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PREVALENCE AND RISK FACTORS OF SARCOPENIA IN NURSING HOME ELDERLY EVALUATED BY BIA: A COHORT STUDY

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Abstract: *Background:* The decline in skeletal muscle is a major problem in elderly and can contribute to the development of functional limitations. The objective of this study was to provide data on sarcopenia prevalence in nursing homes and to assess influencing and associated factors to identify patients at risk for sarcopenia. *Methods:* This study was part of a longitudinal study in 52 nursing homes in Antwerp (Belgium). Between October 2007 to April 2008 a cohort study was conducted. 405 healthy people aged 65 years and older of both genders were included. Body composition was estimated using bio electrical impedance analysis (BIA). Gait speed was assessed using the timed get up and go test. Information on functional status was measured using the Katz score and nutritional assessment was made based on the MNA-SF (Mini Nutritional Assessment – Short Form). A blood sample for 25 (OH) vitamin D3 was collected at baseline. *Results:* The prevalence of sarcopenia in our nursing home population was 14.8%, with a significant gender difference i.e. 19.9% in women and 2.7% in men. Logistic regression analysis shows that older age (p=0.032), female gender (p=0.001) and poor nutritional status (p=0.000) are significantly associated with sarcopenia in nursing homes. *Conclusions:* This study shows that sarcopenia is an important problem in nursing home residents. Attention for this problem is needed especially in elderly women with a poor nutritional status.

Key words: Sarcopenia, elderly, impedance.

Background

Elderly frequently suffer from sarcopenia or the loss in muscle mass (1), which leads to physical dysfunction and therefore seriously increases their risk to fall (2). In turn falls and the associated fractures are an important factor of morbidity among elderly and result in a significant healthcare cost (3). Furthermore sarcopenia has a negative influence on the Quality of Life of elderly and can result in a higher mortality risk (1, 4). Therefore an accurate diagnosis and follow-up of sarcopenia is needed.

A commonly used, inexpensive and accessible method to assess skeletal muscle mass is bioelectrical impedance analysis (BIA) (5). While there is no consensus definition of sarcopenia the definition of Janssen et al. that expresses muscle mass based on the BIA parameters has often been used (6). The muscle mass is expressed as skeletal muscle mass index (SMI). Sarcopenia is then defined as a SMI lower than 2 standard deviations of the SMI of young adults (6). In 2010 a European and consensual definition of sarcopenia, based on muscle mass, strength and function was formulated (7).

Several studies to the prevalence of sarcopenia in elderly have been conducted. The prevalences vary from 8 to 40% as outlined in a review article of Abellan van Kan (8). Due to the different used definitions of sarcopenia and the used measurement method in these studies it is difficult to compare these prevalences.

To the best of our knowledge there is no prevalence study of sarcopenia specifically in nursing home residents. Several risk factors can contribute to the development of sarcopenia including the ageing process itself by changing the muscle turnover, malnutrition, prolonged bed rest and chronic illness (9). All those risk factors, being very common in elderly living in nursing homes, make them very susceptible for sarcopenia.

This cohort study assessed the prevalence of sarcopenia in nursing home elderly and the influencing factors of sarcopenia in nursing home elderly.

Methods

Subjects

405 elderly were recruited from 52 nursing homes in Antwerp, Belgium from September 2007 to April 2008. This cohort study was part of a clinical trial on nutritional

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and immunological issues in nursing home elderly (trial number NCT 00849277). We recruited male and female participants of 65 years or older in residential homes without major conditions. Exclusion criteria for the clinical trial will be described elsewhere. Pacemaker or limb prothesis were contra-indications for BIA, therefore these patients were excluded as well.

In order to determine cut off values for sarcopenia 99 young volunteers (aged 20-30 years) were recruited from the University of Antwerp's students to undergo BIA. None of the subjects had diseases or were taking any medications affecting the results of the BIA.

Ethical approval for this study has been granted by the University of Antwerp's Medical Reasearch ethics committee.

Procedures

Every three weeks the study investigators visited the participants. During those visits, information was gathered concerning the functional status (Katz score) of the participants. The Katz scale is a scale to assess the functional status as a measurement of the ability to perform activities of daily living independently. Six items (bathing, dressing, using the toilet, transfer, continence, and feeding) are scored from 1 'totally independent' to 4 'totally dependent'. Nutritional assessment was made based on the screening tool MNA-SF (Mini Nutritional Assessment – Short Form). The MNA-SF is a validated screening tool used in geriatric health care for nutritional evaluation. It consists of 6 items with a maximum screening score of 14 and resulting in three categories : malnourished (score 0-7), at risk of malnutrition (8-11), normal nutritional status (12-14) (Table 1) (10).

