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Balance in seniors who exercise, considering different levels of fear of falling

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ABSTRACT. The aging process brings changes to one's body balance and may trigger a fear of falling. The aim of this study was to compare and verify correlation between different methods that assess body balance among elderly individuals who exercise, according to different levels of fear of falling. The sample was composed of 186 individuals (68.28±6.years) who exercise. Balance assessment used Timed Up and Go, Unipedal Stance, Sitting-Rising and Functional Reach tests. A question about fear of falling was applied in the form of an interview. Statistical analysis used Spearman and Kruskall Wallis correlation. In results, Timed Up and Go (7.13±1.6s), Unipedal Stance (20.52±9.9s), Sitting-Rising (12.43s±3.2s) and Functional Reach (29.51±6.5) showed significant correlation with fear of falling. Individuals less afraid of falling showed better balance performance when compared to those not afraid of falling. In conclusion, **b**etter balance performance can contribute to decreasing fear of falling.

Keywords: aging, body balance, motor activity.

Equilíbrio em idosos praticantes de atividade física com diferentes níveis de medo de cair

RESUMO. Com o envelhecimento há alterações no equilíbrio, podendo desencadear o medo de cair. O objetivo desse estudo foi comparar e verificar a relação de distintos métodos de avaliação do equilíbrio corporal em idosos praticantes de atividade física, segundo os diferentes níveis de medo de cair. A amostra foi composta por 186 indivíduos (68,28±6,7anos) praticantes de atividade física. Para avaliar o equilíbrio, utilizou-se o *Timed Up and Go*, Apoio Unipodal, Sentar e Levantar e Alcance Funcional. Foi aplicado, em forma de entrevista, questão sobre o medo de cair. Na análise estatística utilizou-se correlação de Spearman e Kruskall Wallis. Nos resultados, o *Timed Up and Go* (7,13±1,6s), Apoio Unipodal (20,52±9,9s), Sentar e Levantar (12,43s±3,2s) e Alcance Funcional (29,51±6,5) apresentaram relação significativa com o medo de cair. Os indivíduos com menos medo de cair apresentaram melhor desempenho de equilíbrio quando comparados com indivíduos sem medo de cair. Dessa forma, o melhor desempenho no equilíbrio pode contribuir para uma diminuição do medo de cair.

Palavras-chave: envelhecimento, equilíbrio postural, atividade motora.

Introduction

The elderly population has been growing worldwide. Closs and Schwanke (2012) showed that between 1970 and 2010, the Ageing Index had a 268% growth in Brazil, confirming the aging of the population. For this reason, there has been an increasing attention from studies that investigate the aging process. A study conducted by Milanović et al. (2013) indicates that an elderly individual's functional capacity decreases with age. Causes of this decrease includes decline in variables such as strength, cardiorespiratory capacity, flexibility and body balance as well (Milanović et al., 2013). In addition, a research carried out by Medeiros et al. (2013) also states that there is a body decline as one ages.

This decrease occurs because sensorial systems (visual, somato-sensorial and vestibular), which compose body balance control, change as one ages, with a decline in stability (Ricci, Gazzola, & Coimbra, 2009). These changes can limit the elderly's functional independence and quality of life (Melo et al., 2009).

A consequence of balance reduction in the elderly may be the occurrence of falls (Ganz, Bao, Shekelle, & Rubenstein, 2007). Around 30% of the elderly suffer at least one fall every year. About 25% of the elderly, within a year, die from direct or

indirect consequences of falls (Ambrose, Paul, & Hausdorff, 2013).

A population-based study conducted by Antes, D'Orsi and Benedetti (2013) highlights that 13% of the investigated elderly suffered a fracture as a consequence of falling. In addition, 24.7% restricted some routine activity after falling. These restrictions may derive from biological effects such as the fractures themselves, social effects such as excessive concern from family members who do not allow the elderly to perform simple everyday tasks, or psychological aspects such as increased fear of falling (Antes, d'Orsi, et al., 2013). Among Brazilian elderly individuals, the prevalence of fear of falling stands approximately at 90% (Lopes, Costa, Santos, Castro, & Bastone, 2009).

For this reason, it becomes important to investigate the fear of falling or the concern with a possible fall, as it is directly linked to the elderly's health, to restriction of activities and to reduction of mobility (Camargos, Dias, Dias, & Freire, 2010). Besides, fear of falling can be the cause of some restrictions of daily activities (Donoghue, Cronin, Savva, O'Regan, & Kenny, 2013) such as climbing stairs and walking on irregular surfaces, which can be lessened with the practice of physical activity and enhanced balance.

