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ANALYSES OF BALANCE CHANGES IN ACTIVE SENIORS IN PRAGUE REGION: RESULTS OF TINETTI AND ANTHROPOMETRIC MEASUREMENT

Eliška FROŇKOVÁ, Jiří KAJZAR, Milada KREJČÍ, Martin HILL, Miroslav TICHÝ

Abstrakt
The submitted thesis was elaborated within the project GAČR ID 17-25710S „Basic research of changes in balance in seniors“. The author's analysed the changes in the balance of seniors from the perspective of wellness and applied an intervention program in the locally active seniors in Prague. It reveals the close relationship between the psychic component and the balancing abilities of the elderly. The aim of the research, carried out in two selected facilities, was to analyses the changes in balance and its impact on senior research groups. Based on the evaluation of the data, it was found that the bio- psycho-social balance of seniors can positively influence balance abilities. The results confirmed the positive health and social benefits of the intervention program for the elderly. Seniors who are physically active show a high score in all the parameters presented in the presented results. Based on the data obtained, the author points out the importance and usefulness of quality intervention programs for the elderly.

Keywords
seniors, balance skills, intervention, bio-psycho-social components of balance, physical activities

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INTRODUCTION

At the same time, the number of people with impaired ability to balance and the associated risk of falls, with health and economic consequences, is increasing. Health promotion is part of a ten-year “Europe 2020” program, which aims to improve the average healthy life expectancy of Europeans. The aim of the research was to focus on the issue of balance among seniors and to look at it in the context of life in a bio - psycho - social context. Body balance translates into a balance of movement, emotion and affects self- confidence and self-esteem. Non-equilibrium social relationships are reflected in the overall balance of seniors. The intervention program can positively affect the human balance and restore the natural defenses of the individual (Krejčí et al. 2016)

OBJECTIVE

To verify in practice the impact of the intervention program on the balance of seniors with respect to overall life satisfaction in the physical, emotional, psychological and social fields. Evaluate changes in the balance of seniors from the bio-psycho-social point of view.

HYPOTHESIS

The interventional motion program was applied twice a week for four weeks. The experimental group was tested before and after the application of the intervention program. Based on this procedure, the following hypothesis was established:

Hypothesis H1: After application of the intervention program, there will be a significant improvement in the Tinetti test results in the experimental group of seniors.

METHODS

Characteristics of the research sample

The experimental set was created by selection on the basis of an input

questionnaire, which were seniors, men and women who are physically active and were willing to cooperate in our research. The condition for entering our research was providing personal data. The experimental group consisted of 42 probands aged over 65, with an average age of 71, living in Prague, at home. Proband attended the lesson regularly twice a week in the morning. The control group consisted of 39 seniors who are physically inactive, with an average age of 81 years, living in Rakovník in the Home for the Elderly.

Experimental sample (ES)
Control sample (KS)

ORGANIZATION

The intervention program was applied in 2018 for four weeks. The program was based on eight lessons of sixty minutes. The exercise units were regularly performed twice a week in the morning at the same time. The exercises were repeated, especially yoga exercises and relaxation with full yoga breath. These exercises were included in the preparatory and final parts. A group of seniors had to individually incorporate certain elements from each hour into their daily routine. In the control group, living in a retirement home in Rakovník, the intervention program was applied on the spot.

Diagnostic and anthropometric measurements were performed before and after the actual program, including a questionnaire survey in both groups of seniors. During the whole intervention program, information was obtained from seniors based on interviews and self-observation, which monitored the behavior of seniors during the program, their reaction to the program content, the personality of the trainer, the methods used.

Assesment and diagnostic methods

- *Functional anthropological examination*: It was created of selected classical anthropometry methods, which were non-invasive, using anthropometric instruments as anthropometer, digital personal scale, Harpenden calliper, manual dynamometer type Collin. Following parameters were examined: Body height, body weight, BMI, girth of chest across mesosternale, girth of waist, abdominal circumference, gluteal circumference, arm circumference relaxed, calf circumference maximal, biepicondylar width of humerus, biepicondylar width of femur, width of wrist, width of ankle, girth of thigh, girth of knee, girth of ankle; thickness of 7 selected skinfolds - calliper measurement type Harpenden (biceps, triceps, suprailiac, abdominal, subscapular, anterior thigh, calf medial). Body Composition Analysis using In-Body 230. The methods in the Functional anthropological examination were provided according methodological description of Bláha (2017).
- *Tinetti Balance Assessment Tool* (Tinetti, Richman et al., 1990). The test was developed to examine the balance ability and gait ability in seniors. Some authors call it as the „Performance-Oriented Mobility Assessment“ (Shumway-Cook, Woollacott, 2016). The total balance score consisted from the two components: static balance score and gait score. The Tinetti Balance Assessment Tool represents a very good test of a balance ability of seniors to evaluation of interventions. It has better test-retest, discriminative and predictive validities concerning fall risk than other tests including “Timed Up and Go test”, “One-leg stand” (Lin, Hwang, Hu et al 2000). During testing procedure seniors may use aids as sticks, crutch, if they use it in daily life. The test requires a hard armless chair, a stopwatch and also, a 15feet even and uniform walkway. The test has 2 sections; the first assesses static

