REFERENCE VALUES FOR BALANCE IN PHYSICALLY ACTIVE ELDERLY WOMEN

VALORES DE REFERÊNCIA PARA O EQUILÍBRIO EM IDOSAS FISICAMENTE ATIVAS

VALORES DE REFERENCIA PARA EL EQUILIBRIO EN MUJERES MAYORES FÍSICAMENTE ACTIVAS

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ABSTRACT

Introduction: Body balance is one of the most important factors related to falls, quality of life, and independence, and its evaluation is therefore important. Objective: To establish reference values for balance tests in physically active older women from different age groups. Methods: The sample consisted of 192 physically active women aged 60 to 79 years who were submitted to the following tests: timed up and go (TUG), one-leg stand (OLS), five-repetition chair stand (CS-5), functional reach (FR), and tandem stand test (TST). Descriptive statistics (percentile analysis) and the Mann-Whitney U test were used. Results: In older women aged 60 to 69 years, the values indicating "good" balance were a score less than 5.7 s in the TUG, achieving 30 s of OLS, performing the CS-5 test in less than 8.5 s, and a result greater than 35.5 cm in the FR test. In older women aged 70 to 79 years, the values indicating "good" balance were a score less than 5.9 s in the TUG, achieving 30 s of OLS, performing the CS-5 in less than 8.5 s, and a result greater than 33 cm in the FR test. In the TST, most of the physically active subjects achieved the ceiling performance. Conclusion: The reference values obtained are similar to or better than those reported in the literature. The use of the TST is not recommended for physically active older women because of its low discriminatory power in this group. ***Level of evidence III; Study of non consecutive patients; without consistently applied reference "gold" standard.***

Keywords: Postural balance; Aged; Motor activity.

RESUMO

Introdução: O equilíbrio corporal é considerado um dos fatores importantes relacionados a quedas, qualidade de vida e independência, o que torna importante sua avaliação. Objetivo: Estabelecer valores de referência dos testes de equilíbrio para idosas que praticam atividade física em diferentes faixas etárias. Métodos: A amostra foi composta por 192 idosas entre 60 e 79 anos que praticam atividades físicas *e realizaram os seguintes testes: Timed Up and Go (TUG), Apoio Unipodal (AU), Sentar e Levantar cinco vezes (SL5), Alcance Funcional (AF) e Tandem Test (TT). Foi realizada estatística descritiva (análise de percentil) e teste U de Mann-Whitney. Resultados: Observou-se que para as mulheres de 60 a 69 anos terem seu equilíbrio "bom", devem ter resultados inferiores a 5,7 segundos no TUG; atingir a marca de 30 segundos no AU; realizar o SL5 em menos de 8,5 segundos e apresentar resultado superior a 35,5 cm no AF. Para as mulheres de 70 a 79 anos terem equilíbrio "bom", devem apresentar resultados inferiores a 5,9 segundos no TUG; atingir 30 segundos no AU; realizar o SL5 em menos de 8,5 segundos e apresentar resultado superior a 33 cm no AF. No TT, a maioria das idosas praticantes de atividade física atingiu o efeito máximo. Conclusão: Verificou-se que os resultados encontrados neste estudo são semelhantes ou superiores aos da literatura. Não se recomenda a utilização do TT para idosas fisicamente ativas por causa do pouco poder discriminativo para esse grupo.* ***Nível de evidência III; Estudo de pacientes não consecutivos; sem padrão de referência "ouro" aplicado uniformemente.***

