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original article

The "*Timed Up and Go*" in the prediction and explanation of falls in old people practicing physical exercises

*O "*Timed Up and Go*" na previsão e explicação de quedas em idosos praticantes de exercícios físicos*

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Abstract – The classic and cognitive "Timed Up and Go" tests (TUG) are used to identify old people prone to falls, but we were unable to find studies that prove their association in old people practicing physical exercise. The objective of this study was to analyze the classic and cognitive versions of TUG in forecasting and explaining the occurrence of falls in old people practicing physical exercise. Participants included 82 physically active old people. Data were collected on the occurrence of falls in the past 12 months among those who performed the classic and the cognitive TUG tests through the pronunciation of animals while performing the test. We used descriptive and inferential statistics with a significance level of 5%. A binary logistic regression was performed to associate the outcome (falls) and the performance in the tests. To identify the predictive values, the ROC Curve was used. The occurrence of falls in the sample was 19.5%. There was a significant difference between the values obtained in the TUG classic and cognitive tests (9.0 ± 1.9 and 10.0 ± 2.2 seconds, respectively). There was no difference between the old people with and without a history of falls in both tests, despite the averages being higher in old people with a history. In the logistic regression analysis, the performance of both versions did not explain the occurrence of falls. In the ROC curve, the TUG classic test showed an accuracy of 65.3% (p= 0.058) and the TUG cognitive test of 58.1% (p= 0.324). The TUG classic and cognitive tests did not correlate with the occurrence of falls and should be used with caution for predicting falls in old people practicing physical exercise.

Key words: Accidents caused by falls; Exercise; Old people.

Resumo – *O teste Timed Up and Go (TUG) clássico e cognitivo é utilizado para identificar idosos propensos a quedas, porém não foram encontrados estudos que comprovem sua associação em idosos praticantes de exercícios físicos. O objetivo deste estudo foi analisar a versão clássica e cognitiva do TUG, na previsão e explicação da ocorrência de quedas, em idosos praticantes de EF. Participaram 82 idosos fisicamente ativos. Foram coletados dados sobre ocorrência de quedas, nos últimos 12 meses, e realizado o teste TUG clássico e o cognitivo por meio da pronúncia de animas enquanto executa o teste. Utilizou-se estatística descritiva e inferencial com nível de significância de 5%. Uma regressão logística binária foi realizada para associar o desfecho (quedas) e o desempenho nos testes. Para identificar os valores preditivos, utilizou-se a Curva ROC. A ocorrência de quedas na amostra foi de 19,5%. Observou-se diferença significativa entre os valores obtidos no TUG clássico e cognitivo (9,0 ±1,9 e 10,0 ±2,2 segundos, respectivamente). Não houve diferença entre idosos com e sem histórico de quedas, em ambos os testes, apesar das médias serem superiores nos idosos com histórico. Na análise de regressão logística, o desempenho de ambas as versões não explicou a ocorrência de quedas. Na curva ROC, o TUG clássico apontou acurácia de 65,3% (p= 0,058) e o TUG cognitivo de 58,1% (p= 0,324). Os testes TUG clássico e cognitivo não se associam com a ocorrência de quedas e devem ser utilizados com cautela para previsão de quedas em idosos praticantes de EF.*

Palavras-chave: *Acidentes por quedas; Aptidão Física; Exercício; Idosos.*

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INTRODUCTION

Many studies have shown significant social and economic epidemiological relevance in the occurrence of falls because they are the most common type of accident and are among the main causes of morbidity and mortality in the old people population[1-5], since approximately 30% of old people fall at least once a year[3,6]. In addition, it has become relevant to establish trustworthy standardized assessments for use in clinical practice so that health professionals can provide support for falls in old people and establish more appropriate interventions. Figueiredo et al.[7] identified through a systematic review the instruments used in the assessment of static, dynamic body balance and risk of falls among old people in Brazil and internationally. Among the tests, the "Timed Up and Go" (TUG), which was developed by Podsiadlo in 1991, stands out[8].

