

Prevalence and Impact of Probable Sarcopenia in Community-Dwelling Older Adults in Pakistan

Abstract

Purpose

The study aimed to assess the prevalence of probable and non-probable sarcopenia among older adults in Pakistan and to compare the quality of life (QoL) between those identified as probable sarcopenic and non-probable sarcopenic.

Methods

A cross-sectional study involving 387 older adults (226 males, 161 females) was conducted from July to December 2023. Anyone taking drugs affecting neuromuscular system and/or having a history of upper limb fracture were excluded. In accordance with the diagnostic criteria outlined by the European Working Group on Sarcopenia in Older People (EWGSOP-2) consensus, the risk of sarcopenia was screened using the SARC-F questionnaire, followed by handgrip strength assessment with a handheld dynamometer. Physical performance, fall risk, and QoL were evaluated using the Short Physical Performance Battery (SPPB), Fall Efficacy Scale (FES), and EuroQOL (EQ-5D-5L), respectively.

Results

Among 387 participants, 180 (46.3%) had lower muscle strength, indicating probable sarcopenia, with a higher prevalence in females (55.9%) than males (39.4%). Although overall QoL scores showed no significant difference between probable and non-probable sarcopenia groups, the probable sarcopenic reported significantly higher pain/discomfort and anxiety/depression levels ($p = 0.001$) in EuroQoL domains. Severe restrictions in usual activities and severe anxiety/depression were also more frequent in the probable sarcopenia group, emphasizing the widespread physical and mental effects of sarcopenia.

Conclusion

The high prevalence (>40%) of probable sarcopenia among older adults in Pakistan highlights the importance of routine screening during clinical visits. Early detection may help identify individuals at risk, enabling timely intervention to potentially prevent further health decline and improve quality of life. Further longitudinal studies are needed to confirm the effectiveness of these measures.

Key words

Muscle strength, Older adults in Pakistan, Physical functional performance, Prevalence, Quality of life, Sarcopenia.

Introduction

The World Health Organization (WHO) predicts that by 2030, 1 in 6 people worldwide will be 60 years or older (**World Health Organization, 2024**). This global trend in aging presents unique challenges for healthcare systems, particularly in developing nations like Pakistan, where limited healthcare resources and varying cultural practices may further exacerbate age-related health issues. While conditions like cardiovascular diseases and diabetes mellitus have historically dominated health priorities, there is growing recognition of sarcopenia as a significant yet underreported concern. Sarcopenia, characterized by the loss of muscle mass, strength, and function, not only hampers daily physical activities but also increases the risk of falls and associated complications (**Chen et al., 2014**). Factors contributing to sarcopenia include physical inactivity, poor nutritional intake, and chronic diseases—all of which are common in Pakistan due to socioeconomic disparities, insufficient health education, and limited access to preventive healthcare services. Research has shown that physical inactivity, even over a short duration of two to three weeks, can lead to substantial declines in muscle mass and strength, initiating a vicious cycle of further inactivity and weakness (**Morley, 2012; Bell et al., 2016**). Chronic diseases prevalent in Pakistan, such as diabetes mellitus, hypertension, and inflammatory conditions, exacerbate sarcopenia through persistent low-grade inflammation, disrupting the balance between tissue repair and breakdown (**Constantin et al., 2013**). For instance, conditions like rheumatoid arthritis, systemic lupus erythematosus, and persistent infections such as tuberculosis, which remain significant health concerns in Pakistan, can accelerate muscle degradation and functional decline (**Bano et al., 2017**).

Reduction in muscle strength and physical performance, being prominent characteristics of sarcopenia, are more common among Asian communities than in other populations. Under the previous definition focusing on decreased muscle mass, prevalence ranged from 6.7–56.7% in males and 0.1–33.6% in females. Using the updated definition, which emphasizes reduced physical performance and muscle strength, prevalence is now 9.6–22.1% in males and 7.7–21.8% in females (**Limpawattana et al., 2015**). The recent definition proposed by European Working Group on Sarcopenia in Older People (EWGSOP2) classifies sarcopenia as reduced muscle mass, probable sarcopenia as reduced muscle strength alone, and severe sarcopenia as a combination of reduced muscle mass, muscle strength, and physical performance (**Cruz-Jentoft et al., 2019**).

Several studies have investigated the prevalence of sarcopenia in older adults worldwide. However, data from many South Asian countries, including Afghanistan, Nepal, Bhutan, Myanmar, Maldives, Mauritius, even Pakistan (**Dhar et al., 2022**) and Bangladesh, remain limited. In Pakistan, the only relevant study identified reported a prevalence of confirmed sarcopenia at 47.18% among older adults, with higher rates observed in males compared to females (**Altaf et al., 2024**). Pakistan's population is aging and going through a demographic shift, with a growing percentage of old

people, much like the rest of the globe. Fifteen million people in Pakistan were sixty years of age or older in 2019 - roughly 7% of the country's overall population. Although they make up a lesser percentage of the population now, projections indicate that the number of older adults people will rise significantly and is expected to reach 40 million by 2050 (**Borgen Project, 2024**). Therefore, sarcopenia is a potential threat for the older adults community of Pakistan as well. Unlike other countries and especially Asian countries, we do not even find the prevalence of highly probable suspects of sarcopenia in Pakistan. Conducting this prevalence study will enable us to compare the data with other regions and countries. Such comparative analysis can help identify unique risk factors specific to Pakistan's population and contribute towards the progress of global strategies to combat sarcopenia effectively. Hence the aim of the current study was to investigate the prevalence of probable sarcopenia in community-dwelling older adults of Pakistan and to gauge how different is their quality of life (QoL) in comparison to the healthy older adults. Furthermore, this study will provide an insight to how probability of sarcopenia can hamper the daily lives of the affected individuals, an aspect not yet explored in the context of Pakistani population.