Descritores: *Equilíbrio postural; Idoso; Atividade motora.*

RESUMEN

Introducción: El equilibrio corporal se considera uno de los factores importantes relacionados con las caídas, la calidad de vida y la independencia, lo que hace que su evaluación sea importante. Objetivo: Establecer valores de referencia para las pruebas de equilibrio para mujeres mayores que practican actividad física, en diferentes grupos de edad. Métodos: La muestra consistió en 192 mujeres con edad entre 60 y 79 años que practican actividades físicas y realizaron las siguientes pruebas: Timed Up and Go (TUG), soporte unipodal (SU), sentarse y pararse cinco veces (SP5), alcance funcional (AF) y el prueba de tándem (PT). Se realizó estadística descriptiva (análisis de percentiles) y prueba U de Mann-Whitney. Resultados: Se observó que para que las mujeres de 60 a 69 años tengan un equilibrio "bueno", deben tener resultados inferiores a 5,7 segundos en el TUG; alcanzar la marca de 30 segundos en él SU; lograr el SP5 en menos de 8,5 segundos y tener un resultado mayor de 35,5 cm en el AF. Para que las mujeres entre 70 a 79 años tengan un "buen" equilibrio, deben presentar resultados de menos de 5,9 segundos en el TUG; alcanzar 30 segundos en él SU; lograr el SL5 en menos de 8,5 segundos y tener un resultado mayor de 33 cm en el AF. En el TT, la mayoría de las mujeres mayores que practican actividad física alcanzaron el máximo efecto. Conclusión: Se observó que los resultados encontrados en este estudio son similares o superiores a

los de la literatura. El uso de TT no se recomienda para mujeres mayores físicamente activas debido al bajo poder discriminativo para este grupo. ***Nivel de Evidencia III; Estudio de pacientes no consecutivos; sin estándar de referencia "oro" aplicado uniformemente.***

Descriptores: *Equilibrio postural; Anciano; Actividad motora.*

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INTRODUCTION

A decrease in body balance is observed with increasing age.[1] Body balance is an important variable within the context of aging since it is easily measured and is associated with falls.[2,3] In addition, good balance is essential to ensure the quality of life and independence of older adults.[4]

Different tests have been proposed for the evaluation of dynamic balance, such as the timed up and go (TUG),[5] functional reach (FR)[6] and five-repetition chair stand (CS-5)[7] tests, and of static balance, such as the one-leg stand (OLS) test[8] and tandem stance test (TST).[7] Although well established, these tests were developed for different populations and thus produced different cut-off points and reference values. The cut-offs were used to identify independent and frail older adults,[5] older adults with severe or moderate mobility limitation,[9] and older adults at risk of falls.[10] In addition, reference values are available for institutionalized older adults[11] and for the Japanese population.[12]

However, the cut-off points and reference values established by the authors cited above may not be sensitive for the population of older women practicing physical activity, and studies establishing reference values for this specific population are therefore important.[13] Physical activity is known to be an important factor to improve body balance since physically activity individuals have better levels of physical capacities, including balance.[14] Furthermore, there is a predominance of women in physical activity groups for older adults,[15] which should have sex-specific parameters as a reference.

Thus, it is necessary to propose reference values to this specific population, since it can help health professionals to have a parameter for clinical practice. Furthermore, we found no studies proposing reference values for different balance tests in Brazilian older women. In addition, it is important to consider that elderly people of different age groups present different levels of balance.[16,17] Therefore, the objective of the present study was to established reference values for balance tests in older women from different age groups practicing physical activity.

MATERIALS AND METHODS

This was a descriptive, exploratory study.[18] The participants in the study were older women participating in four physical activity programs for older adults: 1) University Extension Program Senior Citizen Study Group (GETI in the Portuguese acronym) of the Universidade do Estado de Santa Catarina (UDESC), which offers activities such as water gymnastics, swimming, gymnastics, Pilates and dancing twice a week as well as walking and weight training three times per week, with a duration of each class of 50 min; 2) Health and Leisure Program of the Instituto Federal de Santa Catarina (IFSC), in which older women participate in 60-minute gymnastics classes three times per week; 3) Exchange Group of the Social Service of Commerce (SESC in the Portuguese acronym), which offers volleyball adapted for older adults twice a week, with each session lasting 60 min, and 4) "Cidade Amiga do Idoso de Chapecó", which offers gymnastics, weight training, Pilates, guided walking and water gymnastics twice a week, with a duration of each class of 60 min. The older adults of GETI/UDESC, IFSC and SESC were from the city of Florianópolis, SC, Brazil.

