Sarcopenia and Associated Factors According to the EWGSOP2 Criteria in Older People Living in Nursing Homes: A Cross-Sectional Study

Anna Escribà-Salvans
Research group on Methodology, Methods, Models and Outcomes of Health and Social Sciences (M3O). University of Vic-Central University of Catalonia (UVic-UCC)

Javier Jerez-Roig (javier.jerez@uvic.cat)
Research group on Methodology, Methods, Models and Outcomes of Health and Social Sciences (M3O). University of Vic-Central University of Catalonia (UVic-UCC)

Miriam Molas-Tuneu
Research group on Methodology, Methods, Models and Outcomes of Health and Social Sciences (M3O). University of Vic-Central University of Catalonia (UVic-UCC)

Pau Farrés-Godayol
Research group on Methodology, Methods, Models and Outcomes of Health and Social Sciences (M3O). University of Vic-Central University of Catalonia (UVic-UCC)

Pau Moreno-Martin
Research group on Methodology, Methods, Models and Outcomes of Health and Social Sciences (M3O). University of Vic-Central University of Catalonia (UVic-UCC)

Ester Goutan-Roura
Research group on Tissue Repair and Regeneration Laboratory (TR2Lab). University of Vic-Central University of Catalonia (UVic-UCC)

Helena Güell-Masramon
Faculty of Health Sciences and Welfare. University of Vic-Central University of Catalonia (UVIC-UCC)

Jordi Amblàs-Novellas
Central Catalonia Chronicity Research Group (C3RG). University of Vic-Central University of Catalonia (UVIC-UCC)

Dyego Leandro Bezerra de Souza
Department of Collective Health, Federal University of Rio Grande do Norte

Dawn A Skelton
School of Health and Life Sciences, Glasgow Caledonian University

Miriam Torres-Moreno
Research group on Methodology, Methods, Models and Outcomes of Health and Social Sciences (M3O). University of Vic-Central University of Catalonia (UVic-UCC)

Eduard Minobes-Molina

Research group on Methodology, Methods, Models and Outcomes of Health and Social Sciences (M3O). University of Vic-Central University of Catalonia (UVic-UCC)

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Abstract

Background: In 2018, the European Working Group on Sarcopenia in Older People (EWGSOP2) updated the original definition of sarcopenia, establishing new criteria to be used globally. To our knowledge, this is the first study considering it for the diagnosis of sarcopenia in older people living in Nursing Homes.

Aim: Verify the prevalence and the degree of severity of sarcopenia according to the new EWSGOP2 criteria and to analyse its associated factors in residents living in nursing homes from Central Catalonia (Spain).

Design: A cross-sectional multicenter study was conducted in 4 nursing homes. SARC-F test was applied as the initial screening, muscle strength was measured by a dynamometer, skeletal muscle mass by bioimpedance analysis and physical performance by Gait Speed. Four categories were used: total probable sarcopenia, probable sarcopenia, confirmed sarcopenia and severe sarcopenia.

Results: Among the total sample of 104 nursing home residents (mean age 84.6, ± 7.8), and 84.6% women), 85 (81.7%) (95% confidence interval [CI], 73.0-88.0) had total probable sarcopenia, 63 (60.5%) had probable sarcopenia, 19 (18.3%) confirmed sarcopenia and 7 (6.7%) severe sarcopenia. In the bivariate analysis, obesity was negatively associated and total time in sedentary behavior positively associated with all sarcopenia categories. In addition, malnutrition was positively associated with total and probable sarcopenia. Urinary incontinence was a positive associated factor of total and probable sarcopenia. In the multivariate analysis, obesity represented a negative associate factor: OR=0.13 (0.03 - 0.57), p=0.007 and OR=0.14 (0.03 - 0.60), p=0.008 with total and probable sarcopenia, respectively, adjusted by urinary incontinence. For confirmed sarcopenia, obesity also represented a negative associate factor OR=0.06 (0.01 - 0.99), p=0.049 and the total time in sedentary behavior a positive associate factor OR=1.10 (1.00- 1.20), p=0.040.

Conclusions: According the EWGSOP2 criteria, high prevalence of sarcopenia was found in institutionalized older people, ranging from 6.7% to 81.7% depending on the category. Malnutrition, urinary incontinence and total time in sedentary behavior were associated with sarcopenia whilst obesity represented a protective factor in this population.

