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APPROPRIATENESS OF FIVE MEASURES PROPOSED BY EWGSOP FOR DIAGNOSING SARCOPENIA IN CLINICAL PRACTICE AMONG THE ELDERLY LIVING AT THE SENIOR CENTRE IN BLANSKO, CZECH REPUBLIC - A CASE STUDY

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Abstract: *Objectives:* To evaluate the possibilities of some recommended diagnostic tools on selected groups of the elderly. *Design and Methods*: 79 elderly people (average age 81.8) participated in a study aimed at verifying the possibilities of using diagnostic methods of sarcopenia proposed by the European Working Group on Sarcopenia in Older People (EWGSOP). We measured body composition by bioimpedence analysis (BIA), physical performance with hand-grip dynamometry and the standing balance, sit-to-stand and walking speed items of the Short Physical Performance Battery (SPPB). For data analysis, we used the IRT statistical method. *Results:* We demonstrated that these selected tests have a unidimensional character but they do not measure the level of fitness in the elderly. In addition, we found that the item "Chair Stand" is, according to our experience, too difficult in its current version and thus it underestimates the overall performance of the population in this age category. *Conclusions:* Although the diagnostic tools suggested by EWGSOP are important tools for the senior population in general, we found some difficulties in their use in the sample of seniors who lived at the institution under study. Nevertheless, one possible limitation of our research was the sample size.

Key words: Sarcopenia diagnostics, aging, Alzheimer's disease, institutional care facilities.

Introduction

Sarcopenia is a geriatric syndrome with a multifactorial aetiology which is primarily associated with muscle mass loss and decreasing levels of physical ability (1). The prevalence of sarcopenia varies among people over 65, from 7 to 50% (2), with the most endangered groups being elder residents in institutional care facilities affected by Alzheimer's disease (3-7). Sarcopenia has been a growing problem in our aging population because the care for the afflicted elderly requires high financial costs (8). Therefore, this problem should be a challenge for the scientific community to pay considerable attention to sarcopenia prevention and treatment. The consensus of sarcopenia prevalence and its aetiology was accepted in November 2009 in Rome (9). At the same time, the European Working Group on Sarcopenia in Older People (EWGSOP) was created by the initiative of four European organizations dealing with aging in Europe. EWGSOP also advised some methods of sarcopenia diagnostics for research and clinical practice as one of their sub-tasks. These were published in an extensive report (10). The results of healthy subject measurement minus 2 standard deviations (SDs) were used as reference values to evaluate the level of variables observed among the frail elderly in some of the proposed methods (11). Reference values were obtained from the research after excluding the elderly living in institutional care facilities (12, 13). Therefore, in our view, the use of these diagnostic tools is very restricted for measuring old people over 80 with a certain degree of disability of age who usually live in residential homes (14). The aim of our study was to verify the possibilities of using the EWGSOP proposed sarcopenia diagnostic methods in clinical practice among the elderly over 60 living in assisted care and in a special care ward for people with Alzheimer's disease at the Senior Centre in Blansko (South Moravia, Czech Republic).

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Methods

Subjects

Our study was carried out at the Senior Centre in Blansko in South Moravia. Elderly over 60 who cannot care of themselves in their own homes due to health status deterioration owing to disease or dementia live at this facility. Seniors live in two wards: the home for the elderly is one with the capacity of 70 beds for relatively self-sufficient subjects and the special care home is the other with 34 beds for old people with special care most of whom suffer from some stage of Alzheimer's disease. Everyone living in this facility at the time of the study was asked to participate. The character and suitability of items for assessing of sarcopenia extend were evaluated with two sample groups. In the first research sample, 58 participants were from the home for the elderly (44 female and 14 male), average age 81.5 (the youngest 65 and the oldest 99). The second research sample contained 21 individuals from the special care ward, (16 female and 5 male), average age 82.1 (the youngest 63 and the oldest 93). All the participants were informed about the study and were requested to sign an informed consent. The study was carried out with the approval of the ethics committee of the Faculty of Physical Education and Sport, Charles University in Prague and the Czech Alzheimer Society.

Measurements

To determine body composition, a Professional Body Composition Analyser InBody 720 - Biospace Co., Ltd. Korea was used. The InBody 720 was compared with other types of devices and it was found suitable for the measurement of the body composition in both sexes even among very old people (15, 16). The measurements were carried out according to the instructions provided by the manufacturer. To measure muscle strength, handgrip strength was measured using a Takei A5401 Digital Hand Grip Dynamometer. Both the left and right hands were measured. SPPB was used to evaluate physical performance. The SPPB consists of three timed tests: balance, usual walking speed and chair sitting and standing up. In the balance test, the duration of standing in three different positions- side-by-side, semi-tandem and tandem positions -are measured. In the walking speed test, the time for covering a 4m distance by usual walking speed is measured while the chair test consists of measuring the necessary time for standing up and sitting down in a chair at the fastest speed (17). These are the standardised battery of tests used in the Czech Republic (18). Just passing the item was considered as an accomplishment regardless to the quality of performance in our study.

