Validation and reliability of the Glittre-ADL test to evaluate functional capacity in older adults

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ABSTRACT

Introduction: The decline in functional capacity (FC) interferes with the functional independence of older adults, so it is important to assess the FC and use appropriate instruments for this. **Objective:** To investigate the Glittre Activities of Daily Living (ADL) test's validity and reliability for assessing functional capacity in older adults. **Methods:** Cross-sectional study with a sample of 100 elderly (68 ± 5.16 years). To assess the convergent validity, the Six-Minute Walk Test (6MWT) and the Timed Up and Go Test (TUG) were performed. The intra-examiner test-retest of the Glittre-ADL test was performed on the same day with a 30-minute interval between repetitions and inter-examiner reliability with an interval of seven days. **Results:** There was a strong correlation between the Glittre-ADL test and the 6MWT (r=-0,75; p<0.001) and the TUG (r=0.77; p<0.001). The intra-examiner and inter-examiner reliability was excellent (ICC)=0.91 and 95% CI=0.14-0.97; p<0.001 and ICC=0.91; 95% CI: 0.86-0.94; p<0.001, respectively). **Conclusion:** The Glittre-ADL test demonstrated that it is valid and that its reliability is adequate to assess functional capacity in older adults.

Keywords: self-testing; aged; reproducibility of results; physical phenomena; activities of daily living.

INTRODUCTION

Several structural and functional changes occur during the human aging process that results in a decline in the level of physical activity and, consequently, in the individual's functional capacity[1-3].

Functional capacity is defined as the ability to perform motor tasks during activities of daily living, which allow the individual to take care of himself and live independently. As it is considered an indicator of health in older adults, the measurement and clinical monitoring of functional capacity are important for the development of physical training strategies for this population[4,5].

Thus, there are validated tests to assess functional capacity in older adults, including the 6-minute walk test (6MWT) and the Timed up and Go test (TUG test). The

6MWT is a test that assesses the functional ability in a submaximal way because the person chooses his exercise intensity, it is accepted that there are rest breaks during your execution[6]. The TUG test is an instrument for assessing mobility and functional balance[7]. Despite being validated tests for older adults and assessing functional capacity, the 6MWT and TUG tests are instruments that do not assess the individual globally, involving upper and lower limbs[8].

Nevertheless, there is a measure of functional capacity that has been widely used, which is the Glittre Activities of Daily Living Test (Glittre-ADL test)[9], which is considered a complete measurement instrument, as it involves walking, sitting and getting up from a chair, climbing and walking downstairs, arm movements holding weights, cardiorespiratory conditioning, mobility, memory, agility, and motor coordination. In addition, it is easy to apply, simple and reliable[9,10].

The Glittre-ADL test was first validated for individuals with Chronic Obstructive Pulmonary Disease (COPD)[9], and later for obese and post-bariatric surgery[11], healthy children[12], Parkinson's disease (PD)[13] and after a Stroke[14]. However, it has not yet been validated for older adults.

Thus, the present study aims to investigate the validity and reliability (Intra-Examiner and Inter-Examiner) of the Glittre-ADL test to assess functional capacity in older adults. The hypotheses is that the execution time on the Glittre-ADL test has adequate construct validity (correlated with instruments that evaluate similar constructs 6MWT and TUG). If our assumptions are confirmed, the Glittre-ADL test can be used for the functional capacity of older adults.

METHODS

Study Design and Participants

This is a cross-sectional study carried out from September 2018 to June 2019, in which older adults were included in this study, recruited from physiotherapy clinics of the Nove de Julho University, in São Paulo, Brazil. These older adults were chosen according to the following criteria: between 60 and 80 years of age, hemodynamically stable according to the guidelines of the Sociedade Brasileira de Cardiologia[15] (BP <140mmHg x 90mmHg), and (BP >90mmHg x 60mmHg).

Participants could not present neurological or orthopedic alterations that would interfere with the performance of the test; diagnosis of the acute coronary syndrome (ACS) or be patients with severe cardiac involvements (score >4 indicated by the New York Heart Association (NYHA) functional classification[16]; pulmonary diseases; cardiovascular diseases (CVD) such as angina, heart failure and recent acute myocardial infarction); pain in any part of the body at the time of the test; with a cutoff point for the

Mini-Mental State Examination (MMSE) of 13 for illiterates, 18 for low and medium schooling and 26 for high schooling[17].