Methods

Study design

This cross-sectional study was conducted to determine the prevalence of probable sarcopenia in community dwelling older adults in Pakistan.

Participants

This study included older adults aged 60 years and above from both urban and rural areas across Pakistan to cover a broad population (Figure 1). Participants from rural areas were easier to access due to logistical ease, although the exact number of urban and rural participants was not recorded. Both men and women were included. People were excluded if they were immobile, had confirmed frailty, a history of upper limb fractures or stroke, were taking medications that affect the nerves and muscles, or had severe hearing problems or difficulty understanding instructions. All participants were informed about the study, and gave written consent before joining. The study received ethical approval from the Institutional Review Board and Ethics Committee of Shifa Tameer-e-Millat University (IRB #0124-23). Participants were assessed for anthropometric characteristics, sarcopenia risk, muscle strength, physical performance, and fear of falling.

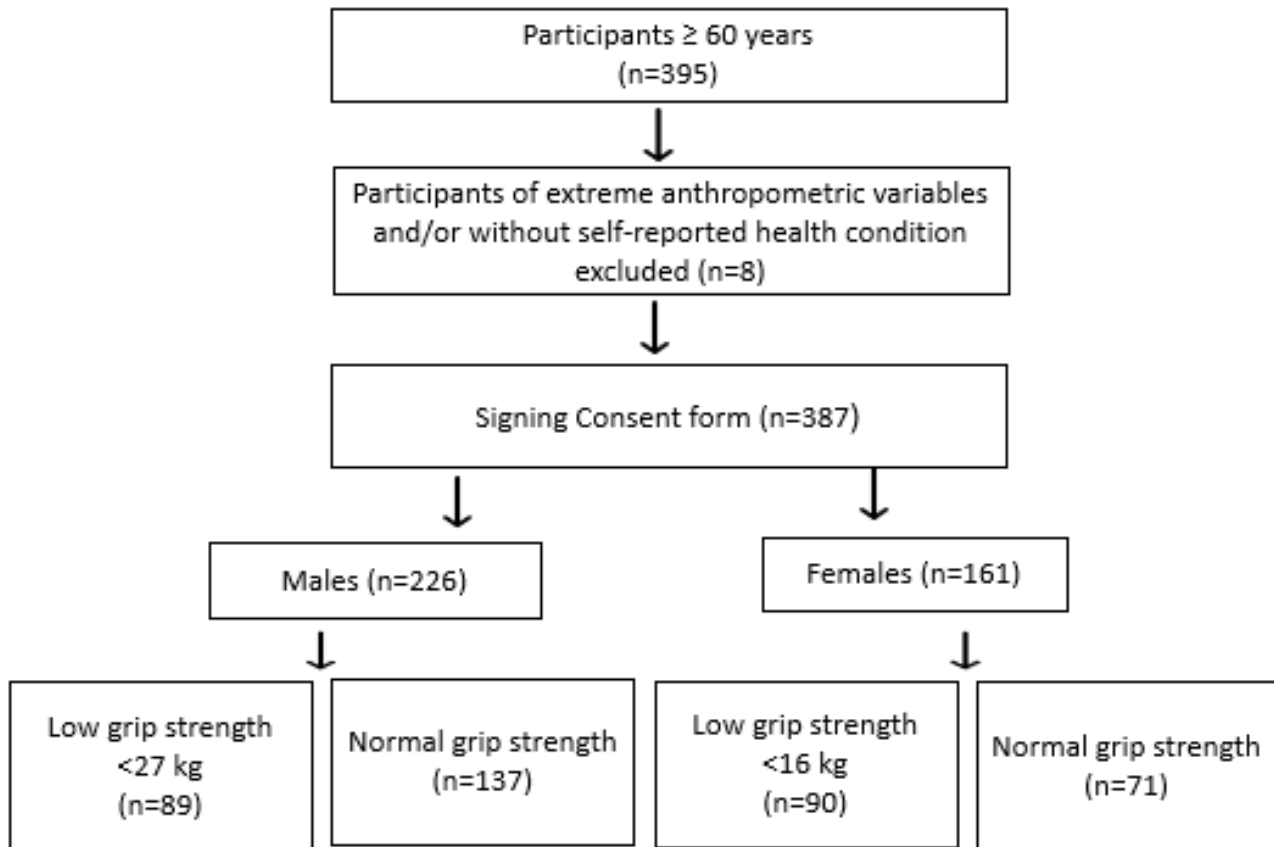


Fig. 1 Screening method for including older adults with probable sarcopenia

Estimation of sample size

The initial sample size for this study was estimated to be 219 participants, based on previously published prevalence data for Swedish older adults (**Wearing et al., 2020**). This calculation was made to detect a prevalence of 28%, with a confidence level of 95% and a margin of error (precision) of ± 0.05 .

By the end of the study period, a total of 387 participants were included. This number reflects all eligible participants available during the study, exceeding the initially estimated sample size. The larger sample size strengthened the statistical power of the study and provided more robust findings.