Introduction

Sarcopenia is a pathology related to the loss of strength and muscle mass in older people (1). This loss of muscle mass is associated with age, it affects the strength and functioning of older people and causes alterations at the biopsychosocial level (2). In addition it leads to negative consequences such as falls, fractures, social isolation, functional decline, hospitalization and mortality (3). Sarcopenia is thought to be prevalent in older adults, especially in those who live in nursing homes (NH) (4). A recent meta-analysis has shown a high prevalence of sarcopenia in NH residents, ranging from 22–85%; this wide range is attributed to different diagnostic criteria (5).

In 2018, the European Working Group on Sarcopenia in Older People 2 (EWGSOP2) updated the original definition of sarcopenia to reflect the scientific and clinical evidence. European Working Group on Sarcopenia in Older People 2's updated recommendations aim to increase awareness of sarcopenia and its risk's. Preventative actions such as exercise can then be prometed (6). The new definition incorporates the following aspects: low muscle strength as the first key determinant of diagnosis, new cut-off levels for the variables used to identify and characterize sarcopenia and using the SARC-F questionnaire or when clinically suspected to assess sarcopenia-associated symptoms to identify individuals at risk of developing sarcopenia (7, 8). The SARC-F questionnaire is a rapid diagnostic test for sarcopenia, with 5 components: Strength, Walking Assistance, Getting up from a chair, Climbing stairs and Falls. Scores range from 0 to 10, with 0 to 2 points for each component. A final score of 4 or higher is predictive of sarcopenia (9).

A systematic review and meta-analysis concludes that sarcopenia is highly prevalent in older NH residents but that prevalence varies considerably depending on definition, and that more studies are needed to clarify the associated factors (5). Early diagnosis of sarcopenia in NH residents would reduce the incidence of death, malnutrition, social isolation, functional decline, hospitalization and mortality (5).

The new EWGSOP2 criteria have already been applied to older people living in the community (10), but there is still a gap in the identification of sarcopenia in institutionalized older people (5, 11). As far as we are aware, this will be the first study applying EWGSOP2 criteria for the diagnosis of sarcopenia in the NH residents environment. Therefore, the main aim of the present study is to verify the prevalence and the degree of severity of sarcopenia according to the new EWSGOP2 criteria and analyse its associated factors in NH residents.

Methodology

Study design and population

A cross-sectional study was conducted from January to March 2020 when recruitment stopped due to the restrictions in Spain due to the COVID-19 pandemic. It follows the STROBE (STrengthening the Reporting of OBservational studies in Epidemiology) standards for cross-sectional studies (12). The study was carried out in 4 NH of Osona (a region of Central Catalonia, Spain) and it is part of the OsoNaH project (13), registered in Clinical Trials (NCT04297904).

All residents aged 65 years or over, permanently living in NHs were included. Subjects in a coma or palliative care (short-term prognosis) and those who refused to participate in the study were excluded. Those participants with severe cognitive impairment who could not follow the therapists' instructions were excluded from the physical tests (14).

Sample size

The sample size was calculated using a difference of proportions between two groups. A proportion difference of 17 points between the two groups with a confidence level of 95% and a power of 80% can be identified with an estimated sample size of 103 participants.

Consent and ethical approval

Ethical permission was obtained by the Ethics and Research Committee of the University of Vic - Central University of Catalonia (registration number 92/2019). Signed informed consent was gained from the resident or his/her legal guardian. All methods were performed in accordance with the relevant guidelines and regulations.

Study procedures and data collection

Sarcopenia (main variable) was assessed according to EWGSOP2 criteria. The SARC-F questionnaire was used both, to determine risk of developing and to assess the prevalence of sarcopenia. In order to confirm diagnosis and determine severity the following physical tests were assessed:

Hand-grip muscle strength, assessed using JAMAR Plus Digital Hand dynamometer (15, 16). The resident held the dynamometer in the hand, with the arm at a right angle and the elbow at the side of the body. Two maximal strength hand grips were obtained from both hands. The highest value from the dominant hand was used for analysis. The reliability of measuring handgrip strength with the Jamar dynamometer is high (ICC ¼ 0.94; $p < .001$) in a clinically compromised population of geriatric patients (15).

