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Quality of life associated with handgrip strength and sarcopenia: EpiFloripa Aging Study

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ABSTRACT

Background: Quality of life (QoL) is an important measure, and it can be defined as the presence of control, autonomy, self-realization and pleasure. This study aims to verify the association between handgrip strength (HGS), sarcopenia and sarcopenic obesity with quality of life (QoL) among community-dwelling older adults in southern Brazil.

Methods: Cross-sectional analyses data of the "EpiFloripa Aging" cohort study were carried out. The participants were community-dwelling older adults (60 years and over). QoL was evaluated by CASP-16 Brazil instrument, with a score of zero, representing no QoL, to 48, total satisfaction. The TAKEI hand dynamometer verified the HGS. Sarcopenia was defined as appendicular skeletal muscle mass/body weight < 2 standard deviations below gender-specific means for young adults. Sarcopenic obesity was identified as the concomitant presence of obesity and sarcopenia. Multiple linear regression was performed to estimate the associations.

Results: The analytical sample consisted of 584 older adults (652% females). In the adjusted analysis, at each increase of one kgf in HGS there was a 0.24 and 0.18 increase in the QoL score, for females and males, respectively. Sarcopenia was negatively associated with QoL in males, and sarcopenic obesity wasn't associated with QoL.

Conclusion: QoL was positively associated with HGS for both sexes, and negatively associated with sarcopenia for males. Low HGS, as well as sarcopenia, lead to critical health losses. Interventions that minimize phenotypes related to these conditions are fundamental, but mainly, conditions as severe as these need to be early identified to reduce the impact on QoL.

1. Introduction

Quality of life (QoL) is a subjective evaluation that crosses different theories and does not present a conceptual consensus. However, this is a measure that covers different aspects of the individual, from basic needs, such as shelter and food, to the most complex ones, such as social, self-realization and happiness (Maslow, 1968). QoL can be considered as acting freely on the environment of someone, being free from interference from other people, having the sense of fun and personal fulfillment (Lima et al., 2014).

QoL can be defined by the presence of control, autonomy, self-realization, and pleasure, so it is possible that factors that cause damage to these dimensions interfere in the QoL of older adults (Haider et al., 2016; Neto et al., 2016). In the literature, instruments that evaluate QoL have been widely referenced as a health-related measure, a subset used as QoL proxies (examples of instruments SF-36, EQ-5D, CDC HRQOL). The health-related measure focuses on the impact of health or lack of health on the various aspects of life, such as social contact,

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psychological well-being, among others. However, this concept neglects people's ability to overcome or adapt to diseases or impairments (Higginson & Carr, 2001; Smith, 1997).

CASP instrument was developed in the United Kingdom, specifically for the population over 50 years old and with the intention of being an instrument of QoL that distinguished aspects that influence health, such as context and individual phenomena. The instrument was developed based on the basic human needs satisfaction model, to distinguish the general QoL from that related to physical and mental functions. Thus, the principle that QoL can be achieved as human needs are met, allows all humans to share common domains (Higgs, Hyde, Wiggins, & Blane, 2003; Hyde, Wiggins, Higgs, & Blane, 2003; Wiggins, Netuveli, Hyde, Higgs, & Blane, 2008). In the literature, we find the term QoL and wellbeing, to refer to the CASP measure.

International studies point to CASP as a general, efficient, objective, standardized, multidimensional QoL assessment instrument with good psychometric properties, mainly because its items were developed considering factors that go beyond health status (Blane, Netuveli, & Montgomery, 2008; Wahrendorf, Ribet, Zins, & Siegrist, 2008; Wiggins et al., 2008). The scale has also been used in over 20 countries in all major continents (Hyde, Wiggins, & Blane, 2015). As well as, a version for use in Brazil (Lima et al., 2014).

The relationship between QoL and age-related changes, such as body composition, is widely investigated in the literature (Guede et al., 2017; Manrique-Espinoza, Salinas-Rodríguez, Rosas-Carrasco, Gutiérrez-Robledo, & Avila-Funes, 2017; Sayer et al., 2006; Trombetti et al., 2016; Woo, Yu, & Visvanathan, 2016).

