Association between sarcopenia and quality of life among adults aged ≥ 65 years from low- and middle-income countries

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ABSTRACT

Background: Sarcopenia has been associated with a lower quality of life (QoL). However, studies on this association from low- and middle-income countries (LMICs) are scarce.

Aims: To examine the association between sarcopenia and QoL, in a large nationally representative sample of older adults from six LMICs.

Methods: Cross-sectional, community-based data from the WHO study on global ageing and adult health (SAGE) were analysed. Non-severe sarcopenia was defined as having low skeletal muscle mass (SMM) and weak handgrip strength but no slow gait speed, while severe sarcopenia was defined as having low SMM, weak handgrip strength, and slow gait speed. QoL was assessed with the 8-item WHO QoL instrument (range 0-100) with higher scores representing better QoL. Multivariable linear regression analysis was conducted.

Results: Data on 14585 people aged ≥65 years were analyzed [mean (SD) age 72.6 (11.5) years; 55.0% female]. After adjustment for potential confounders, compared to no sarcopenia, severe sarcopenia was associated with a significant -3.37 points [95%CI=-5.56, -1.18] lower QoL score. Non-severe sarcopenia was not significantly associated with lower QoL.

Discussion: The association between sarcopenia and QoL observed in our study may be explained by factors such as functional impairment and disability related with sarcopenia.

Conclusions: In this large representative sample of older adults from multiple LMICs, compared to no sarcopenia, only severe sarcopenia was associated with a significantly lower QoL score. Interventions to prevent or manage sarcopenia among older adults in LMICs may contribute to better QoL in this population.

Keywords: Sarcopenia, Quality of life, Older adults, Low- and middle-income countries

INTRODUCTION

Sarcopenia may be defined as "age-related muscle loss, affecting a combination of appendicular muscle mass, muscle strength, and/or physical performance measures" [1], and is associated with adverse health outcomes such as increased risk for falls, dependency, institutionalization, fractures, and higher mortality [1–3]. The prevalence of sarcopenia is high in older adults. In a systematic review including 109 articles and eight various definitions of sarcopenia, it was concluded that sarcopenia prevalence varies from 9.9% to 40.4% in older adults, depending on the definition used [4]. Given that ageing is occurring at a more rapid pace in low- and middle-income countries (LMICs) than in high-income countries, while more than 2/3 of older people are projected to be residing in LMICs in 2050 [5], sarcopenia is likely to become an increasingly important health problem in LMICs in the coming years. In particular, more information on the adverse health outcomes of sarcopenia from LMICs are needed to highlight the importance of sarcopenia prevention in this setting, and to understand the full range of effects if not addressed.

Currently, there is increasing interest in the association between sarcopenia and quality of life (QoL) [6]. QoL may be defined as "an individuals' perception of their position in life in the context of the culture and value systems in which they live, and in relation to their goals, expectations, standards and concerns" [7]. Sarcopenia may increase risk for low QoL, for example, via higher rates of hospitalization, dependency, falls, and disability [1]. Maintaining a high level of QoL in older adults is an important public health priority as a low level of QoL in this population has been found to increase the risk of several negative outcomes, including chronic mental and physical diseases, as well as premature mortality [8–11].

A recent systematic review including 11 studies investigating the relationship between sarcopenia and QoL revealed mixed evidence [6]. The mixed evidence may be owing to the differences between the tools used to measure QoL. For example, one study included in the review compared different measures of health-related QoL and found that when using the SF-36, sarcopenic patients had poorer QoL in terms of physical function but no differences in QoL were found between sarcopenic and non-sarcopenic patients when using the EQ-5D or EQ-VAS [12]. Moreover, the review also included one study that utilized a general QoL tool (CASP-12), and this study found poorer general QoL for sarcopenic patients [13]. Importantly, just two of the 11 studies were carried out in LMICs. Specifically, one small study from Brazil (n=56 females) found that sarcopenia was not significantly associated with QoL [14]. In another study including 543 adults over age 70 years from Mexico, it was found that severe sarcopenia was significantly and inversely associated with QoL when compared with pre- and non-sarcopenic individuals [15]. To the authors' knowledge, no other studies exist on the association between sarcopenia and QoL in LMICs. The existing literature is limited by small study samples, which may explain variation in findings, and by focusing on single LMICs. Multi-country studies are beneficial as they allow for comparison between standardized estimates across settings, and can provide information on whether associations are context-specific.

