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Research paper

Assessment of muscle mass, muscle strength and physical performance in clinical practice: An international survey

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ABSTRACT

Introduction: Several tools are available for the assessment of muscle mass, muscle strength and physical performance in clinical research. However, few data are available on the usage of these tools in clinical practice.
Methods: This study aimed to assess their usage by means of a large online international survey. Since sarcopenia is a specific condition where the assessment of muscle mass, muscle strength and physical performance is important, the survey also assessed the tools used for the diagnosis of this geriatric syndrome.
Results: The survey was completed by 255 clinicians from 55 countries across 5 continents. Among these clinicians with geriatrics, rheumatology and endocrinology as major fields of interest, 53.3% assess muscle mass in daily practice, 54.5% muscle strength and 71.4% physical performance. However, the tools used are very different and no single tool is used by all clinicians. The tools and the cut-off values used by clinicians to diagnose sarcopenia are also heterogeneous.
Conclusion: Because some tools used for the assessment of muscle mass, muscle strength or physical performance in daily practice are less validated than others, a greater awareness from the clinicians of the importance of using appropriate tools is needed.

1. Introduction

In clinical practice, assessments of muscle mass, muscle strength and physical performance are performed for various medical conditions. Indeed, the ability to perform activities of daily living and recreational activities is determined, in part, by the performance of the muscle function. The number of tools available to perform such assessments is substantial but the reliability and the validity of the tools are not always optimal [1,2]. Even where there are recommendations for the utilisation of specific tools in order to optimize their reliability in clinical research, there are no standards for the use of specific instruments in daily practice [3,4]. Indeed, some tools are not available in all settings of clinical daily practice (e.g. dual-energy X-ray absorptiometry). To date, little information is available about the tools used to assess muscle mass, muscle strength or physical performance in daily practice. The gap between research findings and their translation and implementation into clinical practice is a common problem that affects health care outcomes.

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Sarcopenia is currently defined as the loss of skeletal muscle mass and strength that occurs with advancing age [5]. Currently, no consensual operational definition of sarcopenia exists and therefore it is still a challenge to establish both the actual prevalence of sarcopenia and the direct and indirect impacts of sarcopenia on public health [6,7]. It is now quite widely accepted that the assessment of muscle mass, muscle strength as well as physical performance are components of the diagnosis of sarcopenia [4]. However, currently, no unified recommendation exists on which specific tools or thresholds are to be used [8].

The objective of this study, initiated by the European Union Geriatric Medicine Society (EUGMS) Special Interested Group (SIG) on sarcopenia was to perform a large international survey to collect data on current practice for the assessment of muscle mass, muscle strength and physical performance in usual clinical practice. Since sarcopenia is a specific condition characterized by progressive and generalized loss of skeletal muscle mass and strength, and decline in physical performance where all these parameters have to be measured [5], the survey also collected information on the tools used for the diagnosis of this geriatric syndrome. An overview of the use of which instruments are used would allow professional and scientific societies to better understand the real daily practice of their members and to better communicate and adapt recommendations to improve their applicability and adherence in daily practice.

2. Material and method

An online survey was designed with the objective to collect data on all tools used to assess muscle mass, muscle strength and physical performance. The survey focused on clinical practice rather than the instruments used for clinical research. All potential instruments used to assess muscle mass, muscle strength and physical performance were taken from a systematic review [1]. The survey was restricted to assessment of individuals aged 60 years and older. For the diagnosis of sarcopenia and some particular tools (e.g. assessing grip strength, walking speed), a more detailed protocol with more specific follow-up questions (e.g. number of repetition, walking distance, cut-off points) was used.