Among the age-related changes that may have a negative impact on QoL, the most notables are the reduction of strength and muscle mass, and the increase of fat mass (Guede et al., 2017; Sayer et al., 2006; Trombetti et al., 2016; Woo et al., 2016). The measurement of handgrip strength (HGS) has been used as a good indicator of total muscle strength and muscle function in older adults (Ling et al., 2010). The joint reduction of strength and muscle mass is known as sarcopenia (Shaw, Dennison, & Cooper, 2017); its prevalence differs between populations and increases with age, varying from 5.0% to 13.0% in individuals aged 60 to 70 years, and from 11.0% to 50.0% up to 80 years (Beaudart et al., 2015; Cruz-Jentoft et al., 2010; Parra-Rodríguez et al., 2016). The sarcopenic obesity (loss of muscle mass with the increase in fat mass) presents prevalence between 7.0% and 25.0% at the older population (Cho, Shin, & Shin, 2015; Lee, Shook, Drenowatz, & Blair, 2016; Silva Neto, Karnikowiski, Tavares, & Lima, 2012).

It is believed that both muscle strength reduction, sarcopenia, and sarcopenic obesity have a negative impact on the health of older adults, contributing to the risk of fragility, reduced mobility, and functional decline, falls, social isolation, depression and premature death (Cruz-Jentoft et al., 2014; Landi et al., 2013; Neto et al., 2016). These conditions increase the dependency of older adults, which can lead to hospitalization or institutionalization, increasing health spending and compromising the QoL of individuals (Neto et al., 2016).

Geriatric syndromes, such as sarcopenia, although frequent in the population, may have their appearance delayed, to provide active and healthy aging (Lenardt et al., 2016). To value preventive measures, it is essential to know the repercussions of these changes and their impact on the QoL of older adults, since these relationships have not yet been fully elucidated (Beaudart et al., 2017; Neto et al., 2016). Thus, the study aims to verify the association between HGS, sarcopenia, sarcopenic obesity and QoL in older adults, according to sex, from a capital of southern Brazil.

2. Methods

This study is part of a longitudinal, population-based and home-based epidemiological survey, EpiFloripa Aging, conducted with individuals aged 60 years or older in 2009/10 and 2013/14. EpiFloripa was developed to investigate health and life conditions of aged population in Florianópolis, Santa Catarina State, Brazil. This article has a cross-sectional design, with data from the follow-up study, conducted in 2013/14. More detailed information has been previously published and will be presented briefly (Confortin et al., 2017; Schneider et al., 2017).

The baseline sample was 1702 older adults. To the follow-up, it was identified 217 deaths, 159 losses, 129 refusals, consisting of 1197 (70.3%) individuals who performed the home interview and of those, 604 (50.5%) participated of the laboratory, imaging and functional physical capacity tests. The analytical sample of this study was 584 older adults (6 excluded due to inadequate information in the imaging tests).

2.1. Outcome

The QoL was assessed using the Brazilian version of the questionnaire Control, Autonomy, Self-realization and Pleasure (CASP-16 Brazil) (Lima et al., 2014). The instrument presents four domains, without hierarchical organization, distributed in 16 items: control, autonomy, self-realization, and pleasure. Each item has four response options (often, sometimes, rarely or never), in which is given a score. The total score can range from 0, indicating the absence of QoL, to 48, representing total QoL. Given the self-applicable nature of the CASP-16, at the time of the interview, a printed instrument was delivered to the participant so that he could follow up. For the participants who did not know how to read (8.9%), the interviewer did the reading, and the subject verbalized the answer.

2.2. Independent variables

2.2.1. Muscle strength

Muscle strength was evaluated using the handgrip strength, verified by a mechanical dynamometer (Takei Kiki Kogyo TK 1201, Japan), adjusted according to the size of the hands. The arm was chosen by the participant considered with the greatest strength. The procedure was performed twice with a one-minute interval and considered the mean (kilogram-force – kgf) in the analyzes.

2.2.2. Sarcopenia

Sarcopenia was identified by the criteria from the European Working Group on Sarcopenia in Older People (EWGSOP) (Cruz-Jentoft et al., 2010), which considers sarcopenia as the concomitant loss of mass and muscle strength, described in Fig. 1.

