



## Original article

## Sex-specific differences in the prevalence of sarcopenia among pre-frail community-dwelling older adults in Saudi Arabia

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## ABSTRACT

**Objectives:** To assess sex differences in the prevalence of sarcopenia among pre-frail community-dwelling older adults in Saudi Arabia.

**Methods:** This was a cross-sectional study conducted at a tertiary-level hospital in Riyadh, Saudi Arabia, in 2019. The study participants were pre-frail community-dwelling older adults, according to the Edmonton Frail Scale. The SARC-F questionnaire was used to diagnose sarcopenia. The Katz Activities of Daily Living (ADL) was used to rank the adequacy of performance in six functions: bathing, dressing, toileting, transferring, continence, and feeding, while the Lawton Instrumental Activities of Daily Living scale was used to assess the more complex ADL necessary for living in the community.

**Results:** In total, 283 community-dwelling older adults were recruited for this study, with a mean ( $\pm$ SD) age of 70.77 ( $\pm$ 6.26) years; 72.7% of the total were female participants. The majority (85.5%) of the patients reported that they needed home care assistance. The mean ADL score of the participants was high, indicating high function and independence (KATZ-ADL: M 4.60 SD 1.75; Lawton Brody: 60%). The overall prevalence of sarcopenia among the studied participants was 65.7%, which was significantly higher among females (71.9%) than among males (59.1%), with a P-value of 0.007. Among the demographic characteristics of the participants, there was a significant difference in the need for home care assistance in female sarcopenic and non-sarcopenic participants (74.1% vs. 25.9%,  $p = 0.017$ ), but without demonstrable difference in males. Additionally, there was a significant difference ( $P < 0.05$ ) in the prevalence of sarcopenia between male and female participants according to ADL scores. The strongest predictor for sarcopenia prevalence in males was an ADL score  $<2$  according to the Katz index, with an odds ratio of 6.5, while the need for home care was the only significant predictor of sarcopenia among female participants (OR 3.25, CI: 1.14–9.25,  $p = 0.02$ ).

**Conclusion:** Overall, almost two-thirds of the studied pre-frail community-dwelling older adult population were sarcopenic. The prevalence of sarcopenia was significantly higher among females than males. The strongest predictor of sarcopenia was an ADL score  $<2$  based on the Katz index in males and the need for home care assistance in females.

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## 1. Introduction

Globally, Asia is considered the fastest aging region; therefore, aging-related diseases, such as sarcopenia, will have a greater impact on elderly individuals in this area. Sarcopenia is a syndrome characterized by progressive and generalized loss of skeletal mus-

cle mass and strength, and it is strictly associated with physical disability, poor quality of life, and death (Santilli et al., 2014). Besides aging, there is emerging evidence that sarcopenia is a multi-factorial process, with additional risk factors, including malnutrition, hormonal alterations, chronic metabolic diseases, physical inactivity, polypharmacy, and cancer (Kalyani et al 2014; Cruz-Jentoft et al 2014).

The estimated prevalence of sarcopenia varies significantly from 8% to 40%, according to its definition and the racial characteristics of the studied population (Abellan van Kan 2009). Epidemiological data for discordance in sarcopenia prevalence between older males and females have been conflicting (Landi et al 2012; Patel et al 2013). The literature suggests differential sex-specific

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rate of absolute muscle loss, being lower in females than in males, which could not be attributed only to the larger initial muscle mass in males (Payette et al., 2003). In addition, there is a higher mortality risk conferred by sarcopenia in older women, despite having a lower prevalence of sarcopenia than men (Batsis et al. 2014).

These data highlight the need for improved insights into the potential differential sex-specific mechanisms causing sarcopenia. Payette et al. (2003) in their data from the Framingham Heart Study suggested that longitudinal fat-free mass decline was consequent to a withdrawal of anabolic stimuli in males, but reflecting catabolic stimuli increase represented by interleukin-6 in females (Payette et al., 2003). Sex-specific differences in body composition are well known. According to the literature, compared to elderly females, elderly males have more muscle mass with faster muscle deterioration, while elderly females have more fat mass (Du et al 2018; Cheng et al 2012; Cheng et al 2014; Kohara et al 2012; Gallagher, et al 2000; Castillo et al 2003). Moreover, such sex-specific differences in the changes in muscle and fat mass have different impacts on bone mineral density and hip geometric structure.

