DOI: 10.590/1809-2950/13125722012015

ORIGINAL RESEARCH

Performance of healthy adult subjects in Glittre ADL-test

Desempenho de indivíduos adultos saudáveis no teste de AVD-Glittre

El rendimiento de sujetos adultos sanos en la prueba AVD-Glittre

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ABSTRACT | The Glittre ADL-test (TGlittre), validated to assess the functional capacity of patients with chronic obstructive pulmonary disease, has as outcome the shortest total time required to complete it. To date, little is known about the time that healthy individuals take to perform it. This study aimed to describe the total and shortest times spent to perform TGlittre in a sample of healthy adults, and to assess the reliability of the test in this population. The subjects underwent spirometry pre- and post-bronchodilator, anthropometric assessment, International Physical Activity Questionnaire and two TGlittre. 35 subjects were evaluated (15 men), of 29±6 years of age, with forced vital capacity (FVC) of 96±10.6% and forced expiratory volume in the first second (FEV_1) of 97.6±9.26%, in % of predicted, and FEV_1/FVC of 0.86±0.05; height of 1.72±0.11m; weight of 24.5±3.62kg and body mass index of 24.2±3.87kg/m^2, being 74.3% and 25.7% with low and moderate physical activity level, respectively. The mean time spent on the test with better performance was 2.62±0.34min. There was no difference in performance among age groups ($p>0.05$). There was a mean reduction of 6.3±5.8% in the time between TGlittre1 and TGlittre2, however, this difference was not statistically significant ($p>0.05$). An intraclass correlation coefficient of 0.88 ($p<0.05$) between the time of TGlittre1 and 2 was found. The results suggest that in a sample of healthy adults, the shortest and mean time to complete the test are 2.03 and 2.62min, respectively, and that TGlittre is reliable in these subjects.

Keywords | Exercise Tolerance; Activities of Daily Living.

Resumo | O teste de AVD-Glittre (TGlittre), validado para avaliar a capacidade funcional de indivíduos com doença pulmonar obstrutiva crônica, possui como desfecho o menor tempo despendido para completá-lo. Até o presente momento, pouco se sabe acerca desse tempo no desempenho de indivíduos saudáveis. O objetivo do estudo foi avaliar o tempo total de realização do TGlittre em uma amostra de indivíduos adultos saudáveis, o tempo mínimo de execução do teste, assim como a reprodutibilidade do teste nessa população. Os sujeitos foram submetidos à espirometria pré e pós-broncodilatador, avaliação antropométrica, Questionário Internacional de Atividade Física e dois TGlittre. Foram avaliados 35 indivíduos (15 homens) de 29±6 anos, com capacidade vital forçada (CVF) de 96±10,6%, volume expiratório forçado no primeiro segundo (VEF_1) de 97,6±9,26%, em % do previsto, e VEF_1/CVF de 0,86±0,05; altura de 1,72±0,11m; peso de 72,3±12,8kg e índice de massa corpórea de 24,5±3,62kg/m^2, sendo que 74,3% e 25,7% tinham níveis baixo e moderado de atividade física, respectivamente. A média de

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Presentation: Feb. 2014 – Accepted for publication: Jan. 2015 – Financing source: none – Conflict of interests: nothing to declare – Approved by the Ethics Committee on Human Research of UDESC (protocol no. 225/2011).

tempo despendido no teste com melhor desempenho foi de 2,62±0,34min. Não se encontrou diferença na execução entre as faixas etárias (p>0,05). Houve redução, em média, de 6,3±5,8% no tempo entre o TGlittre1 e TGlittre2, porém essa diferença não foi estatisticamente significante (p>0,05). Encontrou-se um coeficiente de correlação intraclasse de 0,88 (p<0,05) entre os tempos do TGlittre1 e TGlittre2. Os resultados demonstraram que, em uma amostra de adultos jovens saudáveis, o tempo mínimo e a média para completar o teste são de 2,62min e 2,03min, respectivamente, e que este é reprodutível nesses indivíduos.
Descritores | Tolerância ao Exercício; Atividades Cotidianas.