Muscle mass was assessed with appendicular muscle mass index (AMMI) by the DXA (General Electric Lunar Prodigy Advance Model). The calculation of AMMI was based on Baumgartner et al. (Baumgartner et al., 1998):

$$AMMI \quad (\mathrm{kg/m^2}) = \frac{(arms \quad lean \quad muscle \quad mass + legs \quad lean \quad muscle \quad mass)}{height^2}$$

To identify sarcopenia, it was adopted the AMMI criteria ≤ 2 standard deviations (SD) to a reference population (young adults from Rosetta Study) (Baumgartner et al., 1998), by sex. The cutoff points for AMMI ($\mathrm{kg/m^2}$) as inadequate (loss of muscle mass) was $< 5.5\ \mathrm{kg/m^2}$ for females and $< 7.26\ \mathrm{kg/m^2}$ males.

The values for the HGS test were defined according to sex and body mass index (BMI):

$$BMI \quad (\mathrm{kg/m^2}) = \frac{body \quad mass}{height^2}$$

BMI was categorized according to the American Academy of Family Physicians (“American Academy of Family Physicians, American Dietetic Association, National Council on the Aging. Nutrition screening e intervention resources for healthcare professionals working with older

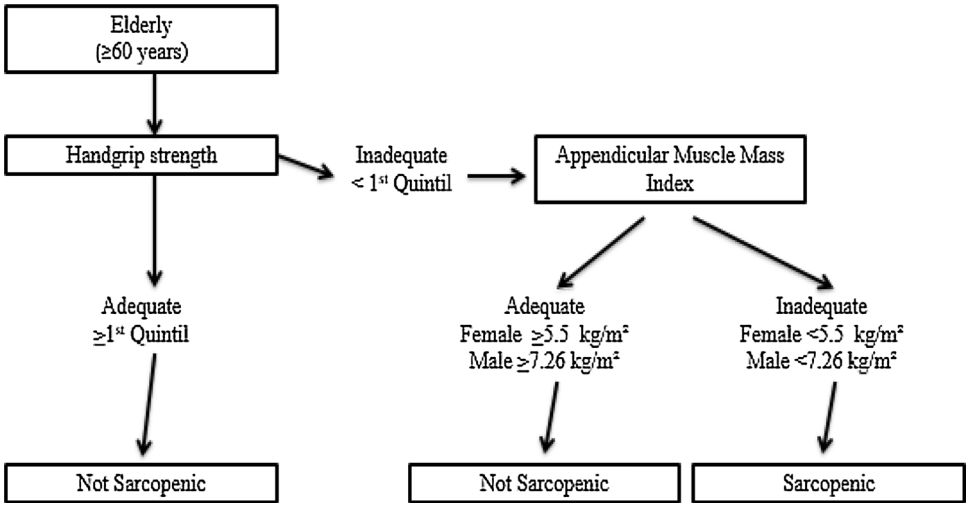

Fig. 1. Algorithm for the identification of cases of sarcopenia in the population of the study.

adults. Nutrition Screening Initiative," 2002), adopted in Brazil by the Food and Nutrition Surveillance System (*Sistema de Vigilância Alimentar e Nutricional* – SISVAN) (Sullivan, Ghushchyan, & Ben-Joseph, 2008): < 22.0 kg/m^2, low weight; 22.0 ≤ BMI ≤27.0 kg/m^2, adequate; > 27.0 kg/m^2, overweight. For each category, the cutoff points for HGS were set in the first quintile, based on Fried et al. (2001).

2.2.3. Sarcopenic obesity

Sarcopenic obesity was identified as the simultaneous presence of obesity and sarcopenia. In this case, considering the method of de Baumgartner (2000), sarcopenia was defined only by AMMI, for females < 5.5 kg/m^2 and males < 7.26 kg/m^2.

The determination of obesity occurred through the percentage of body fat, by DXA. The participants were classified as obese when above the 60th percentile of the study sample, > 44.0% for females and > 31.1% males (Baumgartner, 2000).

