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ORIGINAL ARTICLE

Assessment of the performance of the SarQoL® questionnaire in screening for sarcopenia in older people

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Abstract

Background Because of its low prevalence and the need for physical tests to establish a diagnosis, recruiting sarcopenic people for clinical studies can be a resource-intensive process.

Aims We investigated whether the SarQoL®, a 55-item questionnaire designed to measure quality of life in sarcopenia, could be used to identify older people with a high likelihood of being sarcopenic, and to compare its performance to the SARC-F tool.

Methods We performed a secondary analysis of data from older, community-dwelling participants of the SarcoPhAge study, evaluated for sarcopenia according to the EWGSOP2 criteria, and who completed the SarQoL® and SARC-F questionnaires. We determined the optimal threshold to distinguish between sarcopenic and non-sarcopenic people with the Youden index. Screening performance was evaluated with the area under the curve (AUC) and by calculating sensitivity and specificity.

Results The analysis of 309 participants provided an optimal threshold value of ≤ 52.4 points for identifying people with sarcopenia with the SarQoL® questionnaire, which resulted in a sensitivity of 64.7% (41.1–84.2%), a specificity of 80.5% (75.7–84.7%) and an AUC of 0.771 (0.652–0.889). Compared to the SARC-F, the SarQoL® has greater sensitivity (64.7% vs 52.39%), but slightly lower specificity (80.5% vs. 86.6%).

Discussion The SarQoL® questionnaire showed acceptable screening accuracy, on par with the SARC-F. The optimal threshold of ≤ 52.4 points should be confirmed in other cohorts of older people.

Conclusions This exploratory study showed that the SarQoL® could potentially be applied in a screening strategy, with the added benefit of providing a measure of QoL at the same time.

Keywords Sarcopenia · Screening · SarQoL · Sensitivity · Specificity

Introduction

Sarcopenia has been described by the 2nd European Working Group on Sarcopenia in Older People (EWGSOP2) as a "progressive and generalised skeletal muscle disorder that is associated with increased likelihood of adverse outcomes including falls, fractures, physical disability and mortality". In the same article, the EWGSOP2 also presented a revision of its diagnostic criteria for sarcopenia, presenting a new diagnostic algorithm and changing the threshold values for low muscle strength and low muscle mass [1]. This revision has increased the consistency between studies in the evaluation of sarcopenia, but some studies have observed that it lowers the prevalence of sarcopenia compared to the EWGSOP1 criteria [2, 3]. For clinical research and epidemiological studies, this means that more candidates need to

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be evaluated to achieve a sufficient number of sarcopenic participants to obtain the desired statistical power.

To help researchers recruit sarcopenic individuals in an efficient and cost-effective manner, multiple screening tools have been developed to identify those candidates with the highest probability of having sarcopenia. These come in different forms: there are questionnaires such as the Mini Sarcopenia Risk Assessment (MSRA—both a 7 and 5-item version available) and the SARC-F questionnaire (a 5 and 3-item version exist, as well as a version with calf circumference and a version which takes into account age and body mass) [4]. Other screening instruments rely solely on physical characteristics, such as the score developed by Ishii et al (age, grip strength and calf circumference), muscle mass prediction formulas or the chair stand test [4, 5].

Clinical studies in sarcopenia require a substantial amount of time and effort, because of the need to include and evaluate a large number of candidates to find sufficient sarcopenic subjects to achieve the required level of statistical power. A full diagnostic evaluation where muscle mass is evaluated by dual-energy X-ray absorptiometry (DXA) and muscle strength by dynamometer, as recommended, necessitates the use of qualified personnel and expensive instruments. Given the cost per patient for these evaluations, screening instruments that can significantly increase the proportion of sarcopenic persons within the pool of candidates invited for a full body composition assessment could greatly help the financial feasibility of large-scale clinical studies in sarcopenia. With this in mind, the hypothesis was raised that an existing instrument, developed to measure quality of life in sarcopenia, could potentially be of use in screening candidates for referral to full body composition evaluation and/or physical function assessment.

