Taylor & Francis
Taylor & Francis Group

Expert Review of Pharmacoeconomics & Outcomes Research

ISSN: 1473-7167 (Print) 1744-8379 (Online) Journal homepage: http://www.tandfonline.com/loi/ierp20

Current review of the SarQoL®: a health-related quality of life questionnaire specific to sarcopenia

Charlotte Beaudart, Jean-Yves Reginster, Anton Geerinck, Médéa Locquet & Olivier Bruyère

To cite this article: Charlotte Beaudart, Jean-Yves Reginster, Anton Geerinck, Médéa Locquet & Olivier Bruyère (2017) Current review of the SarQoL®: a health-related quality of life questionnaire specific to sarcopenia, Expert Review of Pharmacoeconomics & Outcomes Research, 17:4, 335-341, DOI: 10.1080/14737167.2017.1360768

To link to this article: http://dx.doi.org/10.1080/14737167.2017.1360768

EXPERT REVIEW OF PHARMACOECONOMICS & OUTCOMES RESEARCH, 2017
VOL. 17, NO. 4, 335–341
https://doi.org/10.1080/14737167.2017.1360768

Taylor & Francis
Taylor & Francis Group

REVIEW

Current review of the SarQoL®: a health-related quality of life questionnaire specific to sarcopenia

Charlotte Beaudart, Jean-Yves Reginster, Anton Geerinck, Médéa Locquet and Olivier Bruyère

Department of Public Health, Epidemiology and Health Economics, University of Liège, Liège, Belgium

ABSTRACT

Introduction: Sarcopenia, defined by a progressive and generalized loss of muscle mass and muscle function, is associated with many harmful clinical consequences. Several studies have reported the impact of sarcopenia on health-related quality of life (HRQoL) using generic quality of life (QoL) questionnaires. The results of these observational studies are quite heterogenous. Indeed, generic tools may not be able to detect subtle effects of sarcopenia on QoL. Recently, a sarcopenia-specific HRQoL questionnaire was developed and validated in a population of sarcopenic subjects to more accurately assess the impact of sarcopenia on QoL.

Areas covered: The purpose of this review is to present evidence regarding the impact of sarcopenia on QoL and to introduce a new specific HRQoL questionnaire, the SarQoL®.

Expert commentary: The self-administered SarQoL®, initially developed in French, comprises 55 items translated into 22 questions. The questionnaire has been shown to be understandable, valid, consistent, and reliable and can therefore be recommended for clinical and research purposes. The questionnaire is now available in 11 different languages with another 20 translations in progress. The instrument's sensitivity to change still needs to be assessed in future longitudinal studies.

ARTICLE HISTORY
Received 28 June 2017
Accepted 25 July 2017

KEYWORDS
Muscle impairments; muscle function; quality of life assessment; sarcopenia; specific questionnaire

1. Introduction

After the age of 25 years, the size and number of type II muscle fibers progressively declines, resulting in a progressive decrease in total muscle mass of approximately 40% between the ages of 25 and 80 years [1]. Beyond a certain defined threshold, this age-related phenomenon is considered abnormal; it was first defined by Rosenberg [2] in 1989 using the term 'sarcopenia'. This first definition only addressed the notion of decreased muscle mass and was the start of many attempts to establish a clinically approved and applicable definition. The definition of sarcopenia has since evolved to include decreased muscle function (i.e. decreased muscle strength and/or physical performance). At present, there is still no universal diagnostic criteria and definition of sarcopenia available in literature; instead, several operational definitions of sarcopenia are available and are used across studies [3–10]. These definitions differ in terms of muscle mass indicators; the cut-off points used to define low muscle mass, low muscle strength and low physical performance; and the proposed tools for measuring these parameters. Sarcopenia, which has been shown to be prevalent in about 10% of community-dwelling subjects aged 65 years or older [11,12], is prospectively associated with several adverse outcomes, such as functional decline, loss of mobility, hospitalization, falls, fractures and mortality [13]. Sarcopenia is now recognized as a major clinical problem for older people and as a significant public health issue [14]. Because of the association of these outcomes with sarcopenia, the impact of this condition [15] on HRQoL, defined by the World Health Organization (WHO) 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', seems intuitively evident but has yet to be shown with well-designed studies. The purpose of this study was to review evidence regarding the impact of sarcopenia on QoL and to introduce a new, specific HRQoL questionnaire, the SarQoL®.

2. Assessment of health-related quality of life in sarcopenia

2.1. How to assess HRQoL?

Two main approaches, namely generic and disease-specific instruments, can be used to measure HRQoL [16]. By definition, a generic QoL questionnaire can be designated for all types of populations of any age with any type of health trouble. The generic questionnaires are therefore widely used in observational and clinical studies since they allow comparisons between, for example, different populations with the same disease or comparisons of a disease's impact on QoL based on the stage of the disease.