The guidelines of the American and British Society for the Prevention of Falls recommend the use of TUG for the evaluation and selection of interventions in old people who seek the services of health organizations[9]. In addition, some authors[8,10-12] affirm that TUG is a valid instrument for risk screening of falls in the old people of their communities. For Barbosa[13], the realization of a second task, cognitive or manual, during the execution of the TUG, was the most appropriate way to identify the propensity of occurrence of falls because the dual task increased the motor demand needed to maintain balance.

In spite of its wide use, TUG's clinical importance in its classical or cognitive versions is still imprecise and divergent, especially when considering different groups with specific characteristics among the old people population. Even among old people practicing physical exercises, in which the incidence of falls reaches 22%[14], it becomes necessary to identify quick instruments of easy application and accessibility to health professionals so that they can assist in the prediction of this occurrence.

In this sense, it should be noted that there is a lack of studies using the classic and cognitive TUG tests in the prediction and explanation of the occurrence of falls among old people practicing physical exercises. According to Perracini et al.[15], there is a difference in the factors related to the occurrence of falls, as the level of physical activity among old people patients. Therefore, this information should be considered in planning interventions for this population. From a research study with old people tied to a systematized program of physical exercises, we intend to contribute to the choice of appropriate instruments for the identification of potential risks for falls since falls are extremely harmful to the quality of life of this population, and our contribution will meet the recommendations of the "WHO Global Report on Falls Prevention in Older Age" report, which demonstrates the concern with falls in the entire world[16].

Therefore, the objective of this study was to analyze the use of the classic and cognitive test versions of TUG on prediction and explanation of the occurrence of falls in the old people practicing physical exercises.

METHODOLOGICAL PROCEDURES

This study was approved by the Committee for Ethics in Research with Human Beings of the State University of Santa Catarina, under protocol nº 185/07. It was a descriptive study whose population was composed of old people practicing physical exercises linked to the Program of University Extension Group of Studies of the Third Age, which includes approximately 300 old people of the community[17]. The classes of this program have a duration of 50 minutes and are held two to three times per week. These classes are moderate by intensity value, which is determined by means of self-report of sensation of greater physical effort and increase in respiratory rate during the execution of the exercises.

The sample was selected intentionally, taking as inclusion criteria: being old people (≥60 years of age), of both genders, and regularly enrolled in the program. All of the program's old people were invited to participate in the study, and we scheduled a date for the tests realization. In this way, participants took part in a voluntary way. The resulting participants included 82 old people practicing physical exercises, with an average age of 67.3 ± 6.73 years, 56 women (68.30%) and 26 men (31.70%). After receiving all the information, the participants signed a free consent form and clarified any concerns they might have had.

For sample characterization, we used a diagnostic test relating to age, gender, and information about last year's occurrence of falls, which factors were based on other studies[15,18,19] that also used the self-report occurrence of falls in the past 12 months.

To evaluate the risk of falls, we used the test "Timed Up and Go" (TUG) in its classical version, developed by Podsiadlo[8] in 1991. The test consists of raising of a standardized chair (seat height 43 cm; arm height 61 cm; seatback height 43 cm; depth 42 cm; width 40 cm), walking 3 meters in a straight line, turning around, returning to the place of departure, and sitting down again. The individual must walk on a comfortable and secure platform using their usual shoes, without any physical assistance or support.

To start the test, the test administrator gives the verbal command "go." The timer is triggered by the first movement of the old person's trunk and finished when the same leans on the chair. The cognitive variable of TUG (cognitive TUG) was obtained by adding to the classic test a simple cognitive task. In this task, the examiner guided the old people by asking them to "Say all the names of animals that you can remember during the test. It can be any kind of animal." This test was adapted from Alvarenga et al.[20] and we did not carry out a new test unless the participant repeated names.

The data were collected by two previously on-the-spot trained researchers to perform physical exercises. At the beginning, we applied the diagnostic test as individual interviews. Afterward, we explained and demonstrated to the old people the procedure of the classic TUG and the cognitive TUG. The first attempt was to familiarize them with the test, and we only counted the second attempt. The break for rest between both

tests was two minutes. All the old people executed first the classical version followed by the cognitive version.