Exercising can be an ally to reduce physiological changes derived from body aging such as balance (Pedrinelli, Garcez-Leme, & Nobre, 2009). Ruzene and Navega (2014) indicate that active elderly individuals show better dynamic balance results when compared to sedentary ones. Moreover, as for fear of falling, according to a study conducted by Doi et al. (2012), it has better results among the elderly who exercise more.

An investigation carried out by Hauser, Sandreschi, Parizzotto, Araújo and Mazo (2015) points out that better balance, assessed by means of the 'Senior Fitness Test' (Rikli & Jones, 2008) can lead the elderly who exercise to be less afraid of falling. However, there still are scarce studies comparing different types of balance (static, dynamic and front), assessed through other test protocols as to different levels of fear of falling.

In this way, the aim of this study was to compare and verify correlation between different methods to assess body balance among seniors who exercise, according to different levels of fear of falling.

Material and method

Population and sample

The population of this study was made up by people aged 55 years old at least, who exercised and were part of the university extension program called Third Age Study Group (*Grupo de Estudos da Terceira Idade* - GETI) at the Health and Sports Sciences Center (*Centro de Ciências da Saúde e do Esporte* - CEFID) of Santa Catarina State University (*Universidade do Estado de Santa Catarina* - UDESC). Every year, according to the university academic calendar, the GETI provides the elderly modalities of physical activities such as: bodybuilding, water aerobics, swimming, fitness, Pilates, dance and guided walking. Participation in the research required the following inclusion criteria: being a GETI member, being 55 years old or over and being physically fit to perform the balance tests proposed for this study. Given these criteria, the sample was composed of 186 individuals (68.28 ± 6.7 years) who exercised and were considered as seniors.

Instruments

The following tests were used for balance assessment:

The Timed Up and Go (TUG) test, which aims to assess dynamic balance. It requires the individual to rise from a chair, walk three meters, return and sit down again on the same chair, while the time spent on said activity is being clocked. Individuals are not allowed to run in this test. Participants can perform a familiarization session and another two attempts before performing the test (Podsiadlo & Richardson, 1991).

The Unipedal Stance (UPS) test assesses static balance. It requires the individual to remain with his arms on the side of his body. Time starts being clocked when he lifts one leg from the ground, and is interrupted when he puts the suspended foot on the ground or reaches the limit time of 30 seconds. Three attempts are made and the longest time is taken into account (Briggs, Gosmann, Birch, Drews, & Shaddeau, 1989).

The Sitting-Rising (SR) test assesses one's ability to sit and stand up. It uses a straight-back chair placed close to a wall. Participants are asked to rise once from the chair. In case of success, they are asked to rise from and sit on the chair 5 times, as fast as possible; this test starts in the sitting position and ends at the end of the fifth repetition (Guralnik et al., 1994).

The Functional Reach (FR) test aims to assess recoverable balance. It requires the individual to stand with his arms and feet parallel to the wall, without leaning on it, with his shoulders at 90º and his elbow outstretched. The initial position is marked on the wall. Afterwards, the subject is asked to move forward, keeping his arms extended, without lifting his heels from the ground and without losing balance. The distance of the first and

the second markings are measured. The initial and final values of the position are compared (Duncan, Weiner, Chandler, & Studenski, 1990).

In addition to the balance tests, a questionnaire was applied, which is part of a broader research and contains questions related to personal data, practice of physical activity, health conditions, pain, falls, vision and hearing. The present research will use questions referring to the participants' personal data (name, sex, age and education); falls in the past year (yes and no); and fear of falling (how often fear of falling is shown: never (1); sometimes (2); often (3); always (4)). The question about fear of falling aimed to present a parameter on this variable and was elaborated based on the Falls Efficacy Scale, adapted for Brazil by Camargos et al. (2010).

Ethical matters

The project was approved by Santa Catarina State University's Ethics Committee on Research Involving Humans under No 052406/2015. The conduction of this research complied with all ethical principles, in accordance with resolution 466/12 of the Brazilian National Health Council. All participants signed an informed consent form.

Data collection

Data were collected at the CEFID/UDESC sports gym. Initially, the individuals answered the research questions. After the interview, balance tests were applied individually by previously trained researches, in the following order: TUG, UPS, SR and FR. On average, 20 minutes were spent on physical assessment and interviews with the individuals.

Data treatment and statistics

For statistical analysis, descriptive statistics was used (mean and standard deviation) for numerical variables, and frequency distribution (%) for categorical variables. Data normality was verified by means of the *Kolgomorov Smirnov* test. First, considering the four fear of falling categories (never, sometimes, often and always), a Spearman correlation analysis was performed between results of the level of fear of falling, balance tests and the participants' ages in order to assess the level of association between these variables.