Sample Size

According to some authors[18,19], a sample of 15 to 20 people would be needed for reliability and agreement studies. For reliability studies, 50 individuals are necessary[20]. As we performed several correlations and tested other measurement proprieties, we chose to increase the sample to include 100 individuals.

The Ethics Committee of the Nove de Julho University approved this study (number 2.993.671). All volunteers included received verbal clarifications regarding the objectives and procedures and agreed to participate in the study by signing an informed consent form.

Evaluations

The International Physical Activity Questionnaire (IPAQ)[21] short version to categorize the participant's level of physical activity was applied. This questionnaire classifies older adults as very active, active, irregularly active, and sedentary, according to the time they use performing each of the proposed tasks[22].

These subjects were randomized to start testing by examiner 1 or examiner 2 using the randomization program available at (www.randomization.com) by a researcher not involved in the research.

Those who started with the test-retest by examiner 1 reproduced the Glittre-ADL test on the same day, after a 30-minute interval to characterize the Intra-Examiner evaluation; individuals who were randomized to start by examiner 2 performed the test Glittre-ADL test only once. The result of the best test applied by examiner 1 was compared with the result of examiner 2, to characterize the inter-examiner assessment.

On the day that the older adults were evaluated by examiner 2, examiner 1 applied the Timed Up and Go (TUG) test[23] and the Six-Minute Walk Test – 6MWT[24,25] for the Glittre-ADL test validity procedure.

A minimum interval of 24 hours and a maximum of 7 days was given between the assessments of examiner 1 and examiner 2 with the aim that the participants had no learning effect on the Glittre-ADL test[9,12].

Glittre-ADL Test

Before starting the assessment, the participants received an explanation of how it would be performed, as described by the Skumlien protocol[9].

The test started with the participants getting up from a chair (without support for the upper limbs and with a height between the feet and the seat of 46 cm), carrying a backpack on their back (2.5 kg for women and 5.0 kg for men). After that they should walk 10 meters on a flat track; in the middle of the way, they

should go up and down two steps (measurements of the steps 17 cm high by 27 cm deep), continued walking towards a shelf where there were three objects with weighing 1 kg each that they should be transferred, one at a time, with both hands, from the upper shelf (at participant's shoulder height) to the lower shelf (at participant's pelvic girdle height) and from there to the floor.

After finishing this sequence of activities, they should place the objects on the central shelf again and then on the top shelf, return along the 10-meter route, climb up and down the steps, and sit back down in the chair (Figure 1).

Functional activity was repeated five times, as quickly as possible, without running. At the end of the test, time was measured.

The test was performed twice with a 30-minute interval between trials and the best performance of the Glittre-ADL test (in seconds) executed by the participant was considered to evaluate validity. It was used to correlate with the Six-Minute Walk Test (6MWT) execution time, and the Timed Up and Go (TUG).

The heart rate (HR), blood pressure (BP), oxygen saturation, and subjective perceived exertion of dyspnea were evaluated using the modified Borg Scale (MBS)[26] at the beginning and end of each lap.

The Six-Minute Walk Test (6MWT)

The Six-minute Walk Test – 6MWT[24], was performed twice by participants with a 30-minute interval between repetitions or until physiological variables normalized. It was performed on a flat walkway over a 30-meter route and a straight track according to American Thoracic Society/European Respiratory Society guidelines[25]. The best performance (in meters) of the two repetitions was taken.

Timed Up and Go (TUG)

To perform the Timed Up and Go – TUG[23] test, participants should get up from a chair with a vertical back, without support for the upper limbs and with a height between the feet and the seat of 46 cm), walk three meters as fast as they can without running, then return and sit down again. The shortest time (in seconds) of the 3-repetition test was used.

Blood pressure (BP), heart rate (HR), and peripheral oxygen saturation (SpO2) were measured before and after evaluation as a protection measure.
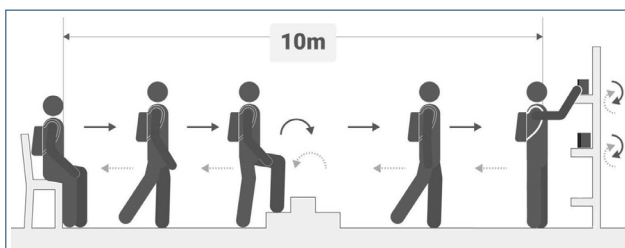

Figure 1: Glittre Activities of Daily Living (ADL) Test.

Statistical Analysis

SPSS (Statistical Package for Social Sciences) software, version 26[27] was used to perform statistical analysis. The Shapiro Wilk test of normality was used to characterize the sample, data distribution, and distribution of measurements obtained using descriptive statistics.