Currently, links between QoL and muscle function have been investigated using generic health-related questionnaires. The three questionnaires most commonly used in the

CONTACT Charlotte Beaudart c.beaudart@ulg.ac.be Department of Public Health, Epidemiology and Health Economics, University of Liège, Belgium
Supplemental data for this article can be accessed here.

literature are (1) the Short-Form 36 questionnaire (SF-36) [17], composed of 36 items measuring eight health-related QoL domains (physical functioning [PF], role limitation due to physical problems [RP], bodily pain [BD], general health [GH], vitality [VT], social functioning [SF], role limitation due to emotional problem [RE], and mental health [MH]); (2) the EuroQoL 5-dimension (EQ-5D) [18] questionnaire, which records the level of self-reported problems in five dimensions (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression); and (3) the EQ visual analog scale (EQ-VAS) questionnaire [18,19], which records the patient's self-rated health on a scale ranging from 0 (worst imaginable health) to 100 (best imaginable health).

2.2. QoL and muscle function

Several studies have shown that lower grip strength is associated with reduced HRQoL. In 2012, Silva Netto showed that handgrip strength correlated positively and significantly with all of the SF-36 dimensions except vitality and mental health [20] in a population of 56 subjects aged 64.92 ± 5.74 years. A significant association between reduced grip strength and reduced QoL was also shown in 2987 community-dwelling men and women aged 59–73 years from the Hertfordshire study in the UK [21], in 764 older adults in the ISCOPE study [22], in 432 hospitalized elderly people [23] and in 117 elderly people with heart failure [24].

Links between QoL and muscle mass have been less frequently investigated. In 2002, Ianuzzi et al. [25] published data showing a significant correlation between low muscle mass and reduced QoL but only for the general health score of the SF-36 questionnaire and only for men, not for women. Bekfani et al. [24] also showed that higher appendicular lean mass (ALM) values were associated with a better QoL in 117 elderly people with heart failure. It should be pointed that none of these studies are prospective studies.

2.3. QoL and sarcopenia

No fewer than 11 different studies investigating QoL in a sarcopenic population were identified through a systematic literature search performed on PubMed (MEDLINE) and Web of Science until March 2016. Results shown that arcopenia was diagnosed using different methods (the definitions of the European Working Group on Sarcopenia in Older People (EWGSOP) or Baumgartner, specific ALM indexes, the SARC-F screening tool). All these studies used generic QoL questionnaires (seven used the SF-36, three used the EQ5D, three used the EQVAS and one used the CASP-12 scale [26]). The results were quite heterogeneous (Table 1), showing either no difference in QoL between sarcopenic and non-sarcopenic participants or poorer QoL for sarcopenic patients, but generally only for specific QoL domains.

These results highlight the fact that only specific domains of QoL are impacted by sarcopenia and, therefore, that generic tools may not be able to detect the subtle effects of sarcopenia on QoL. Moreover, in generic questionnaires, only a restricted number of questions will be relevant to sarcopenia; therefore, it is more difficult to observe a difference between sarcopenic and non-sarcopenic subjects with such a tool than with a specific questionnaire in which all questions are related to sarcopenia. After a treatment that increased muscle function, for example, all responses to a specific questionnaire are likely to vary, and the general score of the scale will be impacted; however, since only a restricted number of questions on a generic questionnaire will vary, variation in the global score will be low. A specific tool would thus be better able to accurately assess the impact of sarcopenia on QoL.

3. The SarQoL®, a specific tool to assess QoL in sarcopenia

3.1. Interest in the development of a specific tool to assess QoL in sarcopenia

Recently, the Department of Public Health, Epidemiology and Health Economics of the University of Liège, Belgium, in collaboration with (1) the Division of Bone Diseases, Faculty of Medicine, Geneva University Hospitals, Geneva, Switzerland; (2) Clinical Gerontology, CHU Toulouse, Toulouse, France; (3) the Frailty in Aging Research Department, Vrije Universiteit Brussel, Brussels, Belgium; and (4) the Geriatric Department, CHU Liège, Liège, Belgium, developed a specific HRQoL questionnaire for sarcopenia, the SarQoL® [41,42]. The purposes of this questionnaire are to create a tool to clinically characterize QoL in subjects with sarcopenia; to enhance the accuracy of clinicians' assessments of well-being and the physical, psychological and social impacts of sarcopenia; to assess changes in QoL over time in this population and, finally, to assess the relevance of therapeutic interventions in the field of sarcopenia by measuring their effectiveness in terms of changes in QoL.

This questionnaire comprises 55 items transcribed into 22 questions. All these questions are specific to muscle mass and muscle function. Therefore, this questionnaire can be used for sarcopenia patients and for any population with impaired muscle function.

