Chapter 23
Assessment of balance of older people living at a social welfare home

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Abstract. More frequently fall of older people can be caused by increasing of the degeneration of a human motor system and a human maintaining balance system. The aim of study was to determine the association of balance and risk of falling of older people lived at a social welfare home. The authors examined the dependence between the ability to maintain balance in the upright position and the assessment of balance and risk of falling in a functional way. The study group were consisted of 26 elderly people. Postural stability examinations was carried out based on the Romberg test, while the functionally balance was evaluated with a Up&Go test. The statical tests did not manifest significant correlation between the static and dynamic stabiliography parameters, but one proved that there existed strong differences for obtained ellipse area results, among the group of patients performing the Up&Go Test within shorter and longer time than 20 sec.

Keywords: stabilography, path length, elipse area, Zebris-FDM, older people

23.1 Introduction

Equilibrium is a postural system that preserves vertical orientation due to balancing of opposing forces acting on a body and their torques. The equilibrium is ensured by the nervous system with reflexive tension of adequate muscles known as postural and antigravitational ones. Keeping the balance, both static and dynamic

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[7] (especially during the movement), depends on the proper control system functioning of the posture holding the center of gravity projection of the body within the underpin field and being able to counteract the external forces that may destabilize the posture [9], [10], [11].

The elderly's systems responsible for keeping the body equilibrium are getting worse due to the lowered nervous system efficiency and its gradual degradation. The functioning of senses is getting worse as well. The lowering of peripheral excitability of the part of atrial organ and sense touch body disorder occur. Sharpness and both peripheral and spatial ability vision are getting impaired. A significant decrease in muscle mass and efficiency is observed. Increased muscles rigidity and trembling growth dominate in the clinical picture, which is associated with the circumstances change of the control balance posture [2]. Neuromotor activities get moderated, the time response lengthens, one worsens: perceptiveness, divisibility and motor coordination [14]. The most often consequence of the elderly's balance loss are falls. As the surveys show about 30-40% of healthy, independent individuals over 60 fall at least once a year, whereas almost 50% over 80. In Poland for every 100 individuals there are 47 downfalls among people aged 70-74 and this number increases accordingly to age [3], [5], [16]. Even 10-25% of downfalls lead to fractures affecting the patients of the social assistance houses and hospitals. These falls are three times more often comparing to the patients dwelling individually. The residence change of social assistance house patients (e.g. moving to different room) increases this hazard by 50% [8]. The majority of the elderly's downfalls occur during moving. Among all downfalls 60% of them are observed towards forward movement because of the slip [2], [14]. One of the most promising diagnostics' method is posturography that allows to assess the magnitude of human balance boundries' changes and plethora of pathological states handicapping the control of upright position balance [3], [16]. As far as diagnostics is concerned there are important tests assessing the balance in functioning way (e.g. Up&Go Test, Berg's equilibrium scale, Tinetti's test etc.), which allow to observe moving demeanor in postural challenging circumstance, simultaneously stating the base downfall hazard based on the tests standards [4].

Taking into consideration above mentioned the aim of the research is the assessment of the balance and the downfall hazard of the elderly dwelling in social assistance houses, based on stabilography parameters (track length, ellipse area) and Up&Go Test. Moreover, the researches decided to state the dependence between the ability of keeping the balance in upright position and both balance assessment and the downfall hazard in functioning way.

23.2 Methods

The experimental research was being carried out in Saint Elizabeth Welfcare Social Centre located in Ruda Śląska using the Zebris FDM system dedicated to evaluate the upright balance position. The investigation of the body balance posture

(the analysis of resultant force's application point of the components acting between feet and ground) was based on the Romberg's test assessing the balance during the free standing on both lower limbs with eyes respectively: closed and open. Legs astride within the pelvis width and arms arranged freely along the body. There were following quantities analysed: path length (the distance that GOP covers) and the ellipse area (COP displacement area). The balance was being assessed in functional way with Up&Go Test. The test consists in performing some simple tasks such as: rising form the chair holding upright back, covering the flat distance of 3 meters, crossing the line ending a given sector, performing 180° rotation, returning to the chair and installing the sitting position. The seat height (46 cm) was established according to the research findings of Siggeirdottir [13]. The test performing time was measured with the command 'Start' until installing the sitting position again [12], [13]. The investigation was carried out twice with a measure of average value. The research group consisted of the elderly aged 65–94 (av. value: 79 ± 8, body mass: 69 ± 1 kg, body height: 159 ± 6 cm) respectively 17 females (age: 82 ± 6, body mass: 68 ± 16 kg, body height: 158 ± 5 cm) and 9 males (age: 73 ± 6, body mass: 74 ± 8 kg, body height: 161 ± 6 cm). The main acceptable condition was the age over 65 and the shortage of neurological occurrences. Men and women who understood the essence of the test were qualified. According to established norms for Up&Go Test people over 65, characterized by good functional mobility, were informed to perform the test within 10-20 sec [14], [15]. The persons being tested, who perform the test over 20 sec, are vulnerable to mobility impairment and downfalls. Hence, the research group was splitted into two subgroups: patients performing the test up to 20 sec (group quantity: 15, av. age: 77 ± 8, body mass: 67 ± 12 kg, body height: 158 ± 6 cm), and over 20 sec (group quantity: 11, av. age: 80 ± 6, body mass: 73 ± 16 kg, body height: 160 ± 6 cm).