2.3. Adjustment variables

The adjustment variables, based on the literature (Haider et al., 2016; Neto et al., 2016; Trombetti et al., 2016), were: age group (60–69, 70–79, 80 years or more), per capita family income in minimum wages (2013: R$678.00/ U$333.00; 2014: R$724.00/ U $303.00) (< 1, 1 to < 3, < 5 to < 10, 10 or more); leisure and transportation physical activity with International Physical Activity Questionnaire (IPAQ) (insufficiently active: 0 to 149 min of physical activity/week, physically active: ≥150 min of physical activity/week) (Benedetti, Mazo, & Barros, 2004); functional dependence with Multidimensional Functional Assesment Questionnaire (BOMFAQ) (no: no dependence to 3 daily life activities dependence, yes: dependence on 4 or more activities) (Rosa, Benício, Latorre, & Ramos, 2003); cognitive deficit with Mini-Mental State Examination, score range from 0 to 30, considering deficit, up until 19/20 to those without formal education and 23/24 with formal education) (Almeida, 1998; Folstein, Folstein, & McHugh, 1975); and depressive symptoms with Geriatric Depression Scale (GDS-15) (no: < 6, yes: ≥6) (Almeida & Almeida, 1999).

2.4. Statistical analysis

Descriptive analyzes were performed for all variables. The prevalence and respective confidence intervals of 95% (CI95%) of each exposure variable were calculated. Continuous variables were expressed as the mean and standard deviation (SD), and QoL according to the nature of the exposures. The means were compared with Mann-Whitney test (dichotomous variables) and Kruskal-Wallis (categorical variables).

For the crude and adjusted analysis, linear regression was used, estimating the regression coefficient with its respective CI95%. For the adjusted analysis, each exposure variable was analyzed using the adjustment variables. Thus, the association between each independent variable (HGS, sarcopenia and sarcopenic obesity) and the QoL score was estimated. All analyzes were stratified by sex and performed in STATA/SE 13.0 (STATA Corp. College Station, Texas, USA), considering the sample weights.

3. Results

Of the 604 older adults who attended the laboratory, image and functional physical examination, 584 underwent evaluation of body composition and HGS, which was the analytical sample of the study.

Table 1 shows the characteristics of the sample, according to sex. The mean score for QoL was 38.2 (± 7.2) and 39.3 (± 6.5), respectively, for females and males. The female sex had a mean HGS of 17.9 (± 5.5), a prevalence of 6.6% (95%CI:3.9–10.8) of sarcopenia and 1.8% (95%CI:0.9;3.3) of sarcopenic obesity. Among males, mean HGS was 29.5 (± 8.5), 9.8% (95%CI:5.6;16.6) presented sarcopenia and 14.2% (95%CI:8.8;22.1) sarcopenic obesity.

There was no statistical difference between the mean QoL and the prevalence of sarcopenia and sarcopenic obesity. For females, there was a higher prevalence of women between 70 and 79 years old, with income of 1 to < 3 minimum wages, physically active, without functional dependence, without a cognitive deficit, and without depressive symptoms. Among males, the highest prevalence was at a younger age (60–69 years), income above 10 minimum wages, physically active, without functional dependence, without a cognitive deficit and no depressive symptoms (Table 1).

The associations between QoL and the independent variables in females and male are presented in Table 2. In the crude analysis, there was a positive association between QoL and HGS, and negative with sarcopenia for females. In the adjusted analysis, the association was only maintained between HGS and QoL; at each increase of one kgf in HGS there was a 0.24 increase in the QoL score.

For males, in the crude analysis, there was an association between HGS and QoL (Coef.:0.26, 95%CI:0.14;0.38), as well as the association between sarcopenia and QoL (Coef.:-3.06; IC95%:-5.82;-0.28). After adjustments, these associations remained significant. In the adjusted analysis, at each increase of one kgf in HGS there was an 0.18 increase in the QoL score. Those who presented sarcopenia had a QoL score of 3.08 points lower (95%CI:-5.73;-0.43) compared to those without sarcopenia (Table 2).

Table 1
Sample characterization and quality of life mean score according to demographic, socioeconomic, lifestyle and health conditions in older adults, by sex. Florianópolis, Santa Catarina, Brazil, 2013/2014.

