Age and Ageing 2015; **44:** 334–338
doi: 10.1093/ageing/afu192
Published electronically 23 December 2014

Performance of the European Working Group on Sarcopenia in Older People algorithm in screening older adults for muscle mass assessment

Roberto Alves Lourenço[1], Mario Pérez-Zepeda[2], Luis Gutiérrez-Robledo[3], Francisco J. García-García[4], Leocadio Rodríguez Mañas[5]

[1]Internal Medicine Department, Faculty of Medical Sciences, Rio de Janeiro State University, Rio de Janeiro, Brazil
[2]Geriatric Epidemiologic Research, Instituto Nacional de Geriatría, Periferico Sur 2767, Colonia San Jeronimo Lidice, Delegacion Magdalena Contreras, Mexico, Distrito Federal 10200, Mexico
[3]General Direction, National Institute of Geriatrics, México, Distrito Federal, Mexico
[4]Servicio de Geriatría, Complejo Hospitalario de Toledo, Toledo, Spain
[5]Servicio de Geriatría, Hospital Universitario de Getafe, Getafe, Spain

Address correspondence to: M. Perez-Zepeda. Tel/Fax: (+52) 55 55 738686. Email: ulises.perez@salud.gob.mx, ulises.perez@me.com

Abstract

Background: there is a lack of consensus on the diagnosis of sarcopenia. A screening and diagnostic algorithm was proposed by the European Working Group on Sarcopenia in Older People (EWGSOP).
Objective: to assess the performance of the EWGSOP algorithm in determining the proportion of subjects suspected of having sarcopenia and selected to undergo subsequent muscle mass (MM) measurement.
Design: a cross-sectional study.
Setting: the cohorts, Frailty in Brazilian Older People Study—Rio de Janeiro (FIBRA-RJ), Brazil; Coyoacan Cohort (CC), Mexico City, Mexico; and Toledo Study for Healthy Aging (TSHA), Toledo, Spain.
Subjects: three thousand two hundred and sixty community-dwelling individuals, 65 years and older.
Methods: initially, the EWGSOP algorithm was applied using its originally proposed cut-off values for gait speed and handgrip strength; in the second step, values tailored for the specific cohorts were used.
Results: using the originally suggested EWGSOP cut-off points, 83.4% of the total cohort (94.4% in TSHA, 75.5% in FIBRA-RJ, 67.8% in CC) would have been considered as suspected of sarcopenia. Adapted cut-off values lowered the proportion of abnormal results to 34.2% (quintile-based approach) and 23.71% (z-score approach).
Conclusions: the algorithm proposed by the EWGSOP is of limited clinical utility in screening older adults for sarcopenia due to the high proportion of subjects selected to further undergo MM assessment. Tailoring cut-off values to specific characteristics of the population being studied reduces the number of people selected for MM assessment, probably improving the performance of the algorithm. Further research including the objective measure of MM is needed to determine the accuracy of these specific cut-off points.

Keywords: *sarcopenia, frailty, handgrip strength, gait speed, aged, diagnostic tests, clinical utility, older people*

Introduction

Sarcopenia is a health problem associated with poor prognosis for several clinical outcomes [1–4]. The European Working Group on Sarcopenia in Older People (EWGSOP) recently proposed a sequential algorithm to screen older adults for sarcopenia. The process includes the assessment of gait speed (GS) and handgrip strength (HS) as a first step to qualify individuals for muscle mass (MM) measurement. The diagnosis of sarcopenia is made in older people with low GS and/or low HS, associated with low values of MM [5].

Body composition and physical performance are highly variable in older adults and strongly dependent on ethnicity and lifestyle. Therefore, some authors have proposed adjusting the cut-off values of these parameters to the specific characteristics of each population [6, 7].

The aim of this study is to assess the performance of the EWGSOP algorithm in screening older adults for subsequent measurement of MM to establish the diagnosis of sarcopenia using different cut-off points for GS and HS.

Methods

Study design and subjects

Cross-sectional data from the baseline assessment of cohorts from three different countries were analysed [8–10]. The Frailty in Brazilian Older People Study (FIBRA-RJ) [8] recruited 739 subjects ≥65 years living in the northern area of Rio de Janeiro, Brazil. The Coyoacan Cohort (CC) [9] recruited 1,294 subjects ≥70 years living in the Coyoacan district of Mexico City, Mexico. Finally, Toledo Study for Healthy Aging (TSHA) [10] recruited 1,693 subjects ≥64 years living in Toledo, Spain.