23.3 Results and Discussion

The obtained results of Up&Go Test and Romberg's Test were presented in Table 1.

Table 23.1: Descriptive statistical analysis of obtained results

	Up&Go Test [s]	Path length [mm]	Elipse area [mm^2]
mean	20,37	499,07	116,40
std deviation	6,95	150,15	104,42
median	18,50	434	78
max	38,20	984	464
min	12,00	324	13

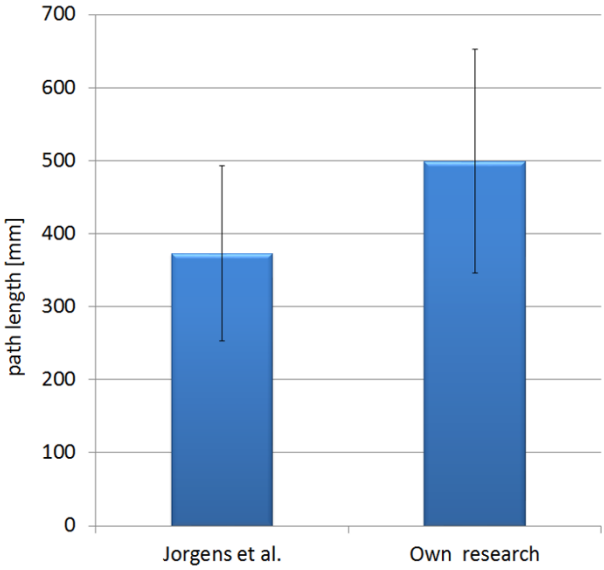

Fig. 23.1: Comparison of the received path length values with Jurgens et al. results [6]

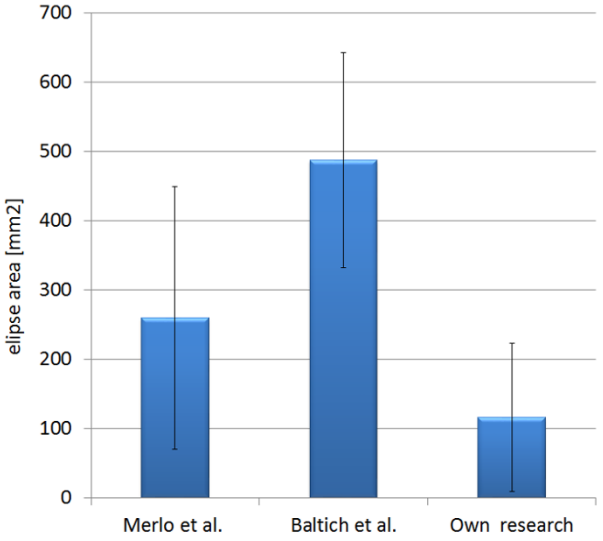

Fig. 23.2: Comparison of the received elipse area values with Baltich et al. and Merlo et al. results [1], [8]

The obtained values of parameters of static stabiliography for the elderly's given group were compared with the findings of other authors [1], [6], [8]. The obtained values of the path length, that is covered by the center of gravity within 30 sec, correspond to the findings of Jorgensen et al. [6]. However, the range of ellipse area values obtained in own research is much lower comparing to research of the elderly carried out by Marlo et al. [8] and Baltich et al. [1] (Fig. 1-2).

The individuals qualified to the research group were performing the Up&Go Test with average time of 20.37 sec. In the research group consisting of 26 eldery people, 42% of the patients were performing the test within the time longer than 20 sec. One can suppose that less than half of the group is vulnerable to often downfalls. Thus, the results were divided, according to the time of performing Up&Go Test, where the limit time value was 20 sec. In order to state the normal distribution of obtained findings, the Shapiro-Wilk test carried out. It was shown that analysed parameters did not comply with normal distribution. The distribution of obtained parameters values of static stabiliography in the function of time performing Up&Go Test was presented in Figure 3 and Figure 4.