The survey was initially designed by OB, CB, JYR, FB, DS and EF and sent to all other authors that critically commented the content. Then, the survey was sent to all members of the SIG on sarcopenia of the EUGMS ($n = 66$) that could give their feedback. The approximate time needed to complete the survey was 10 minutes. The final version of the survey was sent twice, once in June 2015 and once in July 2015 through two different channels. The first was the EUGMS office that forwarded the survey to all their 33 member or observer societies that, in turn, forwarded it to their individual members. The second was a direct contact, via email, to all members of the European Society for Clinical and Economic Aspects of Osteoporosis, Osteoarthritis and Musculoskeletal Disorders (ESCEO). Clinicians from outside Europe could however be a member of these various societies.

Because of their normal distribution, quantitative variables were expressed as mean and standard deviation (SD) and qualitative variables as number and percentage. Comparisons between groups (e.g. based on gender, age group, fields of interest of the clinicians) were performed with analysis of variance. Results were considered to be statistically significant at the 5% level ($P < 0.05$). All calculations were performed using Statistica 10 software.

3. Results

The survey was completed by 255 clinicians from 55 countries. Most of the respondents were from Spain (27.8%), Belgium (12.2%), Slovenia (5.1%) and Brazil (3.9%). The mean age of the clinicians was 49.1 years (± 12.4) and 49.4% of them were women. Most of them were medical doctors (87.8%) with geriatrics (57.6%) and rheumatology (18.8%) as major fields of interest. More than half of the sample (55.7%) worked in a hospital and 24.3% in a University. About a quarter of the respondents (25.1%) participated in the 2015 WCO-IOF-ESCEO congress, 14.9% in the 2014 European League Against Rheumatism (EULAR) meeting and 12.5% in the 2014 EUGMS congress.

Among the whole study population, 53.3% stated that they assessed muscle mass in their daily practice, 54.5% muscle strength and 71.4% physical performance. Around 60% of geriatricians, endocrinologists and rheumatologists assess muscle mass in their daily practice. For muscle strength, the proportion ranged between 53% and 61% for all medical specialities. The field of interest of the respondents was associated with the likelihood of assessing physical performance. Thus, most geriatricians (83.7%) assessed physical performance in their clinical practice whilst this was assessed in approximately half of the endocrinologists and rheumatologists (respectively 53.3 and 54.1%, $P < 0.001$).

Table 1 shows which instruments are used to assess muscle mass, muscle strength and physical performance. Among clinicians assessing muscle mass in clinical practice, around half of them used calf circumference (57.5%) and dual-energy X-ray absorptiometry (45.9%). With regards to muscle strength, the handheld dynamometer was used by 66.4% of respondents whilst the leg press was used by a quarter of them (24.2%). More than half of the clinicians assessed physical performance in daily practice. The most commonly administrated tests were: gait speed, the get up and go test, self-reported physical function, the sit to stand 5 times

Table 1
Tools used to assess muscle mass, muscle strength and physical performance in clinical practice.

Outcomes	Tools	Proportion of users (%)
Muscle mass ($n = 136$)	Calf circumference	57.5
	Dual-energy X-ray absorptiometry (DXA)	45.9
	Skinfold thickness	30.8
	Bioelectrical impedance analysis (BIA)	22.6
	Ultrasonography	18.5
	Magnetic resonance imaging (MRI)	16.4
	CT-scan	14.4
	Other	8.9
Muscle strength ($n = 139$)	Handheld dynamometer	66.4
	Leg press	24.2
	Chest press	9.39
	Isokinetic dynamometer	7.38
	Vigorimeter	2.01
	Other	11.4
Physical performance ($n = 182$)	Gait speed	63.3
	Timed up and go	58.6
	Self-reported physical function	58.1
	Sit to stand 5 times	53.9
	Standing balance	52.9
	Short physical performance battery test (SPPB)	28.8
	Stair climb	25.1
	3-D accelerometer	3.66
	Other	5.76

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Table 2
Use of tools for the diagnosis of sarcopenia in daily practice.