balance abilities on a chair and also in standing, and the other assesses dynamic balance during the gait on a 15feet long walkway. The patient is to sit in an armless chair and will be asked to rise up and stay standing. The patient will then turn 360° and then sit back down. Testing this, the evaluator will look at several key points including how does the patient rise from and sits down on his/her chair, whether or not the patient stays upright while sitting and standing, what happens when the patients' eyes are closed or when the patient gets a small push against the sternum. Next, the patient will have to walk at a normal speed, followed by turning and walking back at a “fast but safe” speed. The patient will then sit back down. As well as in the first part of the test, there are some points the evaluator has to look at. These are the length and height of the steps, the symmetry and continuity of the steps and straightness of the trunk. (Shumway-Cook, Woollacott 2016; Raîche, Hébert, Prince et al. 2000).

STATISTIC METHODS

Appropriate mathematical-statistical methods were used to evaluate the results. The data obtained from the questionnaires were processed on the basis of variation analysis, using the ANOVA software program, and response rates were obtained for individual files (for a scale of 1-5). The activity of seniors was chosen as the main predictor for the analysis of the results. Further, the analysis was performed for multiple sorting for measurement.

The obtained data showed a normal distribution, all tests and results are interpreted at the significance level, ie with 95% confidence. Tables and bar graphs were used to graph the results. In the case of a more detailed analysis of the PivotTable using statistical analysis, graphs showing row or column scores were used for a clear result dimension.

Statistically processed data were evaluated with respect to other findings, which came from the results of a questionnaire survey and subjective evaluation of the impact of exercise on the daily activities of seniors and their current physical and mental condition (Meloun, Hill, Militký, & Kupka, 2000).

INTERVENTION METHOD

The intervention program was based on simple exercises such as: stretching, strengthening and practicing balance exercises, including breathing and relaxation exercises. Experts agree on research findings on the possibility of influencing the mental state by a reflex way if we make some changes at the physical level. There are social changes, especially in interpersonal relationships. The four-week intensive program was chosen because of repeatedly confirmed effective health benefits (Barnett et al 2003, Sherrington et al 2004, Hendl, Good 2011; Šauerová, Vadíková et al 2013).

Increased attention was paid to supporting and maintaining balancing abilities. Exercises in lower positions (lying down, in a four position) are perceived as easier than exercising in higher positions, where keeping balance is more difficult. Each lesson had a certain motto that included specific physical, mental and social techniques and exercises throughout the week, and then in subsequent weekly cycles.

Content topics for each week:
Week 1 "You are never alone"
Week 2 "Change is always possible"
Week 3 "Movement is life"
Week 4 "Enjoy life and every moment"

The movement program itself was based in part on elements of yoga in daily life (Maheshwarananda, 2016) using exercises and positions aimed at developing coordination skills, especially

balance. Simple exercises were gradually combined into a simple exercise set. At the same time, emphasis was placed on proper breathing and careful exercise, taking into account individual motor skills and the current physical condition of seniors. At the same time, closed and open eyes were alternated to support the senses that affect movement control without visual control. All exercise positions have a positive effect on correct posture and strengthen the sense of balance.

RESULTS

Analysis of input and output data of experimental and control group

Here are tables showing the age variance of probands and the subsequent gender breakdown. All published test results are significant at p <0.05.

	Average age	Total
experimental group women	70,2	36
control group women	83,2	29
experimental group men	72	6
control group men	80,3	10

Tab. 1 Age (n=81,16 men, 65 women; ES=42, 6 men,36 women;KS=39, 10 men, 29 women)

Seniors of both the experimental and control groups underwent an InBody measurement before the intervention program began, and height and body weight were measured (Table 3). The mean weight was 73.3 kg in the experimental group and 77.7 kg in the control group. In men the mean weight was measured in the experimental group 86.6 kg, in the control group 73 kg.

BMI was measured in the experimental group on average 26.7, in the control groups 31.

When comparing the results in women, different results show the measurement of the amount of adipose tissue, the experimental group shows an average value of 37% (median 33%), the control group already 42.5% (median 41). A similar difference was seen in the average amount of muscle tissue, the experimental group showed 29.8 kg (median 31 kg), the control group only 25.5 kg (median 24 kg) (see Table 3).

Analysis of the results after application of the intervention program shows a positive change in the composition of muscle and adipose tissue. In Table 3, the ratio of muscle and adipose tissue in both women and men significantly changed after intervention. The experimental group of women did not show a statistically significant change. In women of the control group, the proportion of muscle mass increased by an average of 0.75 kg (median 1 kg), while the proportion of adipose tissue decreased by an average of 0.2% (median -1%).