Anthropometric measurements

Height and weight were measured via a standing scale with height attachment ensuring the participant was not wearing shoes or any heavy clothing. The body mass index (BMI) was calculated as weight, in kilograms, divided by height squared, in meters and categorized as per World Health Organization classification (**Weir & Jan, 2019**). Calf circumference was taken for both legs measured at the calf's greatest girth using an inelastic tape during standing

position with feet 20 cm apart and body weight equally distributed on both feet. The measurement was performed in a standardized way, with three measurements to obtain an average of three measurements (**Tsekoura et al., 2021**).

Risk of sarcopenia

The SARC-F questionnaire is a straightforward tool designed to quickly identify individuals at risk of sarcopenia. It assesses five key areas: muscle strength, the ability to stand from a chair, walking, climbing stairs, and fall history. Each area is scored on a scale of 0 to 2, where 0 represents no difficulty, 1 indicates some difficulty, and 2 signifies significant difficulty or inability to perform the activity. A total score of 4 or more indicates a potential risk of sarcopenia, warranting further diagnostic evaluation. This tool has high specificity (68.9%–88.9%), making it useful for ruling out sarcopenia in individuals who are not at risk and avoiding unnecessary testing. It also demonstrates strong reliability between different assessors and consistency in repeated assessments (**Woo et al., 2014**). However, its sensitivity is relatively low (28.9%–55.3%) based on findings from the European Working Group on Sarcopenia in Older People (**Voelker et al., 2021**). A minor adjustment has been made to the SARC-F questionnaire by replacing the weight used in the strength question from 10 pounds to 5 kilograms, ensuring greater practicality in its application (**Sacar et al., 2021**).

Muscle strength/ Assessment of probable sarcopenia

The risk of sarcopenia was assessed using the EWGSOP2 guidelines, which set specific grip strength cutoffs. For men, a grip strength of less than 27 kg, and for women, a grip strength of less than 16 kg, were considered indicators of weak muscle strength, suggesting a higher probability of sarcopenia (**Dodds et al., 2020**). The Qingfeng hand-held dynamometer was used, which is composed of ABS resin along with a high-quality spring and having a capacity of 130 kg. The dynamometer was calibrated before testing to ensure accuracy of the results (**Kumar et al., 2022; Melhuish et al., 2021**). In accordance with the standardized procedure recommended by the American Society of Hand Therapists, a neutral seated position was assumed with 90° flexion at the elbow joint, followed by squeezing the hand-held dynamometer with full force till a count of 5 seconds, taking 3 readings on each side. The maximum of the three readings for each hand was used for the analysis (**Shechtman et al., 2013**).

Physical performance

Short Physical Performance Battery (SPPB) was used to assess physical performance by testing gait speed, chair stand and balance tests. The score for each component ranges from 0-4. The total score ranges from 0-12 with 0 being the

worst performance and 12 indicating best performance. A total score of ≤ 8 indicates severe sarcopenia (**Pavasini et al., 2016**).

Fear of falling assessment

Fear Efficacy Scale (FES) is a 10-item self-administered questionnaire to assess fear of falling in mainly community-dwelling older population. Older participants were instructed to rate each item. The scores were added up to calculate a total score that ranges from 10 to 100 (10 being an excellent score, 100 being worse) with score over 70 indicating a person has a fear of falling (**Kempen et al., 2008**).

Quality of life

The EQ-5D-5L is a self-reported, health-related, quality-of-life questionnaire. It assesses five components including self-care, mobility, usual-activities, pain or discomfort, and depression or anxiety. Each of the five components have five-level of answers, stretching between no problem (level 1) in that component to having extreme disability and problem (level 5) in that component. The questionnaire additionally includes a visual analogue scale known as EQ-VAS, allowing patients to rate their present health state on a scale ranging from the worst imaginable health state [0] to the best imaginable health state [100] (**Tripathy et al., 2015**). Various studies have shown the validity and reliability of the EQ-5D in general population and in different patient populations (**Balestroni et al., 2012**).

Statistical analysis

Data were analyzed using IBM SPSS Statistics, version 25. Descriptive statistics were used to summarize participant characteristics, with categorical variables expressed as frequencies and percentages and continuous variables as means with standard deviations. Participants were classified into probable and non-probable sarcopenic categories based on criteria such as sarcopenia risk, physical performance levels, and fear of falling. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated to examine the associations between potential risk factors and probable sarcopenia. The selection of statistical tests was based on the type of data and the study objectives. Descriptive statistics provided a comprehensive overview of participant characteristics, while odds ratios with confidence intervals quantified the strength of associations between factors and probable sarcopenia. To ensure robust findings, only participants with complete data were included in the analysis, and those with missing data were excluded. Although confounders such as comorbidities or socioeconomic status were not adjusted for in this study, they are acknowledged as factors that could influence the prevalence of sarcopenia and should be considered in future research.

Results

Demographic and physical characteristics of participants according to gender

Table 1 presents a comprehensive overview of the demographic and physical characteristics of the study participants.

Table 1 outlines key variables, including age, anthropometric measurements, BMI, and various functional assessments, stratified by gender.

Table 1. Participants' characteristics.