Gallagher et al. found that the absolute rate of decline in skeletal muscle mass in men exceeds that in women, and they also found a greater absolute loss of skeletal muscle mass in men than in women (Gallagher, et al 2000). Similar findings were reported by Castillo et al. (Castillo et al 2003). In contrast, Janssen et al. reported a lower prevalence of severe sarcopenia in males than in females over 60 years of age (Janssen et al. 2002). Another study found a lower prevalence of sarcopenia in Hispanic males than in their female counterparts; however, such sex differences in sarcopenia were reported among those younger than 80 years, while for those aged above 80 years, males exhibited a higher prevalence of sarcopenia (Baumgartner, et al 1998).

Consequently, the impact of sex on sarcopenia remains controversial, and the data in this regard are scarce in Saudi Arabia. Therefore, this study aimed to assess the sex differences in the prevalence of sarcopenia among pre-frail community-dwelling older adults in Saudi Arabia.

## 2. Methods

This cross-sectional study was conducted at a tertiary-level hospital in Riyadh, Saudi Arabia, in 2019. The selected hospital is a multi-disciplinary referral hospital in Riyadh, Saudi Arabia. The study participants were prefrail (according to the Edmonton Frail Scale) patients attending outpatient clinics in the study setting, aged 50 years and above, Saudi nationals, and able to walk independently. We excluded patients with physical impairment, sensory impairment, and existing comorbidities, including stroke, dementia, and Parkinson's disease.

The data collection tool for the current study was a questionnaire that consisted of a socio-demographic section (age, sex, marital status, educational level, and body mass index [BMI]), the SARC-F questionnaire, the Katz Activities of Daily Living (ADL) scale, and Lawton Instrumental Activities of Daily Living (Lawton IADL scale).

The SARC-F questionnaire was used to diagnose sarcopenia. This questionnaire consists of five components: strength, assistance with walking, rise from a chair, climb stairs, and falls, with scores ranging from 0 to 10 (0 to 2 points for each component). A score equal to or greater than 4 is predictive of sarcopenia and poor outcomes (Yang et al 2018).

The Katz ADL scale was used to rank the adequacy of performance in six functions: bathing, dressing, toileting, transferring, continence, and feeding. Participants answered yes/no for independence in each of the six functions. A score of 6 indicates full func-

tion, 4 indicates moderate impairment, and 2 or less indicates severe functional impairment (Ibrahim et al 2018).

The Lawton IADL scale was used to assess the more complex ADL necessary for living in the community. Since IADL function is usually lost before ADL function, assessment of IADL may identify incipient decline in physical, cognitive, or both functions in an older adult who might otherwise appear capable and healthy (Pearson et al., 2000; Lawton & Brody 1969; Ward et al 1998). The Lawton IADL scale contains eight items (using the telephone, shopping, preparing food, housekeeping, doing laundry, using transportation, handling medications, handling finances), with a total score ranging from 0 (low function) to 8 (high function) for women, and 0 to 5 for men (males are not assessed on laundry, meal preparation, and housekeeping).

The study was conducted after obtaining ethical approval from the institutional review board of King Saud Medical City. Data were collected by the study researchers. They invited geriatric patients, or their caregivers on their behalf, who were attending the outpatients' clinics at the specified hospital. The researchers explained the aims and objectives of the study to the participants and informed them that participation was voluntary and that the data would be used for research purposes only. Eligible participants, or their caregivers, who agreed to participate were asked to sign a consent form.

### 2.1. Statistical analysis

Statistical analyses were performed using SPSS version 23 (IBM Corp., Armonk, NY, USA). Descriptive data were expressed as mean  $\pm$  standard deviation or as a percentage. Differences between groups were analyzed and determined using the chi-squared test. To assess the predictors associated with sarcopenia, we performed a multiple logistic regression model, and the odds ratios (ORs) and 95% confidence intervals (CIs) were obtained. Statistical significance was set at  $p < 0.05$ .