The data were organized in Microsoft Excel® and analyzed in the statistical program SPSS (Statistical Package *for Social Sciences version* 17.0 for Windows.) The nominal/dichotomous variables of fall history (with and without) and gender (male and female) were treated by means of simple and relative frequency, while we treated the numerical values of age in the classic and cognitive TUGs by using the mean and standard deviation.

In the inferential analysis, the comparison between groups was performed by means of a t test for independent samples or a Mann-Whitney U-test as the distribution of the data. The intra-group comparison was performed by a Wilcoxon test. We used the Chi-Square test or Fisher Exact in the association between nominal variables. To verify the association between the history of falls (outcome) and the values obtained in the classic TUG and the cognitive TUG (explanatory variables), we performed a binary logistic regression, adjusting age and gender. To identify the predictive values of both tests in the occurrence of falls, the ROC Curve was used. We adopted a statistical significance level of 5%.

RESULTS

Participants in this research included 82 old people practicing physical exercises, with women (n= 56) who had an average age of 66.2 ± 6.65 years, while men (n= 26) of 69.7 ± 6.38 years. It was found that this difference was statistically significant (U= 494.5; $d.f.$ = 80; p = 0.02).

In relation to the history of falls in the past 12 months, the occurrence in the sample was 19.5%. There was no association between the history of falls and gender (X^2= 0,413; p= 0.765), since the occurrence in men was 15.4% and in women was 21.4%.

To compare the values obtained in the TUGs, the average time of realization of the classic test was 9.0 ±1.9 seconds, while of the cognitive version, the average was 10.0 ± 2.2 seconds. We found a statistically significant difference between the values (Z= -5.151; p< 0.001), as shown in Figure 1.

The values obtained in the classic TUG and the cognitive TUG were compared according to the occurrence of falls (history of falls) in the past 12 months (Table 1), and we found no significant difference in both tests. In spite of this, we observed that old people with falls presented higher average values for both tests.

As seen in Table 2, there was no association (p>0.05) between the occurrence of falls (outcome) and the values obtained in classic and cognitive TUG (explanatory variables), demonstrating that both tests did not explain the occurrence of falls in the old people practicing physical activities.

To evaluate the quality of the classic and cognitive TUGs in prediction of old people falls, we used the ROC curve (Figure 2). The area under the curve for the classic TUG pointed to an accuracy of 65.3% (p= 0.058), and in the cognitive TUG, an accuracy of 58.1% (p= 0.324). The lack of

significance demonstrates that both tests cannot be used for prediction of falls in the old people practicing physical exercises.

Table 1. Comparison between the values of classic and cognitive TUGs and the history of falls among old people practicing physical exercises.

TUG	with history of falls (n= 16)	without history of falls (n= 66)	E	p
	Average (SD)	Average (SD)		
Classic	9.57 (1.60)	8.86 (1.95)	366,00¥	0.058
Cognitive	10.37 (1.60)	9.90 (2.28)	0,771£	0.443

TUG= Timed up and Go; SD= Standard Deviation; E= Statistical test; *p*= Statistical significance ¥Statistical test U of Mann-Whitney; £ Statistic the *t* test for independent samples.