The instrument investigated in this study is the Sarcopenia Quality of Life (SarQoL®) questionnaire. It evaluates quality of life in sarcopenia through 55 items categorized into 7 domains of health-related dysfunction [6]. It is an auto-administered instrument and takes about 15 min to complete. Its clinimetric properties as a QoL questionnaire have been demonstrated in multiple validation studies conducted in multiple languages [7–18]. Of particular interest in this context is the repeated observation that the SarQoL® questionnaire is able to discriminate between sarcopenic and non-sarcopenic groups, with the former scoring significantly lower on the overall QoL score of the questionnaire compared to the latter. Its focus on the impact of musculoskeletal health on quality of life contributes to our expectation that the overall QoL score produced by the SarQoL® questionnaire could be used to screen older people and identify those with a higher likelihood of sarcopenia.

The objective of this study is therefore to evaluate the capacity of the Overall QoL score of the SarQoL® questionnaire to detect individuals with sarcopenia according to the revised EWGSOP2 consensus criteria. The hypothesis linked to this objective is that the Overall QoL score of the SarQoL® questionnaire has an area under the ROC curve (AUC) greater than 0.7, indicating the test is useful in distinguishing between sarcopenic and non-sarcopenic people [19].

The secondary objective of this study is to compare the screening performance of the Overall QoL score of the SarQoL® questionnaire with the performance of the 5-item SARC-F questionnaire, the screening tool recommended by the EWGSOP2 [1]. The hypothesis linked to this objective is that the Overall QoL score is at least as accurate as the SARC-F, judged by AUC, sensitivity and specificity.

Material and methods

This study is a cross-sectional secondary evaluation of data collected at the third year of follow-up of the Sarcopenia and Physical Impairment with advancing Age (SarcoPhAge) prospective cohort study, carried out in the Liège province of Belgium [20]. The SarcoPhAge study was conducted in compliance with the principles outlined in the Declaration of Helsinki. The study protocol and its amendments received approval from the Ethics Committee of the University Teaching Hospital of Liège (n° 2012-277), and all participants provided written informed consent. This article was written to comply, as much as feasible, with the most recent version of the Standards for Reporting Diagnostic Accuracy (STARD) checklist [21].

Participants

The SarcoPhAge study enrolled a convenience sample of people who visited an outpatient clinic in Liège (Belgium) as well as people who responded to a press advertisement between June 2013 and July 2014. Participants in this study were 65 years of age or older, and, because of the limitations of the dual-energy X-ray absorptiometry (DXA) instrument, people with a BMI above 50 kg/m^2 or with amputated limbs were not eligible. There were no additional inclusion criteria beyond these [20]. The third year of follow-up (July 2015–2016) was selected for inclusion because this was the first year that both the SarQoL® questionnaire and the SARC-F questionnaire were administered to all participants.

Measurements

For each participant, muscle mass was measured with a dual-energy X-ray absorptiometry instrument (Hologic Discovery A, USA) and grip strength with the Saehan hydraulic hand dynamometer (Saehan Corp., Masan, South Korea). Both instruments were calibrated according to the respective

manufacturer's instructions at the recommended intervals. Appendicular skeletal muscle mass was calculated as the sum of all 4 limbs and divided by the squared height of the participant in question to obtain a skeletal muscle mass index ($SMI = ASM/Ht^2$). The grip strength of a person was defined as the highest value out of 6 measurements (3 for the dominant hand and 3 for the non-dominant hand). Detailed descriptions of both measurements are available in the article on the baseline results of the SarcoPhAge study [20]. These data allowed us to diagnose sarcopenia according to the EWGSOP2 criteria in participants with low muscle mass ($ASM/Ht^2 < 7.0$ kg/m^2 for men and < 5.5 kg/m^2 for women) and low muscle strength (grip strength < 27 kg for men and < 16 kg for women) [1]. Sarcopenia diagnosed with the EWGSOP2 criteria constitutes the reference standard in this study because of its status as the current consensus criteria and its applicability to samples recruited in Europe [1].

The index test in this study, the paper-based French-language SarQoL® questionnaire, was completed by the participants without assistance. An Overall QoL score (0–100 points) is calculated where lower scores indicate lower QoL, and thus also greater sarcopenia-related disability [6, 22]. The questionnaire is available in multiple languages from the website www.sarqol.org, and the Overall QoL score was calculated with an Access database developed for this purpose. Given the exploratory nature of this investigation, we did not pre-specify a test-positivity cut-off point.