Tools	Number of users of the tool for the diagnosis of sarcopenia/total number of users of the tool
Muscle mass	
Calf circumference	56/84 (66.7%)
Dual-energy X-ray absorptiometry (DXA)	29/67 (43.3%)
Skinfold thickness	24/45 (53.3%)
Bioelectrical impedance analysis (BIA)	
Single frequency	13/20 (65%)
Multiple frequency	11/15 (73.3%)
Do not know the frequency	1/4 (25%)
Ultrasonography	7/27 (25.9%)
Magnetic resonance imaging (MRI)	5/24 (20.8%)
CT-scan	9/21 (42.8%)
Other	9/13 (69.2%)
Muscle strength	
Handheld dynamometer	
Handgrip dynamometer	51/96 (53.1%)
Other dynamometers	5/11 (45.4%)
Leg press	16/36 (44.4%)
Chest press	5/14 (35.7%)
Isokinetic dynamometer	4/11 (36.4%)
Vigorimeter	2/3 (66.7%)
Other	5/17 (29.4%)
Physical performance	
Gait speed	60/121 (49.6%)
Timed up and go	46/112 (41.1%)
Self-reported physical function	36/111 (32.4%)
Sit to stand 5 times	41/103 (39.8%)
Standing balance	26/101 (25.7%)
Short physical performance battery test (SPPB)	22/55 (40.0%)
Stair climb	15/48 (31.2%)
3-D accelerometer	1/7 (14.3%)
Other	1/11 (9.1%)

test, and the standing balance test. However, the protocol used differed between clinicians.

Table 2 shows the proportion of clinicians using each specific tool for the diagnosis of sarcopenia. For the assessment of muscle mass, calf circumference and skinfold thickness were used for the diagnosis of sarcopenia by 66.7 and 53.3% respectively of the clinicians using these tools. Dual-energy X-ray absorptiometry was used for the diagnosis only by 43.3% of the clinicians using this tool. Bioelectrical impedance analysis was also widely used for the diagnosis (i.e. by 65% of the clinicians using the single frequency apparatus and 73% of those using the multiple frequency apparatus). Regarding muscle strength, the handheld dynamometer to measure grip strength was used for the diagnosis of sarcopenia by approximately half of the clinicians using this tool. When looking at physical performance, gait speed was assessed for the diagnosis by 49.6% of the clinicians accustomed to this tool.

In the diagnosis of sarcopenia, specific cut-offs were mainly applied with DXA (52%), bioelectrical impedance analysis (46% for the single frequency and 73% for the multiple frequency), calf circumference (32%), handheld dynamometer (59% for the handgrip dynamometer and 20% for the other dynamometers), isokinetic dynamometers (75%), gait speed (60%), Short Physical Performance Battery (SPPB) (41%) and the get up and go test (35%). For the other tools, less than 10% of clinicians used specific cut-offs to determine sarcopenia. It is also important to note that even with one specific tool, cut-offs varied greatly. The source of these various cut-offs was very heterogeneous and included consensus papers [4,9–12], manufacturer recommendations, in-house data and values found in specific articles. Among cut-offs proposed by various consensus papers, the one from the European Working Group on Sarcopenia in Older People (EWGSOP) was the most widely applied (i.e. used by 43% of the responders) [4].

4. Discussion

To our knowledge, this is the first large, international survey on the use of tools in clinical practice for the assessment of muscle mass, muscle strength and physical performance. Our results showed that only half of the clinicians measured at least one of these domains in patients aged 60 years and older. In addition, the instruments used were very different and no single tool was used by all clinicians. Moreover, even with the same tool, the protocol could be different (e.g. with the isokinetic dynamometer) and the cut-offs (i.e. for the diagnosis of sarcopenia) were not the same. The large diversity of tools and protocols used is likely to be problematic in clinical practice and renders the transmission of results between clinicians difficult. Moreover, it reduces the possibility for clinicians to compare their data to data from the medical literature.