RESUMEN | La prueba AVD-Glittre (PGlittre), validada para evaluar la capacidad funcional de sujetos con enfermedad pulmonar obstructiva crónica, tiene como resultado el menor tiempo dedicado para completarla. Hasta el presente, poco se conoce sobre este tiempo en el rendimiento de sujetos sanos. Para eso, el objectivo fue evaluar el tiempo total de realización de la PGlittre en una muestra de sujetos adultos sanos, el tiempo mínimo de ejecución de la prueba, así como su reproductibilidad en la población. Los sujetos se sometieron a la espirometría pre y pos broncodilatador, a la evaluación antropométrica, al Cuestionario Internacional de Actividad Física y a dos PGlittre. Se han evaluados 35 sujetos (15 varones) de 29±6 años, con capacidad vital forzada (CVF) de 96±10,6%, volumen espiratorio forzado en el primer segundo (VEF_1) de 97,6±9,26%, en % del previsto, y VEF_1/CVF de 0,86±0,05; altura de 1,72±0,11m; peso de 72,3±12,8kg e índice de masa corporal de 24,5±3,62kg/m^2, en el que el 74,3% y 25,7% tenían bajo y moderado nivel de actividad física, respectivos. La media de tiempo en la prueba con mejor rendimiento fue de 2,62±0,34min. No se ha encontrado diferencias en la ejecución entre el rango de edad (p>0,05). Ha ocurrido una reducción, en media, de 6,3±5,8% en el tiempo entre la PGlittre1 y PGlittre2, pero esa diferencia no ha sido significante estadisticamente (p>0,05). Se ha encontrado un coeficiente de correlación interclase de 0,88 (p<0,05) entre los tiempos de la PGlittre1 y PGlittre2. Los resultados mostraron que, en una muestra de adultos jóvenes sanos, el tiempo mínimo y la media para completar la prueba fueron de 2,62min y 2,03min, respectivamente, y que esto es reproductible en estos sujetos.
Palabras clave | Tolerancia a la Actividad Física; Actividades Cotidianas.

INTRODUCTION

Functional capacity is defined as the ability of an individual to perform activities of daily living (ADL)[1] including self-care (eating, bathing, dressing), work, household chores and leisure[2]. Factors such as aging, obesity[3] and the presence of chronic degenerative diseases[4], especially cardiopulmonary ones[5], may be responsible for impaired functional capacity.

Considered an important treatment outcome in patients with cardiopulmonary diseases, functional capacity can be assessed by a variety of instruments such as questionnaires and field tests[5]. Among them, the six-minute walk test is the most commonly used because it is simple to apply, low cost[6] and validated in several populations[7-10]. However, it only involves the walking activity in the plan. The Glittre-ADL Test (TGlittre), which was developed and validated for patients with chronic obstructive pulmonary disease (COPD), seems to be more representative of ADL as it involves a set of common tasks in daily life apart from walking, as sitting-standing, climbing up and down stairs and moving objects in different heights[11].

Since TGlittre is a relatively new instrument and has been little investigated, there is a lack of information about it. The knowledge about the performance of healthy subjects in this test, for example, is limited. Skumlien, et al.[11], in the validation study, conducted an evaluation in healthy volunteers and showed that the fastest time to complete it without violating the protocol was of 2 minutes. However, the authors did not mention the number of participants, the mean time they took to complete the test or the sample characteristics. In another study, Corrêa, et al.[12] evaluated the performance of 10 healthy subjects in TGlittre, with a mean age of 64 years, and found that they took a mean time of 3.3 minutes (95% CI: 2.8 to 3.8min) to complete it. However, it is known that the functional capacity tends to decrease with aging due to a gradual reduction in muscle strength and maximal oxygen uptake[3]. Thus, by investigating the performance of healthy young subjects in TGlittre, the influence of factors such as age, normal body mass index, absence of cardiopulmonary disorders and low to moderate physical activity levels could provide better information about the minimum and expected time for healthy young individuals,

who are expected to have no impairment of functional capacity.