We included a second index test in this analysis, so as to be able to compare the performance of the SarQoL® questionnaire against the current most widely used screening instrument in sarcopenia, the SARC-F [23]. It is composed of 5 questions on strength, locomotion, rising from a chair, climbing stairs and history of falls. A total score is calculated and ranges from 0 to 10 points, where higher scores are linked with a higher probability of being diagnosed with sarcopenia. A score of ≥ 4 points is used as a cut-off to identify individuals who require a full examination for sarcopenia in clinical practice [23]. The SARC-F was developed to be able to detect sarcopenia as diagnosed with the EWGSOP1 criteria, and a meta-analysis found a pooled sensitivity of 0.21 (0.13–0.31) combined with a specificity of 0.90 (0.83–0.94) [24]. With the publication of the revised EWGSOP2 criteria, several authors have looked again at the performance of the SARC-F, and a meta-analysis that pooled the results from 4 studies found an AUC of 0.75 (95% CI 0.71–0.78) with a sensitivity of 0.77 (95% CI 0.49–0.92) and a specificity of 0.63 (95% CI 0.43–0.79), while the same meta-analysis found a pooled sensitivity of 0.32 (95% CI 0.19–0.47) and specificity of 0.86 (95% CI 0.77–0.92) for the EWGSOP1 criteria in 13 studies [25].

To compare the performance of the SarQoL® questionnaire and the SARC-F instrument with a screening instrument based on physical indicators, we calculated the probability of sarcopenia according to the Ishii formula, which was the best-performing screening instrument in a comparison of 5 with the EWGSOP1 criteria [5]. For men, we used the formula $[0.62 \times (\text{age}-64) - 3.09 \times (\text{grip strength}-50) - 4.64 \times (\text{calf circumference}-42)]$ to calculate the sum score and the formula $[1 / (1 + e^{-(\text{sum score} / 10-11.9)})]$ to calculate the probability of sarcopenia (expressed in percentage). For women, the formula $[0.80 \times (\text{age}-64) - 5.09 \times (\text{grip strength}-34) - 3.28 \times (\text{calf circumference}-42)]$ provided the sum score and the formula $[1 / (1 + e^{-(\text{sum score} / 10-12.5)})]$ the probability of sarcopenia [26]. A sum score higher than 105 for men and 120 for women was used as the cut-off for a high probability of sarcopenia [26]. To the best of our knowledge, its performance when used to screen patients for sarcopenia with the EWGSOP2 criteria has not yet been established.

The reference test and the index tests were performed by the same investigator or completed by the participant during a single study visit. The study investigator also recorded clinical and demographic information needed for the Ishii formula. The results from the reference test and one of the index tests, the SARC-F, was directly available to the investigator. The SarQoL® Overall score and the Ishii score, were calculated some time after the end of the study visit.

Statistical analyses

Statistical analyses were carried out with the Statistical Package for the Social Sciences version 27.0.0.0 (SPSS Statistics; IBM, Armonk, NY). The distribution of variables in this analysis was examined by looking at the distance between median and mean, histogram, QQ-plot, and the Shapiro–Wilk test. Continuous variables are presented as mean ± standard deviation if normally distributed and as median (25th–75th percentile) if not normally distributed. The evaluation of the screening performance of the Overall QoL score of the SarQoL® questionnaire, the SARC-F tool and the Ishii screening test was based on their sensitivity (Se), specificity (Sp), positive likelihood ratio (LR +), negative likelihood ratio (LR-), positive predictive value (PPV), and negative predictive value (NPV) in relation to sarcopenia as diagnosed with the EWGSOP2 criteria. These values and the associated 95% confidence intervals were obtained through the GENLIN procedure, as outlined in document 422875 from IBM support [27]. Receiver Operating Characteristic (ROC) curves and the Area Under the Curve (AUC) provided the overall accuracy of the three screening instruments. An AUC value above 0.9 indicates high accuracy of the screening instrument, between 0.8 and 0.9 excellent accuracy and between 0.7 and 0.8 acceptable accuracy [19]. The Youden J statistic (sensitivity + specificity −1) was used to find the optimal cut-point for the Overall SarQoL score [28]. The analyses presented in this article