The recruitment of the older women was intentional. Subjects who met the following inclusion criteria were invited to participate in the study: female gender, age 60 to 79 years, participation in a physical activity program for older adults for at least three months, and physical condition to perform the balance tests. Women with any occurrence of dizziness on the day of the test and those using an assistive gait device were excluded from the study since these factors interfere with the adequate execution of the tests.

The final sample consisted of 192 older women, including 117 (60.9%) from GETI/UDESC, 38 (19.8%) from IFSC, 23 (11.9%) from SESC, and 14 (7.3%) from "Cidade Amiga do Idoso de Chapecó".

Anamnesis containing questions related to the inclusion criteria was performed to define the participants in the study. Older women who met the inclusion criteria were evaluated regarding body balance using the following tests: TUG,[5] OLS,[8] CS-5,[7] FR,[6] and TST.[7]

The objective of the TUG is to evaluate the dynamic balance. In this test, the subject is asked to rise from a chair, walk 3 m, turn, walk back and sit down again on the same chair. The time to complete the task is recorded with a stopwatch. The subject is not allowed to run in this test. The subject can perform the test once to familiarize with it and more two attempts. During evaluation, the mean of the last two attempts is considered as the final result.[5]

The OLS test evaluates static balance. The time is recorded when the subject lifts one limb from the floor and is stopped when the foot touches the floor again or the maximum time of 30 seconds is reached. Three attempts are performed and the maximum time is considered.[8]

The CS-5 test evaluates balance during rising to standing from sitting. A straight-backed armless chair is used for this test, which is placed against a wall for safety. With the back against the backrest and feet on the floor, the participant crosses her arms with the middle finger towards the acromion and, on a sign, rises, stands upright and then returns to the sitting position. After one attempt, the subject is asked to repeat the test 5 times as fast as possible. The time to complete the test is recorded in seconds. For evaluation, the test is performed once.[7]

The objective of the FR test is to evaluate balance during forward bending. For the test, the subject is positioned perpendicular to a wall without touching it, with the feet parallel, shoulders flexed at 90º and elbows extended. The initial position is marked on the wall. The subject is then asked to lean the trunk forward, keeping the arm extended, without removing the heels from the floor and without losing balance. The distance between the first and second mark is measured and the initial value and final position are compared. Three attempts are performed and the mean of the three measurements is considered.[6]

The TST also evaluates static balance.[7] In the test, the examiner shows the task of remaining in the tandem stance position (the heel of one foot is positioned in front of the other foot so that the heel touches the toes of the second foot). The subject is then asked to position her feet while the examiner provides support at one arm. When the subject is ready, the support is released and the time the subject holds the testing position is recorded. Timing is ended when the participant moves the feet or needs support of the examiner. If this does not occur, the test is

stopped when a maximum time of 10 seconds is reached. The mean of three attempts was used according to Murphy et al..[19]

These four tests were chosen since they evaluate different types of balance: dynamic balance, static balance, balance during sit-to-stand and forward bending. In addition, these tests have been used because of their easy and rapid application and low cost.[5,7,8,20]

The study was approved by the Ethics Committee on Research Involving Humans of the Universidade do Estado de Santa Catarina (052406/2015), and was conducted in accordance with the ethical guidelines of Resolution 466/12 of the National Health Council.

For data collection, older women from the institutions that offer physical activity programs for older adults were contacted. Body balance of the participants was evaluated by the tests performed in a circuit in the following order: TUG,[5] OLS,[8] CS-5,[7] FR[6] and TST[7] according to their respective protocols in gyms indicated by the coordinators of the respective institutions. In order to avoid influencing the test result, the subjects could not have performed physical activities before carrying out the evaluation.

The tests were applied individually by the examiners previously trained. The examiners were undergraduate and postgraduate students of the physiotherapy and physical education courses of UDESC and Universidade do Oeste de Santa Catarina (UNOESC). All participants signed the free informed consent form before data collection.