The sarcopenic subjects used for the development and validation of the French version of the SarQoL® were recruited from the SarcoPhAge study (for *Sarcopenia and Physical Impairments with Advancing Age* – an ongoing Belgian prospective study that enrolled a convenience sample of older subjects with the main objective of assessing the health and functional outcomes of sarcopenia) [27]. Sarcopenia was diagnosed according to the algorithm developed by the EWGSOP [3] :

- An appendicular lean muscle mass/height^2 (SMI) <5.5 kg/m^2 for women and <7.26 kg/m^2 for men assessed using dual-energy X-ray absorptiometry and
- A muscle strength <20 kg for women and <30 kg for men assessed using a hydraulic hand dynamometer or a physical performance ≤8 points assessed with the Short Physical Performance Battery (SPPB) test.

In the whole sample of the SarcoPhAge study [27] (n = 534), 73 subjects were diagnosed with sarcopenia (25 men and 48

Table 1. Literature review of studies assessing QoL in sarcopenia patients.

Reference	Sarcopenia diagnostic criteria	QoL tool(s) used	Results
Beaudart [27]	EWGSOP [3]	SF-36 EQ-5D EQ-VAS	Poorer QoL of sarcopenic patients only for physical functioning No difference in QoL between groups No difference in QoL between groups
Go [28]	ALM/ht^2 <2SD of the sex-specific means of young adults	EQ-5D	Lower QoL for sarcopenic patients
Koo [29]	ALM/weight <1SD of the sex-specific mean of young adults	EQ-5D EQ-VAS	Poorer QoL for sarcopenic patients No difference in QoL between groups
Manrique-Espinoza [30]	EWGSOP [3]	SF-36	Poorer QoL for severe sarcopenic patients for both mental and physical component scores
Messier [31]	(ALBMI) ≤6.44 kg/m^2 for women	SF-36	No difference in QoL between groups
Morishita [32]	SMI index < cut off of Chien et al. [33]	SF-36	Poorer QoL for sarcopenic patients in three domains: physical functioning, bodily pain, vitality
Patel [34]	EWGSOP [3]	SF-36	Poorer QoL for sarcopenic patients in two domains: physical functioning and general health
Pedrero Chamizo [35]	Sex-specific cut off values published by Gómez-Cabello [36]	EQ-VAS	No difference of QoL between sarcopenic group and normal group
Silva Netto [20]	Baumgartner [37]	SF-36	No difference in QoL between groups
Wu [38]	SARC-F [39]	CASP-12 scale	Poorer QoL for sarcopenic patients
Yadav [40]	L3 skeletal mass index (SMI) of ≤52.4 cm^2/m^2 in males and ≤38.5 cm^2/m^2 in females	SF-36	No difference in QoL between groups

ALM: appendicular lean mass; ALBMI: appendicular lean body mass index; SD: standard deviation.

women). Some of them took part in the development and validation of the SarQoL®.

3.2. Development of the SarQoL®

The SarQoL® was first developed in French [41] in four different steps [43,44]. During the first step, a list of 67 items related to QoL in sarcopenia was generated through a literature review. This list was then augmented through qualitative interviews with five sarcopenic subjects and through a structured-questionnaire given to seven different experts in the field of sarcopenia and aging. The resulting list comprised 180 items. During the second step, this list was reduced by asking 21 sarcopenic subjects (median age 76.1 [71.6–80.1] years, 13 women and eight men) and the seven experts to rate the relevance of each item on a Likert scale. Finally, 55 items were included in the SarQoL® and were transformed into 22 questions. All the questions are presented using a Likert scale format. These items are organized into seven domains of dysfunction: physical and mental health, locomotion, body composition, functionality, activities of daily living, leisure activities and fears.

The SarQoL® is a self-administered questionnaire, which means that each patient must complete the questionnaire by himself. A pretest, performed on 20 sarcopenic subjects, indicated that the SarQoL® is comprehensible, easy to complete, independently, in approximately 10–15 min. The total possible score for the SarQoL® is 100 points. An individual score for each domain can also be determined.

3.3. Validation of the SarQoL®

Before using a questionnaire for clinical and research purposes, it is important to ensure that it has the appropriate psychometric properties for its intended application. The SarQoL® has therefore been tested for these proprieties among 296 subjects (median age of 73.3 [68.9–78.6] years, 57% of women) [42].

Several psychometric analyses were performed.

First, the discriminative power of the SarQoL® was tested. The results indicated that sarcopenic subjects (n = 43) presented a significantly reduced QoL compared to non-sarcopenic ones (n = 253) when the SarQoL® was used. Regarding the total score of the SarQoL®, the sarcopenic subjects showed a median QoL of 54.7 (45.9–66.3) compared with 67.8 (57.3–79.0) for non-sarcopenic subjects (p-value adjusted for age and BMI < .001). A significantly reduced QoL was observed for sarcopenic subjects on all seven domains of the QoL in the SarQoL®. These results indicate that the questionnaire has good discriminative power. Moreover, two generic QoL questionnaires (i.e. the SF-6 and EQ5D) were also completed by the study population. These generic questionnaires, which are not specifically related to sarcopenia, were unable to show a difference in QoL between the sarcopenic and non-sarcopenic subjects except on the SF-36 domain of physical functioning, which yielded lower scores for sarcopenic subjects than for non-sarcopenic subjects. These results reinforce the necessity of using a specific HRQoL tool instead of a generic one to assess QoL in a specific disease.

