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Sarcopenia in the Metropolitan Region of Chile: Cross-Sectional Findings from the Chilean National Health Survey 2016–2017

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Sarcopenia en la Región Metropolitana de Chile: Resultados transversales de la Encuesta Nacional de Salud 2016-2017

ABSTRACT

Aim: *To investigate sarcopenia in Chile, including its prevalence and association with sociodemographic and lifestyle factors.* ***Methods:*** *232 participants from the Metropolitan Region, representing 1,037,790 older adults, were included in this cross-sectional analysis. Sarcopenia was defined using the European Working Group on Sarcopenia in Older People 2019 statement. Age, sex, education, place of residency, marital status, smoking, self-perception of health, sleep, alcohol consumption, body mass index, waist circumference, physical activity, sedentary behaviour, and suspicion of cognitive impairment were the risk factors assessed. Poisson regression models were used to analyse the cross-sectional associations of sarcopenia by sociodemographic and lifestyle factors. All analyses accounted for the complex survey design and population expansion weights in Stata 18.* ***Results:*** *22.1% (95% CI: 15.5% to 30.3%) of the included participants exhibited sarcopenia. After adjusting, per each year of increment of age, the prevalence of sarcopenia increased by 4% (PR: 1.04 [95% CI: 1.01 to 1.08]). In addition, people with bad and regular self-reported health had 3.06 (95% CI: 1.34 to 6.98) and 1.88-times (95% CI: 1.03 to 3.41) higher prevalence of sarcopenia than people with a good perception. No other significant associations were identified.* ***Conclusion:*** *Considering that sarcopenia is associated with higher risk of disability and reduction in quality of life and it could begin early in life, actions to address its risk are more urgent than ever.*

Keywords: *Aged; Hand strength; Muscle, Skeletal; Sarcopenia.*

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RESUMEN

Objetivo: *Investigar la sarcopenia en Chile, incluyendo su prevalencia y su asociación con factores sociodemográficos y de estilo de vida.* ***Métodos:*** *Se incluyeron 232 participantes de la Región Metropolitana, que representan a 1.037.790 personas mayores, en este análisis transversal. La sarcopenia se definió utilizando la declaración del Grupo de Trabajo Europeo sobre Sarcopenia en Personas Mayores de 2019. La edad, sexo, educación, lugar de residencia, estado civil, tabaquismo, autopercepción de salud, sueño, consumo de alcohol, índice de masa corporal, circunferencia de cintura, actividad física, comportamiento sedentario y sospecha de deterioro cognitivo fueron los factores de riesgo evaluados. Se utilizaron modelos de regresión de Poisson para analizar las asociaciones transversales de la sarcopenia con factores sociodemográficos y de estilo de vida considerando análisis de muestras complejas y factores de expansión poblacional en Stata 18.* ***Resultados:*** *El 22,1% (IC 95%: 15,5% a 30,3%) de los participantes incluidos presentó sarcopenia. Después del ajuste, por cada año de incremento de edad, la prevalencia de sarcopenia aumentó en un 4% (RP: 1,04 [IC 95%: 1,01 a 1,08]). Además, las personas con mala y regular autopercepción de salud tuvieron 3,06 (IC 95%: 1,34 a 6,98) y 1,88 veces (IC 95%: 1,03 a 3,41) mayor prevalencia de sarcopenia que las personas con una buena percepción. No se identificaron otras asociaciones significativas.* ***Conclusión:*** *Considerando que la sarcopenia está asociada con un mayor riesgo de discapacidad y reducción en la calidad de vida y que podría comenzar temprano en la vida, las acciones para abordar su riesgo son más urgentes que nunca.*

Palabras clave: *Fuerza de la Mano; Músculo Esquelético; Persona mayor; Sarcopenia.*

Sarcopenia is recognised as a complex syndrome characterised by a progressive loss of muscle strength along with a higher risk of disability and reduction in quality of life that begins early in life[1,2,3]. The diminishment of muscle mass and function emerges as one of the most substantial and noteworthy physiological changes during ageing[4]. Consequently, endeavours to comprehend the intricate mechanisms underpinning sarcopenia have witnessed a surge within the scientific community. Despite the headway achieved in this domain, several critical gaps persist, garnering significant attention within our society. These gaps encompass pivotal areas, including the onset of sarcopenia, early diagnostic methodologies, and the formulation of a precise operational definition accompanied by corresponding threshold criteria.

