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## Original Study

## Sarcopenia Is Associated With Physical and Mental Components of Health-Related Quality of Life in Older Adults

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## A B S T R A C T

## Keywords:

Health-related quality of life  
sarcopenia  
older adults

**Objectives:** To estimate the association between sarcopenia and the health-related quality of life (HRQoL) among community-dwelling older adults.

**Design:** Cross-sectional analysis of a prospective cohort.

**Setting:** The Rural Frailty Study, a prospective study on the prevalence of frailty in rural settings in Mexico, with baseline and follow-up measurements conducted in 2009 and 2013, respectively.

**Participants:** Five hundred forty-three men and women older than 70 years.

**Measurements:** Information regarding demographic characteristics, comorbidities, mental status, dependency in activities of daily living, frailty, HRQoL, and other characteristics was obtained. Objective measurements of muscle strength and physical performance were grip strength using a manual hydraulic dynamometer and walking speed; measure of low muscle was by a calf circumference. Sarcopenia was defined according to the European Working Group on Sarcopenia in Older People criteria. Physical and mental components of the HRQoL were measured through the Medical Outcomes Study Health Survey Questionnaire 36-Item Short Form.

**Results:** Prevalence of sarcopenia was 20.6% for severe and 15.8% for moderate. After adjusting for sociodemographic and health characteristics, severe sarcopenia was significantly and inversely associated with both the physical ( $\beta = -5.39$ ;  $P = .010$ ) and the mental components ( $\beta = -3.69$ ;  $P = .057$ ) of HRQoL when compared with pre- and nonsarcopenic individuals.

**Conclusions:** Our results on the association between sarcopenia and HRQoL suggest that the latter declines in the presence of severe sarcopenia in older adults. This finding highlights the relevance of the early detection of sarcopenia in older individuals, and even that its detection must be a part of routine diagnosis procedures.

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Currently, sarcopenia is considered a geriatric syndrome of growing concern in the world.<sup>1</sup> Prevalence of this syndrome is highly variable, ranging from 5% to 13% in older adults aged 60–70 years, and from 11% to 50% in those aged 80 years or older.<sup>2</sup> With regard to

community-dwelling older adults specifically, a recent literature review yielded prevalence rates fluctuating between 1% and 29%.<sup>3</sup>

Rarely an isolated condition, sarcopenia is accompanied by diseases such as anorexia-related undernutrition,<sup>4</sup> vitamin D deficiency,<sup>5</sup> osteoporosis or osteopenia,<sup>6</sup> bone fractures,<sup>5</sup> and obesity.<sup>6,7</sup> Besides the association of sarcopenia with physical health indicators, also has been explored its association with mental health conditions, specifically with the cognitive function. In fact, one recent meta-analysis found a positive association between sarcopenia and cognitive impairment.<sup>8</sup> In addition, previous studies suggest that sarcopenia correlates with poor health-related outcomes such as physical limitations, disability, increased mortality,<sup>9–11</sup> frailty, and poor quality of life,<sup>11,12</sup> as well as with hospitalizations and emergency care use.<sup>13</sup>

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Albeit some of the components defining sarcopenia may play a decisive role in a gradual erosion of quality of life,<sup>3</sup> few studies have analyzed this relationship with inconclusive results.<sup>14–17</sup> Therefore, the aim of this study was to estimate the association between sarcopenia and the health-related quality of life (HRQoL) among community-dwelling older adults.

## Methods

### Sample and Procedures

We used data from the Rural Frailty Study, a prospective study on the prevalence of frailty in rural settings in Mexico, with baseline and follow-up measurements conducted in 2009 and 2013, respectively. Details of the Rural Frailty Study have been reported previously.<sup>18</sup> Briefly, at baseline, the study included a nonprobabilistic sample of 600 older adults, who reside in 7 states of Mexico and across 115 municipalities. This sample size was calculated to detect prevalence rates of at least 4% with power of 80% and  $\alpha$  value of 5%. Response rate for baseline sample was 93%. During follow-up, 668 face-to-face interviews (495 follow-up and 173 refresh sample interviews) were achieved, which represents a response rate of 89%.