Second, we measured the internal consistency, which is the estimation of the questionnaire's homogeneity. A Cronbach's alpha of .87 was found. All individual domains were also significantly and positively correlated with the total score of the SarQoL® (p < .001 for all domains). These results indicated good internal consistency, which is an important psychometric property for the validation of HRQoL questionnaires.

Third, the SarQoL® was also tested for test-retest reliability. Indeed, when no health change is observed over

2 weeks among the population, the score of the SarQoL® is expected to be unchanged. This property is measured with an intra-class coefficient correlation (ICC). Validation analyses indicated excellent test-retest reliability after a 2-week interval, with an ICC of .91 (95% CI .82–.95).

Fourth, construct validity was measured. The purpose of these analyses was to check the correlation between this new specific HRQoL questionnaire for sarcopenia and generic validated HRQoL questionnaires that are not specific to sarcopenia, namely the SF-36 questionnaire and the EQ-5D questionnaire. As the authors expected, the results showed that the total score of the SarQoL® was positively correlated with some domains of the SF-36 questionnaire (physical functioning [$r = .49$, $p < .001$], vitality [$r = .72$, $p < .001$], and general health [$r = .67$, $p < .001$]) and with the utility score of the EQ-5D questionnaire ($r = .47$, $p = .002$), the questions on the EQ-5D questionnaire related to usual activities ($r = -.57$, $p < .001$) and the Mobility Test questionnaire ($r = .77$, $p < .001$). These results confirmed the convergent validity.

The authors confirmed that the SarQoL® is valid, consistent, and reliable and can therefore be proposed for clinical and research purposes. However, they specified that this questionnaire still needs to be validated regarding its sensitivity to change. All the above-mentioned analyses were performed through a cross-sectional study. A longitudinal study is necessary to see the evolution of the SarQoL® results in relation to the evolution of muscle function.

3.4. Translation of the SarQoL®

The SarQoL® has been available in the literature since October 2015. To extend the availability and utilization of this questionnaire, a first translation in English has been performed [45] (the full version of the SarQoL® questionnaire is available in Supplementary data 1). For this translation, the authors developed a standardized protocol and followed five different phases. First, a translation of the SarQoL® from French to English was performed by two independent bilingual translators who were English native speakers. Secondly, the translations were synthesized to produce a 'version 1' of the translated SarQoL. In the third phase, this version 1 was back-translated from English to French by two independent bilingual translators whose first language was French and who were blinded to the original French version. In the fourth phase, an expert committee review compared the back translations with the original questionnaire and agreed to a 'version 2' of the translated questionnaire. Finally, this version 2 was pretested to ensure good comprehension of each question of the questionnaire, and 'version 3', the final version of the English SarQoL®, was produced. The study sample was composed of 297 subjects (137 women [46.1%] and 160 men [53.9%] with a mean age of 79.5 ± 2.62 years) from the Hertfordshire Cohort Study (HCS) who agreed to participate in the UK component of the European Project on Osteoarthritis (EPOSA).

The 22 questions of the SarQoL® were translated without any major difficulties. The same validations that were performed for the French version were performed for the English version. The results were similar: the English SarQoL® showed good discriminative power, excellent test-retest reliability, excellent internal consistency and adequate construct validity. The English version of the SarQoL® is valid for England and has also been culturally validated for America.

Table 2. Translation of the SarQoL® into foreign languages.

Available translated versions	Translation in progress
French[a] (valid for French-speaking European countries)	Thai
English (valid for the UK and America)[a]	Portuguese (European)
Dutch	Arabic
Ukrainian	Lithuanian
Hungarian	Malaysian
Romanian[a]	Filipino
Greek	Russian
Polish[a]	Serbian
Italian	Slovak
German	Turkish
Portuguese (Brazil)	Vietnamese
Czech	Japanese
Spanish	Indonesian
Farsi/Persian	Bulgarian
	Chinese (Cantonese)
	Swedish
	Latvian
	Hindi
	Slovenian
	Croatian

[a]Psychometric properties have been checked for these versions.

At present, the SarQoL® has been translated in 11 other languages, including Dutch, German, Spanish, Italian, Greek, Hungarian, Romanian, Ukrainian, Polish, Persian, and Czech. Only the French, English, Polish and Romanian versions have already been validated. All these versions are available on the SarQoL® website (www.sarqol.org). The translation of the SarQoL® into another 20 different languages is also in progress (Table 2). Researchers interested in the translation and validation of the SarQoL® in their own language (not contained in Table 2) can contact the designers of the SarQoL® (Dr. Charlotte Beaudart, c.beaudart@ulg.ac.be and Pr. Olivier Bruyère, olivier.bruyere@ulg.ac.be). A standardized protocol of translation and validation has been developed to harmonize all the translation processes.