Parametric data were represented as mean and standard deviation (SD), nonparametric variables as median and interquartile interval, and categorical variables by frequency and percentage. For validation of the Glittre-ADL test, Spearman correlation analysis was used with the Six-Minute Walk Test (6MWT), distance in meters, and the Timed Up and Go (TUG) in seconds.

For correlation analysis of the Six-Minute Walk Test (6MWT) with the Glittre-ADL test, the best distance of the two 6MWTs was considered, with the best time of the Glittre-ADL test carried out by Examiner 1 expressed in seconds.

The best time of the three evaluations, in seconds, was used for correlation of the Timed Up and Go test (TUG) with the Glittre-ADL test. The magnitude of the relationship between the variables was classified as weak (correlation coefficient to 0.39), moderate (between 0.40 to 0.69), and strong (up to 0.70)[28].

Participants' best performance was used for reliability analysis and agreement between measures. Reliability analysis for Intra-Examiner and Inter-Examiner reliability was used.

The interclass correlation coefficient (ICC)[29,30] type 2.1 and the respective 95% confidence intervals (95% CI) (ICC: 0.80 to 0.99= excellent, 0.60 to 0.79= good, and <0.60= poor were used. For agreement, Standard Error of Measurement (SEm) and Minimal Detectable Change (MDC)[31] were used.

The ratio between the standard deviation (SD) of the mean of the differences and the square root of 2 (SD of the differences /$\sqrt{2}$) was used to calculate the Standard Error of Measurement (SEm).

The formula MDC=1.96 x$\sqrt{2}$ x SEm in the Bland & Altman[32], was used to calculate minimal detectable change (MDC).

Agreement between inter-raters was measured using the Bland-Altman Plot. The dispersion diagram was built using this test, showing individual differences (on-axis y) as a function of the average observed in the two evaluations (on-axis x)[33].

RESULTS

One hundred seven older adults of both sexes were selected from the physiotherapy clinic for this study. Seven of those participants were excluded (five because they were cardiac patients or had medical restrictions, and the other two participants did not complete the protocol and quit participating in the survey). Thereby, 100 older adults made up the sample. The Demographic and Anthropometric data of the older adult sample can be seen in Table 1.

It is observed in Table 1 that the classification of the level of functionality showed that 62% of the older adults were irregularly active, performing activities of daily living at least five times a week, with assiduity.

Table 2 shows the correlation between the results of the Glittre-ADL test with the 6MWT and the correlation between the results of the Glittre-ADL test with the TUG.

It can be seen in Table 2 that the correlation analysis between the time performance of the Glittre-ADL test and the 6MWT showed that the validity was satisfactory, as the correlations were significant and with a magnitude between moderate and strong (r=-0.75; p≤0.001). The correlation between the Glittre-ADL test time and the TUG was also satisfactory, with a validity of moderate and strong magnitudes (r=0.77; p≤0.001), validating the Glittre-ADL test.

Table 3 shows the intra-examiner and inter-examiner reliability of the Glittre-ADL test.

It can be seen in table 3 an excellent ICC intra-examiner 0.91 (0.86-0.93) and inter-examiner 0.91 (0.88-0.94), with a significance of p<0.001. Figures 2 and 3 show the intra-examiner and inter-examiner correlation.

Figure 2 shows a very strong interclass correlation coefficient, both intra- and inter-examiner, which demonstrates that the vast majority of the older adult participants performed all the Glittre-ADL tests with similar times. The standard error of measurement (SEm) and minimal detectable change (MDC) results corroborate these results, characterizing the reliability and agreement of
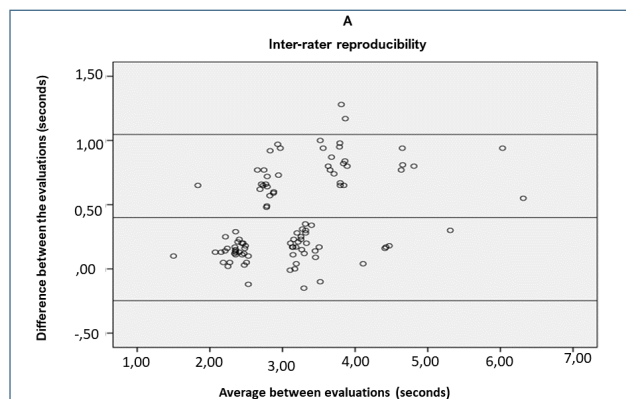