The amount of muscle was measured with a Tanita TBF-300 bioimpedance device (Tanita Institute, Tokyo, Japan). The residents climbed on top of the platform of the bioimpedance device and had to maintain the standing position without support for a few seconds. According to the literature, bioimpedance analysis (BIA) is the validated tool for measuring muscle mass in adults (17, 18). Through the appendicular skeletal muscle mass data, the skeletal muscle mass (SMM) was calculated using the formula of Jansen et al. (18):

SMM (kg) = $[(Ht2/R^{*} \times 0.401) + (\text{gender} \times 3.825) + (\text{age} \times - 0.071)] + 5.102$

*Ht is height in centimetres; R is BIA resistance in ohms. For gender, men = 1 and women = 0. Age is in years.

Finally, physical performance was assessed using the Gait Speed (19) from the Short Physical Performance Battery (SPPB) test. The individual is instructed to walk at a normal pace for 4 meters, including acceleration and deceleration distance, twice, with the use of a walking aid if necessary. The walk is timed and the shortest result is recorded. Gait speed of longer than 5 seconds to walk 4 metres (<0.8 m/s) suggests an increased risk of frailty and the need for further clinical review (20). Prata Martinez *et al*. 2015, demonstrated that the Gait Speed was a valid test with good reproducibility of physical performance in institutionalized older people (ICC=0.99; p=0.001) (20).

Participants with a final score of 4 or higher in SARC-F, were considered as sarcopenia risk. Regarding the physical tests, those individuals with sarcopenia risk and low muscle strength (<27 kg for men and <16 kg for women) were considered as **probable sarcopenia**. Those individuals who had probable sarcopenia and low muscle quantity (<20 kg for men and <15 kg for women) were reported as **confirmed sarcopenia**. In that latter cases, measures of low physical performance (≤0.8 m/s) were used to confirm **severe sarcopenia** (9, 7, 21). The category of **total probable sarcopenia** is composed by those subjects with probable sarcopenia and those with severe cognitive impairment, unable to perform physical tests and considered directly with low muscle strength (1).

Sociodemographic information such as age, sex, level of education, marital status, chronic diseases, smoking and drinking habits and hospitalisations, were obtained from the NH registers and checked with the NH professionals. The anthropometric variables were measured using a Seca 213 measuring device, the Tanita TBF-300. The total number of medications in daily use were registered, as well as the types of medications, according to the *Anatomical Therapeutic Chemical* classification system (22). Nutritional status was assessed using the Mini Nutritional Assessment (MNA) test (23). Continence status was reported using Section H of Minimum Data Set (MDS) version 3.0 (24). Functional capacity was measured using the modified Barthel Index, excluding continence items (25, 26). Cognitive status was assessed using the Pfeiffer Scale (27). Falls (number) over the last year were gained from NH records. Physical capacity was examined using the SPPB (28, 29), and frailty using the Clinical Frailty Scale (30, 31). Sedentary behaviour (SB) was assessed with the placement of the activPAL3TM activity monitor (PAL Technologies Ltd., Glasgow, UK), the device captured data continuously during both awake and sleep time, for 7 consecutive days (32, 33). The following variables were extracted: number of steps in a day, duration in minutes of SB periods, total time in SB (%), SB bouts, total time in standing position and walking in hours and transitions from sitting to standing during 24 hours.

The approximate time to complete the physical tests and questionnaires with each resident was 30 to 45 minutes. The research team that collected the data was trained on the use of all tools and tests. The team collecting data were assessed for reliability of the hand dynamometer, the SPPB (including Gait Speed), BIA and anthropometric measurements, with calculation of the Kappa index and the interclass correlation coefficient (ICC) of the data from 20 residents. The ICC results were higher than 0.75 in all physical tests. The results from these 20 residents were included in the total final sample of the study.

Statistical Analysis

Descriptive analysis was undertaken indicating absolute and relative frequencies for categorical variables. The bivariate analysis was applied through the Chi-square test (or Fisher's, when necessary) and the linear Chi-square test in case of dichotomous and ordinal variables, respectively. The Student T-test (or non-parametric Mann Whitney test) was used for quantitative variables. As an association measure, the Odds Ratio (OR) was calculated, with a confidence level of 95%. Multivariate analysis was performed by logistic regression with robust variance. The significance of the model is presented with the Hosmer Lemeshow test. A level of $p < 0.05$ was statistically significant. Data was analysed by the SPSS version 27 program (SPSS Inc., Chicago IL).