4. Conclusion

In the current context of population aging and improved life expectancy, a great challenge is to limit the burden of disease on individual and public health. Sarcopenia represents an important economic and social burden, and improvements in QoL for people with sarcopenia should be a priority for future interventions designed to prevent or treat sarcopenia. The recent development of the SarQoL®, a HRQoL questionnaire specific to sarcopenia, should help to validate these therapeutic interventions. The SarQoL® has been shown to be understandable, valid, consistent, and reliable and can therefore be recommended for clinical and research purposes. The questionnaire is now available in 11 different languages with an additional 20 translations in progress. The SarQoL®'s sensitivity to change needs to be assessed in future longitudinal studies and in interventional clinical studies.

5. Expert commentary

The measurement of HRQoL has become increasingly important in research and clinical practice over the past three decades. Indeed, HRQoL assessments are considered important for allowing health care providers and regulatory agencies to understand the needs and preoccupations of the population. HRQoL is increasingly used in observational studies and in interventional clinical studies, in which QoL can be considered a primary or secondary end point. Moreover, many current medical interventions are designed to improve QoL rather than to prolong life. The inclusion of QoL measures in studies is no longer restricted to highly developed Western countries but has expanded to countries throughout the world [46,47].

The SarQoL®, recently developed and validated with the purpose to assess HRQoL in sarcopenia, has been shown across different publications to be valid, consistent and reliable. It can be used to assess the QoL of elderly subjects suffering from muscle impairments such as sarcopenia. The SarQoL® can be used by doctors to assess the QoL of their patients in their daily practice, by researchers to assess the QoL of populations with sarcopenia or to determine the impact of non-pharmaceutical therapeutic strategies on sarcopenia, and by industries to evaluate the impact of their interventions (pharmaceutical interventions, dietary interventions, etc.) on the HRQoL of subjects with sarcopenia.

It should be pointed, however, that many different definitions of sarcopenia are available in literature. It has been shown that prevalence of sarcopenia across different definitions and diagnostic criteria can vary widely [48–51]. Therefore, to check whether the SarQoL® can discriminate between sarcopenic subjects and non-sarcopenic subjects in terms of their QoL, unpublished analyses have been performed; no less than six different definitions of sarcopenia have therefore been applied by the authors of the SarQoL® to compare the QoL of sarcopenic subjects with that of non-sarcopenic subjects. Among the six definitions used, two were based on low lean mass alone (Baumgartner [37], Delmonico [52]) and four required both low muscle mass and decreased performance on a functional test (Cruz-Jentoft [3], Studenski [5], Fielding [4], Morley [6]). This unpublished data (which was presented as an oral communication in EUGMS Congress 2016) showed that the SarQoL® is able to discriminate sarcopenic from non-sarcopenic subjects in terms of their QoL regardless of the definition used for the diagnosis as long as the definition includes an assessment of both muscle mass and muscle function. Of course, the prevalence of sarcopenia varied widely across definitions (the highest prevalence was found with Delmonico's definition: 32.8%, and the lowest prevalence was found with Morley's definition: 4.39%). Using the SarQoL®, a lower QoL was found for sarcopenic subjects compared to non-sarcopenic ones when using the definition of the definitions of Cruz-Jentoft (56.3 ± 13.4 vs. 68.0 ± 15.2, $p < .001$), of Studenski (51.1 ± 14.5 vs. 68.2 ± 14.6, $p < .001$), of Fielding (53.8 ± 12.0 vs. 68.3 ± 15.1, $p < .001$), as well as with the definition proposed by Morley (53.3 ± 12.5 vs. 67.1 ± 15.3, $p < .001$). No QoL difference between sarcopenic and non-sarcopenic subjects was found when using the definition of Baumgartner or Delmonico, which were only based on the notion of decreased muscle mass. In this dataset, poorer QoL seems to be more related to muscle function than to muscle mass.

Even if the SarQoL® is demonstrating an interesting discriminative power, regardless of the definition used for the diagnosis of sarcopenia, a weakness of this questionnaire is that one of the major psychometric properties has still not being checked: sensitivity to change. Indeed, the score of the SarQoL® is supposed to vary according to the evolution of muscle function. The SarcoPhAge study [27] showed that the scores of subjects with severe sarcopenia (n = 16) were even lower than those obtained by the sarcopenic subjects, which indicates that the SarQoL® can capture the severity of sarcopenia. However, it is still insufficient to indicate that the SarQoL® can vary according to the evolution of muscle function. The publications related to sarcopenia refer to cross-sectional study design. Sensitivity to change needs to be evaluated using prospective data.