A previous systematic review and meta-analyses estimated the global prevalence of sarcopenia to be between 10 and 27%, depending on the

classification used[5]. The same review highlighted the relevance of estimating national and representative data, considering that most of the estimated prevalence came from Europe, North America, and Asia[5]. In South America, countries such as Brazil[6,7,8] and Chile[9,10,11,12] have made much progress in the area, increasing the interest among the scientific community. Precisely, in Chile, the prevalence of sarcopenia has been estimated between 19.7%[9] and 49.7%[11] according to different cut-off points and measurements[12]. However, the current estimations have not considered a representative population sample and were estimated with previous operational definitions. Therefore, this study aimed to investigate sarcopenia in a representative sample from the Metropolitan region of Chile, including its prevalence and association with sociodemographic and lifestyle factors.

Methods

This cross-sectional study was based on data from adults older than 60 years from the Chilean National Health Survey conducted between 2016 and 2017 (CNHS 2016–2017) and residents in the Metropolitan Region[13]. The CNHS 2016-2017 is a large, nationally representative population-based study of biological and lifestyle risk factors, dietary status, and health status conducted every six years in urban and rural zones. Data for this survey were collected by trained staff, where participants were administered questionnaires and anthropometrical and physiological measures were obtained. The CNHS 2016–2017 was funded by the Chilean Ministry of Health and approved by the Ethics Research Committee of the School of Medicine at the Pontificia Universidad Católica de Chile (No. 16–019)[13]. All participants provided written consent before participation[13].

Sarcopenia

Using the European Working Group on Sarcopenia in Older People 2019 (EWGSOP2) statement[3], sarcopenia was defined based on the combination of low grip strength plus low muscle mass, while severe sarcopenia was defined as having a low grip strength, low muscle mass and slow gait speed. However, due to the small number of participants having severe sarcopenia, sarcopenia and severe sarcopenia were pooled together and hereafter called sarcopenia (classified as a dichotomic variable). This approach has been previously used in international studies[14,15].

Grip strength was measured using a dynamometer (JAMAR® Sammons Preston Inc., B001D7QDJG). This evaluation was carried out with the subject seated in a chair with a backrest, shoulders adducted, elbow flexed at 90°, forearm and wrist in a neutral position. Participants were asked to perform a maximum grip strength with their dominant hand for 3 seconds, with a 1-minute rest between each repetition, making three attempts. The highest value obtained from the repetitions was used. After removing outliers or unfeasible values, grip strengths <27 kg in men and <16 kg in women were classified as low grip strength, following the EWGSOP2 cut-off points[3]. Due to the availability of the dynamometer, this variable was only measured in one region of the whole country, as shown in Supplementary Figure 1 (Metropolitan Region).

In the absence of dual-energy x-ray absorptiometry (DXA) or bioelectrical impedance analysis (BIA), calf circumference (CC) measured with a tape was used as a proxy of muscle mass. The EWGSOP2 has declared that CC may be used as "a diagnostic proxy for older adults in settings where no other muscle mass diagnostic methods are available[3]." The participant had to be seated with the knees at a right angle and the feet flat on the floor, looking straight ahead. The maximum perimeter of the right calf was selected after loosening and tightening the tape 3 or 4 times. If it was impossible to measure the right calf, the left was used. After removing values lower than 3 SD from the median –and decreasing the measured by 3 cm in people with overweight and 7 cm in obese participants[16]– altered calf circumference (low muscle mass) was defined as <33 cm in men and <32 cm in women using the Global Leadership Initiative on Malnutrition[16].

Finally, self-reported walking pace, categorised as slow, average, or brisk, was used as a proxy of gait speed. Walking pace was dichotomised into slow or normal (average or brisk pace) to derive a

proxy for gait speed[13]. Even if self-reported walking pace is not the same measure recommended by the EWGSOP2, previous studies identified that self-reported walking pace is a good marker of walking speed and is strongly associated with adverse health outcomes[17].