Table 1 Clinical characteristics

	Sarcopenic ($n=17$)	Not sarcopenic ($n=292$)	p-value*
Age (years)	80.07 (71.98–86.36)	73.55 (69.68–78.58)	0.011
Gender (women)	10 (58.8%)	170 (58.2%)	0.961
N° of drugs	9.00 (3.50–12.50)	6.00 (4.00–8.00)	0.035
N° of comorbidities	4.00 (3.00–7.00)	4.00 (2.00–5.00)	0.462
Gait speed (m/s)	0.70 ± 0.27	1.14 ± 0.28	< 0.001

*P-values from Mann–Whitney U-test, Pearson Chi-square or Student t-test, depending on variable characteristics

have been performed in all participants who were assessed for sarcopenia using the EWGSOP2 criteria, screened with the SARC-F questionnaire and who completed the SarQoL® questionnaire at the third follow-up of the SarcoPhAge study. A p-value of 0.05 was considered statistically significant.

Results

A total of 309 people were included in this analysis. All participants were assessed for sarcopenia with the EWGSOP2 criteria in the third yearly evaluation of the SarcoPhAge study, and 17 (5.5%) of them were diagnosed with sarcopenia. The sarcopenic participants were older than those not diagnosed as sarcopenic [80.07 (71.98 – 86.36) years versus 73.55 (69.68 –78.58) years, $p=0.011$]. They also took more medication and had a lower gait speed than those not diagnosed with sarcopenia. The complete clinical characteristics for the sample are detailed in Table 1.

The SARC-F questionnaire identified 48 participants (15.5% of the sample) with a score ≥ 4 points and thus suspected of having sarcopenia. A ROC curve of the SarQoL® Overall score and the SARC-F score is presented in Fig. 1. The AUC for the SarQoL® Overall score is 0.771 (95% CI: 0.652–0.889), and for the SARC-F 0.802 (95% CI: 0.696–0.909).

The Youden index was maximised at ≤ 52.4 points for the SarQoL® Overall score ($J_c=0.452$, Se = 0.647, Sp = 0.805). This threshold value, together with the prespecified threshold for the SARC-F, were used for the construction of Table 2, detailing the screening accuracy of the two instruments.

The SarQoL® Overall score, dichotomized at ≤ 52.4 points, had, in absolute numbers, slightly greater sensitivity than the SARC-F score (64.7% vs. 52.9%), because it correctly identified 11 out of the 17 sarcopenic participants, whereas the SARC-F correctly identified 9 out of 17. In terms of their specificity, the SARC-F had, in absolute numbers, slightly greater specificity than the SarQoL® Overall score (80.5% vs. 86.6%), with 253 non-sarcopenic subjects correctly identified compared to the 235 found by the SarQoL® questionnaire.

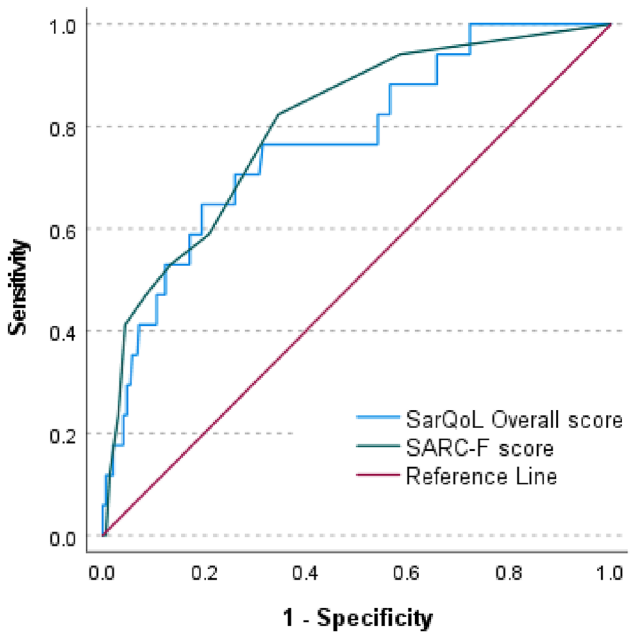

Fig. 1 ROC curves for the SarQoL® overall score and the SARC-F tool

Table 2 Screening accuracy of the SarQoL® overall score and the SARC-F instrument