For the present study, we used information only from the first follow-up measurement, including data from calf circumference and heel-knee measurement tests. Our final analytic sample consisted of 543 men and women older than 70 years, with complete data for all study variables. The study was approved by the Ethics Committee of the National Institute of Public Health. Written informed consent was obtained from all participants.

### Quality of Life

HRQoL was measured with Medical Outcomes Study Health Survey Questionnaire 36-Item Short Form (SF-36),<sup>19</sup> a validated instrument with 36 items regarding 8 outcome domains: physical functioning, social functioning, role limitations because of physical functioning, role limitations because of emotional problems, general mental health, vitality, bodily pain, and self-perception of general health. The SF-36 domains are grouped into 2 categories: (1) physical component summary (PCS), and (2) mental component summary (MCS), with values ranging from 0 to 100 each (100 reflecting the highest HRQoL level). The present study analyzed both components as continuous variables.

### Sarcopenia

Sarcopenia was defined according to 3 criteria suggested by the European Working Group on Sarcopenia in Older People (EWGSOP): muscle mass, muscle strength, and physical performance.<sup>2</sup> It was also classified into 3 categories: presarcopenia (presence of low muscle mass without altering strength or physical performance); moderate sarcopenia (low muscle mass accompanied by low strength or low physical performance), and severe sarcopenia (profound deterioration because of the presence of low muscle mass, low strength, and low physical performance).

Low muscle mass was defined by a calf circumference of  $<31$  cm,<sup>20</sup> and low muscle strength by a handgrip force of  $\leq 20$  kg for women and  $\leq 30$  kg for men. Three trials were performed on the dominant hand using a manual hydraulic dynamometer (Baseline Electronic Smedley Hand Dynamometer, Fabrication Enterprises Inc, White Plains, NY), with the maximal reading retained for analysis. Finally, low physical performance was defined by walking speed calculated from the 4-meter walk and using a cut-off point of  $\leq 0.8$  m/s.

### Covariates

The following covariates were used: sex, age, literacy (self-reported ability to read and write), ethnicity (self-reported use of an indigenous language), and labor status (holding a paid job). Disability was also considered on the basis of difficulties in performing the basic activities of daily living (ADL) and the instrumental activities of daily living (IADL). The former, which include bathing, dressing, toileting, transferring, continence, and feeding were assessed through the Katz ADL Index<sup>21</sup>; the IADL, which include using a telephone, doing shopping, handling medicine, managing money, using public or private transportation and, only for women, the ability to prepare meals, do housekeeping, and do laundry, were assessed through the Lawton and Brody Scale.<sup>22</sup> Subjects who reported needing help or being unable to perform at least 1 activity in each domain were considered disabled for ADL or IADL.

Participants were also asked whether they had been diagnosed by a physician with any of the following chronic diseases: diabetes, hypertension, hypercholesterolemia, osteoporosis, or arthritis.

Cognitive function was assessed on the basis of verbal fluency: participants were asked to name as many animals as possible in the space of 1 minute and were allotted 1 point for each valid name produced. To determine cognitive impairment, we stratified the sample by age and sex. Age was broken down into 5-year periods and categorized in 3 groups: 70–74 years, 75–79 years, and  $\geq 80$  years. Each group was then disaggregated by sex and assigned a cut-off point. Cognitive performance was considered poor in subjects 1.5 standard deviations (SDs) below the mean score in each age group based in previous reports in Mexico (Sosa et al).<sup>23</sup>

### Statistical Analysis

Variables were described using either arithmetic means and SDs or proportions, as appropriate. Kruskal-Wallis and  $\chi^2$  tests were used according to the specific characteristics of the variables.