Results

We recruited 104 residents, representing 68% of the total residents in those NHs (Figure 1). Reasons for not being included in the study included both guardian and individual refusal to take part and a few not meeting age or residence criteria (Figure 1).

Mean age of the participants was 84.6 years (SD=7.8) and 88 (84.6%) were women. The mean number of months living in the NH was 27.5 (SD=112.14); 86 (82.7%) lived in state-run NH and, 18 (17.3%) in private NH. The mean number of chronic diseases was 5.0 (SD=2.39). The mean number of medications taken per day was 6.9 (SD=3.80). Seventy-seven (74.1%) had cognitive impairment: 24 (23.1%) had moderate cognitive impairment and 53 (51.0%) had severe cognitive impairment. 6 (3.1%) residents were smokers and 9 (4.7%) alcohol drinkers. Regarding nutritional variables, 57 (54.3%) were at risk of malnutrition or malnourished, 22 (21.0%) had lost weight in the previous year and only 13 (12.4%) were obese (Body Mass Index (BMI) mean= 27.0 DS=5.11). Urinary incontinence (UI) was identified in 36 (34.6%) residents and faecal incontinence in 36 (34.6%). 40 (38.1%) residents fell one or more times in the previous year: 8 (7.6%) had bone fractures.

The residents have an average wake time of 10.7 (SD=1.16) hours. During waking hours, residents spent in SB (sitting or reclining) a mean of 9.0 (SD=1.64) hours. Although the residents spent an 84.2% (SD=16.85) of their total waking time in SB, in these waking hours the residents also spent 1.6 (SD=1.91) hours in upright position (standing or stepping), walking an average of 1345 (SD=2417.40) steps per day and transitioning from sitting to standing an average of 18.2 (SD=18.28) times (Table 1).

Prevalence and severity of sarcopenia in residents living in NHs

Eighty-five (81.7%) of residents had total probable sarcopenia: 22 residents were given this diagnosis (21.1%) had severe cognitive impairment so could not perform physical tests and 63 (60.5%) for having low muscle strength values. Those with probable sarcopenia, 19 (18.3%) were diagnosed with confirmed sarcopenia because of low muscle mass. Finally, 7 (6.7%) individuals were diagnosed with severe sarcopenia, because of the inability to walk or slow walking speed. Nineteen (18.2%) NH residents had no sarcopenia (Figure 2).

Associated factors of sarcopenia in residents living in NHs

In the bivariate analysis, total probable sarcopenia was significantly associated with nutritional status, obesity, UI and % time in SB. In the multivariate analysis, the variables of probable sarcopenia, obesity and UI, the significance of the model with the Hosmer Lemeshow test had a $p = 0.231$. (Table 2)

Probable sarcopenia showed significant associations with nutritional status, obesity, UI and % time in SB. In the multivariate analysis, the Hosmer Lemeshow test had a $p = 0.209$. (Table 3)

Confirmed sarcopenia showed significant associations with obesity and % time in SB. In the multivariate analysis, the Hosmer Lemeshow test had a $p = 1.000$ (Table 4).

Severe sarcopenia only showed a significant association with obesity and % time in SB (Table 5).

For the multivariate analysis (Tables 2, 3, 4 and 5), obesity (as a nutritional variable or variable of the nutritional status) was combined with UI or % time in SB. Obesity was negatively associated with total probable sarcopenia, probable sarcopenia and confirmed sarcopenia, independent of UI. Obesity and % time in SB showed a significant association with confirmed sarcopenia. The multivariate analysis was not possible for the last level (severe sarcopenia), due to the small sample size.

Discussion

The main objective of this study was to identify the prevalence of sarcopenia in older people living in NH. The results showed a high prevalence of sarcopenia, having the 81.7% presence of some category of sarcopenia. Of them, 60.5% had probable sarcopenia, 18.3% had confirmed sarcopenia, and 6.7% had severe sarcopenia according to the new EWGSOP2 criteria. A current systematic review showed that the prevalence of sarcopenia in their included studies varied from 22–85.4% (5), therefore our results are into the high part of this range. Other cross-sectional studies (4) reported the prevalence of sarcopenia in NH according to the previous EWGSOP1 criteria, suggesting that the 32.8% were identified as affected by sarcopenia, a higher value compared to our 18.3% identified as confirmed sarcopenia using the new algorithm.