Given this background, the aim of the present study was to examine the association between sarcopenia and QoL, in a large representative sample of adults aged ≥65 years from six LMICs (China, Ghana, India, Mexico, Russia, South Africa).

METHODS

Data from the Study on Global Ageing and Adult Health (SAGE) were analyzed. This survey was undertaken in China, Ghana, India, Mexico, Russia, and South Africa between 2007 and 2010. Based on the World Bank classification at the time of the survey, Ghana was the only low-income country, and China and India were lower middle-income countries although China became an upper middle-income country in 2010. The remaining countries were upper middle-income countries. Details of the survey methodology have been published elsewhere [16]. Briefly, in order to obtain nationally representative samples, a multistage clustered sampling design method was used. The sample consisted of adults aged ≥18 years with oversampling of those aged ≥50 years. Trained interviewers conducted face-to-face interviews using a standard questionnaire. Standard translation procedures were undertaken to ensure comparability between countries. The survey response rates were: China 93%; Ghana 81%; India 68%; Mexico 53%; Russia 83%; and South Africa 75%. Sampling weights were constructed to adjust for the population structure as reported by the United Nations Statistical Division. Ethical approval was obtained from the WHO Ethical Review Committee and local ethics research review boards. Written informed consent was obtained from all participants.

Quality of life (QOL)

The 8-item WHO Quality of Life (WHOQoL) instrument, which is a shortened version of the WHOQoL-BREF, was used to assess QOL. There were two questions each for four domains (i.e., physical, psychological, social, environmental) [17]. Participants answered each question, rated on a five-point Likert scale ranging from 1 (not at all) to 5 (completely) or 1 (very dissatisfied) to 5 (very satisfied). A composite score was created by summing the responses of the different questions and rescaling the result from 0 to 100 with higher scores

representing better QOL. Good internal consistency of this scale and acceptable convergent validity with WHOQoL-BREF have been reported [17, 18].

Sarcopenia

Following the criteria of the revised European consensus on the definition and diagnosis of sarcopenia [19], non-severe sarcopenia was defined as having low skeletal muscle mass (SMM) as reflected by lower skeletal mass index (SMI) and weak handgrip strength without slow gait speed, while severe sarcopenia was defined as having low SMM, weak handgrip strength, and slow gait speed. SMM was calculated based on the equation proposed by Lee and colleagues: SMM= 0.244*weight + 7.8*height + 6.6*sex – 0.098*age + race – 3.3 (where female=0 and male=1; race=0 [White and Hispanic], race=1.4 [Black] and race=-1.2 [Asian]) [20]. SMM was further divided by body mass index (BMI) based on measured weight and height to create a SMI [21]. Low SMM was defined as the lowest quintile of the SMI based on sex-stratified values [22]. Country-specific cut-offs were used to determine low SMI, as this indicator is likely to be affected by racial differences in body composition [23]. Handgrip strength was measured using a Smedley Hand Dynamometer (Scandidact Aps, Denmark), which was calibrated regularly. Weak handgrip strength was defined as <27kg for men and <16kg for women using the average value of the two handgrip measurements of the dominant hand [19]. Gait speed was based on a 4m timed walk and was measured by asking the participant to walk at a normal pace. The interviewer recorded the time to completion of the 4m walk. Slow gait speed referred to ≤0.8m/s [19].

Control variables

The selection of the control variables was based on past literature [6], and included age, sex, highest level of education achieved (primary or less, secondary, tertiary), wealth quintiles

based on income, marital status (currently married/cohabiting, never married, separated/divorced/widowed), smoking (never, current, past), physical activity, depression, and number of chronic physical conditions. Levels of physical activity were assessed with the Global Physical Activity Questionnaire and were classified as low, moderate, and high based on conventional cut-offs [24]. Questions based on the World Mental Health Survey version of the Composite International Diagnostic Interview [25] were used for the endorsement of past 12-month DSM-IV depression. Information on 11 chronic physical diseases (angina, arthritis, asthma, chronic back pain, chronic lung disease, diabetes, edentulism, hearing problem, hypertension, stroke, visual impairment) were obtained. The details on the diagnosis of these conditions are provided in **Table S1** (Appendix). The number of chronic conditions was summed and categorized as 0, 1, and ≥2.