Statistical analysis

Percentile analysis was performed to verify the behavior of the results found and to establish reference values for the balance tests in physically active older women. The participants were stratified into two groups: 60 to 69 years and 70 to 79 years. After performing the normality test (Kolmogorov-Smirnov test), the results indicated no normal distribution. The Mann-Whitney U test was used to compare performance in the balance tests between age groups. The data were classified according to the cut-off points used to establish physical fitness reference values for Americans[21] and Brazilians.[22,23] Statistical analysis was performed with the SPSS 20.0 software.

RESULTS

The sample was divided into two age groups: 1) 60 to 69 years including 108 older women with a mean age of 65.01 (±2.08) years; 2) 70 to 79 years including 84 older women with a mean age of 73.76 (±2.81) years. (Table 1)

Comparison of the two groups showed a significance difference in the TUG, OLS and FR tests, while no significant difference was observed in the CS-5 or TST test. These results indicate the need to propose different reference values for the TUG, OLS and FR tests. In addition, for application in clinical settings, different reference values are also shown for the CS-5 and TST tests. (Table 2)

Table 2 shows the percentile classifications, where a value above the 90th percentile is classified as very good, between the 90th and 75th percentile as good, between the 75th and 25th percentile as regular, between the 25th and 10th percentile as poor, and below the 10th percentile as very poor.

Table 1. Comparison of the results of the body balance tests according to age strata of physically active older women.

	60 to 69 years (n=108)		70 to 79 years (n=84)			
Test	**Median**	**Mean (SD)**	**Median**	**Mean (SD)**	**P**	**U**
TUG (s)	6.2	6.37 (1.42)	6.6	6.95 (1.64)	<0.01	3.259.0
OLS (s)	27.2	21.64 (9.76)	10.9	16.19 (11.42)	<0.01	3.292.5
FR (cm)	32.2	31.20 (5.65)	9.7	29.05 (5.24)	0.01	3.583.5
CS-5 (s)	9.6	10.03 (2.40)	29.5	10.31 (2.90)	0.75	4.308.5
TST (s)	10	9.49 (1.33)	10	8.89 (2.34)	0.13	4.097.0

TUG (s): timed up and go in seconds; OLS (s): one-leg stand in seconds; CS-5 (s): five-repetition chair stand in seconds; FR (cm): functional reach in centimeter; TST (s): tandem stance test in seconds; SD: Standard deviation; *U: Mann–Whitney U ; p* ≤ 0.05.

Table 2. Reference values for balance tests in physically active older women from two age groups (60 to 69 and 70 to 79 years).

Age group	Classification	Percentile	Balance test				
			TUG (s)	OLS (s)	CS-5 (s)	FR (cm)	TST (s)
60 to 69 years	Very good	P90	5.3	30.0	7.5	37.4	10.0
	Good	P75	5.7	30.0	8.5	35.5	10.0
	Regular	P50	6.2	27.2	9.6	32.2	10.0
	Poor	P25	6.7	11.4	10.8	27.6	10.0
	Very poor	P10	7.2	6.8	12.1	23.1	8.0
70 to 79 years	Very good	P90	5.6	30.0	7.4	35.7	10.0
	Good	P75	5.9	30.0	8.5	33.0	10.0
	Regular	P50	6.6	10.9	9.7	29.5	10.0
	Poor	P25	7.5	6.0	11.2	25.4	9.1
	Very poor	P10	9.1	3.1	13.5	21.9	5.4

TUG (s): timed up and go in seconds; OLS (s): one-leg stand in seconds; CS-5 (s): five-repetition chair stand in seconds; FR (cm): functional reach in centimeter; TST (s): tandem stance test in seconds.

In the group of older women aged 60 to 69 years, a score less than 5.7 s in the TUG, achieving 30 s of OLS, performing the CS-5 test in less than 8.5 s, and a result greater than 35.5 cm in the FR test were classified as "good" balance. In the group of older women aged 70 to 79 years, the values indicating good balance were a score less than 5.9 s in the TUG, achieving 30 s of OLS, performing the CS-5 in less than 8.5 s, and a result greater than 33 cm in the FR test. In the TST, most older women achieved the best result possible, characterizing the ceiling effect. Thus, this test is not recommended for this specific population.