Sociodemographic and lifestyle covariates

Self-reported data for sociodemographic characteristics, including age, sex, education, place of residency, and marital status, were collected from all participants using questionnaires previously validated for the CNHS 2016–2017[13]. The following categories were derived for the sociodemographic variables: age (60-69 years and ≥70 years), sex (men and women), education level (≤8 years, 9-12 years, and >12 years), place of residency (rural or urban) and marital status (marriage, living together [with or without a civil union agreement], divorced, widower, and single). Among lifestyle variables included, smoking (self-reported as never, ex-smoker, occasional, and current), self-perception of health (bad, regular, or good), and sleep (h/day) were self-reported. Sleep was then classified as ≤6, 7-8, and ≥9 h/day. Alcohol consumption was self-reported and collected using the 'Alcohol Use Disorders Identification Test' (AUDIT) questionnaire developed by the World Health Organisation[18] and adapted for the Chilean population[19]. An AUDIT score greater than 8 points was considered indicative of risky alcohol consumption. Objective body mass index (BMI) was calculated as weight/height2. The Pan American Health Organization (PAHO) criteria for older people were applied to estimate nutritional status (underweight: <23.0 kg/m^2; normal: 23.0–27.9 kg/m^2; overweight: 28.0–31.9 kg/m^2; obese: ≥32.0 kg/m^2)[20]. Waist circumference was measured at the midaxillary line at the midpoint between the costal margin and the iliac crest by an ergonomic circumference measuring tape. Abdominal obesity was defined as ≥90 cm and ≥80 cm in men and women, respectively. The Global Physical Activity Questionnaire (GPAQ) assessed self-reported sitting time and physical activity. The sum of total physical activity was classified as low, moderate and high of metabolic Energy equivalents in minutes per day (METs/min/day) using the Chilean Ministry of Health classification[13]. The number of hours sitting per day was then classified as >= 4 h/day or <4 h/day. Using the Modified Chilean version of the Mini-Mental State Examination (MMSE) questionnaire[13], a score under 14 points out of a maximum of 19 points was suggestive of cognitive impairment (altered MMSE).

Statistical analyses

All statistical analyses were performed just for the Metropolitan Region using the complex sample models (SVY) in STATA V18 software (StataCorp; College Station, TX) and using the specific survey weights provided by the CNHS 2016–2017 for the principal variables of the survey. Only participants with full data available were included (Supplementary Figure 1).

General characteristics of the included population are presented as mean (for continuous variables) and percentage (for categorical variables) along with their respective 95% confidence interval (95% CI).

Poisson regression models with robust standard errors (SEs) were used to analyse the cross-sectional associations of sarcopenia by sociodemographic and lifestyle factors. Prevalence ratio (PR) with its 95% CI[21] was used because this cross-sectional study cannot be used to estimate risk. Poisson regression models with robust SEs were used because they provide PR estimates that are relatively easy to interpret, instead of odds ratios[22]. Robust SEs were used to correct for the underinflation when applying the Poisson model for binary outcomes. Analyses were adjusted for age, sex, and educational status when these were not the exposure of interest. These variables have been widely used as confounders in previous studies[14,15]. A p-value below 0.05 was considered statistically significant.

Results

After excluding individuals lacking data for the exposure (variables utilised to establish sarcopenia categories) and covariates, a total of 232 participants from the Metropolitan Region were

ultimately incorporated, representing 1,037,790 older adults. Among the included participants, 22.1% (95% CI: 15.5% to 30.3%) exhibited sarcopenia, including severe cases (Figure 1). Sociodemographically, a higher proportion of sarcopenia was identified in people older than 70 years (33.7% vs 13.7% in younger than 70), women (24.2% vs 19.7% in men), in people with lower educational levels (36.8% vs 14.9% in those with 13 or more years of education) and in people living together (38.4%) followed by widower (28.7%) (Figure 2). Regarding lifestyle characteristics, sarcopenia was observed more often in people with altered AUDIT (28.5% vs 18.8% in normal AUDIT), those with altered MMSE scores (59.9% vs 20.4% in normal scores), underweight participants (32.8% – higher than the other three categories), those with a bad self-perception of health (51.0% vs 13.9% in those with good self-perception), those with low physical activity levels (30.7% vs 13.0% in the high category), and those who self-reported sleeping at least nine hours a day (24.9% vs 20.1% in those with 7 to 8 hours per day) (Figure 3). Associations between sociodemographic and lifestyle factors with the prevalence of sarcopenia are shown in Table 1.

