table 2:

Adjusted Odds Ratios (ORs) between four different sarcopenia indices and race and ethnicity.

	Grip Strength index**		Gait Speed index*		ALM/BMI index*	
	OR(95% CI)	***p*-value**	**OR(95% CI)**	***p*-value**	**OR(95% CI)**	**p-value**
Race/Ethnicity[+]						
Hispanic	2.60(1.96–3.46)	<0.001	3.21(2.37–4.33)	<0.001	2.70(2.16–3.35)	<0.001
NH-Black	0.96(0.75–1.24)	0.761	3.90(3.00–5.06)	<0.001	0.26(0.18–0.39)	<0.001
Asian/others	2.15(1.31–3.53)	<0.001	3.00(1.71–5.14)	<0.001	3.02(1.71–5.33)	<0.001

[+]References group: NH-White

Adjusted for age, gender, Body Mass Index (BMI) and comorbidities such as diabetes, arthritis, and cardiovascular diseases