

## Comparative analysis of functional mobility among Hungarian community-living and institutionalized elderly individuals

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*Purpose:* Reduced functional mobility is a risk factor for falls. The Timed Up and Go test is a complex measurement tool for functional mobility. Our aims were to assess the functional mobility of: (a) community-living elderly who were participating in an exercise programme ( $n = 40$ ; mean age = 73.7 years), (b) community-living elderly who were physically inactive ( $n = 40$ ; mean age = 74.1 years), and (c) institutionalized elderly ( $n = 40$ ; mean age = 73.5 years) and to compare the results with cut-off values for risk of fall. *Materials and methods:* After measuring functional mobility, one-way independent ANOVAs and sample *t*-tests were used for analysis. *Results:* The functional mobility of the active participants was better than that of the inactive ( $p < .001$ ) and institutionalized participants ( $p < .001$ ). There was no significant difference between the inactive and institutionalized participants ( $p = .990$ ). The functional mobility of the active participants was better, whereas the functional mobility of the inactive participants was worse than the cut-off value of 13.5 s for risk of fall for community-living elderly. The functional mobility of the institutionalized participants did not differ from the 15-s reference value for predicting risk of fall. *Conclusion:* The results indicate that regular physical activity has a positive effect on maintaining functional mobility among both community-living and institutionalized elderly individuals.

**Keywords:** functional mobility, older adults, physical activity

### INTRODUCTION

The elderly are the fastest growing age group worldwide, where falling is the most common cause of their fractures, long-lasting immobilization, and loss of independence [1, 2]. By 2030, the proportion of adults aged 65 years or over will account for about 30% of population [3]. About 30% of community-living people aged 65 or over fall each year, and this rate may be as high as 50% among the institutionalized elderly [4, 5]. Although falling is a multifactorial event – that is, a result of the simultaneous effects of several factors – according to the literature, reduced functional mobility is a constant risk factor [1, 6–9]. Functional mobility describes a person's ability to move around in the environment to pursue the activities of daily living (ADL). The elements of functional mobility include rising from a chair, sitting down, walking, turning, etc. For this reason, the majority of tests to identify older adults at risk of falling is used to measure one or more of these elements [10].

The Timed Up and Go (TUG) test is a complex measurement tool for functional mobility and a frequent and widespread method of screening those who are prone to fall, including both the community-living and institutionalized elderly [11, 12]. It measures the time (in seconds) needed for an individual to stand up from a chair (with back

support) of standard seat height (usually 42–46 cm), walk 3 m, turn around, walk back to the chair, and sit down. A shorter time indicates better functional mobility [11]. The result of this quick, easy-to-perform, and safe test is proven to correlate with the results of several other tests that require more time. Among the frail elderly, results of the TUG test correlate with the Berg Balance Scale ( $r = -.81$ ), the walking-speed test ( $r = -.61$ ), and the Barthel Index ( $r = -.78$ ) [11]. Among community-living elderly, the results of the TUG test correlate with the results of the Tinetti Performance-Oriented Mobility Assessment (balance  $r = -.55$ ; gait = 0.53), the walking-speed test ( $r = -.66$ ), and a scale assessing ADL activities ( $r = -.45$ ) [13].

The TUG test as an assessment of the risk of falling was investigated in several elderly populations with the following cut-off values: Among community-living elderly, the cut-off value of 13.5 s could identify elderly who were “at risk of falling” [14]. Among elderly referred to a fall clinic, the cut-off value of 15 s could identify those who required detailed physiotherapy assessment and targeted intervention [15].

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Our aim was twofold. Using the TUG test, the first thing is to assess the functional mobility in three groups: (a) community-living elderly who were participating in a regular exercises programme, (b) community-living elderly who were physically inactive, and (c) institutionalized elderly who were living in a nursing home; and then to compare the results of the TUG tests to cut-off values for risk of falling published in the geriatric literature.

## MATERIALS AND METHODS

### Participants

This cross-sectional study was conducted in February 2018, in Budapest, Hungary, with the participation of 120 elderly individuals, and in accordance with the 2008 revision of the 1975 Declaration of Helsinki. Inclusion criteria were: (a) age of 60 years or over, (b) ability to walk with or without an assistive device, and (c) no cognitive or sensory impairment that would interfere with the TUG test. The inactive and institutionalized participants were matched by age and gender to the active participants. The maximum age difference was stipulated as 6 years. The mean age in each group was about 74 years. The community-living elderly who were physically active were recruited from attendees of a 60-plus exercise programme. The community-living elderly who were physically inactive were recruited through advertisements in local newspapers, from senior centres, and from religious communities. They were asked to continue their usual daily life, and not to take part in any exercise programmes. The institutionalized elderly were recruited from a nursing home. They participated in a group-based multimodal exercise programme twice a week. This exercise programme consisted of strengthening and balance exercises. The strengthening exercises directed to lower limb muscles playing role in the postural control such as knee extensors, hip extensors, hip abductors, and ankle muscles, using the patients' body weight. The balance exercises related to everyday activity, including stepping forward, sideway, and backward; walking with and without changing direction; timed stand practice (standing on one leg and tandem stance); and sit-to-stand practice.