	SarQoL	SARC-F
True positives	11	9
False positives	57	39
True negatives	235	253
False negatives	6	8
Sensitivity	0.647 (0.411–0.842)	0.529 (0.301–0.750)
Specificity	0.805 (0.757–0.847)	0.866 (0.824–0.902)
Positive predictive value	0.162 (0.088–0.261)	0.188 (0.095–0.313)
Negative predictive value	0.975 (0.950–0.990)	0.969 (0.944–0.986)
Positive likelihood ratio	3.315 (2.175–5.051)	3.964 (2.322–6.768)
Negative likelihood ratio	0.439 (0.230–0.837)	0.543 (0.327–0.901)
AUC	0.771 (0.652–0.889)	0.802 (0.696–0.909)

AUC: area under the ROC curve. Values between parentheses are the 95% confidence interval

The Ishii screening test outperformed both the SARC-F and the SarQoL® Overall score with an AUC of 0.884 (95% CI: 0.840–0.927). The Ishii screening test correctly identified all 17 sarcopenic individuals, and therefore had a sensitivity of 100%, and correctly identified 224 non-sarcopenic individuals for a specificity of 76.7%. It flagged a total of 85 people as being at high risk for sarcopenia, which is 27.5% of the total sample.

We also looked at the sensitivity and specificity of a range of threshold values for the SarQoL® Overall score, which are displayed in Table 3.

Discussion

This exploratory study showed that the SarQoL® questionnaire may be useful in screening potential candidates who are suspected of having sarcopenia for inclusion in clinical trials. The AUC of 0.771 (95% CI: 0.652–0.889) places it into the category of screening instruments with acceptable accuracy and confirms the primary study hypothesis. There might thus be a role for the SarQoL® questionnaire in a recruitment strategy of a clinical trial, certainly if it is already being considered to measure quality of life. We also found that the screening accuracy of the SarQoL® questionnaire in this sample was comparable to the SARC-F questionnaire but inferior to the Ishii screening test. The SarQoL® questionnaire was able to correctly identify more sarcopenic participants than the SARC-F (64.7% vs. 52.9%), but at the cost of a slightly lower specificity (80.5% vs 86.6%). The Ishii screening test, which relies on physical parameters, correctly identified all 17 sarcopenic participants, giving it a sensitivity of 100%, but had the lowest specificity of all three tests at 76.7%.

Table 3 Sensitivity and specificity for a range of threshold values for the SarQoL® overall score

Threshold value	Se	Sp	PPV	NPV
≤ 30 points	5.9%	100%	100%	94.8%
≤ 40 points	17.6%	95.9%	20.0%	95.2%
≤ 50 points	52.9%	85.6%	17.6%	96.9%
≤ 52.4 points (optimal threshold)	**64.7%**	**80.5%**	**16.2%**	**97.5%**
≤ 60 points	76.5%	65.8%	11.5%	98.0%
≤ 70 points	88.2%	40.1%	7.9%	98.3%
≤ 80 points	100%	21.2%	6.9%	100%
≤ 90 points	100%	7.9%	5.9%	100%
≤ 100 points	100%	NA	5.5%	NA

Se sensitivity, *Sp* specificity, *PPV* positive predictive value, *NPV* negative predictive value

Bold value indicates the optimal threshold identified by the Youden index and its associated Se, Sp, PPV and NPV

That the Ishii screening test outperforms the SARC-F and Overall SarQoL® score should not be a great surprise. In fact, the items in the Ishii test closely resemble those that make up the diagnosis of sarcopenia according to the EWGSOP2 criteria, namely grip strength and calf circumference (as an indicator of muscle mass) [26]. The Ishii screening test has also shown, in a Polish study, that it possesses good screening accuracy when used to find sarcopenic people diagnosed with the EWGSOP2 criteria [29]. However, any comparison between the Ishii screening test and the SARC-F and Overall SarQoL® score needs to take into account that the Ishii screening test necessitates a face-to-face contact between the researcher and the potential candidate to obtain grip strength and calf circumference measurements, whereas the SARC-F and the SarQoL® questionnaire can be administered via the postal service, through the internet or via telephone.