Another finding of the present study showed that a fifth of residents had severe cognitive impairment, meaning some of the tests to confirm sarcopenia risk, diagnosis or severity could not be performed. The literature also suggests a high prevalence of people with cognitive impairment and/or sarcopenia (from different criteria) in NHs (5, 13). In this research, we observed that an optimal cognitive status is necessary to determine the degree of severity of sarcopenia using the tests proposed by the EWGSOP2.

Regarding the sarcopenia associated factors in NH residents, nutritional variables such as malnutrition and obesity, UI and % time in SB were found as significantly associated. Furthermore, multivariate analysis showed a negative association of obesity with total probable sarcopenia, with probable sarcopenia and with confirmed sarcopenia; and a positive association of % time in SB with confirmed sarcopenia.

Our results with regard to obesity indicate that, obesity acts as a protective factor for sarcopenia, having obese subjects a lower risk of developing sarcopenia. The literature documents results confirming those of our own study: Landi (34) also concluded that sarcopenia was inversely associated with BMI. During aging, involuntary weight loss (anorexia of aging) is an indicator of frailty and may accelerate the process of muscle wasting. Those who do not experience age-related weight loss may be better able to maintain muscle mass and thus muscle strength (35). In line with above, we must also take into account the concept of malnutrition as a conditioning factor in the older adult. The results concerning malnutrition indicate that there is an association with sarcopenia. Pereira et al. confirmed our findings, identifying that two out of three institutionalized older adults had malnutrition and sarcopenia (36). Malnutrition leads to lower muscle strength and less physical activity (37), which is reflected in this study by the low scores in the hand-grip muscle strength and in the Gait Speed, and reinforced by the high % time in SB (37), which also was identified as an associated factor with sarcopenia.

Various studies claim that higher levels of SB were found to be associated with higher levels of sarcopenia (38, 39). Physical inactivity contributes to development of sarcopenia, whether due to disease-related immobility or disability, or to a sedentary lifestyle, which has been shown to be a risk factor for muscle weakness that in turn, results in reduced activity levels, loss of muscle mass, and muscle strength (40). Regarding the UI results, it was found as an associated factor of sarcopenia. A recent study (41) concluded that the prevalence of sarcopenia in women with pelvic floor dysfunction was high, revealing that UI is strongly associated with musculoskeletal conditions and impaired mobility function in older adults.

In relation to the clinical significance of the research, interventions that include adequate nutritional support and physical exercise patterns can improve the adverse outcomes of sarcopenia in older people living in NHs. Therefore, diagnosis is very important in residential settings (42).

The main limitation of the study lies in the relatively small sample included in the study due to the onset of the COVID-19 pandemic that prevented further data collection. Another important barrier was the high prevalence of people with cognitive impairment in NHs, meaning difficulties to perform the EWGSOP2 tests. For this reason, further studies are needed to verify the usefulness of the new diagnostic criteria in institutionalized older adults.

In summary, this is the first study to verify the prevalence of sarcopenia in institutionalized older adults according to the new EWGSOP2 criteria, identifying a high prevalence. It is now important that we strive to deliver evidence-based interventions in these settings to mitigate sarcopenia and its associated health outcomes.

Conclusions

According the EWGSOP2 criteria, high prevalence of sarcopenia was found in institutionalized older people, ranging from 6.7–81.7% depending on the category. Malnutrition, urinary incontinence and sedentary behavior were associated with sarcopenia whilst obesity represented a protective factor in this population. In terms of implications for clinical practice, evidence-based interventions including physical activity and nutritional diet will be essential to decrease sarcopenia prevalence.

Abbreviations

EWGSOP2: European Working Group on Sarcopenia in Older People; NH: Nursing Home; STROBE: Strengthening the Reporting of Observational Studies in Epidemiology; BIA: Bioimpedance Analysis; SMM: Skeletal Muscle Mass; Ht: Height in centimeters; R: Resistance in Ohms; SPPB: Short Physical Performance Battery; MNA: Mini Nutritional Assessment; MDS: Minimum Data Set; SB: Sedentary

Behavior; ICC: Interclass Correlation Coefficient; OR: Odds Ratio; UI: Urinary Incontinence; BMI: Body Mass Index; SD: Standard Deviation.

Declarations

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Authors' contributions

A.E.S wrote the main text of the manuscript and prepared all tables and figures in the manuscript with the support of J.J.R. and E.M.M.