## 3. Results

In total, 283 community-dwelling older adults were recruited for this study. The sociodemographic characteristics of the participants are presented in Table 1. The mean ( $\pm$ SD) age of the participants was 70.77( $\pm$ 6.26) years, and most of them (72.7%) were females, with 64.7% being in the 50 to 70 years age group. Almost 40% of the participants were obese (BMI  $> 30$  kg /m<sup>2</sup>), and 62% were married. Regarding educational level, 42% of the participants had no formal education, 8% had completed high school, and 12% of participants had high education degrees. The majority (85.5%) of the patients reported that they needed home care assistance.

The mean ADL score of the participants was high, indicating high function and independence (KATZ-ADL: M 4.60 SD 1.75; Lawton Brody: 60%). The overall prevalence of sarcopenia among the studied participants was 65.7%, which was significantly higher among females (71.9%) than among males (59.1%), with a P-value of 0.007.

The sex-specific differences in the prevalence of sarcopenia among the community-dwelling older adults are shown in Table 2. Females aged  $> 70$  years were the most likely to be sarcopenic, with a prevalence of 75.7%; however, there was no statistically significant difference between the two age groups (50–70 and  $> 70$  years old) in the prevalence of sarcopenia in both sexes (P values were  $> 0.05$ ). When the prevalence was calculated according to the BMI, it was higher among both males (57.8%) and females (73%), with BMI  $\geq 30$  kg/m<sup>2</sup>; however, within each sex, the difference in sarcopenia prevalence did not differ significantly by BMI. Similar results were obtained for marital and educa-

**Table 1**  
Demographic characteristic of the participants.

Variable	N = 283	%
Age	Mean 70.77 SD 6.26	
50–70	183	64.7
>70	100	35.3
BMI		
>30 kg/m <sup>2</sup>	160	56.5
≤30 kg/m <sup>2</sup>	112	39.6
Sex		
Male	66	27.3
Female	217	72.7
Marital status		
Single	107	37.8
Married	176	62.2
Educational level		
No formal education	132	42.6
Primary	82	25.3
Intermediate	24	8.4
Secondary	20	11.6
High education degree	25	12.0
Do you need home care		
Yes	242	85.5
No	41	14.5
Activity of daily living: Katz index	Mean 4.60 SD 1.75	
0–2	51	18
3–4	41	14.5
5–6	191	67.5
Activity of daily living: Lawton Brody (less able)		
Less able	31	11
Need assistance	82	29
Independent	170	60.1
Sarcopenia		
Sarcopenic	186	65.7
Non-sarcopenic	97	34.3

Note: Katz Index 6 = High (patient independent) 0 = Low (patient very dependent). BMI, body mass index.