Table 1
MNA-SF screening score (maximum 14 pionts)

Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?	
0 = severe decrease in food intake	
1 = moderate decrease in food intake	
2=no decrease in food intake	
Weight loss during the last 3 months	
0 = weight loss greater than 3kg (6.6lbs)	
1 = does not know	
2 = weight loss between 1 and 3kg (2.2 and 6.6 lbs)	
3 = no weight loss	
Mobility	
0 = bed or chair bound	
1 = able to get out of bed / chair but does not go out	
2= goes out	
Has suffered psychological stress or acute disease in the past 3 months?	
0 = yes	
2 = no	
Neuropsychological problems	
0 = severe dementia or depression	
1 = mild dementia	
2 = no psychological problems	
Body Mass Index (BMI) (weight in kg) / (height in m^2)	
0 = BMI less than 19	
1 = BMI 19 to less than 21	
2 = BMI 21 to less than 23	
3 = BMI 23 or greater	
Score	
12-14	Normal nutritional status
8-11	At risk for malnutrition
0-7	Malnourished

Body composition was estimated at baseline using bio-electrical impedance analysis (BIA). For those analyses we made use of the Body Explorer (Juwell Medical®) with an operating frequency of 50kHz at 800 μA. The subjects were supine on a nonconducting surface. Their arms were abducted away from their trunk and the legs slightly seperated for a few minutes. Four electrodes were attached to the right hand and ankle.

Skeletal muscle mass was calculated using the BIA equation of Janssen (2000) [6]:

SM (kg) = [0.401 x (height^2/resistance) + (3.825 x gender) – (0.071 x age) + 5.102], height is in cm, age in years, resistance in ohms, men=1 and women = 0. We converted absolute SM to an SM index (SMI) by dividing height by meters squared (kg/m^2).

Sarcopenia was defined as the SMI of 2 standard deviations (SDs) or more below the normal sex-specific means for young persons.

Based on the new consensual definition sarcopenia requires a low muscle mass combined with a low muscle strength or low physical performance. In this study we make use of the combination of low muscle mass index, based on the definition of Janssen et al. (6) and a low physical performance based on the get up and go test (cut off value 20 seconds) (11).

A blood sample was collected at baseline and analysed for 25 (OH) vitamin D3 for each participant.

Statistical analysis

Statistical analyses were performed using SPSS version 16.0 (SPSS inc, Chicago, IL, USA). Continuous baseline data were expressed as mean with the corresponding minimum and maximum. Normality was studied by assessing the normal probability plots and Kolmogorov Smirnov test. For categorical baseline data, frequencies and percentages were calculated. Comparisons between groups were performed using Mann Whitney U test and Chi2 tests for categorical variables. To confirm associations found in the univariate analyses , a logistic regression analysis was performed with dependent variable sarcopenia/no sarcopenia, and ORs with 95% CIs were calculated. The independent variables were checked for possible interaction and multicollinearity. For all the analyses a p-value of <0.05 was considered statistically significant.

Results

Participants

405 participants were enrolled in the study.

The characteristics of the participants are shown in Table 2. Participants were more often female and had a mean age of 83.5.

Table 2
Baseline characteristics

Characteristic	
Age	83.53 (55-100)
≤ 75	53 (13.1%)
76-80	74 (18.3%)
81-85	108 (26.7%)
86-90	109 (26.9%)
91-95	48 (11.9%)
>95	13 (3.2%)
Men	118 (29.1%)
Katz score	10.32 (0-21)
25 (OH) vitamin D3	15.34 (2.5-59.6)
Current smoker	38 (9.5%)
MNA-SF	12.72 (4-14)
Use of ACE-I or sartane	116 (32.0%)
Chronic illness	137 (34.2%)

Prevalence of sarcopenia

The mean SMI of the young men and women is respectively 9.29 kg/m^2 and 6.84 kg/m^2. Based on the definition of sarcopenia (mean SMI minus 2SD) the cut off value for sarcopenia in men is 8.058 kg/m^2 and 6.154 kg/m^2 in women.

Based on those cut off values the prevalence of sarcopenia in our nursing home population is 23.5 %; i.e. 30% in women and 7.6% in men.