Figure 2: Bland Altman plot (n=100) for Test-Retest reliability (A: Intra-Examiner).
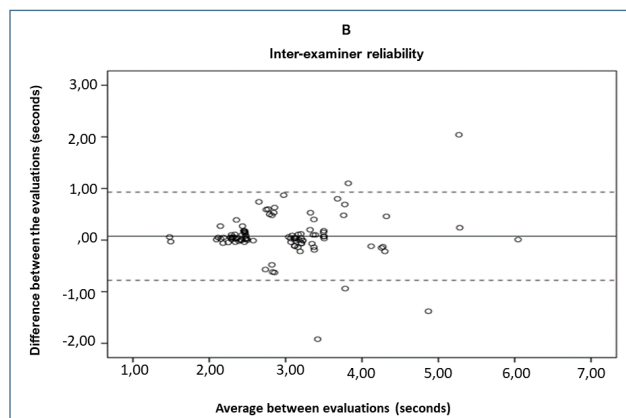
Figure 3: Bland Altman plot (n=100) for Test-Retest reliability (B: Inter-Examiner).

Table 1: Demographic and Anthropometric Data of the Older Adult Sample (N=100).

Characteristics	N=100
Female/male	64/36
Age (years)	68 ± 5.16
Weight (kg)	70 ± 12.84
Height (meters)	1.60 ± 0.09
BMI (kg/m²)	26.98 ± 4.22
Low Weight (%)	8
Eutrophy (%)	49
Overweight (%)	43
MMSE (average schooling)	26 ± 2.69
IPAQ (%)	
Very active/active/irregularly active/ sedentary	7/27/62/4

*BMI: Body Mass Index; MMSE: Mini-Mental State Examination; IPAQ: International Physical Activity Questionnaire; kg: Kilogram; M: Meter. Data expressed as mean± SD.

Table 2: Correlations between the 6MWT, TUG test and Glittre-ADL test for the older adults – Validity

Measure with similar construct		r	p
Glittre-ADL Test*	6MWT*	-0.76	<0.001
Glittre-ADL Test*	TUG*	0.77	<0.001

ADL: Activities of Daily living; 6MWT: Six - Minute Walk Test; TUG: Timed Up and Go
*Considered the best time in for the ADL-Glittre test and TUG (seconds) and the best distance (meters) in the 6MWT.

Table 3: Intra-Examiner and Inter-Examiner reliability of the Glittre-ADL Test.

Analyses	Intra-Examiner	Inter-Examiner	Significance (p)
Reliability			
ICC-CI95%	0.91 (0.86-0.93) *	0.91 (0.88-0.94) *	<0.001
Agreement			
MDC (Seconds)	0.04	0.07	<0.001
SEm (Seconds)	0.03	0.05	<0.001

SEm: Standard Error of Measurement; MDC: Minimal Detectable Change; ICC: Intraclass Correlation Coefficient: CI: Confidence Intervals; *p≤0.05.

the tests. The solid line indicates mean bias and the dashed line (Figures 2 and 3) indicates the upper and lower limits of agreement between the tests (95% CI).

DISCUSSION

The aims of this study was to investigate the validity and reliability (Intra-Examiner and Inter-Examiner reliability) of the Glittre-ADL test to assess functional capacity in older adults.

This was the first study that investigated the validity and reliability of the Glittre-ADL test in the older adults, in which adequate validity and reliability were demonstrated for this population. We observed that the criterion validity of the Glittre-ADL test reflects its potential to analyze functional capacity in older adults; the shorter its execution time, the greater the distance traveled in the 6MWT, and the shorter the TUG execution time will be. This is to say that the greater the mobility restriction, the longer it will take to perform the Glittre-ADL test and vice versa. Similar results were found in validation of the Glittre-ADL test with healthy children[12] in which they found a negative correlation of strong magnitude between the time of the Glittre-ADL test and the distance traveled in the 6MWT, also verifying this relationship between the best performance of the time on the Glittre-ADL test with a longer distance traveled in the 6MWT.

The choice of the 6MWT for comparison was made because, besides being validated for older adults, it already has reference values established for use with Brazilians[34]. It is a submaximal test, as it is made up of mostly daily living activities[12], and the metabolic, ventilatory, and cardiovascular responses generated by the Glittre-ADL test are similar to those induced by the 6MWT[34] which indicates that they are comparable.