At present, unpublished preliminary data regarding sensitivity to change have been obtained from the SarcoPhAge study [27]. The SarQoL® and two generic HRQoL questionnaires (EQ-5D and EQVAS) were completed by 301 subjects from the SarcoPhAge study [27] at baseline and after 1 year of follow-up. The results showed that the QoL of the general population (75.0 ± 5.97 years, 59% women) decreased over time, regardless of the questionnaire that was used ($p < .001$ with the SarQoL®, $p = .03$ with the EQVAS, $p < .001$ with the EQ-5D). The skeletal muscle index (ALM/h^2) did not change significantly, but a decrease in muscle strength and gait speed was observed ($p < .001$ for both). A significant correlation was found between the 1-year decrease in gait speed and the 1-year decrease in QoL only when the SarQoL® questionnaire was used and not when using the generic questionnaires (EQ-5D or EQVAS). The results indicated correlations of $r = .21$ ($p < .001$) for the whole cohort population and $r = .41$ ($p = .013$) for the sarcopenic population (n = 38). These associations were not observed for muscle mass ($p = .65$) or muscle strength ($p = .06$). In a multivariate regression, the association between decreased gait speed and decreased QoL, assessed with the SarQoL®, was significant independent of age, sex, number of comorbidities and number of drugs used ($p < .001$ for both the whole cohort and the sarcopenic subjects). These findings suggest that a decrease in physical performance (gait speed) is associated with a decrease in QoL, specifically in terms of muscle impairments, in the elderly, specifically those suffering from sarcopenia. The specific SarQoL® seems better adapted than generic tools to identify muscle function-related decreases in QoL.

6. Five-year view

More robust data regarding sensitivity to change should be available in the next few years. Indeed, currently, the SarQoL® is being used within the SarcoPhAge study [27]. Each year, people aged 65 years and older complete this questionnaire. Moreover,

aside from the studies involved in the translation and validation of the SarQoL®, this sarcopenia-specific QoL questionnaire is also being used in three different prospective studies: one in Lyon, France, one in Geneva, Switzerland, and one in Toulouse, France. This means that prospective data should be available soon to assess the evolution of the QoL for evaluating the evolution in muscle function among populations aged 65 years and older.

The SarQoL® should also be tested in interventional studies to assess its sensitivity to change. If interventions can increase muscle mass, muscle strength and muscle performance, it could be hypothesized that these same interventions will also increase HRQoL. The SarQoL® has still not been tested in such types of interventional studies, but future results regarding the evolution of HRQoL in sarcopenic subjects following a therapeutic intervention should be available in the next few years.

Finally, the development of a short-form of the SarQoL® is also scheduled. The purpose is to facilitate and increase the use of this questionnaire by clinical doctors in their daily practice.

Key issues

- Limit the burden of sarcopenia on individual and public health is a great issue;
- Improvement of QoL in sarcopenia should be a priority for futures intervention designed to prevent or treat sarcopenia;
- The recent development of the SarQoL®, a HRQoL questionnaire specific to sarcopenia, should help to validate these therapeutic interventions.
- The SarQoL® has been shown to be understandable, valid, consistent, and reliable and can therefore be recommended for clinical and research purposes. The questionnaire is now available in 11 different languages with an additional 20 translations in progress. The SarQoL®'s sensitivity to change needs to be assessed in future longitudinal studies and in interventional clinical studies.

Funding

C Beaudart is supported by a fellowship from the FNRS (Fonds National de la Recherche Scientifique de Belgique FRS-FNRS — www.frs-fnrs.be).

Declaration of interest

C Beaudart, O Bruyère and JY Reginster are the shareholders of SarQoL® sprl. The authors have no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties.

References

Papers of special note have been highlighted as either of interest (•) or of considerable interest (••) to readers.