After adjusting for sex, age and educational level, only age and self-perception of health were associated with a higher prevalence of sarcopenia. In the case of age, for each year of age, the prevalence of sarcopenia increased by 4% (PR: 1.04 [95% CI: 1.01 to 1.08]). In comparison, the prevalence of sarcopenia in people with bad and regular self-reported health was 3.06 (95% CI: 1.34 to 6.98) and 1.88 times (95% CI: 1.03 to 3.41) higher than in people with a good perception of health.

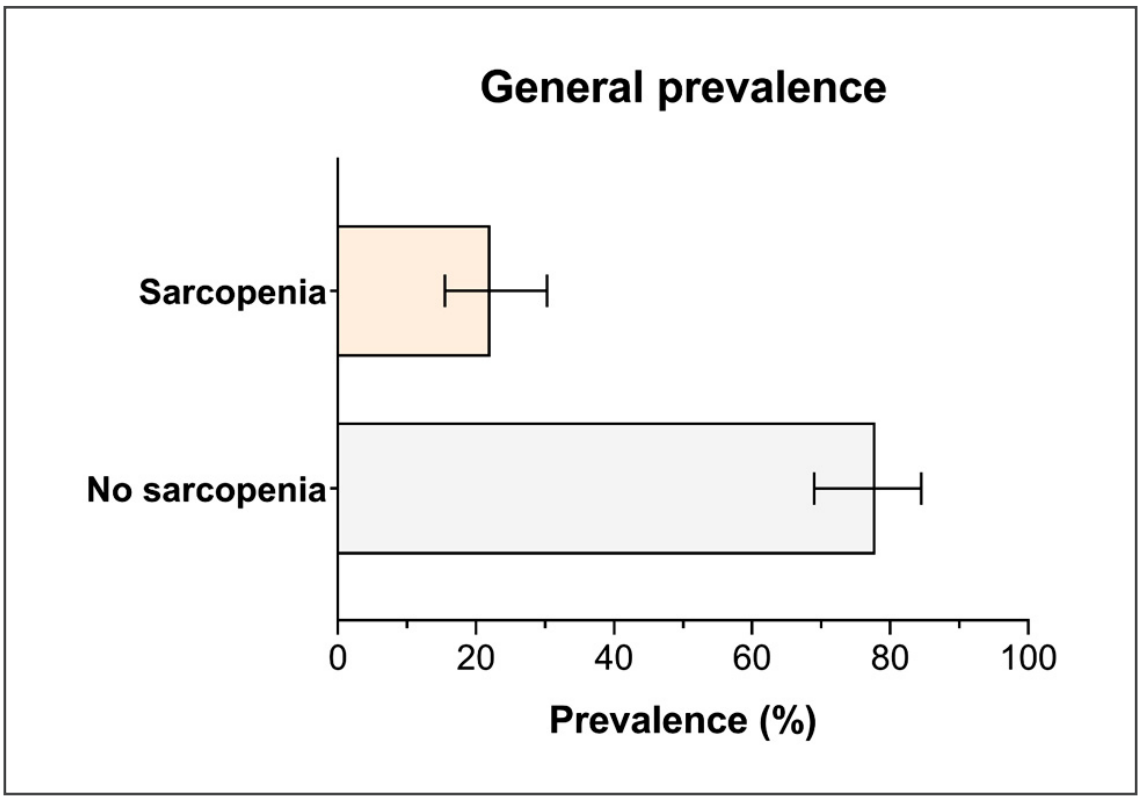

Figure 1: *General prevalence of Sarcopenia in older Chilean adults from the Metropolitan Region. Sarcopenia includes both sarcopenia and severe sarcopenia.*