**Table 2**  
Sex-specific difference with prevalence of sarcopenia among pre-frail community-dwelling older adults.

Variable	Male		p-value	Female		p-value
	Sarcopenia	Non-sarcopenia		Sarcopenia	Non-sarcopenia	
N (%)	31 (59.1)	27 (40.9)		156 (71.9)	61 (28.1)	0.007
Age			0.117			0.224
50–70	16 (45.7)	19 (54.3)		99 (69.7)	43 (30.3)	
>70	15 (65.2)	8 (34.4)		57 (75.7)	18 (24.3)	
BMI			0.174			0.373
>30 kg/m <sup>2</sup>	26 (57.8)	19 (42.2)		81 (73.4)	29 (26.6)	
≤30 kg/m <sup>2</sup>	4 (36.4)	7 (63.6)		69 (70.4)	29 (29.6)	
Marital status			0.311			0.118
Single	6 (66.7)	3 (33.3)		74 (76.3)	23 (23.7)	
Married	25 (51.0)	24 (49.0)		82 (68.1)	38 (31.9)	
Educational level			0.320			0.761
No formal education	8 (57.1)	6 (42.9)		87 (73.5)	31 (26.5)	
Primary	10 (66.7)	5 (33.3)		44 (72.1)	17 (27.9)	
Intermediate	4 (57.1)	3 (42.9)		11 (68.8)	5 (31.3)	
Secondary	2 (22)	7 (77.8)		8 (72.7)	3 (27.3)	
High education degree	7 (53.8)	6 (46.2)		6 (54.5)	5 (45.5)	
Do you need home care			0.487			0.017
Yes	19 (45.2)	23 (54.8)		147 (74.1)	51 (25.9)	
No	8 (50)	8 (50)		9 (47.4)	10 (52.6)	
Activity of daily living: Katz index			0.050			0.013
0–2	6 (75)	2 (25)		32 (82.1)	7 (17.9)	
3–4	7 (22.2)	2 (22.2)		29 (87.5)	4 (12.5)	
5–6	18 (43.9)	23 (56.1)		95 (65.5)	50 (34.5)	
Activity of daily living: Lawton Brody			0.016			0.013
Less able	4(100)	0		22 (84.6)	4 (15.4)	
Need assistance	11 (73.3)	4 (26.7)		51 (75.8)	16 (24.2)	
Independent	16 (41)	23 (59)		83 (66.9)	41 (33.1)	

Note: Katz Index 6 = High (patient independent) 0 = Low (patient very dependent). BMI, body mass index.

tional levels. Among the demographic characteristics of the participants, there was a significant difference in the need for home care assistance in female sarcopenic and non-sarcopenic participants [147 (74.1%) vs. 51 (25.9%) ( $p = 0.017$ ), but without demonstrable differences in males. Additionally, there was a significant difference ( $P < 0.05$ ) in the prevalence of sarcopenia between male and female participants according to ADL scores.

Multiple logistic regression was performed to assess the impact of some factors on the prevalence of sarcopenia in both sexes. The model contained seven independent variables (age, BMI level, marital status, educational level, need for home care assistance, ADL by Katz index, and IADL by Lawton Brody). As shown in Table 3, one variable each emerged as a significant predictor in male and female participants. The strongest predictor in male participants was ADL score < 2 by Katz index, with an odds ratio of 6.5 (OR 6.5, CI: 1.32–32.7,  $p = 0.036$ ), indicating that subjects with ADL score < 2 were more than six times at risk of sarcopenia. Meanwhile, the need for home care was the only significant predictor of sarcopenia among female participants (OR 3.25, CI: 1.14–9.25,  $p = 0.02$ ). However, there was no significant association between the risk of sarcopenia and each of the following variables: age, BMI, marital status, and educational level. This was reported for both sexes, with  $P$  values > 0.05.

#### 4. Discussion

This study aimed to assess the sex differences in the prevalence of sarcopenia among community-dwelling elderly patients in Saudi Arabia. We found that sarcopenia is prevalent among almost two-thirds of the studied population and is significantly higher among females than among males. ADL score differed significantly between sarcopenic and non-sarcopenic patients in both sexes; however, the need for home care assistance differed significantly among females only. The strongest predictor of sarcopenia in

**Table 3**

Multiple logistic regression model for sarcopenia in pre-frail male and female participants.

Variable	OR (95% CI)	P-value
<b>Male participants</b>		
Age (ref: 70 and below)	1.58 (0.30–8.25)	0.587
BMI (ref: >30 kg/m <sup>2</sup> )	0.06 (0.02–2.71)	0.063
Marital status (ref: Single)	2.04 (0.26–15.8)	0.493
<b>Educational level</b>		
No formal education	1.46 (0.21–10.1)	0.496
Do you need home care (ref: Yes)	0.78 (0.12–5.0)	0.493
<b>Activity of daily living: Katz index</b>		
<2 patient very dependent	6.5 (1.32–32.7)	0.036
Activity of daily living: Lawton Brody (less able)	1.28 (0.08–18.6)	0.999
Charlson Comorbidity Index (Mild)	0.98 (0.15–6.20)	0.938
<b>Female participants</b>		
Age (ref: 70 and below)	0.76 (0.35–1.66)	0.501
BMI (ref: >30 kg/m <sup>2</sup> )	0.86 (0.46–1.73)	0.744
Marital status (ref: Single)	0.69 (0.34–1.40)	0.312
<b>Educational level</b>		
No formal education	1.14 (0.53–2.45)	0.723
Do you need home care (ref: Yes)	3.25 (1.14–9.25)	0.02
<b>Activity of daily living: Katz index</b>		
<2 patient very dependent	1.50 (0.36–6.15)	0.569
Activity of daily living: Lawton Brody (less able)	0.82 (0.21–3.12)	0.774