Variables	Total (n=387)		Male (n=226)		Female (n=161)	
	Mean	SD	Mean	SD	Mean	SD
Age (years)	65.75	5.99	66.11	6.01	65.26	5.95
Height (m)	1.64	0.13	1.69	0.11	1.56	0.12
Weight (kg)	66.14	14.34	69.03	11.31	62.08	16.96
BMI (kg/m ²)	24.56	5.10	24.12	4.16	25.18	6.15
Underweight (kg/m ²)	17.05	1.83	17.39	2.31	16.71	1.20
n	26		16		10	
Normal (kg/m ²)	21.92	1.83	22.03	1.78	21.74	1.92
n	200		91		109	
Overweight (kg/m ²)	26.76	1.40	26.64	1.38	26.95	1.43
n	112		44		68	
Obese (kg/m ²)	34.31	4.65	33.35	2.60	34.91	5.53
n	49		28		21	
Calf circumference (cm)						
Right	30.73	5.23	32.19	3.59	28.67	6.38
Left	30.73	5.10	32.18	3.51	28.70	6.20
Hand grip strength (kg)						
Right	21.92	11.84	28.05	8.93	13.31	9.93
Left	20.50	12.13	26.52	9.93	12.04	9.66
SARC-F	1.97	1.54	1.72	1.31	2.33	1.76
FES	14.67	13.39	12.88	9.26	17.18	17.35
SPPB	5.90	1.73	6.22	1.63	5.45	1.78
EQ-VAS	72.69	13.5	75.75	11.97	68.39	14.57

Abbreviations: BMI, Body Mass Index; FES, Fall Efficacy Scale; SPPB, Short Physical Performance Battery; EQ-VAS; EuroQoL's visual analogue scale

The study included 387 participants, with 226 males and 161 females, and an average age of 65.75 years. Males were slightly older on average (66.11 years) than females (65.26 years). Men were taller, heavier, and had larger calf circumferences than women, but women had a higher average BMI (25.18 vs. 24.12 kg/m²). When grouped by BMI categories, more women were classified as overweight or obese, while more men fell into the underweight

category. Grip strength was much higher in men than in women for both hands, which matches previous studies showing that men generally have greater muscle strength. Men also performed better on physical performance tests (SPPB) and reported lower fear of falling (FES). In contrast, women had higher SARC-F scores, demonstrating a greater risk of sarcopenia. Men also reported better quality of life (EQ-VAS) compared to women. These differences highlight the greater risk of sarcopenia and lower physical performance in women, reflecting the importance of targeted approaches to address these issues in older women (Table 1).

Characteristics of older adults according to probable and non-probable sarcopenia

Characteristics of older adults according to probable and non-probable sarcopenia are shown in Table 2.

Table 2. Characteristics of older adults with probable and non-probable sarcopenia

Variable	Total participants (n=387)		P value
	Probable sarcopenia (n= 179)	Non-probable sarcopenia (n= 208)	
Age (yrs.)	67.00±6.96	64.68±4.78	0.00
Height (m)	1.65±0.10	1.63±0.15	0.25
Weight (kg)	66.83±16.50	65.55±12.18	0.38
BMI (kg/m ²)	24.52±6.06	24.59±4.12	0.89
HGS (Right) (kg)	13.34±9.77	29.30±7.83	0.00
HGS (Left) (kg)	11.34±9.07	28.38±8.30	0.00
Calf Circumference (Right) (cm)	30.80±5.77	30.66±4.73	0.78
Calf Circumference (Left) (cm)	30.68±5.63	30.78±4.62	0.83
SARC-F	1.92±1.81	2.01±1.27	0.56
FES	16.59±15.72	13.01±10.77	0.009
SPPB	5.79±2.04	5.99±1.42	0.27
EQ VAS	68.06±14.68	76.67±11.16	0.00
EuroQoL			
Mobility	1 (1 – 2)	1 (1 – 2)	0.083
Selfcare	1 (1 – 1)	1 (1 – 1)	0.053
Usual activities	1 (1 – 2)	1 (1 – 2)	0.543
Pain/discomfort	2 (1 – 2)	2 (1 – 2)	0.001
Anxiety/depression	1 (1 – 2)	1 (1 – 1)	0.001
Visual health scale	70 (60 – 80)	80 (70 – 85)	0.001

Abbreviations: BMI, Body Mass Index; HGS, Handgrip strength; FES, Fall Efficacy Scale; SPPB, Short Physical Performance Battery, EQ-VAS; EuroQoL's visual analogue scale, EuroQoL; health-related quality of life

The prevalence of probable sarcopenia, detected by gender specific handgrip strength cut-off values, was 46.3% (n=179) with 166(42.9%) based on right-hand grip strength and 192(49.6%) based on left handgrip strength. Amongst males, there was a prevalence of 39.4% (n=89) with 80(35.4%) based on right-hand grip strength and 99(43.8%) based on left-hand grip strength whereas in females, the prevalence was 55.9% (n=90) with 86(53.4%) based on right-hand grip strength and 93(57.8%) based on left-hand grip strength. Men had significantly (p-value=0.00) greater right handgrip strength (28.05 ± 8.93 kg vs 13.31 ± 9.93 kg) and left handgrip strength (26.52 ± 9.93 kg vs 12.04 ± 9.66 kg). Furthermore, the prevalence of risk of sarcopenia based on scoring of SARC-F was 3.5% (n=8) in males and 17.4 (n=28) in females.