	Females			Males		
	n	Mean (SD)	QoL mean score (SD)	n	Mean (SD)	QoL mean score (SD)
QoL	381	38.2(7.2)		203	39.3(6.5)	
HGS (kgf)	389	17.9(5.5)		207	29.5(8.5)	
	n	**% (95%CI)**	**QoL mean score (SD)**	**n**	**% (95%CI)**	**QoL mean score (SD)**
Sarcopenia						
No	370	93.4(89.2;96.1)	38.4(7.1)	184	90.2(83.4;94.4)	39.7(6.3)
Yes	19	6.6(3.9;10.8)	35.3(8.5)	18	9.8(5.6;16.6)	35.6(7.5)
Sarcopenic obesity						
No	379	98.2(96.6;99.1)	38.2(7.2)	183	85.8(77.9;91.2)	39.5(6.3)
Yes	12	1.8(0.9;3.3)	37.0(6.2)	24	14.2(8.8;22.1)	37.4(7.6)
Age group						
60-69	160	40.5(34.1;47.2)	39.7 (6.0)	93	45.5(36.6;54.7)	40.2(5.8)
70-79	170	42.3(35.8;49.1)	37.4(7.3)	82	40.0(32.3;48.3)	39.0(6.5)
80 or more	61	17.2(12.9;22.8)	36.7(9.0)	32	14.5(9.1;22.3)	37.0(7.7)
Family income (minimum wages)						
< 1	37	8.6(6.0;12.1)	36.3(8.2)	8	3.3(1.5;7.3)	34.3(8.9)
1 to < 3	122	35.3(28.7;42.5)	38.0(6.9)	48	22.4(17.2;28.6)	38.3(7.9)
3 to < 5	87	19.9(15.2;25.7)	37.4(7.8)	34	14.9(10.1;21.5)	38.9(6.7)
5 to < 10	91	24.27(18.24;31.5)	39.0(6.7)	49	28.2(20.8;37.0)	38.9(5.9)
≥10	39	11.9(8.0;17.3)	40.4(6.4)	64	31.2(24.5;38.8)	40.6(5.0)
Physical activity at leisure and transportation						
Insufficiently active	192	48.5(42.3;54.8)	35.3(7.6)	64	27.3(20.1;36.0)	37.3(7.1)
Physically active	199	51.5(45.2;57.7)	40.9(5.6)	142	72.7(64.0;79.9)	40.1(6.0)
Functional dependence in DLA						
No	276	70.4(62.5;77.3)	40.1(5.1)	167	82.1(73.1;88.6)	40.7(5.6)
Yes	115	29.6(22.7;37.5)	33.6(7.8)	37	17.9(11.4;26.9)	33.3(6.2)
Cognitive deficit						
No	296	75.0(68.8;80.3)	39.0(6.6)	172	85.4(76.5;91.4)	39.9(5.8)
Yes	91	25.0(19.7;31.2)	35.5(8.4)	35	14.6(8.6;23.5)	36.1(8.6)
Depressive symptoms						
No	306	81.5(75.8;86.1)	40.1(5.6)	182	88.6(79.9;93.8)	40.3(5.5)
Yes	75	18.5(13.9;24.2)	30.3(7.6)	20	11.5(6.2;20.1)	29.7(6.9)

QoL: quality of life. 95%CI: 95% confidence interval. SD: standard deviation. HGS: Handgrip strength. DLA: daily life activities.

Table 2
Crude and adjusted linear regression analysis for association test between HGS, sarcopenia and sarcopenic obesity to the quality of life, according to sex. Florianópolis, Santa Catarina, Brazil, 2013/2014.

	Crude analysis Coef. (95%CI)	Adjusted analysis[a] Coef. (95%CI)
Females		
HGS	**0.40(0.22;0.58)**	**0.24(0.11;0.37)**
Sarcopenia	**−5.53(-9.91;-1.15)**	−2.39(-6.84;-2.06)
Sarcopenic obesity	−1.52(-5.94;2.90)	−0.35(-4.22;3.52)
Males		
HGS	**0.26(0.14;0.38)**	**0.18(0.06;0.30)**
Sarcopenia	**−3.06(-5.82;-0.28)**	**−3.08(-5.73;-0.43)**
Sarcopenic obesity	0.27(-2.72;3.25)	0.01(-2.62;2.64)

Coef.: linear regression coefficient. 95%CI: 95% confidence interval. HGS: Handgrip strength.