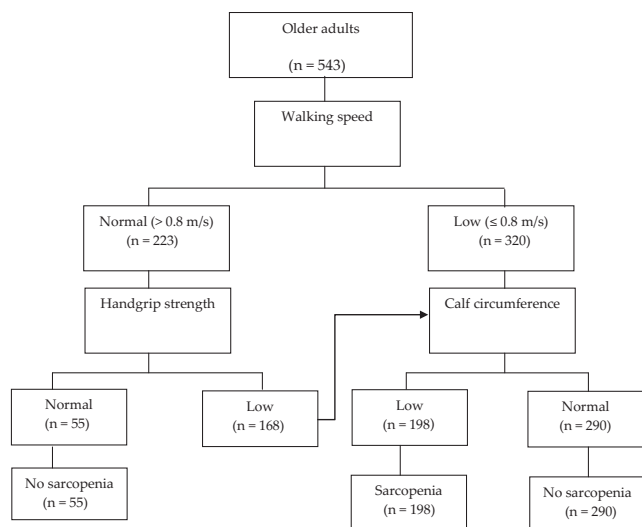
The association between different levels of sarcopenia and the SF-36 PCS and MCS domains was estimated through multivariate linear regression models. The final models were evaluated for collinearity, goodness of fit, and residuals. Differences were considered statistically significant where  $P < .05$  and marginally significant if  $.05 < P < .10$  (95% confidence intervals were also reported).

## Results

The following general characteristics were observed in the study sample: 543 older adults were included, the mean age of participants was 76.1 years (SD = 3.1 years). 52.7% were female, 60.2% were illiterate, 36.1% spoke an indigenous language, 30% held paid jobs, and 48.6% were married/cohabiting. Regarding health characteristics of the study population, 43.2% had overweight/obesity, 3.3% underweight and 53.5% adequate weight; 52.7% was reported at least 1 chronic condition and 21.6% had multimorbidity, defined as the presence of 2 or more chronic diseases. Prevalences of ADL and IADL disability were 12.2% and 15.2%, respectively, and 14.2% had cognitive impairment. The mean number of drugs was 1.45 (SD = 0.73), taking into account only the older adults who used at least 1 drug. Finally, 33.3% performed a moderate level of physical activity, and 29.5% a high level.

Figure 1 shows the distribution of the older adults according to the EWGSOP sarcopenia algorithm. Prevalence of sarcopenia was 20.6% severe and 15.8% moderate, with pre- and nonsarcopenic individuals accounting for 63.5% of the population. Meanwhile, mean of the PCS and MCS of the HRQoL scores were 59.6 (SD = 24.8) and 75.4 (SD = 19.4), respectively.

Table 1 shows the sociodemographic characteristics and health conditions of participants by sarcopenia status. In comparison with



**Fig. 1.** European Working Group on Sarcopenia algorithm in rural older Mexican adults.

pre- and nonsarcopenic individuals, those with moderate and severe sarcopenia were older ( $P < .001$ ), mostly female ( $P < .001$ ), illiterate ( $P = .010$ ), indigenous ( $P < .001$ ), and unemployed ( $P < .001$ ). They also displayed greater ADL and IADL disability (both  $P < .001$ ). In addition, the PCS ( $P < .001$ ) and MCS ( $P < .001$ ) scores of HRQoL were lower among those with severe sarcopenia in comparison with less severe degree of sarcopenia.

Table 2 present the results of the multivariate linear regression analyses for the association between sarcopenia and the SF-36 components. Linear regression analysis demonstrated that severe sarcopenia was inversely associated with both components of HRQoL. Adjusting for potential confounding variables did not change the results: severe sarcopenia was inversely associated with PCS ( $\beta = -5.39$ ;  $P = .010$ ) and MCS ( $\beta = -3.69$ ;  $P = .057$ ) when compared with pre- and nonsarcopenic individuals.

**Discussion**

Sarcopenia constitutes a major health problem affecting millions of older adults around the world. Despite its mounting prevalence, however, no general agreement has been reached regarding a

conceptual or empirical definition.<sup>24,25</sup> Highly variable global rate reports may be attributable to the wide array of definitions and methods used to measure sarcopenia.<sup>3</sup>

Our results on prevalence are consistent with several other studies having adopted the EWGSOP criteria. In fact, a systematic review of studies using the same criteria to analyze sarcopenia among community-dwelling adults and older adults aged 59.2–85.8 years indicated that prevalence fluctuated as much as 1%–29%, occurred more frequently among women and increased with age.<sup>3</sup>

For the older Mexican adult population specifically, several studies using the same EWGSOP criteria, have reported prevalence of sarcopenia that ranged from 9.3% to 33.6%. In a cohort of 70-year-olds and older adults, residing in Mexico City, the prevalence of sarcopenia (muscle mass measured by calf circumference) was 33.6%<sup>26</sup> (27.2% with severe and 6% with moderate levels). Another study in women reported 11% and 14.6%<sup>27</sup> of sarcopenia (muscle mass measured by calf circumference or skeletal muscle mass index, respectively); and 1 recent study reported 9.3%<sup>28</sup> of sarcopenia in 60-year-olds and older adults.