1. Deschenes MR. Effects of aging on muscle fibre type and size. Sports Med. 2004;34:809–824.
2. Rosenberg IH. Sarcopenia: origins and clinical relevance. J Nutr. 1997 May 01;127:990S–991S.
3. Cruz-Jentoft AJ, Baeyens JP, Bauer JM, et al. Sarcopenia: European consensus on definition and diagnosis: report of the European Working Group on Sarcopenia in Older People. Age Ageing. 2010 Apr 16;39:412–423.
4. Fielding RA, Vellas B, Evans WJ, et al. Sarcopenia: an undiagnosed condition in older adults. Current consensus definition: prevalence, etiology, and consequences. International working group on sarcopenia. J Am Med Dir Assoc. 2011 Apr 30;12:249–256.
5. Studenski SA, Peters KW, Alley DE, et al. The FNIH sarcopenia project: rationale, study description, conference recommendations, and final estimates. J Gerontol A Biol Sci Med Sci. 2014;69:547–558.
6. Morley JE, Abbatecola AM, Argiles JM, et al. Sarcopenia with limited mobility: an international consensus. J Am Med Dir Assoc. 2011;12:403–409.
7. Muscaritoli M, Anker SD, Argilés J, et al. Consensus definition of sarcopenia, cachexia and pre-cachexia: joint document elaborated by Special Interest Groups (SIG) "cachexia-anorexia in chronic wasting diseases" and "nutrition in geriatrics". Clin Nutr. 2010;29:154–159.
8. Dam -T-T, Peters KW, Fragala M, et al. An evidence-based comparison of operational criteria for the presence of sarcopenia. J Gerontol A Biol Sci Med Sci. 2014;69:584–590.
9. Cooper C, Dere W, Evans W, et al. Frailty and sarcopenia: definitions and outcome parameters. Osteoporos Int. 2012 Feb 01;23:1839–1848.
10. Chen L-K, Liu L-K, Woo J, et al. Sarcopenia in Asia: consensus report of the Asian Working Group for Sarcopenia. J Am Med Dir Assoc. 2014;15:95–101.
11. Cruz-Jentoft AJ, Landi F, Schneider SM, et al. Prevalence of and interventions for sarcopenia in ageing adults: a systematic review. Report of the International Sarcopenia Initiative (EWGSOP and IWGS). Age Ageing. 2014 Sep 23;43:748–759.
12. Shafiee G, Keshtkar A, Soltani A, et al. Prevalence of sarcopenia in the world: a systematic review and meta- analysis of general population studies. J Diabetes Metab Disord. 2017;16:21.
13. Beaudart C, Zaaria M, Pasleau F, et al. Health outcomes of sarcopenia: a systematic review and meta-analysis. PLoS One. 2017;12:e0169548. Wright JM, editor.
14. Beaudart C, Rizzoli R, Bruyère O, et al. Sarcopenia: burden and challenges for public health. Arch Public Heal BioMed Central Ltd. 2014;72:45.
• **Burden of sarcopenia for public health.**
15. Cao L, Morley JE, Rosenberg H, et al. Sarcopenia is recognized as an independent condition by an international classification of disease, tenth revision, clinical modification (ICD-10-CM) code. J Am Med Dir Assoc. 2016;17:675–677.
• **Sarcopenia is recognized as an independent condition.**
16. Rizzoli R, Reginster JY, Arnal JF, et al. Quality of life in sarcopenia and frailty. Calcif Tissue Int. 2013 Jul 06;93:101–120.
• **Review paper on quality of life in sarcopenia.**
17. Ware JE Jr., Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care. 1992 Jun 11;30:473–483.
18. Rabin R, De Charro F. EQ-5D: a measure of health status from the EuroQol Group. Ann Med. 2001 Aug 09;33:337–343.
19. Brooks R. EuroQol: the current state of play. Health Policy (New York). 1996 Jun 06;37:53–72.
20. Silva Neto LS, Karnikowiski MG, Tavares AB, et al. Association between sarcopenia, sarcopenic obesity, muscle strength and quality of life variables in elderly women. Rev Bras Fisioter. 2012 Sep 18;16:360–367.
21. Sayer AA, Syddall HE, Martin HJ, et al. Is grip strength associated with health-related quality of life? Findings from the Hertfordshire Cohort Study. Age Ageing. 2006 May 13;35:409–415.
22. Chan OYA, Van Houwelingen AH, Gussekloo J, et al. Comparison of quadriceps strength and handgrip strength in their association with health outcomes in older adults in primary care. Age (Dordr). 2014;36:9714.

23. Gariballa S, Alessa A. Association between muscle function, cognitive state, depression symptoms and quality of life of older people: evidence from clinical practice. Aging Clin Exp Res. 2017.
24. Bekfani T, Pellicori P, Morris DA, et al. Sarcopenia in patients with heart failure with preserved ejection fraction: impact on muscle strength, exercise capacity and quality of life. Int J Cardiol. 2016;222:41–46.
25. Iannuzzi-Sucich M, Prestwood KM, Kenny AM. Prevalence of sarcopenia and predictors of skeletal muscle mass in healthy, older men and women. J Gerontol A Biol Sci Med Sci. 2002 Nov 29;57:M772–7.
26. Sexton E, King-Kallimanis BL, Conroy RM, et al. Psychometric evaluation of the CASP-19 quality of life scale in an older Irish cohort. Qual Life Res. 2013;22:2549–2559.
27. Beaudart C, Reginster JY, Petermans J, et al. Quality of life and physical components linked to sarcopenia: the SarcoPhAge study. Exp Gerontol. 2015;69:103–110.
28. Go SW, Cha YH, Lee JA, et al. Association between Sarcopenia, bone density, and health-related quality of life in Korean men. Korean J Fam Med. 2013;34:281–288.
29. Koo H-K, Park J-H, Park HK, et al. Conflicting role of sarcopenia and obesity in male patients with chronic obstructive pulmonary disease: Korean national health and nutrition examination survey. PLoS One. 2014;9:e110448. Cappello F, editor.
30. Manrique-Espinoza B, Salinas-Rodríguez A, Rosas-Carrasco O, et al. Sarcopenia is associated with physical and mental components of health-related quality of life in older adults. J Am Med Dir Assoc. 2017;18:636.e1-636.e5.
31. Messier V, Karelis AD, Lavoie M-E, et al. Metabolic profile and quality of life in class I sarcopenic overweight and obese postmenopausal women: a MONET study. Appl Physiol Nutr Metab [Physiol Appl Nutr Métabolisme]. 2009;34:18–24.
32. Morishita S, Kaida K, Tanaka T, et al. Prevalence of sarcopenia and relevance of body composition, physiological function, fatigue, and health-related quality of life in patients before allogeneic hematopoietic stem cell transplantation. Support Care Cancer. 2012 Apr 25;20:3161–3168.
33. Chien MY, Huang TY, Wu YT. Prevalence of sarcopenia estimated using a bioelectrical impedance analysis prediction equation in community-dwelling elderly people in Taiwan. J Am Geriatr Soc. 2008 Aug 12;56:1710–1715.
34. Patel HP, Syddall HE, Jameson K, et al. Prevalence of sarcopenia in community-dwelling older people in the UK using the European Working Group on Sarcopenia in Older People (EWGSOP) definition: findings from the Hertfordshire Cohort Study (HCS). Age Ageing. 2013 Feb 07;42:378–384.
35. Pedrero-Chamizo R, G?mez-Cabello A, M?Lendez A, et al. Higher levels of physical fitness are associated with a reduced risk of suffering sarcopenic obesity and better perceived health among the elderly. The EXERNET multi-center study. J Nutr Health Aging. 2015;19:211–217.
36. Gomez-Cabello A, Pedrero-Chamizo R, Olivares PR, et al. Prevalence of overweight and obesity in non-institutionalized people aged 65 or over from Spain: the elderly EXERNET multi-centre study. Obes Rev. 2011;12:583–592.
37. Baumgartner RN, Koehler KM, Gallagher D, et al. Epidemiology of sarcopenia among the elderly in New Mexico. Am J Epidemiol. 1998 Apr 29;147:755–763.