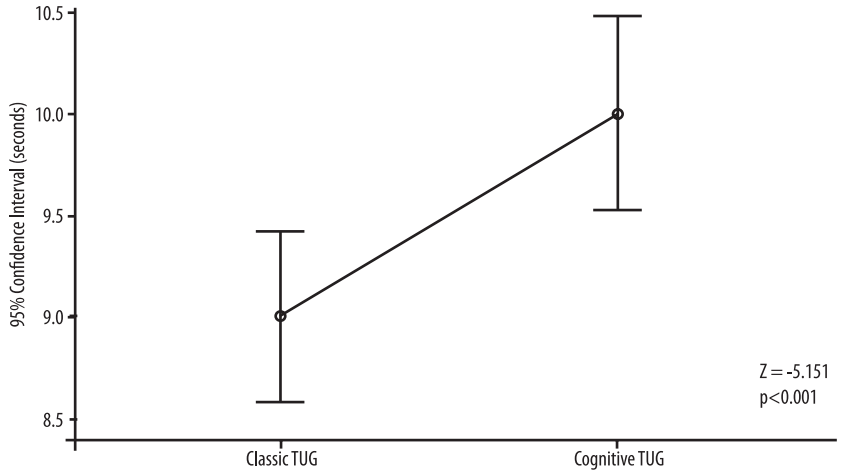

Figure 1: Graphical representation of the difference of time of classic and cognitive TUG test performance

Table 2. Logistic regression analysis of the values obtained in TUG (classic and cognitive) in the occurrence of falls in the old people practicing physical exercises.

Variable¥	B	OR	CI 95%		p
TUG classic	- 0.176	0.839	0.644	1.093	0.193
TUG cognitive	0.004	1.004	0.665	1.516	0.985

TUG= "Timed Up & Go"; B= Logistic Coefficient; OR (Odds Ratio) = Ratio of Risk for falls; CI 95%=Confidence Interval for the Hazard Ratio; *p*= level of significance; ¥ Adjust by gender and age.

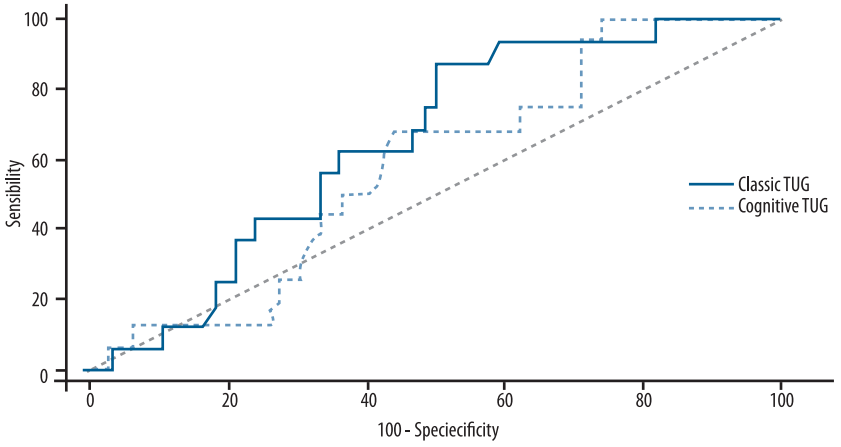

Figure 2. ROC curve of performance of classic and cognitive TUG tests as for the occurrence of falls in old people practitioners of physical exercises.

DISCUSSION

The occurrence of falls varied according to the old people profile evaluated and can be associated with several factors. Siqueira et al.[3], while investigating 4,003 old people residents in areas of basic health units of various Brazilian municipalities, showed that the prevalence of falls was of 34.8% and was associated with factors such as advanced age, sedentary lifestyle, poor perception of health, and great number of medications. Among old people practicing physical exercises, the research developed by Beck et al.[21] showed an incidence of 7.63%, which value is below what we found in the present study (19.5%). We believe that there is a relationship in the form of "U" between the occurrence of falls and the practice of physical exercises since practicing little exercise or too much can be considered risk factors[22,23]. This premise can explain the occurrence of falls among old people practicing physical exercises. However, this relationship was not confirmed by Peeters et al.[24] in a longitudinal study of 1,337 older adults, which implies that several factors may be involved in the occurrence of falls, beyond the level of physical activity.

Silva Duarte and Arantes[25] compared the performance of the classic TUG among old women with different levels of physical activity (inactive, moderately active, and active). The results of the TUG were 11.47 (± 2.70), 9.98 (± 1.73), and 8.45 (± 1.55) seconds, respectively. Such results suggest that old women with moderately active and active levels of physical activity have lower execution time and, therefore, a lower risk of falls, compared to sedentary old people. So, the functional mobility TUG test is showed to be sensitive to differentiate the groups of different levels of physical activity and the risk of falls. The old people practicing physical exercises presented a similar performance in the classic TUG to the moderately active old people group.