Therefore, this study aimed to evaluate the performance of healthy young adults in TGlittre and the minimum time to perform the test, as well as to verify the reliability of TGlittre in this sample.

METHODOLOGY

Subjects

The study sample consisted of healthy individuals from both sexes, recruited from the community and selected in a non-probabilistic intentional way. The inclusion criteria were: between 20 and 39 years of age, and clinical stability (characterized by the absence of any acute illness within 6 weeks prior to the study). Subjects with forced vital capacity (FVC) <80% (post-bronchodilator), forced expiratory volume in the first second (FEV_1) <80% predicted (post-bronchodilator) and FEV_1/FVC<0.75 (post-bronchodilator), with a history of musculoskeletal, cardiovascular, respiratory or any other chronic disorders, high physical activity level rated by the short form of the International Physical Activity Questionnaire (IPAQ)[13] and unable to perform any of the study evaluations were excluded.

The study was approved by the Ethics Committee on Human Research of Santa Catarina State University (UDESC), Florianópolis, (SC), Brazil (protocol number 225/2011). All participants signed an informed consent form.

Procedures

Initially, the subjects were interviewed and anthropometric data were collected. Then, subjects performed a pulmonary function test pre- and post- bronchodilator (BD). Subsequently, the IPAQ short form[13] and two TGlittre, with an interval of 30min between them, were applied.

Anthropometric measurements

The anthropometric data were collected with the subject barefoot and in the upright position. The weight and height were measured by a Tanita digital scale (BC-558) and Sanny stadiometer, respectively. The body mass index (BMI) was calculated using the formula below.

$$BMI = \frac{\text{weight (kg)}}{\text{height (m)}^2}$$

Pulmonary function test

The pulmonary function was evaluated with an EasyOneTM spirometer (NDD, Switzerland), in accordance with the procedures of the American Thoracic Society/European Respiratory Society[14]. Forced expiratory volume in the first second in absolute value (FEV_1) and percentage of predicted (FEV_1% pred), forced vital capacity in absolute value (FVC) and percentage of predicted (FVC% pred), and FEV_1/FVC were assessed. The predicted values were based on the equation by Pereira, et al.[15].

Physical activity level

The level of physical activity was assessed using the IPAQ short form, which was validated for the Brazilian population in 2001[13]. This questionnaire consists of 8 questions and allows the discrimination of activity duration. Three intensity levels are determined: low, moderate and high.

Glittre ADL-test (TGlittre)

TGlittre consists of a standardized circuit of 10 meters which must be performed in the shortest possible time with the following sequence: from the sitting position, the individual stands and walks; halfway, he or she goes up and down two steps (17cm height × 27cm width) and then walks again. At the end, there are two shelves with three objects weighing 1kg each, positioned on the top shelf (at shoulder height) to be moved down, one by one, to the lower shelf (at waist height) and subsequently to the ground; next, the objects must be placed again on the lower shelf, and finally moved to the top shelf; afterwards, the individual walks back, sits again and immediately starts another lap following the same ADL-circuit until 5 laps are completed. During the test the subject must carry a backpack weighing 2.5kg for women and 5.0kg for men[11].

The blood pressure was checked at the beginning and at the end of the test. The pulse oxygen saturation (SpO_2),

heart rate (HR) and dyspnea perception, assessed by the Modified Borg Scale[16], were evaluated at every lap and at the beginning and immediately after the end of the test. If the subject presented systolic and diastolic blood pressures above 180mmHg and 100mmHg, respectively, and a SpO_2≤85%, the test would be interrupted. The total time to complete the test was registered.