Sarcopenia has been shown to compromise the health of older adults mainly as a result of its association with adverse events such as reduced mobility, increased risk of falls and bone fractures, ADL and IADL disability, and loss of independence.<sup>2</sup> Sarcopenia has also an independent effect on the risk of death<sup>2,8</sup>; specifically, Wu et al<sup>13</sup> has reported that sarcopenia is a major predictor of 4-year mortality in Taiwanese older adults. In addition, hospitalized patients with sarcopenia are at increased risk for complications including infections, pressure ulcers, and loss of autonomy (conditions often leading to institutionalization and death).<sup>11</sup> Complications from sarcopenia clearly exert an impact on quality of life and highlight the relevance of detecting its early signs in older adults.

As for the association between severe sarcopenia and low quality of life in physical functioning, our results are analogous to those obtained by the few studies having analyzed sarcopenia specifically about the components of quality of life.<sup>29</sup> In all cases, a detrimental impact was identified in the physical role, vitality,<sup>14</sup> mobility, and normal activity of sufferers<sup>15</sup>; the physical function of both men and women yielded lower values in the presence of sarcopenia.<sup>17</sup> In addition, 2 recent studies, with older adults of Mexico City and Taiwan, found a significant negative bivariate association between sarcopenia (defined by the SARC-F scale) and quality of life.<sup>13,28</sup> Furthermore, another study using the CASP-12 scale for analyzing quality of life, reported that sarcopenia was associated with subsequent quality of life at 2 and 4 years of follow-up.<sup>13</sup>

**Table 1**  
Sociodemographic and Health Characteristics of Study Sample

Variables	Sarcopenia Status			P*
	Non-/Pre-Sarcopenia (n = 345)	Moderate (n = 86)	Severe (n = 112)	
Age, y (mean ± SD)	75.70 ± 2.94	76.31 ± 2.96	77.40 ± 3.45	<.001
Female (%)	44.93	60.47	70.54	<.001
Literacy (%)	42.03	37.21	34.82	.347
Speaking an indigenous language (%)	30.43	55.81	38.39	<.001
Paid job (%)	36.81	25.58	12.50	<.001
Cognitive decline (%)	28.12	30.23	35.71	.313
Hypertension (%)	36.23	32.56	41.96	.369
Diabetes (%)	13.62	4.65	13.39	.067
Hypercholesterolemia (%)	13.91	13.95	11.61	.815
Arthritis (%)	12.17	10.47	11.61	.906
Osteoporosis (%)	8.99	5.81	9.82	.572
ADL disability (%)	15.65	9.30	36.61	<.001
IADL disability (%)	20.58	15.12	45.54	<.001
Quality of life				
SF-36 PCS	65.47	69.40	43.33	<.001
SF-36 MCS	82.85	83.21	69.82	<.001

\*Kruskal-Wallis or  $\chi^2$  tests.