Statistics

Item Response Theory (IRT) was used to verify the structure, diagnostics quality and suitability of tests items. IRT is non-linear technique which has overtaken the common linear model from Classical Test Theory (CTT). IRT is an appropriate approach for modelling the relation between latent continuous variables and categorical manifest data (19). It stresses that the performance in a test is influenced by the level of skills and the character of item (difficulty) in IRT (20). All participants and indicators are located on the same scale. It can express the degree of the latent trait and the probability of passing the task (21).

The main supposition for using IRT is that the tested items have a unidimensional character, if all items measure the same latent variable. This supposition is based the principal of local independence (22, 23). The unidimensionality of chosen indicators was verified through non-parametric IRT commonly known as Mokken scale (24). Scalability coefficient H, which expresses level of items unidimensionality, was determined on rule of thumb value from the literature as coefH $\geq$ 0.4 (23). For the fit index, or how well the chosen model depicted the data, the Root means square of approximation (RMSEA) (25) and Akaike Information Criterion (AIC) (26) were used.

Suitability of used items was verified by two basic IRT models where the property of difficulty as well as property of discrimination of items for determination of physical fitness in each population was evaluated. Every performance was scored on a binary scale (0 - fail, 1- pass).

1. Rasch model: in this model, difficulty parameter is free and discrimination parameter is fixed on value 1
2. Two Parameter Logistic Model (2PL): in this model both parameters (difficulty, discrimination) are free.

The computer programs R and IRT PRO were used for the data analysis.

Results

The home for the elderly results IRT

Unidimensionality

Mokken scale scalability coefficient confirmed the seniors home population unidimensionality of all five used items, coef H = 0.632.

From results of the Rasch model, it is evident that for the population from the home for the elderly the most difficult indicators were the "balance" and "chair stand" tests. Only 34% of seniors passed the "balance" test and only 22% passed the "chair stand" test. It is obvious that

the tested population from the home for the elderly would have to have exceedingly above average level of latent trait of physical fitness. In contrast to these tests, 76% of the seniors passed the "hand grip" test and from the data analysis it is apparent that this indicator did not discriminate well the level of physical fitness of this population (Table 1).

Table 1
Rasch Model results of difficulties of items

Item	Label	A	s.e.	C	s.e.	B	s.e.
1	in body	1.00	-----	-0.26	-----	0.26	0.31
2	Balance	1.00	-----	-0.82	-----	0.82	0.32
3	gait speed	1.00	-----	0.01	-----	-0.01	0.31
4	chair stand	1.00	-----	-1.58	-----	1.58	0.36
5	hand grip	1.00	-----	1.47	-----	-1.47	0.35

Fit indices: RMSEA = 0.16, AIC = 315.81

The fit of Rasch model showed under average results. RMSEA = 0.16 was, in this model, higher than the recommended value of 0.08. This means that data did not fit data well. One of the reasons can be that each of five items measured the latent trait physical fitness with significantly different discrimination parameter. In other words, at the home for the elderly population used items assessed with same trait but with not equal weight. Therefore, we decided to set discrimination parameter free. This approach and model is called 2PL.

Results from 2PL showed that both the problematically too difficult items have a lower value of difficulty parameter in this model. However, the "chair stand" test was indicated at an extreme value of discrimination. This finding supported our assumption about inappropriateness of this test at the home for the elderly population (Table 2). Moreover from values of both fit indices is evident that 2PL model showed significantly improvement of fit RMSEA = 0.04 which meant a very good fit and significantly lower value of AIC = 279.83.

We confirmed that all five used items have a unidimensional character in evaluating the physical fitness latent trait without, however, same weight for assessing the degree of sarcopenia. Moreover, the indicators "balance" and "chair stand" seem to be too difficult for the home for the elderly population.