Statistical Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS, version 20.0). The descriptive statistics was used for all variables (mean, standard deviation, median and 95% confidence interval). Data normality was verified by the Shapiro-Wilk test. To verify the correlation between performance on TGlittre and anthropometric variables, the Pearson correlation coefficient was used. The intraclass correlation coefficient (ICC) was used to assess the reliability of the test. The Wilcoxon test was used to verify the difference between the variation of the HR and the maximum HR in percentage of age-predicted ($maxHR\%_{pred}$), in both tests. The statistical significance level was 5% ($p<0.05$).

RESULTS

Forty-three individuals participated in the study. Of these, eight were excluded: five for not being able to perform the pulmonary function test; one for having FEV_1<80% predicted; one for showing activity level classified as "high" on IPAQ; and one for being a former smoker, with a family history of COPD, in addition to presenting the FEV_1/FVC ratio of 0.7, i.e., very close to the lower limit of normality. Thus, 35 completed the protocol: 15 (42.8%) males; 26 (74.3%) with low-intensity physical activity; and 9 (25.7%) with moderate intensity physical activity.

Sample characterization is presented in Table 1. Out of the 35 subjects, 30 (85.7%) showed better performance in the second TGlittre. The mean time spent on the second test was 2.62±0.34min (95% CI: 2.48-2.72min). The shortest time to perform the test was 2.03min. The performance in TGlittre did not correlate with age ($r=-0.17$, $p=0.322$), body mass ($r=0.08$, $p=0.637$) or height ($r=-0.22$, $p=0.197$).

There was no statistically significant reduction in the mean time spent between the first and second TGlittre ($p>0.05$). An ICC of 0.88 ($p<0.05$) was found between the time spent in TGlittre1 and TGlittre2, as shown in Figure 1. The data relating to the performance in both ADL-Glittre tests, the variation of HR and dyspnea perception during the tests and their ICC are described in Table 2. There was no difference between the variation of HR ($p=0.62$) and the maxHR% predicted ($p=0.07$), in both tests. Besides, the subjects performed the first and second TGlittre with a mean of 66.9% and 68.6% of $maxHR\%_{pred}$, respectively.

The sample was divided into four age groups (20-24, 25-29, 30-34 and 35-39 years old), and there was no statistically significant difference in the performance in TGlittre among them ($p>0.05$) (Table 3). A significant difference in body mass was observed – it was statistically higher in the group of people who were 30-34 years old in comparison to the groups of individuals who were 20-24 and 25-29 years old ($p<0.05$).

Table 1. Sample characterization

	Mean	SD	Median	CI95%	
				LL	UL
Age (years)	29.0	6.00	28.0	26.9	31.1
Body mass (kg)	72.3	12.8	69.5	67.9	76.7
Height (m)	1.72	0.11	1.70	1.68	1.75
BMI (kg/m²)	24.5	3.62	23.6	23.2	25.7
Initial HR (bpm)	76.7	13.4	76	72.1	81.3
FVC (L)	4.39	1.11	4.21	4.01	4.77
FVC (%prev)	96.0	10.6	97.0	92.4	99.7
FEV_1 (L)	3.71	0.86	3.57	3.41	4.00
FEV_1 (%prev)	97.6	9.26	97.0	94.4	100.0
FEV_1/FVC	0.86	0.05	0.86	0.83	0.87

SD: standard deviation; CI95%: confidence interval 95%; LL: lower limit; UL: upper limit; BMI (kg/m²): body mass index in kilograms per square meter; FEV_1(L): forced expiratory volume in one second in liters; FEV_1(%prev): forced expiratory volume in one second in percentage of predicted; FVC (L): forced vital capacity in liters; FVC (%prev): forced vital capacity in percentage of predicted

Table 2. Performance in ADL-Glittre Tests 1 and 2

	TGlittre 1 Mean±SD	TGlittre 2 Mean±SD	Intraclass Correlation (CI95%)
Time spent (min)	2.80±0.36	2.62±0.34	0.88* (0.20-0.96)
ΔHR (bpm)	48.8±14.5	49.8±15.8	0.69* (0.38-0.84)
Δdyspnea perception	0.5 [0.5-2]**	1 [0.5-2]**	0.92* (0.86-0.94)