In order to evaluate the dependency between holding balance in upright position and balance assessment is functional way, one determined the Spearman correlation coefficient, i.e. the number determining how given variables are correlated. In accepted time intervals (up to 20 sec and over 20 sec), one calculated the correlation coefficient between time Up&Go Test in function of path length and ellipse area. The anlyses that had been carried out did not statically evidence any significant correlation between static and dynamic stabiliography parameters. The (statical) influence of time performing Up&Go Test (up to 20 sec and above 20 sec) on considered static stabiliography parameters (path length and ellipse area) was investigated with nonparametric test U Mann-Whitney for independent samples. Having assumed the significance level $\alpha = 0,05$ one demonstrated that there were differences, statically important, according to obtained results of the ellipse area between the analysed groups (p = 0,038).

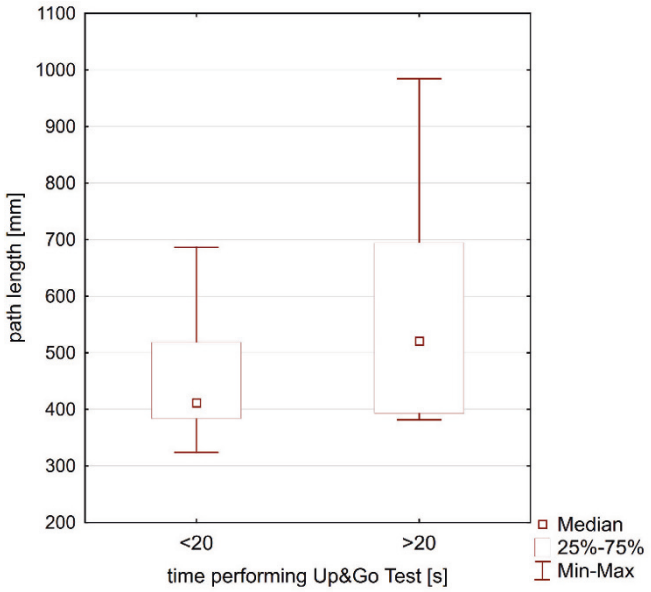

Fig. 23.3: The distribution of obtained results of path length in the function of time performing Up&Go Test

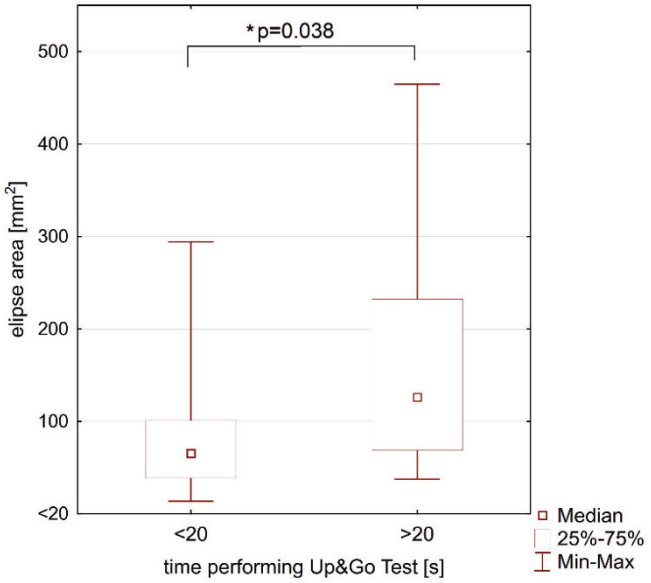

Fig. 23.4: The distribution of obtained results of elipse area in the function of time performing Up&Go Test

23.4 Conclusion

In the article the dependencies between the ability to hold the balance in upright position and hazard assessment of downfall for the elderly were analysed. The static stabiliography research was being carried out with Zebris FDM platform, whereas the dynamic balance assessment was based on Up&Go Test [7]. Interpreting the Up&Go Test results one assumed that fit persons being tested performed the test within 20 sec. That amount of time differentiates individuals with good functional mobility and those who are vulnerable to downfalls. The persons being tested who performed the test in 20 sec or longer can be classified as those revealing balance disturbances facing problems with altering the sitting onto upright position and vice versa. The average time of performing the test in a given group was 20 sec. There were 42% of the persons being tested to be found in the group that was vulnerable to downfalls. The average value of the path length of the persons being tested is 499,07 mm and the ellipse area is $116,39 mm^2$. The statical tests, that had been carried our, did not manifest significant correlation between the static and dynamic stabiliography parameters, but one proved that there existed strong differences for obtained ellipse area results, among the group of patients performing the Up&Go Test within shorter and longer time than 20 sec (p = 0,038). The entire research follows, therefore, that there is not strong dependency between holding the balance in upright position and functional assessment. It seems to be necessary to implement both investigations simultaneously (static stabiliography, Up&Go Test). The research, being discussed in this article, indicates that early diagnosis of balance impairment is extremely important, because combined with well oriented rehabilitation can mitigate the negative aspects of malfunction and improve the mobility of the elderly. Thus determining the hidden causes of balance loss and associated with it the downfall hazard is an essential challenge.

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