Based on the consensus definition the prevalence of sarcopenia is 14.8%; i.e. 19.9% in women and 2.7% in men.

Characteristics of patients with sarcopenia (based on the consensus definition)

Univariate analyses (Student's t-test and Chi2) were used to examine the relationship between age, gender, Katz score, smoking, chronicalal illnes, the use of ACE inhibitor or sartane, nutritional status, 25 (OH) vitamin D3 status and sarcopenia. 25 (OH) vitamin D3 was considered deficient under 12 ng/ml. As illustrated in table 3 a significant difference regarding age and gender was found. Sarcopenia patients were older and women seem to be more vulnerable for sarcopenia than men. Furthermore the MNA-SF score (risk on malnutrition) was significantly associated with sarcopenia. Patients with a higher Katz score (higher physical dependency) seem to be more at risk for sarcopenia, whereas patients using an ACE-inhibitor or sartane seem to be more protected against sarcopenia.

Table 3
Factors univariately associated with sarcopenia in our population

	No Sarcopenia	Sarcopenia	p
Age	82.87 (55-100)	86.84 (61-99)	0.000*
Gender (% within gender)			
Women	213 (80.1%)	53 (19.9%)	
Men	110 (97.3%)	3 (2.7%)	0.000
Katz score	9.76 (0-21)	11.43 (6-19)	0.003*
Hypovitaminosis D (cut off value 12ng/ml) (% within hypovitaminosis D)			
No	114 (87.7%)	16 (12.3%)	
Yes	162 (84.8%)	29 (15.2%)	0.466
Current smoker (% within current smoker)			
No	284 (83.8%)	55 (16.2%)	
Yes	35 (97.2%)	1 (2.8%)	0.031
Chronic illness (% within chronic illness)			
No	210 (84.3%)	39 (15.7%)	
Yes	110 (88.0%)	15 (12.0%)	0.342
ACE-I or sartane(% within ACE-I or sartane)			
No	189 (81.1%)	44 (18.9%)	
Yes	95 (90.5%)	10 (9.5%)	0.030
MNA-SF	12.96 (8-14)	11.73 (4-14)	0.000*

Continuous data were expressed as mean with the corresponding minimum and maximum, for categorical baseline data percentages were calculated. *p-values for the continuous data were based on the Mann Whitney U test

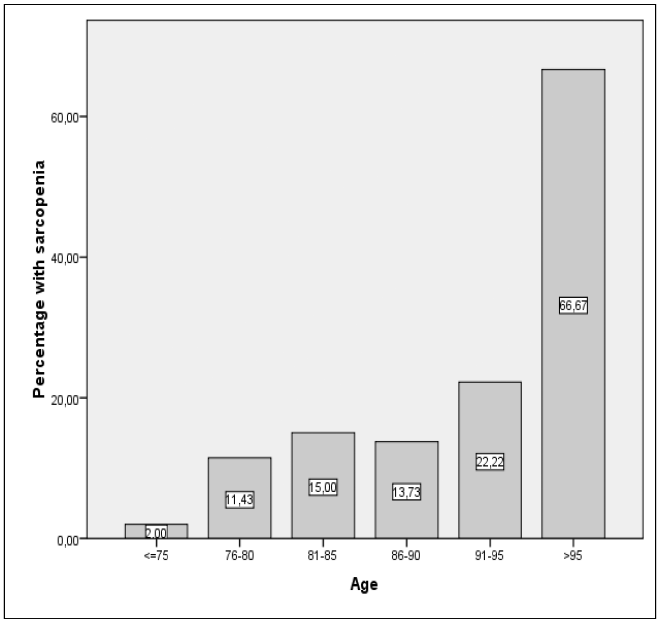

Figure 1. shows the evolution of sarcopenia throughout different age categories

Factors associated with sarcopenia (based on the consensus definition)

A logistic regression analysis with sarcopenia/no sarcopenia as outcome parameter was performed to confirm associations found in the univariate analysis. The factors age, gender, smoking status, Katz score, nutritional status (based on MNA-SF) and the use of ACE-I or sartane were analysed as independent variables, with sarcopenia/no sarcopenia as the dependent variable. Table 4 shows the analysis results. Only significant related factors were shown. Women had more often sarcopenia than men and age has a positive association with the chance on sarcopenia. Elderly with a better nutritional status had a significantly reduced chance of sarcopenia.