To evaluate the performance of the algorithm, three different strategies were used, depending upon the criteria from which the cut-off points for GS and HS were defined. In the samples of FIBRA-RJ, CC and TSHA, GS and HS were available in 88.61, 73.66 and 85.85% of the cohorts, respectively. Only the data of subjects with available tests were analysed. There were no differences in age, sex and functional status between subjects with complete data and those with incomplete data.

Variables

The total time in seconds to walk at usual pace in a 4.6-, 4- and 3-m path (FIBRA-RJ, CC and TSHA, respectively) was measured. GS was calculated dividing distance by total time (meters/second). Three criteria for cut-off values were used to define low GS: the first one was the reference value ≤0.8 m/s proposed by EWGSOP; in the second, low GS was considered in those subjects in the lowest quintile of GS of groups stratified by sex and height (above or under the mean of height for sex and site); finally, in the third criteria, low GS was defined as less than −1 SD of z-values, estimated by comparing individual results with the mean and SD of the whole sample (z-value = individual value − mean/SD) [6, 11].

For HS, three trials were performed in the dominant hand using manual hydraulic dynamometers, and the best results (kilograms) were used for analyses. In addition to the cut-off defined by the EWGSOP (≤20 kg for women; ≤30 kg for men), the same alternative approaches used for GS were replicated. Notwithstanding, the quintile-based values were defined by sex and body mass index (BMI) quartiles and not by height mean only (Supplementary data, available in *Age and Ageing* online).

Statistical analysis

Descriptive statistics with means for continuous variables and frequencies for dichotomous variables were performed. As distributions for HS, GS, height, weight and BMI were normal, parametric statistics were used. One-way ANOVA was used to test differences between cohorts for continuous variables and χ^2 for dichotomous variables. Concordance between different cut-off values was assessed by means of Cohen's kappa.

Results

A total of 2,936 subjects were analysed: 655 from FIBRA-RJ, 828 from CC and 1,453 from TSHA (Table 1). The mean age of the whole sample was 75.57 years (±6.34). There was a predominance of female gender among the cohorts, from 70.2% (FIBRA RJ) to 54.3% (CC). A significant difference ($P < 0.001$) was found in mean values of GS between cohorts: FIBRA-RJ, 0.87 m/s (±0.29); CC, 0.74 m/s (±0.34); and TSHA, 0.57 m/s (±0.22). There was also a statistically significant difference in HS between the three populations, with a mean for the whole sample of 21.73 kg (±9.11). Cut-off values (lowest quintile according to the corresponding group) for GS and HS are shown in the Supplementary data, available in *Age and Ageing* online.

The percentages of subjects with EWGSOP cut-off values promoting MM assessment ranged from 89% (TSHA) to 40.2% (FIBRA-RJ) for GS and from 69.2% (TSHA) to 18.5% (CC) for HS. Accordingly, the overall proportion of individuals suspected of being sarcopenic was 83.4% for the whole sample (Table 2). The highest proportion was found in TSHA (94.4%) and the lowest in CC (67.8%).

When using the quintile-based approach, low GS was shown in 20.9% and low HS in 20.7% of the whole population (Table 2). Up to 34.2% would have been classified as suspected of being sarcopenic in the whole sample, ranging from 30.7% (FIBRA RJ) to 39.9% (TSHA).

With the z-value approach, 13.19% had low GS and 15.74% low HS in the whole sample. Accordingly, 23.71% of subjects would have been classified with probable sarcopenia in the whole sample, with a minimum of 22.58% (CC) and maximum of 24.16% (FIBRA RJ and TSHA).