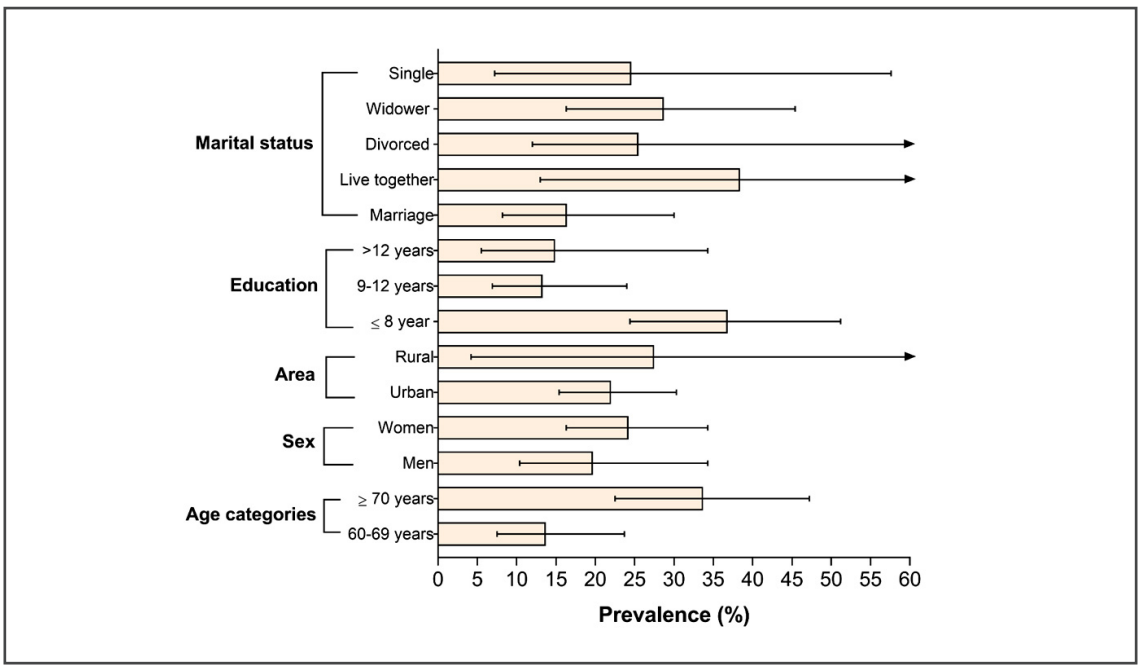

Figure 2: *Prevalence of Sarcopenia by sociodemographic characteristics in older Chilean adults from the Metropolitan Region.*