SD: standard deviation; CI95%: confidence interval 95%; TGlittre: ADL-Glittre Test; ΔHR: variation between initial and final HR; Δdyspnea perception: variation between initial and final dyspnea; *p<0.05 in intraclass correlation: excelent correlation (0.8-1.0), good correlation (0.6-0.8), satisfactory correlation (0.4-0.6) and weak correlation (0.2-0.4); ** median [interquartile range: 25-75%]

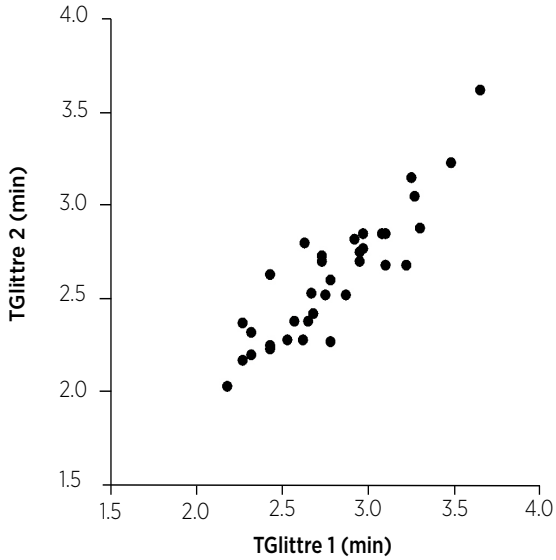

Figure 1. Intraclass correlation coefficient among the time spent in the ADL-Glittre Tests (TGlittre) 1 and 2 (ICC=0.88; p<0.05)

Table 3. Total time to perform TGlittre, anthropometric and pulmonary function variables in each age group

	Age groups (years)			
	20-24 (n=9; 22.2% M)	25-29 (n=9; 55.6% M)	30-34 (n=9; 55.6% M)	35-39 (n=8; 37.5% M)
TGlittre (min)	2.62±0.43	2.67±0.30	2.58±0.33	2.53±0.33
Body mass (kg)	66.2±3.87	68.7±2.46	83.3±3.45*	70.8±4.07
Height (m)	1.66±0.85	1.73±0.12	1.78±0.11	1.70±0.10
BMI (kg/m^2)	24.2±3.87	22.6±2.46	26.4±3.45	24.5±4.07
FVC (%prev)	87.9±6.75	95.4±7.20	97.7±12.5	104.0±9.60
FEV_1 (%prev)	90.7±7.23	98.1±6.74	97.3±11.0	105.0±6.46
FEV_1/FVC	0.89±0.47	0.87±0.40	0.82±0.39	0.84±0.52

SD: standard deviation; M: male; BMI (kg/m^2): body mass index in kilograms per square meter; FEV_1 (%prev): expiratory volume in one second in percentage of predicted; FVC (%prev): forced vital capacity in percentage of predicted. *p<0.05 *vs.* age groups 20-24 and 25-29 years old

DISCUSSION

This study aimed to evaluate the total time required for healthy young adults to perform TGlittre. Furthermore, it also aimed to verify the reliability of this test in this population.

Skumlien, et al.[11], in a pilot study, found that the shortest time healthy subjects took to perform TGlittre was 2min. However, the subjects' characteristics (age or anthropometric measures) were not mentioned. The present study found a minimum time that is very close to theirs, confirming that healthy young adults need at least 2min to perform the test without violating the protocol, i.e., without running, skipping any steps or moving more than one object at a time. Thus, these results may indicate that young individuals that perform the test at a time close to this possibly do not have any impairment of functional capacity.