Table 2
2PL Model results of difficulties and discrimination of items

Item	Label	A		s.e.	c		s.e.	B	s.e.
1	in body	2	5.28	2.81	1	-0.85	1.77	0.16	0.30
2	Balance	4	4.17	1.54	3	-1.86	1.18	0.45	0.27
3	gait speed	6	3.65	1.29	5	-0.06	1.27	0.02	0.35
4	chair stand*	8	44.37	6.46	7	-33.21	6.14	0.75	0.14
5	hand grip	10	1.48	0.92	9	1.59	0.99	-1.07	0.36

* Extreme value of discrimination. Fit indices: RMSEA = 0.04, AIC = 279.83

The special care ward results IRT

During the data colleting procedure, it was determined that no participants were able to pass the "chair stand" test in the special care ward. Therefore, this indicator had to be removed from this part of our study. Its variability was 0.

Unidimensionality

The Mokken scale scalability coefficient did not categorically confirm the unidimensionality of all four used items for the special ward population, coef H = 0.347. We assume that this result could be due to the small research sample n=21.

Table 3
Rasch Model results of difficulties of items

Item	Label	A	s.e.	c	s.e.	B	s.e.
1	in body	1.00	-----	-1.11	-----	1.11	0.55
2	Balance	1.00	-----	-2.65	-----	2.65	0.75
3	gait speed	1.00	-----	-0.84	-----	0.84	0.53
4	hand grip	1.00	-----	-0.59	-----	0.59	0.52

Fit indices: RMSEA = 0.24, AIC = 96.77

The Rasch model showed that, with the special care population, only 29% passed the "in body" item. Moreover, the "balance" test was found for this tested population as explicitly and inappropriately difficult as only 9% of the participants passed this test. Even the other two tests, the "gait speed" and "hand grip", showed a significantly greater difficulty for individuals in the special care ward in comparison with the population of the home for the elderly (Table 3).

The Rasch model fit indices with the second research sample express similar below average values with the special care ward population. RMSEA = 0.24 was much higher than the recommended acceptable value of the RMSEA model ≤ 0.08. In next step, we used 2PL model for verifying weights of discrimination parameter of the four used items.

Table 4
2PL Model results of difficulties and discrimination of items

Item	Label	A		s.e.	C		s.e.	B	s.e.
1	in body*	2	79.07	14.16	1	-39.75	8.17	0.50	0.08
2	balance*	4	31.60	10.45	3	-40.01	5.32	1.27	0.41
3	gait speed*	6	123.44	431.43	5	-38.10	10.40	0.31	1.05
4	hand grip	8	-0.50	0.62	7	-0.53	0.47	-1.06	1.49

* Extreme discrimination value; Fit indices: RMSEA = 0.02, AIC = 83.35

Despite the decreasing of difficulty parameters for the items "in body", "balance" and "gait speed" these indicators showed in the 2PL model extreme values of

discrimination parameter (Table 4). This finding supported our assumption that the current assessing of the degree of sarcopenia by these tests with a senior population who have restricted locomotion is inappropriate.

Significantly improved values of fit indices RMSEA = 0.02 as well as AIC = 83.35 confirmed that the 2PL model with set discrimination parameter free explains the significantly appropriate structure of used four items. This finding also confirmed the suggestion that the tests used for both populations measure the same latent variable, but the weight of each test for assessing the degree of sarcopenia is significantly different.

Discussion

In our study, we tried to use the recommended methods of sarcopenia diagnostics among the elderly over 60. All the residents living in the home for the elderly and special care ward were asked to participate in research groups. We are aware of the fact that our research groups were small which limits the results being applied to the population of the elderly. However, some of our findings are startling and worth noting. Although all the selected methods were declared as applicable to our selected population groups (10, 11, 16), only 11 subjects (4 female and 7 male) were able to complete all the measurements despite the fact that only meeting the conditions was considered as an accomplishment regardless to the quality of performance. The most common reasons, similar to those in previous studies, as to why they were not able to carry out some measurements were: being wheelchair bound (27), the use of walking aids (5, 28), joint prostheses (29), high blood pressure (29), for applying InBody it was the use of diuretic drugs (28) and for the hand grip were rheumatism and paralysis of one of the upper limbs (30). The biggest problem was an inability to understand the task due to one of the stages of dementia in the special care ward (5).

We demonstrated that the tests recommended for evaluating the degree of physical fitness at two different seniors' populations do not have equal value (discrimination parameter). These results are evident despite the fact that our research samples were small. The most problematic item was the "chair stand test", which is in the present form is too difficult for both populations. This fact leads to underestimation of the performance in both populations. In addition, the second population from the special care ward with items "in body", "balance" and "gait speed" also showed problems through its extreme discriminations parameter. Therefore, the target of further studies should be to confirm or disprove the conclusions of this study. Moreover, further studies should be also focused on looking for and discovering suitable indicators for diagnostic of sarcopenia in senior care facilities.

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