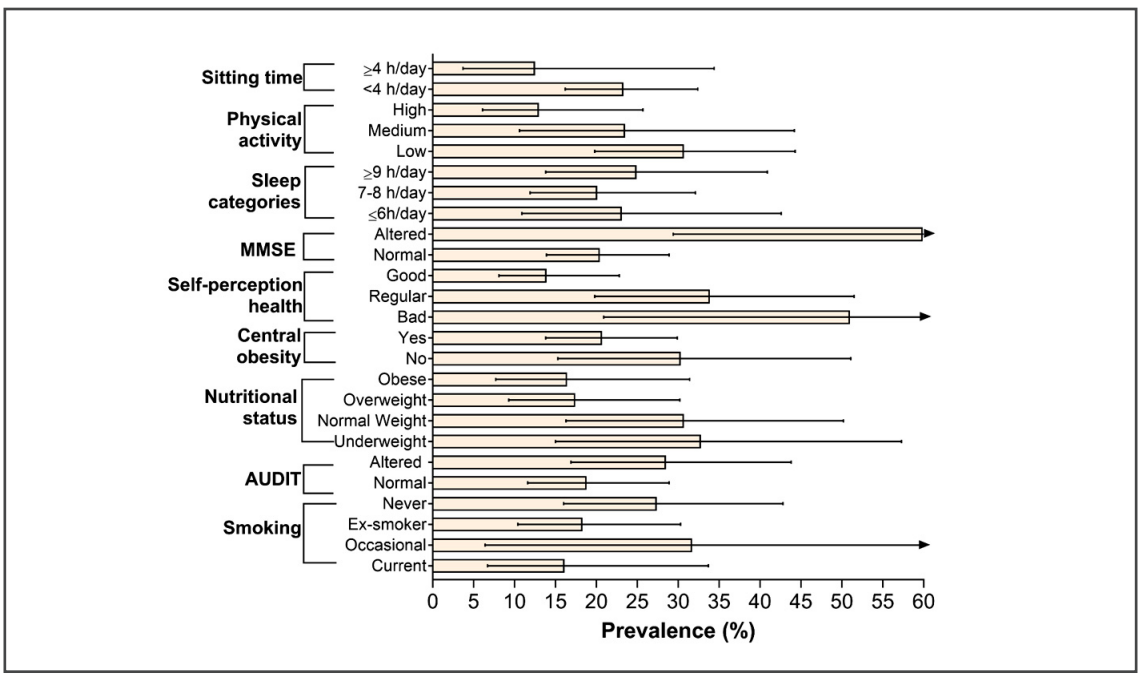

Figure 3: *Prevalence of Sarcopenia by lifestyle in older Chilean adults from the Metropolitan Region. MMSE: Mini Mental test (Altered defined as lower than 14 points), AUDIT: Alcohol Use Disorders Identification Test (Altered defined as more than 8 points).*

Table 1. Baseline characteristics by sarcopenia status in older adults from the Metropolitan Region.

	Prevalence		Prevalence Ratio	
	No sarcopenia	Sarcopenia*	Adjusted PR (95% CI)	p-value
n	176	56	-	-
n expanded (95% CI)	808.438 (723.340; 876.933)	229.352 (160.857; 314.450)	-	-
Sociodemographic				
Age (years), mean (95% CI)	68.1 (66.5; 69.6)	73.9 (69.8; 78.0)	1.04 (1.01; 1.08)	0.022
Age categories, % (95% CI)				
60-69 years	64.5 (54.7; 73.3)	36.2 (20.7; 55.2)	1.00 (Ref)	
≥70 years	35.5 (26.7; 45.3)	63.8 (44.8; 79.3)	1.90 (0.91; 3.96)	0.085
Sex, % (95% CI)				
Men	49.3 (39.0; 59.6)	42.8 (25.2; 62.4)	1.00 (Ref.)	
Women	50.7 (40.4; 61.0)	57.1 (37.6; 74.8)	1.02 (0.53; 1.97)	0.945
Education, % (95% CI)				
≤8 years	29.0 (21.4; 37.9)	59.5 (40.9; 75.7)	1.77 (0.58; 5.42)	0.311
9-12 years	44.6 (34.6; 55.2)	24.2 (12.6; 41.3)	0.92 (0.30; 2.83)	0.879
>12 years	26.4 (17.5; 37.7)	16.3 (6.3; 36.2)	1.00 (Ref.)	
Zone, % (95% CI)				
Urban	99.2 (98.0; 99.7)	98.9 (92.6; 99.9)	1.00 (Ref.)	
Rural	0.8 (0.30; 2.0)	1.1 (0.10; 7.4)	0.92 (0.24; 3.52)	0.900
Marital status, % (95% CI)				
Marriage	55.3 (44.9; 65.3)	38.4 (21.3; 58.9)	1.00 (Ref.)	
Live together	4.6 (1.8; 10.8)	10.0 (3.3; 26.5)	2.47 (0.81; 7.50)	0.112
Divorced	14.3 (8.5; 23.1)	17.4 (8.2; 33.2)	1.45 (0.68; 3.08)	0.335
Widower	16.5 (10.5; 24.9)	23.6 (13.0; 38.9)	1.10 (0.52; 2.33)	0.808
Single	9.3 (4.6; 17.7)	10.6 (3.2; 30.5)	1.57 (0.46; 5.34)	0.472
Lifestyle and health-related factors				
Smoking, % (95% CI)				
Current	15.7 (9.5; 25.1)	10.7 (4.6; 22.9)	0.84 (0.30; 2.33)	0.739
Occasional	3.1 (1.0; 10.3)	5.0 (1.2; 19.0)	2.22 (0.53; 9.19)	0.271
Ex-smoker	44.2 (34.1; 54.8)	35.1 (20.2; 53.4)	0.78 (0.40; 1.53)	0.474
Never	37.0 (27.8; 47.2)	49.2 (31.3; 67.4)	.	.
AUDIT, % (95% CI)				
Normal	69.0 (58.7; 77.6)	56.3 (37.6; 73.3)	1.00 (Ref.)	
Altered	31.0 (22.4; 41.3)	43.7 (26.7; 62.4)	1.58 (0.82; 2.97)	0.177
Nutritional status, % (95% CI)				
Underweight	7.7 (3.9; 14.8)	13.4 (6.2; 26.5)	1.01 (0.49; 2.08)	0.976
Normal weight	23.1 (15.7; 32.6)	36.2 (19.8; 56.6)	1.00 (Ref.)	
Overweight	48.8 (38.5; 59.1)	36.3 (20.5; 55.8)	0.64 (0.31; 1.32)	0.224
Obese	20.4 (13.3; 29.9)	14.1 (6.6;27.4)	0.55 (0.23; 1.33)	0.185

