RESEARCH ARTICLE

Prevalence of sarcopenia in an elderly population in rural South India: a cross-sectional study [version 1; peer review: 2 not approved]

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Abstract

Background: Sarcopenia is a condition common in the elderly characterized by progressive and generalized loss of skeletal muscle mass and strength leading to poor quality of life. According to a working definition proposed by the European Working Group on Sarcopenia in Older People (EWGSOP), the criteria for a diagnosis of sarcopenia is based on documentation of low muscle mass with either poor muscle strength or low physical performance. The objective of the present study was to determine the prevalence of sarcopenia in the rural elderly population of South India.

Methods: We conducted a cross-sectional survey of 240 elderly people, 60 years and above, 118 men and 122 women, in rural areas of Dakshina Kannada district. We measured their height, weight, gait speed (using an 8-foot walk test) and muscle strength (using a handgrip dynamometer). Appendicular skeletal mass was calculated using height and weight adjusted for sex and Asian people using the Lee formula.

Results: Sarcopenia was found in 34 (14.2%) participants. Of all those having sarcopenia, 27 (79.4%) were ≤ 75 years, 30 (88.2%) were women, 27 (79.4%) were married, 23 (67.6%) had below poverty line status.

Conclusions: The prevalence of sarcopenia found in the present study was 14.2% in an elderly population more than 60 years of age and was found to be more in women. Large-scale multi-centric community-based surveys will help determine the actual burden of sarcopenia in India.

Keywords

sarcopenia, muscle strength, muscle function, gait speed, grip strength, elderly

Open Peer Review

Approval Status **XX**

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Any reports and responses or comments on the article can be found at the end of the article.

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Introduction

There has been an increase in longevity globally. According to the United Nations, the proportion of people above the age of 60 years is 13% at a global level and 8.6% in India^{1,2}. Sarcopenia is a condition that is common in elderly people and is characterized by progressive and generalized loss of skeletal muscle mass and strength³. It can lead to mobility problems, an increased risk of falls and fractures, impaired ability to perform activities of daily living, disability and loss of independence in the elderly. According to a working definition proposed by the European Working Group on Sarcopenia in Older People (EWGSOP), the criteria for diagnosis of sarcopenia is based on documentation of low muscle mass with either poor muscle strength or low physical performance⁴. Sarcopenia has been proposed to be primarily due to aging or secondary to reduced activity, such as bed rest, chronic diseases, malignancy, poor nutrition or endocrinal diseases^{5,6}. The objective of the present study was to determine the prevalence of sarcopenia in the rural elderly population of South India.

Methods

Study setting

The present study was conducted in the coastal district of Dakshina Kannada in Karnataka. Karnataka is the 9th biggest state and according to the Census 2010, the geriatric population (>60 years) was 7.9%, 7th in India in terms of percentage of older persons.

Study population

Elderly persons >60 years of age².

Study design and sample size

A cross sectional study was conducted between July 15 and September 15, 2018.

Prevalence of sarcopenia in India, according to a multi-continent study, was found to be 17.5%⁷. With a margin of error as 5% and 95% confidence level, the required sample size was 222. Considering a non-enrolment rate of 10%, a total of 240 participants were enrolled.

Sampling

Participants were approached using a door-to-door method. All family members above 60 years were approached for enrolment. The enrolment was started from the nearest village in the field practice area and it continued until the sample size was reached in the next contiguous village.

Inclusion and exclusion criteria

All individuals above 60 years of age were included. Participants who were unable to walk, very frail, had cardio-pulmonary problems, which can lead to restriction of examination of muscle function, were advised for a consultation in the nearby tertiary care hospital and excluded from the study.