All authors reviewed and approved the final version of the manuscript.

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Availability of data and material

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

Ethical permission was obtained by the Ethics and Research Committee of the University of Vic - Central University of Catalonia (registration number 92/2019). Signed informed consent was gained from the resident or his/her legal guardian. All methods were performed in accordance with the relevant guidelines and regulations.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

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Tables

Due to technical limitations, tables are only available as a download in the Supplemental Files section.

Figures

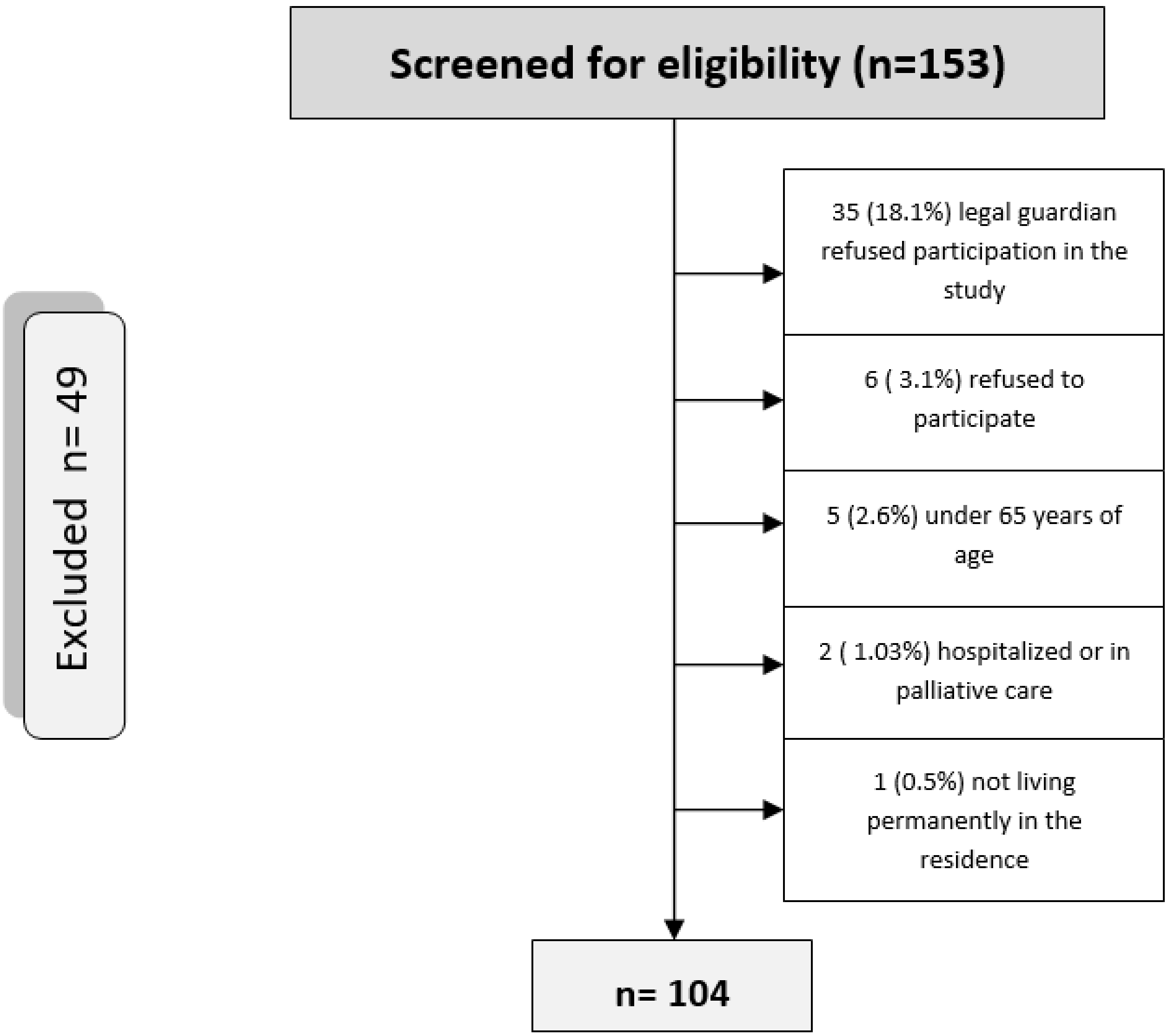

Figure 1

Flow chart of the sampling process.