[a] Adjusted for age group, family income, physical activity of leisure and transportation, functional dependence, cognitive deficit and depressive symptoms.

4. Discussion

In the present study, the mean HGS was positively associated with QoL in both sexes, and sarcopenia was negatively associated with QoL in males.

The results pointed to the association between HGS and QoL for females and males, as verified by other studies (Guede et al., 2017; Haider et al., 2016; Sayer et al., 2006). HGS is considered a marker of total muscle strength (Ling et al., 2010), and its reduction has repercussions on health. In older adults, the reduction of muscle strength can lead to a limitation in mobility performance and physical disability (Manini & Clark, 2011), morbidities (Pessini, Barbosa, & Trindade, 2016) and increase mortality (Ling et al., 2010; Newman et al., 2006).

The negative association between sarcopenia and QoL is consistent with previous studies (Manrique-Espinoza et al., 2017; Trombetti et al., 2016; Woo et al., 2016), and as expected, some factors considered a risk for sarcopenia are well documented in the literature (Shaw et al., 2017), such as sedentary behavior, adiposity, and multimorbidities, and deserve care to prevent deterioration of health and complications. Despite, sarcopenic obesity was not associated with QoL, reinforces the importance of muscle mass, strength and function for the QoL of older adults. The maintenance of the strength allows the subjects to be more active, to have greater autonomy over their lives, and provides better QoL (Haider et al., 2016).

Like others geriatric syndromes, sarcopenia can also be postponed. Considering the impact muscle and mass strength have on QoL, interventions that minimize the phenotypes related these conditions are fundamental. The adoption of exercises that improve the efficiency of muscular development and strength, as well as nutritional counseling, based on individual needs and socioeconomic level with a multi-professional team is emphasized (Lenardt et al., 2016).

The strengths of this study involve the use of a population-based research data from a middle-income country, like Brazil; the application of a validated and standardized instruments by well-trained interviewers; and the evaluation of sarcopenia, using a gold standard, hardly

used in population studies, especially in low and middle-income countries. Also, the chosen exposures, HGS, sarcopenia, and sarcopenic obesity, which are considered good indicators of the health status of older adults.

The evaluation of QoL, as well as sarcopenia, are very heterogeneous in the literature, and so it was not possible to compare the results between studies and populations. There are several instruments that consider different aspects of older individuals lives, but the chosen QoL instrument, CASP, has shown to be effective, objective, standardized and multidimensional for the evaluation on this population. The CASP with 19 original items was also analysed, but no differences were found in the associations compared to the results with CASP-16 Brazil (Lima et al., 2014). Regarding sarcopenia, there are some measurement techniques and diagnostic criteria that can be adopted for its definition (Kim, Lee, Kye, Chung, & Kim, 2014), such as those used in the present study (Baumgartner, 2000; Cruz-Jentoft et al., 2010).

The losses occurred between the follow-up study, and the clinical exams are limitations that might be underestimating the results found, due to selection bias. The use of a self-reported measure of physical activity can also lead to information bias. However, it was obtained through a validated instrument. The situations cited are common in epidemiological studies and all possible procedures for avoiding them have been provided by the study team.

This study shows that QoL was positively associated with HGS in both sexes, and negatively associated with sarcopenia in males. The presence of sarcopenia and low HGS among the elderly have damaging repercussions on older adult's health, affecting their QoL. Both evaluations are essential in the multidimensional assessment of this aged population, and for the development of preventive strategies and treatments of their complications.

The HGS evaluation is a quick, simple, noninvasive and low-cost measure that can be adopted by health professionals in the geriatric evaluation. It can also be a tool for monitoring and evaluate health groups results.

Conflicts of interest

None.

Ethical standards

All procedures were in accordance with the Ethics Committee of Research with Human Beings (CEPSH) at the Federal University of Santa Catarina (UFSC), under CAAE number 16731313.0.0000.0121, on July 9, 2013 and Brazil's Health Nacional Council (CNS) Resolution number 466/2012.

Informed consent

Informed consent was obtained from all individual participants included in the study.

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