Statistical analysis

The statistical analysis was conducted with Stata 14.2 (Stata Corp LP, College station, Texas). The analysis was restricted to people aged ≥65 years as sarcopenia is an age-related condition. The pair-wise difference in sample characteristics by sarcopenia status (i.e., non-severe sarcopenia vs. no sarcopenia; severe sarcopenia vs. no sarcopenia) was tested by Chi-squared tests and Student's *t*-tests for categorical and continuous variables, respectively. Using the overall sample, multivariable linear regression analysis was conducted with the three-category sarcopenia variable (i.e., no sarcopenia, non-severe sarcopenia, severe sarcopenia) as the independent variable and QoL as the dependent variable. This was done to assess the difference in mean QoL values between no sarcopenia (reference category) and non-severe sarcopenia or severe sarcopenia. Furthermore, to examine the between country-heterogeneity in the association between sarcopenia and QoL, we conducted country-wise analysis and calculated the Higgin's I^2, which represents the degree of heterogeneity that is

not explained by sampling error with values of 25%, 50%, and 75% often being considered as low, moderate, and high levels of heterogeneity [26]. Overall estimates were obtained based on country-wise estimates by meta-analysis with fixed effects. All regression analyses were adjusted for age, sex, education, wealth, marital status, smoking, physical activity, depression, number of chronic physical conditions, and country, with the exception of the country-wise analysis which was not adjusted for country. Adjustment for country was done by including dummy variables for each country in the model as in previous SAGE publications [27, 28]. The sample weighting and the complex study design were taken into account in all analyses. Results from the regression analyses are presented as b-coefficients with 95% confidence intervals (CIs). The level of statistical significance was set at $P<0.05$.

RESULTS

The final sample consisted of 14585 people aged ≥65 years. The sample size per country was: China n=5360; Ghana n=1975; India n=2441; Mexico n=1375; Russia n=1950; South Africa n=1484. Overall, the prevalence of non-severe and severe sarcopenia were 4.7% and 7.3%, respectively. The sample characteristics are provided in **Table 1**. The mean (SD) age was 72.6 (11.5) years and 55.0% were females. People with non-severe or severe sarcopenia (vs. no sarcopenia) were significantly more likely to be older, have lower levels of education and wealth, as well as more chronic physical conditions. Furthermore, people with non-severe sarcopenia were more likely to be males, while individuals with severe sarcopenia were more likely to have low levels of physical activity. The association between sarcopenia and QoL estimated by multivariable linear regression is shown in **Table 2**. Compared to no sarcopenia, severe sarcopenia was associated with a significant -3.37 points [95%CI=-5.56, -1.18] lower QoL score. Non-severe sarcopenia was also associated with a lower QoL score, but this was not statistically significant. Country-wise analysis showed that sarcopenia (i.e.,

non-severe and severe) is associated with lower QoL scores in Russia, India, China, South Africa, and Mexico although this was not statistically significant in all countries (**Figure 1**). The overall estimate based on a meta-analysis was b-coefficient=-1.81 [95%CI=-3.05, -0.57] with a very low level of between-country heterogeneity (I^2=0.0%).

DISCUSSION

Main findings

In this large representative sample of adults aged ≥65 years from six LMICs, compared to no sarcopenia, severe sarcopenia was associated with a significantly lower QoL score. However, non-severe sarcopenia was not significantly associated with lower QoL scores. Country-wise analysis showed no evidence of between-country heterogeneity in the association between sarcopenia and QoL. To the best of our knowledge, our study is the first nationally representative study on the association between sarcopenia and QoL from LMICs, while it is also the first multi-country study on this topic.

Interpretation of the findings

The results of our study are in line with previous studies which have mostly been conducted in high-income countries, and have mainly found a significant but modest decrease in QoL among people with sarcopenia [6]. When focusing only on LMICs, our study results concur with those of the study conducted in Mexico [15] but not with the study conducted in Brazil, [14] which did not find significant results. However, it should be noted that the Brazilian study had a very small sample size (n=56) and could have lacked statistical power. It is also worth mentioning that the prevalence of slow gait speed has been reported to be high in the countries included in this study [29], and this may partly explain why the prevalence of severe sarcopenia was high (7.3%).