Levels of fear of falling were grouped and classified into: G1 = group that is never afraid of falling, G2 = group that sometimes is afraid of falling, and G3 = group that is often and always afraid of falling. To verify association of levels of fear of falling (G1, G2 and G3) with falls and education, the Chi-Squared test was performed. For comparison between levels of fear of falling (G1, G2 and G3) with Timed Up and Go, Unipedal Stance and Sitting-Rising 5 times tests, the Kruskall Wallis test was adopted; for Functional Reach, due to data normality, One-Way Anova was used. A $p < 0.05\%$ significance level was adopted.

Results and discussion

The participants of this study were divided into different levels of fear of falling: never (n = 89); sometimes (n = 58); often (n = 27) and always (n = 12). Associating levels of fear of falling (G1 = never; G2 = sometimes; G3 = often and always) with education (up to 8 years and 9 years or more of study) and fall (yes and no), significant difference was found as to education. There was a trend of elderly individuals with high education level (53.1%) having never been afraid of falling, and elderly individuals with low education level (35.7%) having often or always been afraid of falling (Table 1).

Table 1. Association between levels of fear of falling with falls and the participants' education (n=186).

	Falls (past 12 months)			
Levels of fear of falling	Yes f(%)	No f(%)	X^2	*P*
G1	13(35.1)	76(51)		
G2	12(32.4)	46(30.9)	4.47	0.10
G3	12(32.4)	27(18.1)		
	Education			
	Up to 8 years f(%)	9 years or more f(%)	X^2	*P*
G1	20(35.7)	69(53.1) §		
G2	16(28.6)	42(32.3)	10.95	0.00*
G3	20(35.7) §	19(14.6)		

Legend: G1= never afraid of falling; G2= sometimes afraid of falling; G3= often or always afraid of falling; $p < 0.05$; X^2=chi-squared test; §=Residual adjustment>2; *$p < 0.05$.

Table 2 displays correlation between levels of fear of falling with balance tests and the participants' ages; it is possible to observe that, despite weak and moderate correlations, fear of falling showed significant relation with the different balance tests and age. Thus, the better the performance in balance tests, the lesser the senior's fear of falling. In addition, results indicate significant correlation between age and different levels of fear of falling, showing that the older the senior's age, the greater his or her fear of falling was.

Comparing different levels of fear of falling (G1 = never; G2 = sometimes; G3 = often or always) with the TUG, UPS, SR and FR balance tests, significant difference was found between G1 and G3 for all balance tests. Besides, there was difference between G1 and G2 for TUG and UPS. Thus, all elderly individualsless afraid of falling showed better

performance in body balance tests compared to those who were more afraid of falling (Table 3).

Table 2. Correlation between levels of fear of falling with balance tests and the participants' ages (n = 186).

Numerical variables	Mean	Standard deviation	*Rho*	*p*
TUG(s)	7.13	± 1.6	0.419	0.00⋆
UPS(s)	20.52	± 9.9	-0.320	0.00⋆
SR5(s)	12.43	± 3.2	0.224	0.00⋆
FR(cm)	29.51	± 6.5	-0.238	0.00⋆
Age(years)	68.28	± 6.7	0.270	0.00⋆

Legend: TUG(s) = Timed Up and Go in seconds; UPS (s) = Unipedal Stance in seconds; SR5(s) = Sitting-Rising 5 Times in seconds; FR (cm) = Functional Reach in centimeters; *Rho* = Spearman Correlation; *p = level of significance;* ⋆*p< = 0.05.*

Table 3. Comparison between different levels of fear of falling and balance tests.

	G1	G2	G3	*P*
TUG	6.56(1.07)^{AB}	7.16(1.38)^{BC}	7.97(1.94)^{AC}	0.00⋆
UPS	23.46(8.74)^{AB}	19.14(9.93)^{B}	15.58(10.28)^{A}	0.00⋆
SR5	12.02(3.2)^{A}	12.39(2.90)	13.15(3.72)^{A}	0.00⋆
FR⋆⋆	30.9(6.49)^{A}	28.91(6.01)	27.97(6.86)^{A}	0.00⋆

Legend G1 = never afraid of falling; G2 = sometimes afraid of falling; G3 = often oralways afraid of falling; A = Difference between 'G1' and 'G3'; B = Difference between 'G1' and 'G2'; C = Difference between 'G2' and 'G3'; ⋆⋆Bonferroni Post Hoc; TUG = Timed Up and Go; UPS = Unipedal Stance; SL5 = Sitting-Rising 5 times; FR = Functional Reach; ⋆p < 0.05.