Data collection

A survey was conducted for those enrolled in the study. Variables collected were age, sex, and socio-economic class

based on availability of Below Poverty Line (BPL) card. Anthropometric assessment included height and weight measurements using a portable stadiometer (SECA 213) and digital weighing machine (SECA 803). Weight was measured to the nearest of 100 gm with minimum clothing, after removing belt, shoes and any heavy extra clothing. Height was measured with accuracy to the nearest 0.1cm with participant standing without footwear with weight borne evenly on both feet and head in Frankfurt plane.

Muscle function using gait speed. This was done using an 8-feet (2.4 meters) walking course with no obstructions for an additional two feet at either end. This was measured using a carpenter measuring tape. The participants were made to walk at their usual speed and time taken to cover the marked 8-feet distance was clocked using a stop-watch. A cut-off of <0.8m/s was considered as 'slow' performance^{5,9}.

Appendicular muscle mass (ASM). This was calculated using the Lee formula:

$$ASM = (0.244 * \text{body weight}) + (7.8 * \text{height}) + (6.6 * \text{gender}) - (0.098 * \text{age}) + (\text{race} - 3.3).$$
 For Asian people this was calculated as -1.2⁸.

Skeletal muscle index (SMI) was determined by dividing ASM with height in m². With no reference values available from any large scale studies in India, the ASM cut-offs considered were <7.0kg/m² in men and 5.7 in women based on previous study in Brazil⁹.

Muscle strength. Hand grip strength represented the muscle strength of the participant. We used Jamar® Plus+ Digital Hand Dynamometer (Patterson Medical, Cedarburg, WI, United Kingdom). A cut-off of <30 kg for men and <20 kg for women was considered 'low' muscle strength⁹.

Data analysis

Participants with sarcopenia were classified as those with poor ASM (using Lee's equation) among all participants with either low muscle strength or slow gait speed (Figure 1). Data were analysed using Statistical Package for the Social Sciences (SPSS) for Windows, Version 23 Chicago, SPSS Inc. Data are presented as numbers (percentage).

Ethical approval

Approval was obtained from Yenepoya University Ethics Committee - 1 before the commencement of the study (YEC-1; Protocol No: 2018/110). Written informed consent was obtained from all the study participants for voluntary participation and privacy and confidentiality of the participants were ensured.

Results

Figure 1 explains the methodology of deriving the number of participants with sarcopenia. All the participants were subjected to 8 feet walk test and a gait speed of <0.8m/sec was considered as slow. All those with normal gait speed (>0.8m/sec; 109, 45.4%) underwent hand grip dynamometry. Men with grip strength

Figure 1. Study process for assessment of sarcopenia in the participants (>60 years). SMI, skeletal muscle index. *Lee Equation: $ASM = (0.244 * \text{body weight}) + (7.8 * \text{height}) + (6.6 * \text{gender}) - (0.098 * \text{age}) + (\text{race} - 3.3)$ where for Asian race it is -1.2. Skeletal Muscle index(SMI) = $ASM/(\text{height in meter})$.

<30 kg and women with grip strength <20 kg were considered as having low grip strength. Those with normal grip strength (>30kg men, >20kg women) were considered non-sarcopenic (25, 10.4%). Those with poor grip strength were assessed for ASM using Lee's formula, which was then converted to SMI. A value of <7.0kg/m² in men and <5.7kg/m² in women was considered as low SMI. The number of participants with normal gait speed, low muscle strength and low SMI were considered as having sarcopenia (12, 5%). Participants with normal gait speed, low grip strength and normal SMI were considered as non-sarcopenic (72, 30%).

Participants who had slow gait speed (131, 54.6%) also had their SMI determined (hand grip strength assessment was not used for determination of sarcopenia in the slow gait speed group). Those with slow gait speed and normal SMI were considered non-sarcopenic (109, 45.4%). Those with slow gait speed and

low SMI were considered sarcopenic (22, 9.2%). Thus, overall 34 (14.2%) participants were found to have sarcopenia.