Comparing the performance of these subjects to patients with cardiopulmonary diseases in TGlittre, it is clear that healthy people need less time to complete it. In a study by Valadares, et al.[17], patients with heart failure spent a mean time of 6.30min (95% CI: 2.80-9.80min) to perform the test. Skumlien, et al.[11] and Corrêa, et al.[12] found the mean times of 4.67min (25-75% interquartile range: 3.40-5.47min) and 5.30min (95% CI: 3.20-11.3min), respectively, for patients with COPD. These results were considerably higher than those found in the present study. However, the mean age of the subjects in this study is lower than the patients studied by these authors, and it is known that, besides the presence of cardiopulmonary disease, another factor associated with decreased functional capacity is the aging process[3]. Therefore, this difference may have been influenced by the two combined factors. Corrêa, et al.[12] compared the performance of patients with COPD with that of healthy subjects, paired by sex, age and BMI, and found that TGlittre is able to detect functional limitations induced by COPD. Observing the performance of these subjects, it is clear that they spent a mean time of 3.30min (95% CI: 2.80-3.80min)[12], which is longer than that observed in the present study. Thus, TGlittre seems to be able to differentiate the functional capacity of young individuals from elderly ones. However, studies with a more specific design for this purpose are needed to confirm these findings.

Iwama, et al.[3], in the study that developed reference equations for the six-minute walk test (6MWT) in a healthy Brazilian population, found that age is directly

related to the walked distance. In the present study, no significant differences were observed in the performance of TGlittre among age groups and no correlation was found between the time spent on the test and the age of the individuals. One possible explanation is that the study evaluated only subjects aged less than 40 years old and that the age range was too small to cause changes in functional capacity induced by the aging process.

Another factor that seems to be related to functional capacity reduction is the increased body mass[18]. Studies have shown that body mass correlates with the distance on the 6MWT[3,18,19]. Obese people, for example, commonly show reduced lean body mass and an increase in work load during exercise, thus showing worse performance in the 6MWT[18]. However, this study found no association between body mass and the time spent on TGlittre. But observing the BMI of these subjects, it was noticed that only 3 of them were obese, which could have caused the statistical difference among the groups, since they were over 30 years old. Moreover, the obesity was in a lower degree, which may not have been sufficient to cause a significant decline in functional capacity.

It is known that TGlittre is reliable in patients with COPD. Skumlien, et al.[11], in their validation study, used two TGlittre on two consecutive days in a group of 52 patients, stages 2 and 3 of GOLD[20], and a strong correlation was found between them ($r=0.93$, $p<0.05$). In this study, two tests were applied to healthy young adults, and there was an excellent ICC between them. Moreover, variations in HR and dyspnea perception presented good to excellent ICCCCI[21] between the two tests. There was no statistical difference in HR variation and the individuals reached approximately 67% $maxHR\%_{pred}$ in both tests. These results demonstrate that the test is also reliable in this sample, despite its short time, that the individuals perform both tests at the same effort level and the submaximal nature of the task.

Additionally, no significant differences were found between TGlittre 1 and 2. However, there was a mean reduction of 6.3% in the execution time of the second test compared to the first one. This value was very close to that found by Skumlien, et al.[11], which was 7%. The improved performance on the second test is probably due to a learning effect. This effect is also described in other tests that evaluate the functional capacity, such as the 6MWT[19]. However, it is expected that this effect does not persist for more than a few weeks, as in the 6MWT[11,19].

This was the first study to investigate the performance of healthy adults in TGlittre. Nevertheless, reference equations for it remain unknown. Since it is a relatively new test, more studies are needed to determine reference values for different age groups of healthy population, allowing a better interpretation of clinical findings in populations of patients with diseases that can lead to impaired functional capacity.

CONCLUSION

In summary, healthy young adults take, in average, 2.62min to complete TGlittre, and the test seemed to be reliable in a sample of healthy young adults, allowing a better comparison of the functional capacity between healthy subjects and functional impaired patients. Moreover, the study demonstrated a need for at least 2min to complete the TGlittre tasks.

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