Note: Katz Index 6 = High (patient independent) 0 = Low (patient very dependent). BMI, body mass index.

men was an ADL score < 2, according to the Katz index, and the need for home care assistance in women.

Our finding that sarcopenia is significantly higher among females is in contrast with previous studies, where Wu and Hashemi reported that male sex was independently associated with sarcopenia in community-dwelling older individuals in Taiwan and Iran (Hashemi et al 2016; Wu et al., 2014). In addition, a Chinese study including 526 community-dwelling individuals showed that subjects diagnosed with sarcopenia were more likely to be men (Kim et al 2009). Contrarily, another study showed a higher prevalence of severe sarcopenia among females than among males (Janssen et al 2002). Moreover, a higher risk of sarcopenia was reported in females among community-dwelling elderly adults (Gao et al 2015; Volpato et al 2014). The higher prevalence among males was primarily explained by gradual mass loss with age, which is insignificant or only slightly significant in females (Gallagher et al 2000; Castillo et al 2000; Shimokata et al 2014). In addition, a quantitative review revealed that, in individuals aged 75 years and above, the decrease in muscle mass ranges from 0.8 to 0.98% per year in males and 0.64 to 0.70% per year in females (Mitchell et al 2012). It should be noted here that more than 72% of the studied population in the current study were females, which might have contributed to such sex-specific differences.

The overall prevalence of sarcopenia in this study was estimated to be 65.7%. In Brazil, the total prevalence of sarcopenia was estimated to be 18%, which is far lower than that in our study (Moreira, et al 2019). In a review by Mayhew et al, the prevalence was 36.7% and 62.2% in men and women, respectively, which is also considered lower than ours at 59.1% and 71.9%, respectively (Mayhew et al 2019). However, the study augments our hypothesis that the prevalence is higher among females (Mayhew et al 2019).

Similar to our study, previous studies have suggested that elderly patients with sarcopenia have lower ADL scores (Morandi et al 2015; Oliveira et al 2009). In addition, Bahat et al. reported that sarcopenia defined according to the European Working Group on Sarcopenia in Older People was associated with ADL and IADL (Bahat et al 2018). They also found that more than half of their

study participants were completely independent in their ADL and IADL, a finding that is in line with our results despite the high prevalence of sarcopenia in our study compared to theirs at 65.7% vs. 0.8%, respectively (Bahat et al 2018). This could be explained by the differences between the study populations in terms of age and clinical status.

The current study has some limitations, including the small sample size and inclusion of one health care institution; therefore, the results cannot be generalized to the whole Saudi Arabia kingdom. Moreover, its cross-sectional design has a limited ability to show causal relationships.

## 5. Conclusion

Overall, almost two-thirds of the studied pre-frail community-dwelling older adult population in the current study were sarcopenic. The prevalence of sarcopenia was significantly higher among females than among males. Activities of daily living (ADL) differed significantly between sarcopenic and non-sarcopenic participants in both sexes. The need for home care assistance differed significantly among sarcopenic and non-sarcopenic female participants, but not in males. The strongest predictor of sarcopenia was an ADL score < 2, based on the Katz index in males and the need for home care assistance in females.

## CRedit authorship contribution statement

All authors contributed to conceptualization, data curation and analysis, writing the manuscript, and agree to be accountable for all aspects of the work. All authors have contributed to and approved the final version of the manuscript.

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None.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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