### Assessments

Data were collected through a questionnaire (for the community-living participants), institutional documentation (for the institutionalized participants), and a physiotherapist-administered TUG test (for all participants). The participants' age, gender, weight, and height were collected, and their body mass index (BMI) was calculated. Their history of chronic diseases, including cardiopulmonary disease, hypertension, diabetes mellitus, and lower limb arthritis, were also collected. During the TUG test, habitual footwear or walking aids was allowed. Participants were also allowed to use arm support for rising, if necessary. Two consecutive trials were averaged. Between the trials, there was a 30-s rest time, if needed. A longer time indicated worse functional mobility. The TUG tests had high interrater (interclass correlation coefficients = .99) and intrarater (intraclass correlation coefficients = .99) reliability [16].

### Procedure

After participants were informed about the purpose and procedure of the study and their right to withdraw at any time, their written informed consent was obtained, and the data were gathered within a 2-week period. The testing was always performed in the morning.

### Statistical analysis

Continuous data were given as a mean with a standard deviation (*SD*) and discrete data were given as frequencies and percentages. Normal distributions were verified by skewness and kurtosis, as well as the Shapiro–Wilk test. One-way analyses of variance (ANOVAs) and  $\chi^2$  tests were used to analyse the descriptive values of the three groups. If the ANOVAs indicated significant differences, post-hoc tests according to the Games–Howell method were used to perform pairwise comparisons between the groups. One-sample *t*-tests were used to compare the TUG score of each group to the reference value for the risk of falling. Statistical analyses were carried out with PASW Statistics for Windows, version 18.0 (SPSS Inc., Released 2009, Chicago, IL, USA). The values of *p* less than .05 were considered significant.

## RESULTS

Characteristics of the study sample are shown in Table 1.

In terms of BMI, there was a statistically significant difference between groups [ $F(2, 117) = 9.498, p < .001$ ]. The results of the post-hoc test showed that the BMI of the active participants was significantly lower than the BMI of both the inactive ( $p = .001$ ) and institutionalized participants ( $p = .001$ ). Simultaneously, the difference between the inactive and the institutionalized participants was not statistically significant ( $p = .975$ ).

As for the chronic diseases, among the active participants, there were significantly fewer individuals with cardiopulmonary disease and/or lower limb osteoarthritis compared to the inactive and institutionalized participants. There was a statistically significant difference between groups [ $F(2, 117) = 15.817, p < .001$ ]. The post-hoc test revealed that the active participants suffered from significantly less chronic diseases compared to both the inactive ( $p < .001$ ) and institutionalized participants ( $p < .001$ ). However, the difference between the inactive and the institutionalized participants was not statistically significant ( $p = .964$ ).

In the TUG test, there was a statistically significant difference [ $F(2, 117) = 27.174, p < .001$ ]. The results of the post-hoc test showed that the active participants performed the TUG test significantly better than the inactive ( $p < .001$ ) and institutionalized participants ( $p < .001$ ). At the same time, there was no significant difference between the inactive and the institutionalized participants ( $p = .990$ ).

The results of the TUG test for the active participants ( $M = 10.07$  s,  $SD = 3.3$ ) was significantly better by 3.43 s (95% CI [2.36, 4.48]) than the 13.5 s reference value for the risk of falling [ $t(39) = -6.549, p < .001$ ]. As for the inactive