Table 2 describes the distinctive characteristics between individuals identified as probable sarcopenic and those classified as non-probable sarcopenic within the study. Participants with probable sarcopenia were significantly older than their counterparts without probable sarcopenia, emphasizing the potential association between age and sarcopenia risk. While BMI and calf circumference did not differ significantly between the groups, handgrip strength was markedly lower in the probable sarcopenia group for both hands, reinforcing the relevance of grip strength as a reliable marker for sarcopenia. Fear of falling was notably higher among those with probable sarcopenia, suggesting a potential correlation between sarcopenia and perceived fall risk. Participants with probable sarcopenia reported significantly lower EQ-VAS scores, indicating poorer self-perceived health ($p < 0.001$). In the EuroQoL domains, the probable sarcopenia group reported significantly higher levels of pain/discomfort and anxiety/depression ($p = 0.001$), showing the broader effect of sarcopenia on physical and mental well-being. While no significant differences were observed in other characteristics, the findings reflect the need for a comprehensive understanding of the complex relationship between age, functional capacity, and QoL in the context of sarcopenia among the older adult population.

Quality of life of probable and non-probable sarcopenic population

Quality of life of probable and non-probable sarcopenic population are demonstrated in Table 3.

Table 3. EuroQoL dimensions for probable and non-probable sarcopenia

Domains	Levels	Probable sarcopenia (n=179)		Non-probable sarcopenia (n=208)	
		Percentage (%)	Frequency	Percentage (%)	Frequency
Mobility	1	72.8	131	64.4	134
	2	20.55	37	28.8	60
	3	4.40	8	5.8	12
	4	1.7	3	1	2
	5	0	0	0	0
Self-care	1	83.3	150	75.5	157
	2	11.17	20	18.2	38
	3	3.3	6	5.3	11
	4	1.7	3	1	2
	5	0	0	0	0
Usual activities	1	57.2	103	55.7	116
	2	26.25	47	38	79
	3	6.7	12	4.8	10
	4	1.1	2	1	2
	5	8.3	15	0.5	1
Pain/discomfort	1	32.2	58	45.7	95
	2	48.04	86	45.2	94
	3	17.8	32	7.7	16
	4	1.7	3	1.4	3
	5	0	0	0	0
Anxiety/depression	1	55.8	100	84.1	175
	2	37.8	68	9.6	20
	3	3.8	7	5.3	11
	4	1.7	3	1	2
	5	0.6	1	0	0

In Table 3, the analysis of EuroQoL data reveals interesting differences in health-related QoL between individuals with probable sarcopenia (n=179) and those without probable sarcopenia (n=208). Across various domains such as mobility, self-care, usual activities, pain/discomfort, and anxiety/depression, distinct patterns appear. Probable sarcopenia is associated with relatively higher percentages of moderate limitations in mobility (1.7 vs 1), self-care (1.7 vs 1), usual activities (1.1 vs 1), pain/discomfort (1.7 vs 1.4) and anxiety/depression (1.7 vs 1) compared to the non-probable sarcopenia group. Additionally, individuals with probable sarcopenia report significantly higher levels of severe restriction in usual activities (8.3 vs 0.5) and severe anxiety/depression (0.6 vs 0), reflecting a comprehensive impact on overall well-being.

Factors Associated with Probable Sarcopenia

The results of both simple and multiple logistic regression analyses investigating factors associated with probable sarcopenia are shown in Table 4. In the simple regression, individual factors were assessed, while the multiple regression refined these associations. The table displays odds ratios, 95% confidence intervals, and *p* values.

Table 4: Factors associated with probable sarcopenia

Factors	Simple logistic regression analysis			Multiple logistic regression analysis		
	Odd ratio	95% CI	<i>p</i> value	Odd ratio	95% CI	<i>p</i> value
Age (y)	0.935	0.90-0.97	0.001			
Gender	0.512	0.34-0.77	0.001	0.35	0.26 – 0.44	0.001
Weight (kg)	0.994	0.98-1.01	0.38			
Height	0.414	0.09-1.89	0.26			
BMI (kg/m ²)	1.00	0.96-1.04	0.89			
Grip strength (kg) – Right	1.23	1.18-1.21	0.001	0.46	0.01 – 0.03	0.001
Grip strength (kg) – Left	1.25	1.19-1.30	0.001	0.54	0.02 – 0.28	0.001
Calf circumference (cm)- Right	0.99	0.96-1.03	0.78			
Calf circumference (cm) – Left	1.00	0.97-1.04	0.84			
Physical performance	1.07	0.95-1.19	0.27	-0.13	(-0.06) – (-0.01)	0.002
Risk of sarcopenia	1.04	0.91-1.18	0.56	0.09	0.002 – 0.06	0.03
Fear of falls	0.98	0.96-1.00	0.01	-0.09	-0.06 – 0.000	0.02

As is observed in Table 4, simple logistic regression showed that older age (OR=0.935, 95% CI:0.90–0.97, *p*=0.001), male gender (OR=0.512, 95% CI:0.34–0.77, *p*=0.001), and greater grip strength (both hands, *p*=0.001) were associated with lower odds of probable sarcopenia. The multiple regression model refined these relationships, demonstrating particularly strong protection from male gender (OR=0.35, 95% CI:0.26–0.44, *p*=0.001) along with independent protective effects of better physical performance (β =−0.13, 95% CI:−0.06 to −0.01, *p*=0.002) and reduced fear of falls (β =−0.09, 95% CI:−0.06 to 0.000, *p*=0.02), while higher sarcopenia risk scores showed positive association (β =0.09, 95% CI:0.002–0.06, *p*=0.03). Interestingly, the strengthened gender association in the adjusted model (OR change from 0.51 to 0.35) suggests confounding in the unadjusted analysis. These findings collectively highlight the multifactorial nature of sarcopenia risk, with demographic, physical, and psychological factors all contributing independently.