...continued table 1

	Prevalence		Prevalence Ratio	
	No sarcopenia	Sarcopenia*	Adjusted PR (95% CI)	p-value
Central obesity, % (95% CI)				
No	12.2 (7.3; 19.7)	18.8 (9.1; 34.7)	1.00 (Ref.)	
Yes	87.8 (80.3; 92.7)	81.2 (65.3; 90.9)	0.59 (0.29; 1.20)	0.146
Self-perception of health, % (95% CI)				
Bad	3.4 (1.3; 8.6)	12.6 (4.7; 29.7)	3.06 (1.34; 6.98)	0.008
Regular	26.0 (17.6; 36.5)	47.1 (29.4; 65.6)	1.88 (1.03; 3.41)	0.039
Good	70.6 (60.1; 79.3)	40.3 (24.1; 58.8)	1.00 (Ref.)	
Self-reported physical activity (METs/min/día), % (95% CI)				
Low	34.0 (24.9; 44.5)	51.7 (33.3; 69.5)	1.00 (Ref.)	
Moderate	27.1 (18.9; 37.1)	28.3 (13.2; 50.8)	0.80 (0.39; 1.63)	0.536
High	38.9 (28.9; 50.0)	20.0 (9.5; 37.2)	0.61 (0.26; 1.44)	0.256
Sitting time, % (95% CI)				
<4 hours/day	86.8 (77.7; 92.5)	93.4 (80.5; 97.9)	1.00 (Ref.)	
≥4 hours/day	13.2 (7.5; 22.3)	6.6 (2.1; 19.5)	0.60 (0.18; 1.94)	0.389
Sleep (h/day), mean (95% CI)	7.3 (6.9; 7.6)	7.4 (6.8; 7.9)	1.04 (0.92; 1.17)	0.528
Sleep categories, % (95% CI)				
≤6 h/day	27.6 (19.4; 37.5)	29.3 (14.2; 50.8)	0.90 (0.47; 1.70)	0.743
7- 8 h/day	50.6 (40.3; 60.9)	45.1 (27.9; 63.6)	1.00 (Ref.)	
≥9 h/day	21.8 (14.5; 31.6)	25.6 (14.0; 42.1)	1.05 (0.50; 2.21)	0.898
MMSE, % (95% CI)				
Normal	97.9 (94.8; 99.2)	88.8 (74.8; 95.5)	1.00 (Ref.)	
Altered	2.1 (0.8; 5.2)	11.2 (4.5; 25.2)	1.62 (0.90; 2.93)	0.110

*Either Sarcopenia or severe Sarcopenia. Prevalence Ratio (PR) was used to estimate the association between sarcopenia and the respective risk factors. Analyses were adjusted for age, sex and education when these were not the variables of interest using the complex sample models in Stata (svy) and survey weights provided by the CNHS 2016-2017. -Not enough data for running the analyses. AUDIT: Alcohol Use Disorders Identification Test; MMSE: Mini Mental test; METs: Metabolic Energy Equivalent.