Table 4

Factors related to sarcopenia, assessed by multivariate logistic regression analysis (n=312, Nagelkerke R2=0.287)

Variables in the model	B	OR	95% CI	p-value
Age	0.062	1.064	1.005-1.126	0.032
Gender (male)	2.579	13.190	2.877-60.473	0.001
MNA-SF	-0.601	0.548	0.425-0.707	0.000
Constant	-1.739	0.176		0.558

Discussion

This is the first cohort study to study the prevalence of sarcopenia among nursing home residents. The participants in our study had a mean age of 83.5 and were mostly women, which is representative for the nursing home population in Belgium. Our study showed a prevalence rate of sarcopenia of 14.8% whith a large gender difference i.e. 19.9% in women and 2.7 % in men. Furthermore our study shows that age, gender and nutritional status are factors associated with sarcopenia.

Only healthy elderly people were recruited into the study. The results of this study cannot be generalized to nursing home population as a whole, which may include residents with comorbidities and therefore underestimate the real prevalence of sarcopenia in nursing homes.

Furthermore the used equation of Janssen is based on data from the NHANES III study, which did not include nursing home residents (6). This fact can influence the prevalence rates as well.

Most previous studies on the prevalence of sarcopenia are conducted in community-dwelling elderly. These studies have given different prevalence rates, depending on the study sample, the definition and the assessment tool used, ranging from 8 to 40% (8).

The NHANES III study which makes use of the BIA shows a higher prevalence of 7% in men and a lower prevalence (10%) in women (12). A European cohort study EPIDOS, using DEXA shows an increasing prevalence rate with age from 8.9% in the 76-80 age group to 10.9% in the 86-95 age group, whereas the prevalence rates in our study increase from 11.43% in the 76-80 group to 16.3% in the 86-95 age group (13). The InCHIANTI study shows an increasing prevalence of sarcopenia with age, but an opposite gender difference (based on handgrip and calf cross-sectional areas) (13, 14).

The prevalence rates in our study are very comparable with the found results in literature in community dwelling elderly. One should expect a higher prevalence rate of sarcopenia in nursing home elderly due to the higher age, higher malnutrition rate (15, 16) and higher functional dependency compared with community dwelling elderly (17, 18). This can be due to the relatively healthy elderly population in our study (as stated above).

Several studies have investigated the potential of nutritional, pharmaceutical and physical interventions to prevent or reduce the risk of sarcopenia. Until now there is no evidence that any pharmaceutical or nutritional supplement should be effective against sarcopenia (19, 20). However, resistence training can increase muscle mass and muscle strength in elderly (19, 20).

Vitamin D has been associated with muscle weakness and recurrent falling in elderly people (21-23). There is no consensus on what concentration of 25(OH) vit D defines vitamin D deficiency. Different studies use the normal lower limit as 25(OH) vit D levels below 12 ng/ml (30 nmol/liter) (24). Studies have shown that vitamin D supplements have an effect on muscle strenght and muscle function, and thereby a reduction in fall risk (25-27). Vitamin D has a direct effect on the muscle tissue due to specific receptors (28, 29). The results of our study cannot confirm this. This can be due to the high prevalence rate of hypovitaminosis D in our study population.

The results of our study suggest that the use of an ACE-I or sartane can have a protective role in the development of sarcopenia as well as the nutritional status. Further research on the role of nutritional support and ACE-I in the protection of sarcopenia is necessary. Further research to the effect of sarcopenia on falls and associated fractures can be valuable

Conclusions

This study shows that sarcopenia, with a prevalence of 14.8-23.5%, is an important health issue in nursing home elderly. A growing attention for this problem is needed in this vulnerable and frail population.

Competing interests: The authors have no conflicts of interest to report.

Authors' contributions: The authors' responsibilities were as follows – KVP, VV, PVR: design of the experiment; KVP, LR, TVD, VV: data collection; KVP, LR, TVD, VV: analysis of data; KVP: draft of manuscript; All authors have seen and approved the final version of the manuscript.