Classification of older adults into probable and non-probable sarcopenic categories based on various characteristics

Participants were classified into probable and non-probable sarcopenic based on various characteristics, including BMI, risk of sarcopenia, performance level, and fear of falling. The results are shown in figure 2.

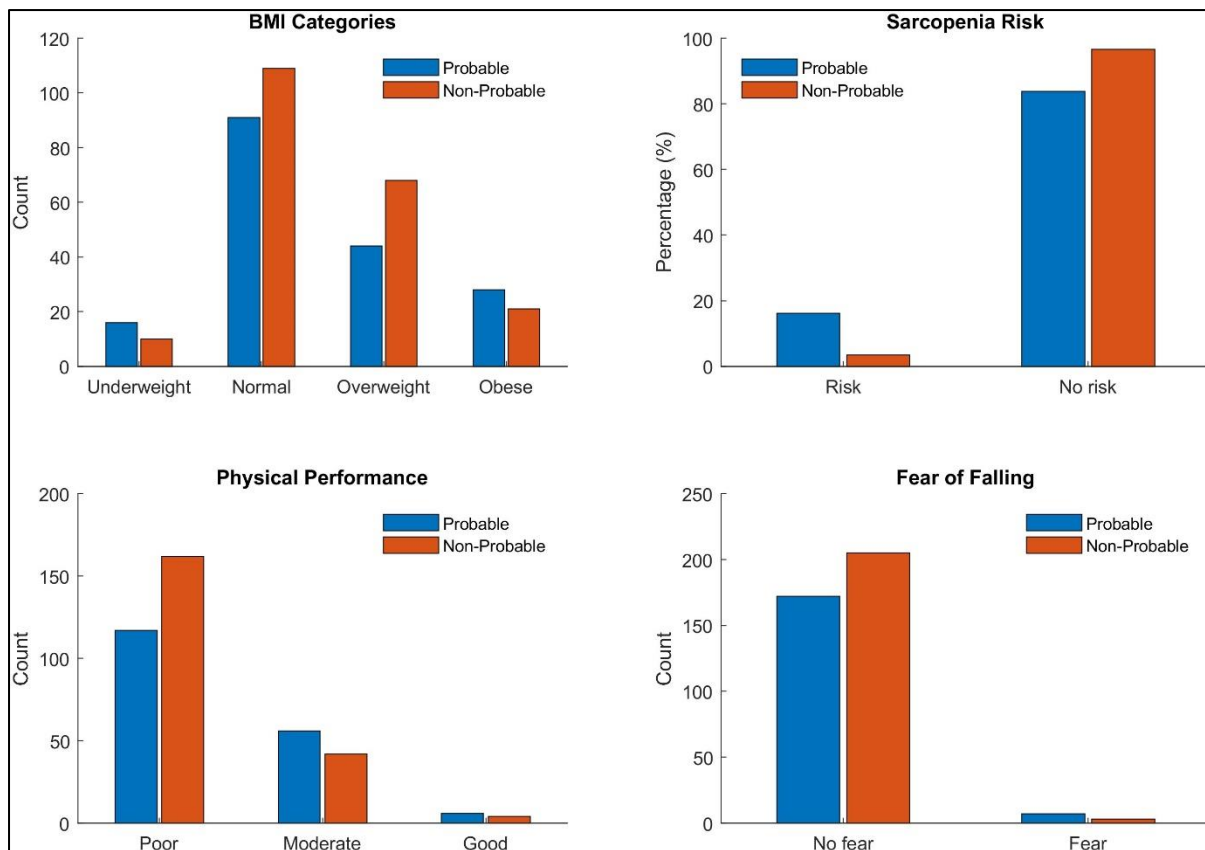


Fig. 2 Classification of the participants into probable and non-probable sarcopenic categories based on various characteristics. Upper left: categorized by BMI; Upper right: classified by risk of sarcopenia; Lower left: grouped by level of performance; Lower right: sorted by fear of falling.

Figure 2 shows prevalence of both probable and non-probable sarcopenic older adults as per various characteristics including BMI, risk of developing sarcopenia, physical performance, and risk of falls. There tends to be an increase in both probable ($n=91$) and non-probable ($n=109$) sarcopenia in older adults with normal BMI, following a general decreasing pattern in both with increasing BMI such as overweight ($n=112$) and for obese ($n=49$) categories. For prevalence with respect to risk of sarcopenia, there was an increased risk shown in probable sarcopenic individuals as compared to non-probable sarcopenic individuals (16.2% vs 3.4%). However, individuals representing no risk of sarcopenia were predominantly non-probable sarcopenic individuals (96.6% vs 83.8%). Regarding levels of physical performance, majority of moderate-level performers were probable sarcopenic individuals ($n=56$ vs $n=42$) whereas the number of good performers was almost same for probable ($n=6$) and non-probable ($n=4$) sarcopenic individuals. Nearly all participants in both groups reported no fear of falling (non-probable sarcopenic: 98.6%, $n=205/208$; probable sarcopenic: 96.1%, $n=172/179$), with a slightly higher percentage in the non-probable sarcopenia group.

Discussion

The aim of this study was to determine the prevalence of probable sarcopenia in the Pakistani older adults population, a previously unexplored area, and to compare these individuals with healthy older adults across various aspects of QoL. Probable sarcopenia was identified in 46.3% of the older adults, with a higher prevalence observed in females (55.9%) compared to males (39.4%).