In the present study, results indicate that individuals who were more afraid of falling showed worse results in different body balance tests compared to those less afraid of falling. These findings agree with results of a systematic review that points fear of falling being associated with self-reported balance issues (Kumar, Carpenter, Morris, Iliffe, & Kendrick, 2013).

Levels of fear of falling were associated with education as well; the elderly with higher education level tend to not being afraid of falling, while those with lower education level tend to be often or always afraid of falling. Study conducted by Antes, Schneider, Benedetti and d'Orsi (2013), which aimed to identify factors linked to fear of falling, states that education may relate to concern with falling. Corroborating, a review study conducted by Kumar et al., (2013) states that low education level indicates greater fear of falling.

When it comes to age, the present study also found correlation between levels of fear of falling and age. This finding is in line with the review study by Kumar et al. (2013), which found association between different age groups and fear of falling. However, Antes, Schneider et al. (2013) observed no association between these variables. It is worth highlighting that in mentioned studies, age groups were classified in different ways, while in the present study this variable was related numerically.

Concerning the Timed Up and Go (TUG), this test was used for comparison of balance and fear of falling and presents similar findings in the literature. Reelick, Van Iersel, Kessels and Rikkert (2009) observed that elderly individuals who were more afraid of falling took more time to perform the TUG. Doi et al. (2012) aimed to investigate correlation between fear of falling and physical activity among elderly women. When comparing the group 'afraid of falling' with the group 'not afraid of falling', the authors found better performance in the TUG test for the group 'not afraid of falling' (p = 0.013).

About Sitting-Rising 5 times (SR5), our results also show statistically significant difference between the group that is never afraid of falling (G1) and that is often or always afraid of falling (G3). Corroborating, in a review study, Kumar et al. (2014) identified that the fact that the individual is capable of rising from a chair indicates less fear of falling. In a study conducted by Tomita et al. (2015), similar to the present study, the authors sought to investigate whether results in different physical performance tests was different between individuals who were and were not afraid of falling. As a result, they found that TUG and SR5 showed different values between groups, corroborating with findings of the present study, which also found difference between individuals who were more and less afraid of falling. However, in the study by Tomita et al. (2015), the Functional Reach test (FR) showed no statistical difference between groups.

Although no statistical difference was found for FR in the study above presented (Tomita et al., 2015), results of this test in the present study also proved different between individuals from G1 and G3. In the same way, Lopes et al., (2009) found in their results correlation between fear of falling and the FR test, justified by inability or incapacity to perform this test, suggested by the presence of balance deficit, which may be linked to fear of falling.

As for the Unipedal Stance (UPS) test, Moreira (2013) observed that those seniors who had suffered falls and were afraid of falling showed shorter time of left unipedal support compared to those without falls and who were afraid of falling. Although the present research has not differentiated fall group and no fall groups, it is possible to observe that the elderly who were afraid of falling took less time to perform the unipedal support test. It is worth highlighting that, during walking, unipedal support phases decrease in individuals who were more afraid of falling (Lopes et al., 2009), and these phases are not stimulated in their everyday lives, which can explain worse results in UPS among individuals more afraid of falling in the present study.

Studies using other balance tests also show differences in this variable as to fear of falling. A study conducted by Carvalho, Pinto, and Mota (2007) verified that individuals with better body balance are less afraid of falling. Guthrie et al. (2011) also found that balance, assessed by means of BERG balance scale, is associated with fear of falling. The authors suggest, additionally, that balance can be a more important variable to fear of falling than consumption of medicines, for instance, which is a variable commonly linked in the literature to concern with falls (Guthrie et al., 2011).

According to the findings of our research and previously presented studies that corroborate our results, balance is associated with fear of falling. In this way, there is a need for strategies aimed at enhancing balance. In a systematic review, Kumar et al. (2014) found that exercises can be a way to lessen fear of falling in the elderly. In the same way, Gusi et al. (2012), when performing a body balance intervention, observed improvement in the participants' fear of falling.

Limitations of this study include the fact that the question used to assess fear of falling targeted the seniors' perception about levels of fear of falling, although the literature has instruments (Camargos et al., 2010) that assess fear of falling regarding routine-specific activities. Despite that, the question used in the present study contemplates the proposal of this research as to assessment of fear of falling level.

Conclusion

It can be concluded that seniors more afraid of falling showed worse balance when compared to those less afraid of it. In addition, it was detected that the Timed Up and Go, Unipedal Stance, Functional Reach and Sitting-Rising 5 times balance tests correlated with less fear of falling.

In this way, it is worth noting the importance of detecting fear of falling in the elderly and, thus, planning and directing a balance training for elderly people in order to decrease this fear. Moreover, based on the trainings, longitudinal researches should be carried out in order to verify their effects concerning fear of falling.

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