In this study, a statistically significant difference was found ($p< 0.001$) between the values obtained in the classic test TUG (9.0 ± 1.9 seconds) and the TUG with cognitive variation (10.0 ± 2.2 seconds). Such evidence comes to meet to the study carried out by Barbosa et al.,[13] found that the interference of one task, cognitive or manual, in the final time obtained in test TUG. In this study, the authors affirmed that the old people had a worse performance in the test when associated with the realization of a second task, whether cognitive or motor. During the present study, we used the repetition of animal names. Despite its being a simple task, it significantly changed the values of agility and dynamic balance, even if only for a second.

Goncalves and Coimbra[26], when evaluating and comparing the functional balance of 96 elders of the community, equally divided into three groups according to the history of falls (without history of falls, with one fall and with recurrent falls), revealed that old people with a history of falls (including one or more) took longer to complete the TUG test (14.57 ± 4.23 seconds and 14.48 ± 4.46 seconds, respectively) than old people without a history of falls (11.43 ± 2.95 seconds), and this difference is significant (p= 0.002). However, for Shumway-Cook et al.[10], the ability to predict the fall

did not increase with the addition of a secondary task.

In this study, the performance of the classic TUG and its cognitive variation (cognitive TUG) did not explain the occurrence of falls. This observation concurs with the study carried out by Thrane et al. [27] with 974 old people of the community (average age of 77.5 years) in which they evaluated using the TUG and a questionnaire covering the falls over the past 12 months. Thrane et al. came to the conclusion that the TUG was statistically associated with the history of men falling, but not of women. In the same way, another test widely used to predict falls in old people, the Scale of Balance of BERG, is also not advised for application in old people practicing physical exercises, because a ceiling effect is observed in this population[28]. It is believed that the profile of the samples being composed of old people practicing physical exercises can justify the lack of association and deserves more studies that focus on adjustments.

With respect to the accuracy of the TUG test, the study of Alexander et al.[29] found a value of 68% for the classical version, suggesting that 12.47 seconds is considered a predictive value ideal for Brazilian old people residents in the community. However, as observed in the present study, both versions of the TUG test may not be used for prediction of falls since the ROC curve did not show significant values and, therefore, has low accuracy values. This result confirms the lack of association of tests with the occurrence of falls in old people practicing physical exercises.

A systematic review[30] investigates the effects of physical exercise programs in reducing the risk of falls in the old people of the community, concluding that there is a need for appropriate methods to identify the most susceptible people to this occurrence, and suggesting that the exposition be controlled to experimental situations similar to the real conditions of a fall.

CONCLUSION

The findings of this study indicate that the classic and cognitive TUG tests do not correlate with the occurrence of falls and, therefore, are not indicated for prediction of this event in old people practicing physical exercises. The measurement of the level of physical activity by means of direct measurement, the identification of some control variables such as the time of practice of physical exercise and a larger sample size could enhance the inferences made. In addition, the randomization in the implementation of the procedures and tests of reliability among researchers could reduce the biases in the study. However, we believe that these results bring important contributions for the clinical practice of health professionals who work with old people practicing physical exercises because it demonstrates that its application should be performed with caution. This finding is in concordance with the Model for the Prevention of Falls in Active Aging of the OMS,[16] which proposes, between the strategies for reducing this event, the investment in the improvement of evaluations with procedures based on evidence and that are culturally appropriate for the evaluated population.

In addition, it is noted that further studies are needed to find instruments that are sensitive and specific for the screening of falls in the physically active old people population since the use of equipment, such as force platforms, are expensive and infeasible in daily practice. The fall, being an event of multi-factorial cause, may be associated with several factors, both intrinsic and extrinsic; therefore, its prediction must be analyzed in a wide manner within the protocols of old people evaluation.

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