Our findings align to some extent with studies from other countries that have evaluated probable sarcopenia in older adults populations, with differences likely due to cultural, topographical, and genetic factors, as well as variations in diagnostic criteria and possible potential sampling biases (e.g., urban vs. rural considerations). For example, **Kim et al. (2019)** found a 13.7% prevalence of sarcopenia (17.2% in men, 10.1% in women) among community-dwelling older adults (mean age: 75.9 years) in the Korean Frailty and Aging Cohort Study. In China, the prevalence of possible sarcopenia was reported to be 11.11% using criteria from the Asian Working Group for Sarcopenia in Older Populations (**Wang et al., 2022**). Meanwhile, in Britain, a prevalence of 19% was found in early older adults (**Dodds et al., 2020**). However, the results from a Colombian study are most comparable to ours, with a higher prevalence of probable sarcopenia in females (57.2%) compared to males (42.8%) (**Pérez-Sousa et al., 2021**). This emphasizes that the clinicians and healthcare professionals should consider grip strength as a component of a comprehensive physical assessment to identify decreased grip strength and recommend increased physical activity as an appropriate intervention.

Variations in hand grip strength in the current study were evident between individuals identified as probable and non-probable sarcopenic, forming the basic aspect of the probable sarcopenia diagnosis. Additionally, substantial gender-based differences were observed, with females exhibiting a markedly lower mean hand grip strength (12.7 kg) for the average of both hands compared to males (27.3 kg). This corresponds more closely with the average values in the higher age group of >80 years (16.6 kg in females and 27.75 kg in males) as reported in a US-based study by Amy et al., 2015 (**Yorke et al., 2015**). As far as Asian population is concerned, there is evidence regarding the unique trajectory of sarcopenia in females where functional decline may precede significant muscle mass loss (**Weng et al., 2025**). The higher prevalence of sarcopenia in females compared to males is similar to global patterns (**Tay et al., 2015**). This difference may be due to factors like lower physical activity levels, hormonal changes, and different diets among women. In Pakistan, cultural and social factors, such as fewer opportunities for exercise and dietary differences for women, might make this issue worse.

The findings of the study show that the mean age, height, weight, right calf circumference, and FES scores of subjects with probable sarcopenia are higher than those of non-probable subjects. Conversely, the mean values of BMI, bilateral grip strength, left calf circumference, SARC-F, SPPB, and EuroQOL VAS are lower in probable sarcopenic subjects compared to non-probable ones. The discrepancy between bilateral calf circumference in terms of probability of sarcopenic may be attributed to the fact that the majority of older adults were right-side dominant, thus preserving the right calf circumference even in probable sarcopenic cases. This suggests that muscle wasting may manifest asymmetrically in dominant versus non-dominant limbs, potentially delaying the visible signs of sarcopenia on the dominant side. Further research could investigate whether this asymmetry is a reliable early marker of sarcopenia progression and whether interventions should be tailored to address such disparities.

There was a significant difference between probable and non-probable sarcopenic cases, consistent with previous studies, in terms of age (Tsekoura et al., 2021), handgrip strength (Tsekoura et al., 2021; Lim et al., 2022), fall risk (Lim et al., 2022; Cebrià i Iranzo et al., 2020), and specific aspects of QoL (Tsekoura et al., 2021). However, nonsignificant differences were observed between both cohorts in certain subcomponents of QoL, such as mobility, self-care, and activities of daily living (ADLs). This finding contrasts with the results of study by Cebrià i Iranzo et al. (2020), which reported significant differences in these areas. It is important to note that their study exclusively included older adults who had been hospitalized within the past month, potentially explaining the discrepancy. The hospitalization factor could have heightened the impact of sarcopenia on mobility and self-care in their sample, compared to our community-dwelling population.

In comparing the characteristics of probable and non-probable sarcopenic older adults, results (Table 2) showed no significant difference in BMI between groups (probable sarcopenic: 24.52 ± 6.06 vs non-probable: 24.59 ± 4.12). These findings align relatively closely with those of Wang et al. (2022) who reported BMI values of 26.04 ± 3.11 for probable and 25.50 ± 3.22 for non-probable sarcopenic individuals. However, Tay et al. (2015) observed a greater difference in BMI, with mean values of 21.7 ± 2.4 for probable and 24.7 ± 3.8 for non-probable sarcopenic participants. It should be noted that Tay's study included a younger population of individuals over 50 years old, with probable sarcopenia determined by either weak handgrip strength or slow gait speed, which may account for the observed disparity.

Regarding physical performance, our study found comparable results between groups, with mean scores of 5.79 ± 2.04 for probable sarcopenic individuals and 5.99 ± 1.42 for non-probable sarcopenic subjects. These findings suggest that physical performance was relatively similar across both cohorts, potentially reflecting the early stages of sarcopenia where functional limitations may not yet be pronounced. Differences in physical performance metrics across studies may reflect variations in sample characteristics or assessment methods.