Table 1. Characteristics of the study sample

	Physically active community-living elderly (n = 40)	Physically inactive community-living elderly (n = 40)	Institutionalized elderly (n = 40)	p
Age (years) [mean (SD)]	73.7 (8.2)	74.1 (12.1)	73.5 (7.8)	.976
BMI (kg/m <sup>2</sup> ) [mean (SD)]	22.4 (5.9)	26.9 (5.3)	27.2 (4.4)	<.001
Male [frequency (%)]	3 (8)	10 (25)	4 (10)	.750
Female [frequency (%)]	37 (92)	30 (75)	36 (90)	
<i>Medical history</i>				
Cardiopulmonary disease [number (%)]	7 (17)	28 (70)	13 (32)	<.001
Hypertension [number (%)]	27 (67)	29 (72)	34 (85)	.072
Diabetes mellitus [number (%)]	7 (17)	16 (40)	13 (32)	.145
Lower limb osteoarthritis [number (%)]	12 (30)	34 (85)	30 (75)	<.001
Number of chronic diseases [mean (SD)]	1.78 (1.1)	3.15 (1.4)	3.08 (1.6)	<.001
TUG (s) [mean (SD)]	10.8 (3.3)	15.1 (1.9)	15.2 (1.9)	<.001

Note. Data are presented as mean and standard deviation for continuous data and frequency and percentage for categorical data. SD: standard deviation; BMI: body mass index; TUG: Timed Up and Go.

participants, their performance of the TUG test was significantly worse by 1.67 s (95% CI [1.04, 2.26]) than the 13.5-s reference value for the risk of falling [ $t(39) = 5.467$ ,  $p < .001$ ]. The performance of the institutionalized participants did not differ significantly from the 15-s reference value for the risk of falling [ $t(39) = 0.913$ ,  $p = .367$ ].

## DISCUSSION AND CONCLUSIONS

The aims of this study were to assess the functional mobility of three groups: (a) community-living elderly who were participating in a regular exercises programme, (b) community-living elderly who were physically inactive, and (c) institutionalized elderly who were living in a nursing home. We analysed their functional mobility with the TUG test. Furthermore, we compared the results of the TUG test results for each group to cut-off values for the risk of falling published in the geriatric literature.

The guidelines for assessment and prevention of falls, published by the American Geriatrics Society and British Geriatrics Society nearly two decades ago, recommend applying the TUG test as the first step of a screening algorithm to identify elderly people who are at risk of falling [17, 18]. For this reason, we considered it important to assess the functional mobility of elderly people who were participating in an exercise programme, that is, those who were in the everyday care of a physiotherapist.

We found that the functional mobility of the active participants was significantly better than the 13.5-s cut-off value for the risk of falling for community-living elderly individuals [14]. This result can be attributed to the fact that members of this group participated in an exercise programme consisting of muscle strengthening, flexibility, balance, and walking exercises once or twice a week for at least 6 months. At the same time, the functional mobility of the community-living elderly who were inactive was significantly worse compared to the 13.5-s cut-off value. This result of our study showed that the inactive participants

were especially prone to falling and therefore this population requires additional detailed assessment and targeted intervention. Despite the fact that the functional abilities of older people living in a long-term institution usually decline, we found that the functional mobility of elderly individuals living in a nursing home did not differ from the cut-off value of 15 s for the risk of falling [15]. This finding can be explained by the fact that although the elderly who are admitted to a long-term care institution have lost their independence due to physical or mental deterioration, they can still participate in programmes aiming to maintain their functional mobility.

There are some limitations of this study, which must be acknowledged. First, the participants were recruited using a non-probability sampling method. Thus, our results cannot be extrapolated to elderly people who are not willing to participate in exercise programmes. In addition, we used a cross-sectional design, which might reduce the strength of our evidence. Therefore, further retrospective or prospective studies are needed to confirm our results. Finally, differences in the TUG test could be attributed to differences in the number of chronic diseases. Therefore, future studies would be worth conducting on a more homogeneous sample recruited from a larger sample frame.

Despite the limitations, our results indicate that regular physical activity has a positive effect on maintaining the functional mobility of both community-living and institutionalized elderly individuals.

Some recent studies conducted on children, with and without physical disabilities, applied the TUG test to measuring functional mobility, suggesting a more widespread use of this test [19–21]. The normal values for the age group from 3 to 18 years have recently been published [22, 23]. In Hungary, several research teams are investigating the effects of neurological interventions among children with neurological disorders [24–29]. Therefore, future research is worth conducting in order to use the TUG test to reveal the functional mobility of Hungarian children.

To sum up the results of this study, the attention of health care professionals working in geriatrics should be called to the fact that community-living elderly individuals who are physically inactive are at risk of falling. It is important to design programmes that motivate them to have a physically active lifestyle. Simultaneously, programmes must be safe, considering the multimorbidity and actual condition of older people. According to these considerations, the physiotherapist plays an important role in and is responsible for the design and modification of the content presented in the exercise programmes.

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*Authors' contribution:* ÉK and AS summarized the scientific background of the paper and carried out the statistical analyses. IJSz and LM collected the data and performed the necessary calculations. AS, ZsG, and VF finalized the manuscript.

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