**Table 2**  
Factors Associated With HRQoL in Older Adults

Covariables	36-SF					MCS (n = 543)				
	PCS (n = 543)									
	Coef.	SE	Lower 95% CI	Upper 95% CI	P Value	Coef.	SE	Lower 95% CI	Upper 95% CI	P Value
Sarcopenia status (reference no/pre sarcopenia)										
Moderate	3.45	2.22	−0.90	7.81	.120	0.36	2.06	−3.69	4.40	.862
Severe	−5.39	2.08	−9.47	−1.30	.010	−3.69	1.93	−7.48	0.11	.057
Female	−0.32	1.74	−3.74	3.10	.853	−0.34	1.62	−3.52	2.83	.831
Age	−0.34	0.26	−0.84	0.17	.188	−0.13	0.24	−0.59	0.34	.601
Literacy	4.37	1.62	1.19	7.55	.007	4.14	1.50	1.19	7.10	.006
Speaking an indigenous language	0.75	1.67	−2.53	4.02	.654	3.68	1.55	0.64	6.72	.018
Paid job	6.02	1.91	2.27	9.77	.002	3.11	1.77	−0.37	6.59	.080
Cognitive decline	−1.33	1.73	−4.74	2.07	.443	−6.78	1.61	−9.94	−3.62	.000
Hypertension	−2.40	1.71	−5.76	0.96	.161	−1.11	1.59	−4.23	2.01	.484
Diabetes	−1.74	2.46	−6.57	3.09	.480	−1.65	2.28	−6.14	2.83	.469
Hypercholesterolemia	−3.40	2.35	−8.01	1.21	.148	1.82	2.18	−2.46	6.10	.404
Arthritis	−8.70	2.55	−13.72	−3.69	.001	−4.54	2.37	−9.19	0.12	.056
Osteoporosis	−4.13	2.89	−9.81	1.54	.153	−0.98	2.68	−6.25	4.29	.714
ADL disability	−21.88	2.44	−26.68	−17.08	.000	−14.52	2.27	−18.98	−10.07	.000
IADL disability	−15.38	2.13	−19.57	−11.20	.000	−4.42	1.98	−8.31	−0.54	.026

CI, confidence interval; Coef, coefficient; SE, standard error.

One possible explanation of the relationship between severe sarcopenia and low quality of life in the physical dimension might be that high levels of inflammatory markers such as C-reactive protein,<sup>30</sup> inflammatory interleukins, and tumor necrosis factor alpha,<sup>31</sup> not only diminished muscle quality and quantity, but also caused general symptoms such as hyporexia, fatigue, lower food intake, and reduced mobility, all of which contribute to muscle loss.

An interesting finding from our work was the association between sarcopenia and HRQoL in the SF-36 MCS scores. Similar results were reported by a previous study of rural older adults in Brazil, where individuals with sarcopenia obtained a lower score than individuals without sarcopenia in the SF-36 section on emotional role functioning,<sup>32</sup> including items on self-perceived anxiety and depression. While these symptoms could very well be the pathways by means of which sarcopenia associates negatively with the mental component of quality of life, little research exists in this regard. According to several studies, the intimate link between sarcopenia and anxiety stems from a persistent fear of falling among sarcopenics,<sup>33</sup> a fear which can exist and be self-perceived even among those who have not fallen.<sup>34</sup> A 2-way relationship could be at play here, where reduced mobility promotes loss of strength and muscle mass in individuals with sarcopenia, who, feeling weak and unstable, are understandably afraid of falling.

On the other hand, and regarding the association between sarcopenia and MCS of HRQoL, a feasible explanation might be through a similar mechanism present in depression, which is known by hormonal alterations also present in sarcopenia, in particular through an increase in tumor necrosis factor alpha and inflammatory interleukins.<sup>35</sup> Specifically, inflammatory states can alter the hypothalamic-pituitary-adrenal axis and thus modify cortisol secretion, a process associated with depression in both sexes.<sup>36</sup>

Regarding the implications of our results, it is important to promote intervention strategies with the aim of attenuating or even reversing sarcopenia because recent studies have shown the importance of preserve strength and endurance in younger cohorts of people.<sup>37</sup> Evidence suggest starting even before age 50 years, in such a way that individuals at risk for sarcopenia can be identified before the decrease in muscle mass and physical function exceed a critical threshold.<sup>38</sup>

Our study presents several limitations. First, its cross-sectional design limited the ability of establishing causal associations or even of discarding the possibility of reverse causality. Second, the use of calf

circumference to define muscle mass was only a proxy measurement. It should be noted, however, that calf circumference provides a sensitive measure of muscle mass for sarcopenia and frailty screening in older adults.<sup>37</sup> Nonetheless, as sarcopenia has been shown to increase with age, a significant proportion of our sample population, consisting of older adults aged 70–80 years, can be reasonably expected to present this condition.<sup>3,27</sup>

In conclusion, our study demonstrates that severe sarcopenia is associated with the physical and mental components of HRQoL. This finding highlights the relevance of detecting sarcopenia in individuals from the time of their initial visits to primary care units. Identification of sarcopenia does not currently form part of routine diagnosis procedures in Mexico; however, evidence from this and previous research underlines the need for early detection in light of the adverse effects of sarcopenia on HRQoL.<sup>3</sup>

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