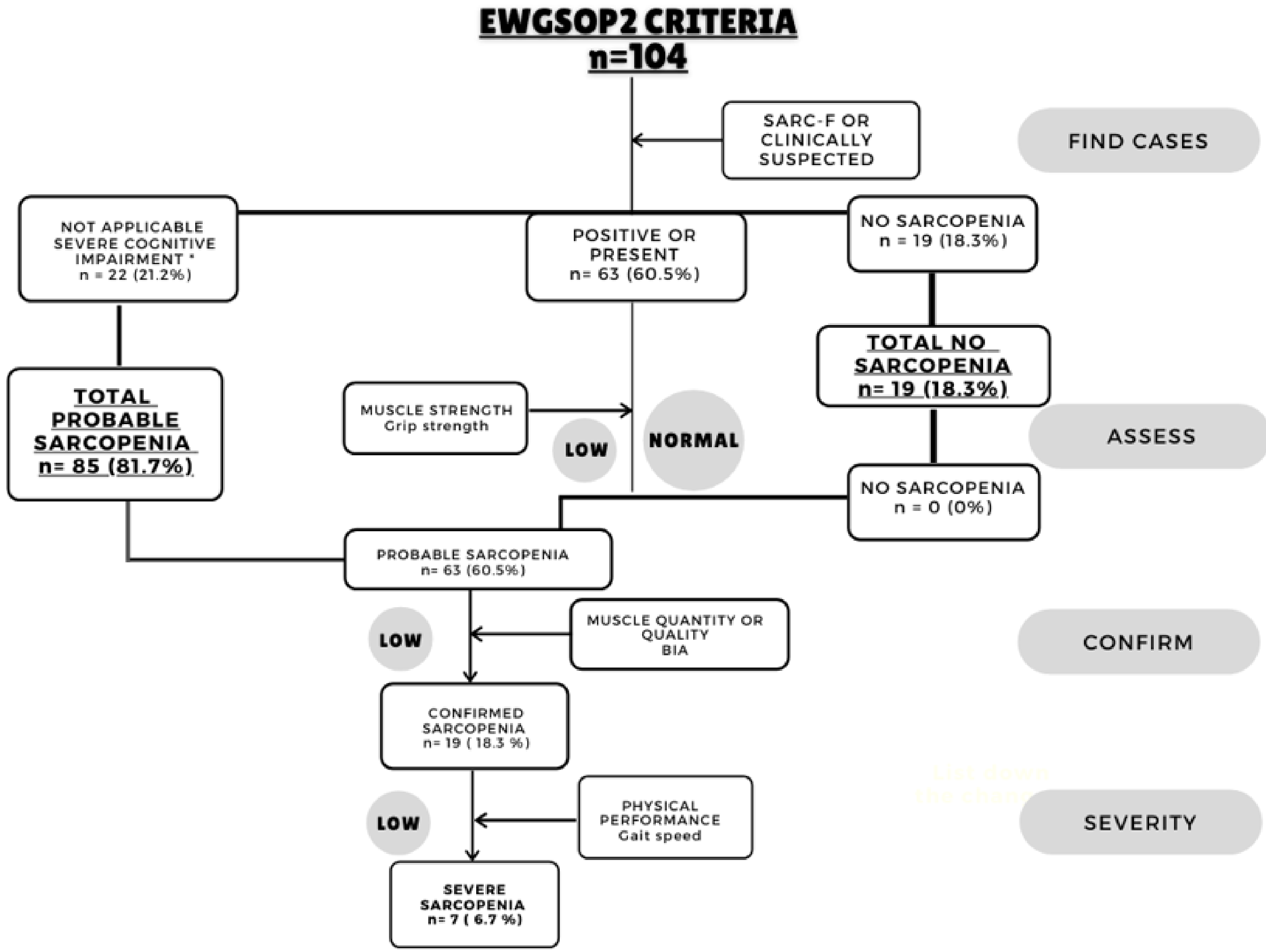

Figure 2

Classification of sarcopenia among institutionalized older people, according to the EWGSOP2 algorithm for case-finding, making diagnosis and quantifying severity. * Consider other reasons for low muscle strength7.

Supplementary Files

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- Table1rev.docx
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