There are several plausible pathways that likely explain the observed association between sarcopenia and lower QoL. First, sarcopenia is often associated with functional impairment and disability due to low muscle mass and muscle strength, hindering effective execution of activities of daily living which can consequently lower QoL [30]. Second, sarcopenia has been found to be associated with an increased risk of falls [31], and this may lead to lower QoL via injury, hospitalization, and personal costs [32, 33]. Moreover, sarcopenia is also associated with a higher risk of experiencing "fear of falling" [34], and thus, those with sarcopenia may avoid activities owing to this fear and this may negatively affect their QoL. Third, sarcopenia increases risk of multiple chronic conditions and multimorbidity [35], via mechanisms such as high serum inflammatory parameters and chronic inflammation [36], which are associated with lower levels of QoL due to their symptoms or associated disability [37]. Furthermore, multiple mental health complications may occur as the result of sarcopenia [38]. For example, chronic inflammation plays a role in the progression of sarcopenia as well as the expression and evolution of anxiety disorders [39]. In turn, mental health complications have been identified as a key risk factor of low levels of QoL [40]. Finally, sarcopenia has been associated with sleep problems such as short and long sleep duration. Sleep problems may indeed increase risk of sarcopenia and low QoL. In the common pathophysiological background of sarcopenia and sleep-related problems, the physiological relevance of myokine, a physiologically active substance derived from skeletal muscle, is important. Indeed, a low level of irisin is associated with sarcopenia [41].

Implications of the findings

Findings from the present study suggest that prevention of or improvements in sarcopenia may lead to better QoL among older adults in LMICs. For example, interventions should

consider utilizing physical activity and strength training which have been shown to improve sarcopenic outcomes or prevent sarcopenia and also lead to better QoL [42–44]. In support of this, research suggests that such interventions would be well received in LMIC settings [44]. Finally, in LMICs, malnutrition is a common phenomenon [45], and is implicated in the development of sarcopenia [46]. Importantly, malnutrition is also associated with lower levels of QoL [47]. It thus may be prudent to implement interventions to address malnutrition in LMICs to prevent sarcopenia and improve QoL.

Strengths and limitations

The use of large nationally representative datasets from multiple LMICs is a clear strength of the current study. However, findings must be interpreted in light of several limitations. First, the majority of variables were self-reported, potentially introducing recall and social-desirability bias into the findings. Second, the study is cross-sectional in nature, and thus, the direction of the association cannot be confirmed. Third, there are still no universal operative definitions of sarcopenia. Our definition was based on that proposed by international groups of experts, but it is possible that the results may differ if a different definition for sarcopenia was used. Next, the questionnaire used to evaluate QoL in our study (WHOQoL) has not been validated among people with sarcopenia. The only validated QoL tool for use among people with sarcopenia is the SarQoL [48], but this was not available in the SAGE. Future studies on this topic from LMICs should seek to use the SarQoL. Finally, as in many community-based epidemiological studies, ASM was based on a population equation and not direct assessment, and this is a limitation of the accuracy of sarcopenia diagnosis. However, anthropometric equations for the estimation of muscle mass have been validated against gold standard methods such as magnetic resonance imaging and dual-energy X-ray absorptiometry in diverse populations, and good concordance rates have been reported [20, 49].

Conclusion

In this large representative sample of older adults from multiple LMICs, compared to no sarcopenia, severe sarcopenia was associated with a significantly lower QoL score. Interventions to prevent sarcopenia or improve its severity (e.g., promotion of physical activity) may also have the added benefit of improving QoL in this population.

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ETHICS DECLARATIONS

Compliance with Ethical Standards

The presented work complies with the ethical standards of medical publishing.

Conflict of Interest

The authors have no conflicts of interest to declare for this study.

Ethical approval

Ethical approval was obtained from the WHO Ethical Review Committee and local research review boards.

Informed consent

Informed consent was obtained from all participants.

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Fig. 1 Country-wise association between sarcopenia and quality of life (outcome) estimated by multivariable linear regression

Abbreviation: CI Confidence interval

Sarcopenia includes both non-severe and severe sarcopenia.

Quality of life was based on a scale ranging from 0 to 100 with higher scores representing better quality of life.

Models are adjusted for age, sex, education, wealth, marital status, smoking, physical activity, depression, and number of chronic physical conditions.

The b-coefficients represent the mean difference in quality of life scores among those with and without sarcopenia.

Overall estimate was obtained by meta-analysis with fixed effects.