Regarding the static balance tests, the results showed that, among older women aged 60 to 69 years, 49.1% performed at the ceiling in the OLS test (30s) and 78.7% in the TST (10 s). Among women aged 70 to 79 years, 37.3% performed at the ceiling in the OLS test and 70.2% in the TST. The TST is therefore a poorly sensitive and less indicated test for the population of physically active older women.

DISCUSSION

The objective of this study was to propose reference values for balance tests in physically active older women. In the TUG, a time less than 5.9 s was classified as good balance. In the original study of the TUG,[5] the authors proposed that independent older adults do the test in less than 10 s. On the other hand, Kumar et al.[24] used a TUG cut-off point of 13.5 s to identify a risk of falls.

These values found[5,24] are, respectively, 69% and 128% higher than those found in the present study and do therefore not appear to be sensitive for the population studied. The parameters proposed in this study differ from those proposed by Podsiadlo and Richardson,[5] possibly because of differences in the type of sample since the original study investigated a population considered to be frail.

Regarding the OLS test, the results showed that 49.1% of the sample achieved ceiling performance in this test (30 s). In a review,[25] it was found that more than 50% of the sample achieved ceiling performance (60 s) in the OLS test, in agreement with the present findings. It should be noted that the systematic review[25] only involved studies on community-dwelling older adults. Nevertheless, despite observation of the ceiling effect in the studies, the OLS seems to be the most sensitive test for the evaluation of static balance in physically active older women.

In the CS-5 test, the 50th percentile was 9.6 s for 60 to 69-year-old women and 9.69 s for 70 to 79-year-old women. A meta-analysis[12] was carried out to establish reference values for the CS-5 in the independent Japanese population older than 60 years. Although physical performance

in the CS-5 has been suggested to be better in the Japanese population,[26] the present results of this study showed the same reference pattern (8.5 s) as reported in the study of Nakazono et al.[12]

For the FR test, "good" balance was classified when the result was greater than 33 cm for women aged 70 to 79 years. A study involving independent older adults[6] found that the risk of falls was 13 times higher when the reach was less than 17 cm in the FR test. Other research, Duncan et al.[10] established that subjects with a reach lower than 25.4 cm had a two-fold higher risk of falls. However, it should be noted that the sample studied by Duncan et al.[10] consisted of community-dwelling older men aged 70 to 104 years and that factors such as age group, diseases, cognitive aspects and level of independence were not considered.

A high proportion of the older women evaluated exhibited the ceiling effect in the TST when compared to one-leg standing. Fuchs et al.[16] justified the use of the OLS test for the evaluation of static balance because of its higher level of difficulty and differentiation compared to the TST. Thus, the TST does not seem to be sensitive for the population studied and its application to physically active older women is not recommended.

The reference values proposed in the present study were found to be better than those reported in other studies.[3,10,11,20,27] This finding can be explained by the fact that our sample consisted of physically active subjects and exercise has been shown to contribute to the improvement of body balance.[14] In addition, those studies proposed reference values for variables such as falls,[3] limitations in functional mobility[9] and dependence,[20] which influenced the values obtained.

One limitation of the study was the fact that the sample consisted of older women practicing physical activity, but the level of physical activity of these subjects was not considered. In addition, the results cannot be extrapolated to older men.

CONCLUSION

The performance values of older women in the different balance tests were higher than those originally proposed for these tests. These values were found to be adequate for use in this specific population. Furthermore, most women of this population achieved ceiling performance in the TST. This test is therefore not recommended because of its low discriminatory power.

Evaluations using percentile scores will permit to define the level of balance in physically active older women according to age group. This will serve as a parameter for the planning, execution and evaluation of balance-related physical exercise programs for older women. Studies involving subjects of other age strata and both genders from different regions of Brazil are necessary.

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