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References

1. Cruz-Jentoft, A.J., et al., Understanding sarcopenia as a geriatric syndrome. Curr Opin Clin Nutr Metab Care 2010,13:1-7.
2. Otaka, Y., [Muscle and bone health as a risk factor of fall among the elderly. Sarcopenia and falls in older people]. Clin Calcium 2008,18: 761-6.
3. Haentjens, P., G. Lamraski, and S. Boonen, Costs and consequences of hip fracture occurrence in old age: an economic perspective. Disabil Rehabil 2005,27:1129-41.
4. Cesari, M., et al., Skeletal muscle and mortality results from the InCHIANTI Study. J Gerontol A Biol Sci Med Sci 2009,64:377-84.
5. Pahor, M., T. Manini, and M. Cesari, Sarcopenia: clinical evaluation, biological markers and other evaluation tools. J Nutr Health Aging 2009, 13:724-8.
6. Janssen, I., et al., Estimation of skeletal muscle mass by bioelectrical impedance analysis. J Appl Physiol 2000,89:465-71.
7. Cruz-Jentoft, A.J., et al., Sarcopenia: European consensus on definition and diagnosis: Report of the European Working Group on Sarcopenia in Older People. Age Ageing 2010,39:412-23.
8. Abellan van Kan, G., Epidemiology and consequences of sarcopenia. J Nutr Health Aging 2009,13:708-12.
9. Bauer, J.M., M.J. Kaiser, and C.C. Sieber, Sarcopenia in nursing home residents. J Am Med Dir Assoc 2008,9:545-51.
10. Kaiser, M.J., et al., Validation of the Mini Nutritional Assessment short-form (MNA-SF): a practical tool for identification of nutritional status. J Nutr Health Aging 2009,13(9):782-8.
11. Podsiadlo, D. and S. Richardson, The timed "Up & Go": a test of basic functional mobility for frail elderly persons. J Am Geriatr Soc 1991,39: 142-8.
12. Janssen, I., S.B. Heymsfield, and R. Ross, Low relative skeletal muscle mass (sarcopenia) in older persons is associated with functional impairment and physical disability. J Am Geriatr Soc 2002,50:889-96.
13. Rolland, Y., et al., Sarcopenia, calf circumference, and physical function of elderly women: a cross-sectional study. J Am Geriatr Soc 2003,51:1120-4.
14. Lauretani, F., et al., Age-associated changes in skeletal muscles and their effect on mobility: an operational diagnosis of sarcopenia. J Appl Physiol 2003,95:1851-60.
15. Griep, M.I., et al., Risk of malnutrition in retirement homes elderly persons measured by the "mini-nutritional assessment". J Gerontol A Biol Sci Med Sci 2000,55:M57-63.
16. Morley, J.E. and A.J. Silver, Nutritional issues in nursing home care. Ann Intern Med 1995,123:850-9.
17. Beland, F. and M.V. Zunzunegui, Predictors of functional status in older people living at home. Age Ageing 1999,28:153-9.
18. Molaschi, M., et al., Health and functional status in elderly patients living in nursing homes. Arch Gerontol Geriatr 1995,21:267-76.
19. Jones, T.E., et al., Sarcopenia--mechanisms and treatments. J Geriatr Phys Ther 2009,32:39-45.
20. Bautmans, I., K. Van Puyvelde, and T. Mets, Sarcopenia and functional decline: pathophysiology, prevention and therapy. Acta Clin Belg 2009, 64:303-16.
21. Ceglia, L., Vitamin D and its role in skeletal muscle. Curr Opin Clin Nutr Metab Care 2009,12:628-33.
22. Bischoff-Ferrari, H.A. and H.B. Staehelin, Importance of vitamin D and calcium at older age. Int J Vitam Nutr Res 2008,78:286-92.
23. Wolff, A.E., A.N. Jones, and K.E. Hansen, Vitamin D and musculoskeletal health. Nat Clin Pract Rheumatol 2008,4:580-8.
24. Gaugris, S., et al., Vitamin D inadequacy among post-menopausal women: a systematic review. QJM 2005,98:667-76.
25. Bischoff, H.A., et al., Effects of vitamin D and calcium supplementation on falls: a randomized controlled trial. J Bone Miner Res 2003,18:343-51.
26. Pfeifer, M., et al., Effects of a short-term vitamin D and calcium supplementation on body sway and secondary hyperparathyroidism in elderly women. J Bone Miner Res 2000,15:1113-8.
27. Pfeifer, M., et al., Effects of a long-term vitamin D and calcium supplementation on falls and parameters of muscle function in community-dwelling older individuals. Osteoporos Int 2009,20:315-22.
28. Bischoff-Ferrari, H.A., et al., Vitamin D receptor expression in human muscle tissue decreases with age. J Bone Miner Res 2004,19:265-9.
29. Glerup, H., et al., Hypovitaminosis D myopathy without biochemical signs of osteomalacic bone involvement. Calcif Tissue Int 2000,66:419-24.