Table 1 describes the socio-demographic characteristics of the 240 participants enrolled in the study. Of all those having sarcopenia, 27 (79.4%) were ≤75 years, 30 (88.2%) were women, 23 (67.6%) had BPL status, and 27 (79.4%) were married.

Discussion

This study enrolled 240 rural elderly participants (>60 years) and found the prevalence of sarcopenia using gait speed, hand grip strength and skeletal muscle index as 14.2%. The prevalence of sarcopenia was 3.4% in men and 24.5% in women. According to a large multi-centric study conducted in nine countries, the overall prevalence of sarcopenia was 15.2% and in India this was 17.5%⁷. The higher prevalence in this study was probably because the age group included in the

Table 1. Demographic characteristics of study participants with and without sarcopenia.

Characteristic (n total)		Sarcopenia n= 34 (%)	No sarcopenia n=206 (%)
Age group	≤75 years (212)	27 (79.4)	185 (89.8)
	>75 years (28)	7 (20.6)	21 (10.2)
Sex	Men (118)	4 (11.8)	114 (55.3)
	Women(122)	30 (88.2)	92 (44.7)
Socioeconomic status	Above poverty line (109)	11 (32.4)	98 (47.6)
	Below poverty line (131)	23 (67.6)	108 (52.4)
Marital status	Married (183)	27 (79.4)	156 (75.7)
	Unmarried (5)	0	5 (2.4)
	Widowed (52)	7 (20.6)	45 (21.9)

multi-centric study was ≥65 years. There are no other studies to estimate the prevalence of sarcopenia in India, to the best of our knowledge, for further comparison. In a study in Brazil, using a similar algorithm to EWGSOP, the prevalence of sarcopenia was found to be 16.1% in men and 14.4% in women⁹. In another study to estimate the functional measures of sarcopenia in six low and middle-income countries, India had the highest concomitant presence of poor grip strength and reduced gait speed, 33% as compared to 12.3% in South Africa¹⁰.

Strength and limitation

With no large scale surveys done so far in India, this study provides some insight into scale of problem of sarcopenia in community dwelling elderly persons. But the study has some important limitations. Firstly, the equation used to derive the appendicular skeletal mass has not been validated for the Indian population. Secondly, we do not have normative population level data on hand-grip strength in the Indian

population, therefore we used the EWGSOP recommendations. Lastly, we did not validate our findings with body-composition analysis due to logistics involved in a community-based study.

Conclusion

The prevalence of sarcopenia found in the present study was 14.2% in an elderly population (<60 years of age) and was more likely to occur in women compared to men (24.5% vs 3.4%). Larger community-based surveys are required to determine the actual burden of the problem in India.

Data availability

Underlying data

Zenodo: Sarcopenia in elderly population of Karnataka, <http://doi.org/10.5281/zenodo.3691939>¹¹.

Data are available under the terms of the [Creative Commons Attribution 4.0 International license](#) (CC-BY 4.0).

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<http://www.doi.org/10.5281/zenodo.3691939>

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Harnish P. Patel

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Thank you for this manuscript. The authors are to be commended for making the effort to conduct this study. Sarcopenia is and remains a burden for many of our older population, irrespective of ethnicity so studies like these are very much needed.

However, the study has many flaws that preclude it from being indexed.

Comments below:

- Please use the term older rather than elderly.
- Data are based on the EWGSOP (1) diagnostic algorithm published in 2010. This has been updated in 2019 (EWGSOP2) and the authors must discuss the rationale for using the older definition or present a comparative analysis. Indeed, was there a reason not to use the AWGS/AWGS(2)?

Abstract:

- Please present frequency and percentages.
- Why was the study important?

Introduction:

- Perhaps too short?
- Needs to mention the newer definitions of sarcopenia based on the importance of strength measures.
- SARC-F is recommended as initial screening.
- Reference 3 was the original definition of sarcopenia based on mass (loss of flesh) but not strength. The definitions have been refined over time and the EWGSOP/AWGS/FNIH/IWG

were instrumental in trying to reach a consensus definition (we have still not reached a global consensus definition).