The screening efficacy of the SARC-F, one of the most widely used tools and recommend by several organizations, has been investigated for multiple diagnostic criteria and summarized in a meta-analysis published in 2021. The authors found that the screening accuracy of the SARC-F was characterized by relatively low sensitivity (27–39%) combined with relatively high specificity (86–91%) when used in conjunction with the EWGSOP, Asian Working Group on Sarcopenia, International Working Group on Sarcopenia, and the Foundation for the National Institutes of Health Sarcopenia Project criteria. Interestingly, when they calculated the pooled sensitivity and specificity of the SARC-F based on the EWGSOP2 criteria, they found inverse results: moderate sensitivity (77%) and lower specificity (63%), although these results were only based on 4 studies. It is also important to mention that 3 of the 4 included studies focused on hospitalized patients, and that the pooled prevalence of sarcopenia was higher than in the general population at 21.56% [25]. We are aware of two other studies that are not included in this meta-analysis, namely Piotrowicz et al who reported a sensitivity of 35.3% and a specificity of 85.7%, and Nguyen et al, with a sensitivity of 64.9% and a specificity of 68.2%, both of which recruited community-dwelling older people [29, 30]. It has been argued that the SARC-F is better suited to ruling out sarcopenia rather than case-finding, which seems to be the case for the last two articles mentioned, but not so for the 4 included in the meta-analysis of Lu et al [31, 32].

In our study, the SarQoL® questionnaire performed similarly to the SARC-F questionnaire, with slightly greater sensitivity but slightly lower specificity. The SarQoL® questionnaire was able to correctly identify more sarcopenic patients in the sample, but the PPV of 16.2% was lower than the PPV of 18.8% of the SARC-F instrument. This means that 68 people would have been singled out for further investigation by the SarQoL®

questionnaire, and 48 for the SARC-F, for two additional sarcopenic subjects to be found. Therefore, in our example, the SarQoL® questionnaire would have been preferable if the recruitment strategy called for finding the greatest number of sarcopenic participants in the shortest amount of time, accepting the extra cost in performing complete body composition and/or physical performance assessments on more people. The SarQoL® questionnaire also has the advantage that it is self-administered and, therefore, requires fewer hours of study personnel time than the SARC-F, which is interviewer-administered.

The specific purpose for which a screening instrument is used can influence which of its characteristics to prioritize. In an ideal situation, a screening instrument would be inexpensive, easy to administer, without side effects, reliable, valid, and both highly sensitive and specific. Oftentimes, however, a trade-off needs to be made between these characteristics. Both the SARC-F and the SarQoL® questionnaire are inexpensive, easy to administer and without side effects given that they are questionnaires. The SarQoL® questionnaire has also demonstrated to be reliable in multiple studies [11]. However, both the SARC-F and the SarQoL® questionnaire are not highly sensitive nor highly specific, and are not as sensitive as the Ishii screening test. Nonetheless, if its limitations are taken into account, the SarQoL® questionnaire could be useful within certain contexts.

There are some limitations to take into account when interpreting the results of this study. First off, this study was a secondary analysis of data collected previously, and not specifically designed to answer the research question. This has led to certain issues around the reduction of risk of bias, such as the fact that the research assistant was not blinded to the results of the body composition analysis, grip strength measurement and SARC-F score. A second issue is the fact that, because no pre-specified cut-off exists, we determined the optimal threshold for the Overall QoL score of the SarQoL® questionnaire with the Youden index. This reflects the best balance between sensitivity and specificity, but may not necessarily be generalizable. The various studies performed with the SarQoL® questionnaire have already shown that absolute quality of life scores can significantly differ between countries. Normative population data or pilot studies will be needed to inform the appropriate threshold value in different situations. Lastly, because of the design of this study, we did not perform sample size calculations but provided confidence intervals around the main outcome values to provide a measure of precision. For both the SarQoL® and the SARC-F questionnaire, relatively large confidence intervals are observed around their point estimates, owing to the small number of people diagnosed with sarcopenia according to the EWGSOP2 criteria in this sample.

This study shows the feasibility of using the SarQoL® questionnaire as a tool to select those people who may benefit from a complete sarcopenia evaluation. While this study presents an interesting new use for the SarQoL® questionnaire, caution should be used in applying the threshold value used in this study (≤ 52.4 points) to other populations.

Conclusion

In the population presented in this study, the SarQoL® Overall score, dichotomized at ≤ 52.4 points, performed roughly equal in terms of sensitivity and specificity to the SARC-F tool in identifying people considered sarcopenic with the EWGSOP2 criteria.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s40520-021-01913-z.

Author's contributions AG, CB, OB and J-YR designed the study. ML and CB collected the data. AG performed the analysis and wrote the manuscript. All authors provided feedback on the manuscript and analyses and approved the final manuscript.