According to the EWGSOP2 guidelines, SARC-F can serve as an adjunct screening tool for identifying probable sarcopenia and sarcopenia. In our study, we found that a SARC-F score of four or higher - a threshold defined by EWGSOP2 (Kumar et al., 2022) - was relatively uncommon in our sample. Specifically, 16.1% of those with probable sarcopenia and only 3.4% of those without probable sarcopenia met this criterion. This aligns with existing literature indicating that a SARC-F score of four or above has high specificity but low sensitivity for detecting probable sarcopenia. Interestingly, 96.6% of individuals without probable sarcopenia had scores below four, supporting the assertion that this cut-off is effective in distinguishing between those with and without probable sarcopenia (Woo et al., 2014; Sacar et al., 2021; Bahat et al., 2018). Among the SARC-F components, the most challenging tasks for the majority of participants were rising from a chair and climbing a flight of stairs. Therefore, the presence of difficulties with these activities in an older adult's history could be a strong indicator for further assessment of probable sarcopenia.

Interestingly, our findings revealed that a higher percentage of individuals with probable sarcopenia reported no issues with mobility, self-care, and usual activities. In contrast, a greater proportion of those without probable sarcopenia reported no problems with pain/discomfort and anxiety/depression. This suggests that the impact of sarcopenia on daily activities and self-care may not be immediately apparent, making it challenging to detect and address the condition early. Consequently, this delay in identification could hinder proactive measures to prevent

complications such as reduced mobility and difficulties with self-care and ADLs, which are commonly associated with advanced sarcopenia. Conversely, it is expected that the quality-of-life indicators, such as pain/discomfort and anxiety/depression, would be better among those without probable sarcopenia, as supported by **Murphy et al. (2014)**.

EQ-5D-5L tool for evaluating the health related QOL was based on rating present health state for each domain on a scale ranging from best state (Level 1) to the worst state (Level 5) (**Go et al., 2013**). Participants in the non-probable sarcopenia group reported fewer problems across the domains of mobility, self-care, and usual activities compared to those in the probable sarcopenia group. Although the probable sarcopenia group had a slightly higher percentage of individuals reporting no issues, the differences between the groups were not extensive. The non-probable sarcopenia group also had a slightly higher number of individuals reporting minor problems (Level 1) in the domains of pain/discomfort and anxiety/depression. However, the most severe levels of problems (Levels 4 and 5) were reported exclusively by the probable sarcopenia group. Furthermore, the mean score on the EQ-VAS was higher in the non-probable sarcopenia cohort compared to the probable sarcopenia cohort, suggesting that individuals with probable sarcopenia perceive their health more negatively, experiencing increased fatigue or reduced energy. This finding is consistent with the results of **Suzan et al., (2022)**, who observed similar patterns of reduced energy and increased fatigue in individuals with sarcopenia. The discrepancies amongst fraction of individuals falling in each level of each domain may be attributed to cultural, topographical, and socioeconomic factors within our sample (**Khan et al., 2023**). A significant portion of our participants were from the northern areas of Pakistan, where an active lifestyle is more common compared to those from plains or urban centers. Despite having handgrip strength below cutoff values, the lower muscle strength did not markedly affect their QoL, and hence many probable sarcopenic older adults fall in the level 1 denoting no problems. Conversely, individuals in the non-probable sarcopenia group, who were often retired and thus more sedentary, reported slightly more issues with mobility, usual activities, and self-care. However, the overall differences between the two groups were not substantial. Additionally, the socioeconomic status of our participants, predominantly from the upper middle class, likely provided optimal living conditions and good nutrition, which may have mitigated some of the negative impacts on QoL. This is reflected in the higher proportion of individuals reporting only minor problems (Level 1) in each domain across both groups.

The results of this study have significant clinical implications, showing a prevalence of 46.3% for probable sarcopenia among the community-living older adults in Pakistan. This emphasizes the need for greater awareness about the effect of diminished muscle strength in older adults, both among healthcare providers and the general public. Since probable sarcopenia is an early indicator of sarcopenia, prompt detection is crucial to prevent further decline. Therefore, integrating assessments for probable sarcopenia into routine comprehensive older adults evaluations is essential. This approach could facilitate early identification of at-risk individuals and enable timely interventions to address muscle loss and its associated challenges. Both the SARC-F and EURO-QOL are self-reported questionnaires, which may introduce response bias and affect data accuracy. To address this limitation, future research should include larger and more diverse samples to better estimate the prevalence of probable sarcopenia in the older adults. Also, although confounders such as comorbidities or socioeconomic status were not adjusted for in this study, they are acknowledged as factors that could influence the prevalence of sarcopenia and should be considered in future research. Another limitation is that many participants were from rural areas

due to logistical ease. Differences in lifestyle, healthcare access, and work demands between urban and rural areas could have affected the results. Finally, using a self-reported tool like SARC-F may have introduced some bias in identifying sarcopenia risk. Future studies should include a more diverse group of participants and explore the impact of cultural factors in more detail to better understand sarcopenia in Pakistan.

Conclusion

This study determined a high prevalence of probable sarcopenia (46.3%) among community-dwelling older adults in Pakistan based on handgrip strength criteria. Our cross-sectional findings show that sarcopenia is significantly associated with lower quality of life and may represent an important health consideration in this population. Given this high prevalence, regular handgrip strength measurements could be considered as a potential screening tool in clinical settings. These results support the potential value of including sarcopenia assessment in national health programs for early identification. However, as this was a cross-sectional study, future longitudinal research is needed to: (1) understand sarcopenia progression, (2) establish causal relationships with health outcomes, and (3) evaluate interventions specific to the Pakistani context. While our data cannot establish causality, public health initiatives might consider raising awareness among healthcare workers about sarcopenia's high prevalence. General recommendations for physical activity and balanced nutrition may be beneficial, though targeted interventions require further study.

Declarations

Funding

Not applicable

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