Interestingly, several tools used to measure muscle mass, muscle strength, and physical performance were stated. Not surprisingly, the handheld dynamometer to assess muscle strength and gait speed to assess physical performance was the most widely used tools. Regarding muscle mass, besides Dual-energy X-ray absorptiometry and bioelectrical impedance analysis currently suggested by various guidelines in the field of sarcopenia, it is interesting to note that the place for anthropometrics seems to be high. However, all tools currently used by clinicians are not specifically focused on older people, for whom case finding should be performed. Thus, the validity and the reliability of all these tools need to be taken into account. Indeed, some of the tools used by clinicians are not optimal regarding their psychometric properties [1,2]. In a systematic review of performance-based physical function in older community-dwelling persons, Freiberger et al. showed that among 12 different instruments, the Short Physical Performance Battery could be most highly recommended in terms of validity, reliability and responsiveness, followed by the Physical Performance Test and the Continuous Scale Physical Functional Performance [2]. In another systematic review, Mijnarends et al. assessed the measurement properties of tools to measure muscle mass, muscle strength, and physical performance in community-dwelling older people [1]. They showed that for a home setting, bioelectrical impedance analysis, handheld dynamometry and gait speed or the Short Physical Performance Battery are the most valid, reliable, and feasible tools. It re-emphasises the importance of optimal quality assessment and quality control of all instruments used in both clinical research and clinical practice. Moreover, it highlights the need to make practitioners aware of the importance of the choice of an optimal tool. However, the cost and the availability of the instruments need also to be taken into account. This is particularly true in clinical practice but maybe less so in clinical research. For example, the use of DXA is widely recommended to evaluate muscle mass in research but, in clinical practice, the use of and access to DXA can be difficult in routine health care, due to its elevated costs and specialized professional requirements [13].

For the diagnosis of sarcopenia, there seems to be a major gap between clinical practice and the research community. While epidemiological studies now often use the most recent consensus definitions of sarcopenia [4,9–12], this is not the case in clinical practice where other tools and other cut-off values are used. However, it has been shown that the use of different tools or cut-off values can substantially influence the apparent prevalence of sarcopenia [14–17]. This could lead to some patients being managed for sarcopenia with one medical doctor and not with another that would use a different tool or another cut-off threshold. It highlights the importance of reaching a consensus on the diagnostic criteria for sarcopenia that would be accepted by

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all interested parties including scientific societies, patient societies and health services.

This survey was completed by 255 clinicians from 55 countries across 5 continents. In some countries, the number of responses was low making between-countries comparisons difficult. The exact response rate is unknown, not only because none of the authors of this paper sent the emails themselves and all the data were thus obtained through the office of the two organisations (i.e. EUGMS and ESCEO), but also because each society affiliated to the EUGMS was asked to send the survey to their individual members. Moreover, it should be pointed out that this survey was sent through two different European societies. This means that some results, mainly regarding the wider use of the EWGSOP's cut-offs for the diagnosis of sarcopenia, should be interpreted with caution. It should also be noted that the results reflect clinicians belonging to professional societies and therefore there is a selection bias that likely overestimates the proportion of clinicians using these tools in clinical practice.

Sarcopenia, muscle weakness and poor physical performance in older people are associated with severe adverse outcomes, such as mortality, disability, fractures and hospitalisation [5]. Therefore, the early identification of any of these problems is important to prevent further decline and associated adverse events. Half of the clinicians did not administer any tests to screen for muscle-related health problems. In addition, tests that are currently used lack sufficient validity and reliability and hence, this suggests that many older adults at risk are not appropriately treated.

In conclusion, many tools are currently used by medical specialists to assess muscle mass, muscle strength or physical performance. Since some of these instruments are less validated than others, a greater awareness among practitioners of the importance of using a fully validated tool is essential. In clinical practice, the various tools used for the diagnosis of sarcopenia are not standardized, likely due to the lack of a well-accepted recommendation. The results of this survey should be used to try to standardize the assessment procedures of muscular performance in clinical practice.

Author agreement

All authors agree with the final version of the manuscript.

Disclosure of interest

The authors declare that they have no competing interest.

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