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Availability of data and material Data are available as a supplementary file.

Code availability No specific code was written for this study.

Declarations

Conflict of interest CB, J-YR and OB are shareholders of SarQoL sprl. AG, BD-H and ML report no conflicts of interest related to this work.

Ethical approval The SarcoPhAge study was approved by the Ethics Committee of the University Teaching Hospital of Liège (n° 2012-277). Because this is a secondary analysis of previously collected data, no additional approval was sought for this specific analysis.

Statement of human and animal rights This study was approved by the ethical committee of the University Hospital of Liège and complied with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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

Consent to participate All participants provided written informed consent.

Consent for publication Not applicable.

References

1. Cruz-Jentoft AJ, Bahat G, Bauer J et al (2018) Sarcopenia: revised European consensus on definition and diagnosis. Age Ageing 48:16–31. https://doi.org/10.1093/ageing/afy169
2. Van Ancum JM, Alcazar J, Meskers CGM et al (2020) Impact of using the updated EWGSOP2 definition in diagnosing sarcopenia: a clinical perspective. Arch Gerontol Geriatr 90. https://doi.org/10.1016/j.archger.2020.104125
3. Locquet M, Beaudart C, Petermans J et al (2019) EWGSOP2 Versus EWGSOP1: impact on the Prevalence of Sarcopenia and Its Major Health Consequences. J Am Med Dir Assoc 20:384–385. https://doi.org/10.1016/j.jamda.2018.11.027
4. Mohd Nawi SN, Khow KS, Shiong Lim W et al (2019) Screening tools for sarcopenia in community-dwellers: a scoping review screening tools for Sarcopenia-Siti N Mohd Nawi et al. Ann Acad Med Singapore 48:201
5. Locquet M, Beaudart C, Reginster JY et al (2018) Comparison of the performance of five screening methods for sarcopenia. Clin Epidemiol 10:71–82. https://doi.org/10.2147/CLEP.S148638
6. Beaudart C, Biver E, Reginster JY et al (2015) Development of a self-administrated quality of life questionnaire for sarcopenia in elderly subjects: The SarQoL. Age Ageing 44:960–966
7. Beaudart C, Biver E, Reginster J-Y et al (2017) Validation of the SarQoL®, a specific health-related quality of life questionnaire for Sarcopenia. J Cachexia Sarcopenia Muscle. https://doi.org/10.1002/jcsm.12149
8. Beaudart C, Edwards M, Moss C et al (2017) English translation and validation of the SarQoL®, a quality of life questionnaire specific for sarcopenia. Age Ageing 46:271–277. https://doi.org/10.1093/ageing/afw192
9. Fábrega R, Antonio C, Amat M et al (2019) Psychometric properties of the spanish version of the sarcopenia and quality of life, a quality of life questionnaire specific for sarcopenia. Calcif Tissue Int. https://doi.org/10.1007/s00223-019-00635-9
10. Geerinck A, Bruyère O, Locquet M et al (2018) Evaluation of the responsiveness of the sarqol® questionnaire, a patient-reported outcome measure specific to sarcopenia. Adv Ther 35:1842–1858. https://doi.org/10.1007/s12325-018-0820-z
11. Geerinck A, Alekna V, Beaudart C et al (2019) Standard error of measurement and smallest detectable change of the Sarcopenia Quality of Life (Sarqol) questionnaire: an analysis of subjects from 9 validation studies. PLoS ONE 14:e0216065. https://doi.org/10.1371/journal.pone.0216065
12. Erdogan T, Eris S, Avci S et al (2021) Sarcopenia quality-of-life questionnaire (SarQoL)®: translation, cross-cultural adaptation and validation in Turkish. Aging Clin Exp Res. https://doi.org/10.1007/s40520-020-01780-0
13. Geerinck A, Scheppers A, Beaudart C et al (2018) Translation and validation of the Dutch SarQoL ®, a quality of life questionnaire specific to sarcopenia. J Musculoskelet Neuronal Interact 18:463–472