Finally, agreement between EWGSOP and the alternative approaches was 0.319 ($P < 0.001$) and 0.115 ($P < 0.001$), for

Table 1. General characteristics of the population

	FIBRA RJ (n = 655, 22.3%)			CC (n = 828, 28.2%)			TSHA (n = 1,453, 49.48%)			Total (N = 2,936)		
	Men (29.8%)	Women (70.2%)	Total	Men (45.7%)	Women (54.3%)	Total	Men (44.1%)	Women (55.9%)	Total	Men (41.23%)	Women (58.77%)	Total
Age, mean (±SD)	76.5 (6.93)	70.23 (6.94)	76.5 (6.93)	76.39 (6.49)	76.31 (6.99)	76.35 (6.76)	74.71 (5.56)	74.83 (5.87)	74.78 (5.74)	75.48 (6.13)	75.63 (6.49)	75.57 (6.34)
GS, mean (±SD)	0.95 (0.31)	0.84 (0.28)	0.87 (0.29)	0.83 (0.32)	0.67 (0.33)	0.74 (0.34)	0.61 (0.22)	0.53 (0.2)	0.57 (0.22)	0.73 (0.3)	0.65 (0.29)	0.68 (0.3)
HS, mean (±SD)	29.08 (7.88)	17.86 (5.11)	21.2 (7.9)	26.01 (7.57)	16.47 (8.44)	20.83 (9.28)	29.19 (8.7)	16.91 (5.8)	22.32 (9.45)	28.28 (8.38)	17.13 (6.37)	21.73 (9.11)
Height, mean (±SD)	1.68 (0.06)	1.53 (0.06)	1.58 (0.09)	1.62 (0.07)	1.47 (0.08)	1.54 (0.1)	1.64 (0.06)	1.52 (0.06)	1.57 (0.08)	1.64 (0.07)	1.51 (0.07)	1.56 (0.09)
Weight, mean (±SD)	72.52 (13.04)	64.84 (12.33)	67.13 (13)	68.32 (12.1)	59.91 (12.25)	63.75 (12.8)	76.39 (11.73)	69.52 (12.77)	72 (12.78)	73.49 (12.55)	65.99 (13.12)	69.08 (13.4)
BMI, mean (±SD)	25.6 (4.22)	27.39 (4.9)	26.86 (4.78)	25.95 (4.13)	27.58 (5.72)	26.83 (5.12)	28.28 (3.86)	30.08 (5.25)	29.29 (4.77)	27.19 (4.18)	28.76 (5.43)	28.11 (5.01)

Proportions under de cohort acronym are the fraction of the whole sample (N = 2,936).
n or N, number of subjects; FIBRA-RJ, Frailty in Brazilian Older People Study—Rio de Janeiro; CC, Coyoacan Cohort; TSHA, Toledo Study for Healthy Aging; SD, standard deviation; GS, gait speed; HS, handgrip strength; BMI, body mass index.

the quintile based and z-score, respectively. On the other hand, the agreement between quintile-based and z-score approach was 0.736 ($P < 0.001$).

Discussion

Developing strategies to screen and diagnose sarcopenia is currently a relevant issue, both in clinical and research settings. Due to the high costs of methods to measure MM and the high percentage of older adults who potentially would be assessed, screening tests should aim at selecting only those at the highest likelihood of having sarcopenia. In 2010, an algorithm to diagnose sarcopenia was published [5], and due to its sound rationale and empirical basis, it quickly became an important reference. Accordingly, the main aim of the proposed algorithm is to restrict MM measurement to those subjects meeting one of two conditions—low GS and/or low HS. The cut-off values for both variables were based on previous works which state that they are good points to estimate risk for a number of adverse health outcomes and increased mortality [12, 13]. In the present work, we tested for the first time this proposal, in three cohorts of community-dwelling older adults from diverse ethnic and cultural background. Our findings do not support using the algorithm and its cut-off points as a screening tool due to the high proportion of people (higher than 80%) who met the criteria for MM assessment. A tool that selects such a high proportion of subjects cannot be considered a good screening instrument [14]. As stated by Feinstein, 'we might be willing to perform a confirmation test when a discovery test is positive, but if the rate of false positives diagnoses is too high, the advantages of a low-cost screening test will be ruined by disadvantages of high-cost confirmation test' [15].

One of the potential explanations for this finding is that both GS and HS are highly sensitive to anthropometric and cultural characteristics [16], making the original EWGSOP proposed cut-off values not widely usable across different populations [17]. This same effect has been also reported in other studies. For example, Jeune *et al.* [18] found a North–South gradient in HS among European countries, with substantially lower values in Calabria. Likewise, Kamarul *et al.* [19] concluded that HS values derived from western populations cannot be applied to the Malaysian population.