The choice of the second test, the TUG[23], for correlation, was due to also having been validated for older adults[35]; it has characteristics similar to the Glittre-ADL test such as standing up from a chair, walking, returning and sitting down again, and outcome time. The correlation was positive, and the lower the performance concerning the time in the Glittre-ADL test, the better will be its time in the TUG.

Other essential data obtained by the TUG showed that the older adults in the survey had a low risk of falls and good functional mobility. To consider fall risk as well, the test score must be above 15 seconds and for good functional mobility, below 12 seconds. The older adults who participated in this survey were below this score (6.58±0.13 seconds), which corroborated with the classification of non-frail older adults[36].

Participants in our study spent an average of 189.21 seconds performing the Glittre-ADL test; similar to the study with obese participants who were divided into three categories: obese candidates for bariatric surgery (average 186 seconds), obese after bariatric surgery (131 seconds), and obese noncandidates for surgery (122 seconds)[11]. In individuals with Parkinson's disease, the average found was 221.4 seconds, well above the values found in all studies that validated the Glittre-ADL test. This possibly occurred because they were individuals with chronic motor weakness such as muscle rigidity, bradykinesia with a consequent decrease in gait speed[13] and also different from the validation study of the Glittre-ADL test in patients with Chronic Obstructive Pulmonary Disease (COPD)[9], whose results were also longer, with a mean time of 256 seconds for individuals who participated in the validity of the test and 263 seconds for individuals who participated in the reliability test. These longer times in this population with COPD possibly occurred because they are individuals with cardiorespiratory changes such as dyspnea and higher heart rate (HR), which requires more time to perform the test tasks.

Therefore, in light of these results, we note that the test can track disabilities resulting from some health impairments since these individuals with disabilities had better results than the healthy older adults in the study.

We observed that there was an improvement in the performance time of the Glittre-ADL test on the second repetition with the examiner 1, with a decrease of 12.73 seconds. Other studies of individuals with chronic obstructive pulmonary disease (COPD)[37], sequelae and in Stroke[14] observed similar results with a decrease of 0.03 minutes, in healthy children[12], with a difference of 13.20 seconds in the validity group and of 10 seconds in the reliability group. Those results suggest that there was a learning effect between the first and second tests, but it does not invalidate the results performed by different examiners because the standard error of minimal measurement indicates reliability among the examiners.

Another point we must highlight is that we found high values of the Interclass Correlation Coefficient (ICC) in the reliability of the test to both intra- and inter-examiner, but with very low intra-examiner standard errors of measurements (SEm) for the test. Although the values of the standard error of measurement (SEm) do not contribute to test reliability they are necessary values of clinical and physical order since the changes found to demonstrate the measurement error. This result shows that there was no change in physical conditioning and clinical condition in the variable tested.

The great performance of the older adults in this study's test can be justified by their level of physical activity, considered active or irregularly active, and, therefore, practitioners of activities like the Glittre-ADL test during their daily routine[37]. Of the 100 older adults we evaluated, 57 obtained a maximum performance and 43 a minimum performance in the Six-Minute Walk Test (6MWT), which represents an appropriate functional capacity[33].

Our study had the participation of 64 women and 36 men. It is very common to find more elderly women practicing physical activities than men, as shown by Andreotti and Okuma[38], whose objective of the study was to describe the socio-demographic

profile of those entering a Physical Activity Program, showing a prevalence of women. One reason for this would be because women have a more sensitive perception of the body, socially and historically created by the medicalization process, which makes them more attentive than men to possible diseases. In this way, the practice of physical activities in the female universe gains a large proportion due to health, beauty and control of body weight, a phenomenon observed, above all, in more developed societies Boltanski[39] another reason can be explained by the mortality differential, with an average higher life for women.

Another important point found in our study was that most of the patients in our study were either irregularly active or active, which may justify the excellent performance in the Glittre-ADL, 6MWT, and TUG tests. Similar findings were also found in the study by Grimm et al.[40], in which they point out that the higher the level of physical activity, the condition of the elderly, even in relation to daily activities, the better their functional capacity.

We concluded that the Glittre-ADL test is a valid and reliable assessment to assess functional capacity in healthy older adults. This study may help to assess the effectiveness of different therapies in older adults. However, other studies investigating the impacts and importance of the Glittre-ADL test on the older population with limitations should be conducted.

Study limitations

As a limitation of the study, we need to point out the absence of older adults characterized as frail or less active, which prevents using the Glittre-ADL test for functional classification.

Conclusion

The Glittre-ADL test showed good results in the construct validity and excellent results for Intra-Examiner and Inter-Examiner reliability, proving to be valid for assessing functionality in older adults.

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