14. Tsekoura M, Billis E, Gliatis J et al (2018) Cross cultural adaptation of the Greek sarcopenia quality of life (SarQoL) questionnaire. Disabil Rehabil. https://doi.org/10.1080/09638288.2018.1514076
15. Konstantynowicz J, Abramowicz P, Glinkowski W et al (2018) Polish validation of the SarQoL®, a quality of life questionnaire specific to sarcopenia. J Clin Med 7:323. https://doi.org/10.3390/jcm7100323
16. Gasparik AI, Mihai G, Beaudart C et al (2018) Correction to: Psychometric performance of the Romanian version of the SarQoL(R), a health-related quality of life questionnaire for sarcopenia. Arch Osteoporos 13:98
17. Alekna V, Kilaite J, Tamulaitiene M et al (2019) Validation of the Lithuanian version of sarcopenia-specific quality of life questionnaire (SarQoL®). Eur Geriatr Med 10:761–767
18. Safonova YA, Lesnyak OM, Baranova IA et al (2019) Russian translation and validation of SarQoL® - quality of life questionnaire for patients with sarcopenia. Nauchno-Prakticheskaya Revmatol 57:38–45. https://doi.org/10.14412/1995-4484-2019-38-45
19. Mandrekar JN (2010) Receiver operating characteristic curve in diagnostic test assessment. J Thorac Oncol 5:1315–1316. https://doi.org/10.1097/JTO.0b013e3181ec173d
20. Beaudart C, Reginster JY, Petermans J et al (2015) Quality of life and physical components linked to sarcopenia: the SarcoPhAge study. Exp Gerontol 69:103–110
21. Bossuyt PM, Reitsma JB, Bruns DE et al (2015) STARD 2015: an updated list of essential items for reporting diagnostic accuracy studies. BMJ 351:1–9. https://doi.org/10.1136/bmj.h5527
22. Beaudart C, Biver E, Reginster JY et al (2017) Validation of the SarQoL®, a specific health-related quality of life questionnaire for Sarcopenia. J Cachexia Sarcopenia Muscle 8:238–244. https://doi.org/10.1002/jcsm.12149
23. Malmstrom TK, Miller DK, Simonsick EM et al (2016) SARC-F: A symptom score to predict persons with sarcopenia at risk for poor functional outcomes. J Cachexia Sarcopenia Muscle 7:28–36. https://doi.org/10.1002/jcsm.12048
24. Ida S, Kaneko R, Murata K (2018) SARC-F for Screening of Sarcopenia Among Older Adults: a Meta-analysis of Screening Test Accuracy. J Am Med Dir Assoc 19:685–689. https://doi.org/10.1016/j.jamda.2018.04.001
25. Lu JL, Ding LY, Xu Q et al (2021) Screening accuracy of SARC-F for sarcopenia in the elderly: a diagnostic meta-analysis. J Nutr Heal Aging 25:172–182. https://doi.org/10.1007/s12603-020-1471-8
26. Ishii S, Tanaka T, Shibasaki K et al (2014) Development of a simple screening test for sarcopenia in older adults. Geriatr Gerontol Int 14:93–101. https://doi.org/10.1111/ggi.12197
27. IBM Support (2018) Can SPSS statistics produce epidemiological statistics from 2x2 tables such as positive and negative predictive values, sensitivity, specificity and likelihood ratios? Retrieved from https://www.ibm.com/support/pages/can-spss-statistics-produce-epidemiological-statistics-2x2-tables-such-positive-and-negative-predictive-values-sensitivity-specificity-and-likelihood-ratios
28. Youden WJ (1950) Index for rating diagostic tests. Cancer 3:32–35. https://doi.org/10.1002/1097-0142(1950)3:1%3c32::AID-CNCR2820030106%3e3.0.CO;2-3
29. Piotrowicz K, Głuszewska A, Czesak J et al (2021) SARC-F as a case-finding tool for sarcopenia according to the EWGSOP2. National validation and comparison with other diagnostic standards. Aging Clin Exp Res. https://doi.org/10.1007/s40520-020-01782-y
30. Nguyen TN (2020) Reliability and validity of SARC-F questionnaire to assess sarcopenia among vietnamese geriatric patients. Clin Interv Aging 15:879–886
31. Piotrowicz K, Gryglewska B, Gąsowski J (2021) The usefulness of SARC - F. Aging Clin Exp Res. https://doi.org/10.1007/s40520-021-01839-6
32. Ünsal F, Murat M, Levent K (2021) SARC-F as a case-finding tool in sarcopenia: valid or unnecessary? Aging Clin Exp Res. https://doi.org/10.1007/s40520-021-01838-7