In this study, we have tailored the cut-off values to the characteristics of each population, using the same rationale underlying the development of the GS and HS cut-off values proposed in several studies and adopted by the EWGSOP algorithm [6, 12]. When this way to proceed is assessed, some differences in the proportions of selected individuals still remain between cohorts; however, they are not striking and can be explained by other factors. In addition, the percentage of people who would have their MM measured dropped from near 90% to around 30%. An indeed lower percentage and variability is achieved when the z-score approach is used. Although this proportion is still elevated, it seems to be of

Table 2. Proportion of subjects meeting the criteria for muscle mass measurement according to the cut-off points for gait speed (0.8 m/s or less) and grip strength (<30 kg for men and <20 kg for women) suggested by the EWGSOP, or the cut-offs calculated according to the lowest quintiles in every cohort and z-scores

Cohort	Low gait speed			Low handgrip strength			Expected proportion of subjects sent to muscle mass measurement		
Cut-off	EWGSOP[a] (%)	Quintiles[b] (%)	z-scores[c] (%)	EWGSOP[a] (%)	Quintiles[b] (%)	z-scores[c] (%)	EWGSOP[a] (%)	Quintiles[b] (%)	z-score[c] (%)
FIBRA RJ	40.2	19.5	15.29	66.2	16.5	12.18	75.5	30.7	24.16
CC	62.9	18.5	12.8	18.5	18.8	13.77	67.8	31.2	22.58
TSHA	89	22.7	12.46	69.2	23.3	18.25	94.4	39.9	24.16
Total	71.3	20.9	13.19	55.6	20.7	15.74	83.4	34.2	23.71

EWGSOP, European Working Group on Sarcopenia in Older People; FIBRA RJ, Frailty in Brazilian Older People Study—Rio de Janeiro; CC, Coyoacan Cohort; TSHA, Toledo Study for Healthy Aging.

[a]According to pre-established 0.8 or 20/30.

[b]According to the worst quintile adjusted by gender plus height for GS or BMI quartiles for HS.

[c]According to >1 SD from the mean (the mean and standard deviation of comparison correspond to the stratified groups by country, gender and height for GS and BMI quartiles for HS of individual values).

higher clinical utility, taking into account that the prevalence ranges between 6 and 8% when the EWGSOP algorithm is used [20].

In conclusion, the current form of the EWGSOP algorithm with its proposed cut-off points for GS and HS does not seem to be of clinical utility [21] in the screening of sarcopenia in older adults in all possible scenarios. Adapting the cut-off values to the specific characteristics of specific populations greatly reduces the number of individuals selected to MM measurement and, probably, will improve its performance. Further research including the assessment of MM in our cohorts is needed to determine the accuracy of these alternative approaches [22].

Key points

- Following the EWGSOP cut-off values, up to 90% of the population enrolled in the cohorts would have been tagged as abnormal.
- Cut-off point values tailored for specific populations reduce subjects considered as abnormal by recommended values.
- Screening could be of low clinical utility using the EWGSOP algorithm when using recommended cut-off values.
- Further research should aim at assessing clinical utility of this algorithm.

Conflicts of interest

None declared.

Ethics statement

The studies were reviewed and accepted by the Local Ethics Committee of each cohort.

Funding

This work was supported by different agencies for each cohort. The FIBRA RJ study was supported by Brazilian agencies: the Conselho Nacional de Pesquisa (grant number 555087/2006-9) and the Fundação Carlos Chagas de Apoio à Pesquisa (grant number E-26/171.469/2006). The Coyoacan Cohort was funded by the Comisión Nacional de Ciencia y Tecnología of Mexico (grant number SALUD-2006-C01-45075). Finally, TSHA was supported by Spanish agencies: the Instituto de Salud Carlos III, Ministerio de Economía y Competitividad (grant numbers PI07/90637, PI07/90306, PI11/01068, RD 06/0013, RD12/0043) and the Instituto de Ciencias de la Salud, Consejería de Sanidad de Castilla-La Mancha (grant number 03031-00).