• **First operational definition of sarcopenia.**

38. Wu T-Y, Liaw C-K, Chen F-C, et al. Sarcopenia screened with SARC-F questionnaire is associated with quality of life and 4-year mortality. J Am Med Dir Assoc. 2016;17:1129–1135.
39. Malmstrom TK, Morley JE. SARC-F: a simple questionnaire to rapidly diagnose sarcopenia. J Am Med Dir Assoc. 2013;14:531–532.
40. Yadav A, Chang Y-H, Carpenter S, et al. Relationship between sarcopenia, six-minute walk distance and health-related quality of life in liver transplant candidates. Clin Transplant. 2015;29:134–141.
41. Beaudart C, Biver E, Reginster J-Y, et al. Development of a self-administrated quality of life questionnaire for sarcopenia in elderly subjects: the SarQoL. Age Ageing. 2015;44:960–966.

•• **Development of the original SarQoL® questionnaire.**

42. Beaudart C, Biver E, Reginster J-Y, et al. Validation of the SarQoL®, a specific health-related quality of life questionnaire for Sarcopenia. J Cachexia Sarcopenia Muscle. 2017 Apr;8(2):238-244.

•• **Validation of the original SarQoL® questionnaire.**

43. Johnson C, Aaronson NK, Blazeby JM, et al. EORTS quality of life group : guidelines for developing questionnaire modules. Eur Organ Res Treat Cancer. 2011. 4th ed. Available from: http://groups.eortc.be/qol/sites/default/files/archives/guidelines_for_developing_questionnaire-_final.pdf
44. Guyatt GH, Bombardier C, Tugwell PX. Measuring disease-specific quality of life in clinical trials. Cmaj. 1986 Apr;15(134):889–895.
45. Beaudart C, Edwards MH, Moss C, et al. English translation and validation of the SarQoL®, a quality of life questionnaire specific for sarcopenia. Age Ageing. 2016;0:1–7.
46. Nglazi MD, West SJ, Dave JA, et al. Quality of life in individuals living with HIV/AIDS attending a public sector antiretroviral service in Cape Town, South Africa. BMC Public Health. 2014;14:676.
47. Zhou J, Ru X, Hearst N, et al. Individual and household-level predictors of health related quality of life among middle-aged people in rural Mid-east China: a cross-sectional study. BMC Public Health. 2014;14:660.
48. Dupuy C, Lauwers-Cances V, Guyonnet S, et al. Searching for a relevant definition of sarcopenia: results from the cross-sectional EPIDOS study. J Cachexia Sarcopenia Muscle. 2015;6:144–154.
49. Bijlsma AY, Meskers MC, Molendijk M, et al. Diagnostic measures for sarcopenia and bone mineral density. Osteoporos Int. 2013 May 08;24:2681–2691.
50. Beaudart C, Reginster JY, Slomian J, et al. Prevalence of sarcopenia: the impact of different diagnostic cut-off limits. J Musculoskelet Neuronal Interact. 2014;14:425–431.
51. Beaudart C, Reginster JY, Slomian J, et al. Estimation of sarcopenia prevalence using various assessment tools. Exp Gerontol. 2014 Dec 03;61C:31–37.
52. Delmonico MJ, Harris TB, Lee JS, et al. Alternative definitions of sarcopenia, lower extremity performance, and functional impairment with aging in older men and women. J Am Geriatr Soc. 2007 May 12;55:769–774.