- Mention the close associations with falls and frailty.
- Why is it important to understand the burden of sarcopenia in this population? What could be the driving factors of poverty - malnutrition, education, financial? What are the influencing factors on sarcopenia that would inform a public health message?

Methods:

- Stick to 'older' people rather than geriatric population. It is correct that the specialty is Geriatric Medicine but always refer to 'older people'.
- <0.8m/s is slower gait speed rather than low physical performance.
- Does the Lee formula only measure total skeletal muscle mass? If so how did the authors arrive at ASM?
- How was grip measured and what standard procedure did the authors use to avoid introducing measurement bias?

Results:

- Table one is sparse on information - Needs values of grip strength, total skeletal muscle mass, ASM, SMI, gait speed. Were there any significant differences in these values between non sarcopenics and sarcopenics?
- Again what defines poverty line?

Discussion:

- The discussion is not complete.
- What was the rationale for using EWGSOP? Why was this study important? I understand that the study is unique, but how reproducible is it?
- Is knowing the burden of sarcopenia above poverty/malnutrition/disease a priority from LMIC countries? This is perhaps a contentious question. If the public health message is to reduce the burden of sarcopenia, should the focus be on dealing with the factors that contribute to it - malnutrition for example?

References:

- The reference list is quite short and needs to include several studies or meta-analyses that report on worldwide sarcopenia prevalence as well as prevalence in LMIC.

Is the work clearly and accurately presented and does it cite the current literature?

No

Is the study design appropriate and is the work technically sound?

No

Are sufficient details of methods and analysis provided to allow replication by others?

No

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

No

Are the conclusions drawn adequately supported by the results?

No

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Sarcopenia, frailty, comprehensive geriatric assessment

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Reviewer Report 24 July 2020

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Min Yang

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Thank you for inviting me to review this manuscript. It addressed an old topic in the research field of sarcopenia and did not provide any valuable information for our readers. Here are my considerations.

1. This work did not cite the updated information from the current literature. For example, they cited the information from the EWGSOP that published 10 years ago. In fact, the EWGSOP2 has been published in 2018. Besides, the AWGS 2019 and other updated literature were not cited.
2. The method of sampling likely induced selection bias.
3. The diagnostic criteria of sarcopenia were not appropriate. The ASM was calculated based on anthropometric measures, which were not recommended by any consensus on sarcopenia. Because this method can not accurately estimate skeletal muscle mass. In addition, the cutoffs of the three components of sarcopenia were based on a Brail study. This is wired. Why did the authors not set these cutoffs according to the AWGS 2019 (or AWGS 2014), since the Indians are Asian? Moreover, a 2.4-meters walking test was performed to measure gait speed. The walking course is too short. Why did the authors not

apply the 4-meter or 6-meter walking tests, which are the most widely used tests and are recommended by international consensuses such as EWGSOP, AWGS, FNIH, and SCWD?

4. Because the diagnostic criteria of sarcopenia in this study were inappropriate, the prevalence of so-called 'sarcopenia' in this study would make no sense and might mislead our readers.
5. This study did not report sufficient details of methods and analysis provided to allow replication by others. For example, the method to measure handgrip strength was not clearly reported.
6. The introduction was too short. The authors did not tell us why it is important to conduct this study.
7. The discussion section did not offer our readers valuable information.
8. There are some typos in the main text. For example, "elderly population (<60 years of age) " in the conclusion section (it should be ≥ 60 years of age). Besides, "the ASM cut-offs considered were $<7.0\text{kg/m}^2$ in men and 5.7 in women " in the method section (it should be SMI instead of ASM).

Is the work clearly and accurately presented and does it cite the current literature?

No

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

No

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

No

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Sarcopenia; myosteatorsis; frailty; geriatric syndromes; evidence-based medicine.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

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