Supplementary data

Supplementary data mentioned in the text are available to subscribers in *Age and Ageing* online.

References

1. Cooper C, Dere W, Evans W *et al*. Frailty and sarcopenia: definitions and outcome parameters. Osteoporos Int 2012; 23: 1839–48.
2. Sayer AA, Robinson SM, Patel HP, Shavlakadze T, Cooper C, Grounds MD. New horizons in the pathogenesis, diagnosis and management of sarcopenia. Age Ageing 2013; 42: 145–50.
3. Roubenoff R, Hughes VA. Sarcopenia: current concepts. J Gerontol A Biol Sci Med Sci 2000; 55: M716–24.
4. Morley JE, Malmstrom TK. Frailty, sarcopenia, and hormones. Endocrinol Metab Clin North Am 2013; 42: 391–405.
5. 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; 39: 412–23.

6. Fried LP, Tangen CM, Walston J *et al*. Frailty in older adults: evidence for a phenotype. J Gerontol A Biol Sci Med Sci 2001; 56: M146–56.
7. Searle SD, Mitniski A, Gahbauer EA, Gill TM, Rockwood K. A standard procedure for creating a frailty index. BMC Geriatr 2008; 8: 24.
8. Moreira VG, Lourenco RA. Prevalence and factors associated with frailty in an older population from the City of Rio de Janeiro, Brazil: the FIBRA RJ Study. Clinics 2013; 68: 979–85.
9. Ruiz-Arregui L, Avila-Funes JA, Amieva H *et al*. The Coyoacan Cohort Study: design, methodology, and participants' characteristics of a Mexican study on nutritional and psychosocial markers of frailty. J Frailty Aging 2013; 2: 68–76.
10. Garcia-Garcia F, Gutierrez-Avila G, Alfaro-Acha A *et al*. The prevalence of frailty syndrome in an older population from Spain. The Toledo Study for Healthy Aging. J Nutr Health Aging 2011; 15: 852–6.
11. Bijlsma AY, Meskers CG, van Heemst D *et al*. Diagnostic criteria for sarcopenia relate differently to insulin resistance. Age (Dordr) 2013; 35: 2367–75.
12. Abellan van Kan G, Rolland Y, Andrieu S *et al*. Gait speed at usual pace as a predictor of adverse outcomes in community-dwelling older people an International Academy on Nutrition and Aging (IANA) Task Force. J Nutr Health Aging 2009; 13: 881–9.
13. Lauretani F, Russo CR, Bandinelli S *et al*. Age-associated changes in skeletal muscles and their effect on mobility: an operational diagnosis of sarcopenia. J Appl Physiol 2003; 95: 1851–60.
14. Morrison AS. Screening. In: Rothman KJ, Greenland S, eds. Modern Epidemiology, 2nd edition. Philadelphia: Lippincott Williams & Wilkins, 1998; 499–518.
15. Feinstein AR. Clinical Epidemiology: The Architecture of Clinical Research. Philadelphia: W.B. Saunders Co., 1985.
16. Bohannon RW. Population representative gait speed and its determinants. J Geriatr Phys Ther 2008; 31: 49–52.
17. Santos-Eggimann B, Cuenoud P, Spagnoli J, Junod J. Prevalence of frailty in middle-aged and older community-dwelling Europeans living in 10 countries. J Gerontol A Biol Sci Med Sci 2009; 64: 675–81.
18. Jeune B, Skytthe A, Cournil A *et al*. Handgrip strength among nonagenarians and centenarians in three European regions. J Gerontol A Biol Sci Med Sci 2006; 61: 707–12.
19. Kamarul T, Ahmad TS, Loh WY. Hand grip strength in the adult Malaysian population. J Orthop Surg 2006; 14: 172–7.
20. 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; 42: 378–84.
21. Bossuyt PMM, Reitsma JB, Linnet K, Moons KGM. Beyond diagnostic accuracy: the clinical utility of diagnostic tests. Clin Chem 2012; 58: 1636–43.
22. Rodríguez-Mañas L, Fried LP. Frailty in the clinical scenario. Lancet. Published Online 1 October 2014 http://dx.doi.org/10.1016/S0140-6736(14)61595-6.

Received 1 December 2013; accepted in revised form 12 November 2014