Discussion

We identified that 22.1% of the included population from the Metropolitan Region had sarcopenia (either sarcopenia or severe sarcopenia). Moreover, people older than 70 years, women, participants with lower educational levels, occasional smokers, those with altered AUDIT and suspicion of cognitive impairment, and those who self-reported a bad perception of health, low physical activity levels, or slept more than nine hours per day were those with higher prevalences. Regarding factors associated with a higher prevalence, the prevalence was significantly higher in people with bad or regular self-reported health status, and as it was expected, increased with each year of age. A previous Chilean study also identified that sarcopenia was more likely

to increase with age and falls, as well as decrease with overweight and obesity[9]. Other international studies have also identified that women, people aged over 65 years, and underweight people are more likely to have sarcopenia[23,24].

This is the first study to investigate the prevalence of sarcopenia in the Metropolitan Region of Chile using a nationally representative sample. Yet, other studies in the country have also estimated its prevalence. For instance, in 155 older participants, Crovetto et al.[11] identified that 45.2% and 5.2% of participants had sarcopenia and severe sarcopenia, respectively. They also used CC to measure muscle mass. However, they did not consider the nutritional status correction; therefore, their prevalence may be even higher. Lera et al.[9] also estimated the prevalence of sarcopenia, proposing Chilean cut-off points in a sample of 1,006 older adults from Santiago. Using the previous EWGSOP guideline (2010), they identified a prevalence of 19.1%, which was similar in both sexes[9].

Although this study did not investigate the association between sarcopenia and all-cause mortality, this association has been widely reported across Occidental and Oriental populations. Moreover, the association has also been reported in Chilean older adults, those who had almost 1.5 times higher risk of all-cause mortality than their counterparts[10]. Indeed, sarcopenic people are expected to live more years with disabilities and multimorbidity, representing a higher burden for societies and families[25,26]. Undoubtedly, interest in the topic has increased among Chilean scientific communities; in fact, a software tool for faster diagnosis was developed among community-dwelling older adults[27]. However, its evaluation and surveillance beyond research are already limited in older people, and it is almost non-existent in middle-aged populations. The latter makes it difficult to identify middle-aged individuals at risk in whom this condition could be reversed. Hence, efforts are still insufficient if we consider that the individual markers used to define sarcopenia could start their deterioration after ~35 years of age[5]. Thus, considering this decline occurs progressively, studying sarcopenia should start earlier in life and not just because of ageing.

Strengths and limitations

This study used representative data from the Metropolitan Region of Chile, which allows for generalising the results of this article to all people older than 60 from this area. Moreover, sociodemographic and lifestyle factors were estimated following standardised protocols. However, this study has some limitations. Firstly, gait speed and muscle mass were not calculated using the original and gold standard variables but proxies. However, previous studies have shown a high correlation with these measurements[16,28]. Moreover, and in the particular case of CC, the EWGSOP2 has endorsed its use when no other measure is available. Secondly, some variables were self-reported, which might be subject to recall bias and underestimate the prevalence of sarcopenia by different sociodemographic and lifestyle classifications. Thirdly, grip strength was only measured in a limited sample size from just one region in Chile, limiting the final number of participants included in this analysis, as well as the inclusion of other regions in the country. Fourthly, even if the model was adjusted, unmeasured or residual confounders could still partially influence our findings. Finally, due to the cross-sectional nature of this research, causality cannot be estimated.

Conclusion

In a representative sample of Chilean older adults from the Metropolitan Region, we identified that 22.1% had sarcopenia. People over 70 years of age, women, participants with lower educational levels, occasional smokers, those with suspected cognitive impairment or alcohol consumption problems, and those who reported poor self-perception of health, those with lower levels of physical activity, or those who slept more than nine hours a day, had a higher prevalence.

Considering that sarcopenia is associated with a higher risk of disability and reduction in quality of life, and it could begin early in life, actions to address its risk and treatment are more urgent than ever.

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