Analysis of anthropometric measurements

Women	Control sample (CS)				Experimental sample (ES)				Divide[b]
				Divide[a]				Divide[a]	p-
Imput	n	Median	Mean - SD	p-value	n	Median	Mean - SD	p-value	
Height	28	1.59 (1.52, 1.63)	1.58 ± 0.0637	---	36	1.65 (1.63, 1.69)	1.66 ±	---	<0.001
Weight	28	73.5 (68.5, 83.7)	77.7 ± 16.1	---	36	71.3 (62, 81.4)	73.3 ± 11.5	---	0,18
BMI	28	30 (26.5, 35.1)	31 ± 5.94	---	36	25.9 (23.5, 30)	26.7 ± 4.03	---	0,003
Fat (%)	28	41 (38, 52)	42.5 ± 9.69	---	34	33 (29.7, 44.7)	37 ± 10.2	---	0,03
Muscles (kg)	28	24 (22, 28.8)	25.5 ± 4.12	---	34	31 (26.3, 33)	29.8 ± 4.91	---	0,001
Output									
Height	28	0 (0, 0)	0.00025 ± 0.0013	0,33	36	0 (0, 0)	-0.184 ±	0,05	0,03
Weight	28	0.05 (-1, 1)	-0.264 ± 1.64	0,68	36	0.55 (-0.45, 1.48)	-7.28 ± 22.8	0,2	0,34
BMI	28	-0.00875 (-0.537,	-0.102 ± 0.662	0,5	36	0.192 (-0.17,	-2.67 ± 8.34	0,24	0,39
Fat (%)	28	-1 (-1, 1)	-0.214 ± 1.45	0,51	34	0.2 (-1, 2.1)	-1.57 ± 11.2	0,56	0,29
Muscles (kg)	28	1 (0, 1)	0.75 ± 0.95	0,001	32	-0.3 (-1.23, 0.2)	-3.86 ± 9.24	0,03	<0.001

Tab. 2 Anthropometric analysis (n = 65, ES 36 women; KS 28 women)

We had similar results in men as in women. Table 5 shows the difference between baseline and baseline. After application of the intervention program, the proportion of muscle tissue increased on average by 0.7 kg (median 1). Adipose tissue decreased by 1 kg (median - 2). Statistically significant differences were in the male control group.

Men	Control sample (CS)				Experimental sample (ES)				Divide[b]
				Divide[a]				Divide[a]	p-value
Imput	n	Median	Mean - SD	p-value	n	Median	Mean - SD	p-value	
Height	11	1.63 (1.57, 1.71)	1.64 ± 0.0669	---	6	1.8 (1.74, 1.85)	1.8 ± 0.0535	---	<0.001
Weight	11	73 (71, 83)	73.8 ± 8.7	---	6	86.6 (81.3, 89)	85.3 ± 4.17	---	0,18
BMI	11	27.8 (25.7, 29.4)	27.6 ± 3.1	---	6	26.2 (24.8, 28.2)	26.5 ± 1.72	---	0,003
Fat (%)	11	33 (27, 39)	34.3 ± 8.51	---	6	21.5 (18.7, 25.4)	22 ± 3.29	---	0,03
Muscles (kg)	11	24 (21, 28)	25.6 ± 4.03	---	6	39.8 (37.5, 41)	39.3 ± 1.7	---	0,001
Output									
Height	11	0 (0, 0)	0.00182 ± 0.00386	0,18	6	0 (0, 0)	-0.29 ± 0.648	0,4	0,03
Weight	11	-1 (-2, -1)	-1 ± 1.04	0,02	6	-0.5 (-84.1, 2.15)	-28 ± 40.9	0,6	0,34
BMI	11	-0.637 (-0.744, -0.342)	-0.42 ± 0.419	0,03	6	-0.163 (-28.2, 0.618)	-9.38 ± 13.6	0,53	0,39
Fat (%)	11	-2 (-2, 1)	-1.09 ± 1.38	0,03	6	-0.5 (-25.4, -0.1)	-8.87 ± 12.2	0,07	0,29
Muscles (kg)	11	1 (0, 1)	0.727 ± 1.14	0,09	5	0 (-18.5, 1)	-6.98 ± 14.8	0,89	<0.001

Tab. 3 Anthropometric analysis analysis (n = 16, ES 6, KS 10)

Table 4 shows the relationship of each variable to activity status. Obviously, physical activity plays an important role in anthropometric indicators. Statistical analysis showed a significant difference between the active (experimental) and passive (control) groups. BMI and muscle mass ratio were significant variables.

Variable	Predictors	
Height	0,513	**
Fat	0,443	**
Fat %	-0,243	*
BMI	-0,314	**

Tab. 4 Results of relationship between activity status and individual variables (n = 81)

Evaluation results using the O2PLS method (the method of regression analysis using the orthogonal projection method for evaluating the relationships of variables among themselves, in our case it was a relationship of activity to other evaluated parameters. The results showed a significant effect of height and muscle mass.

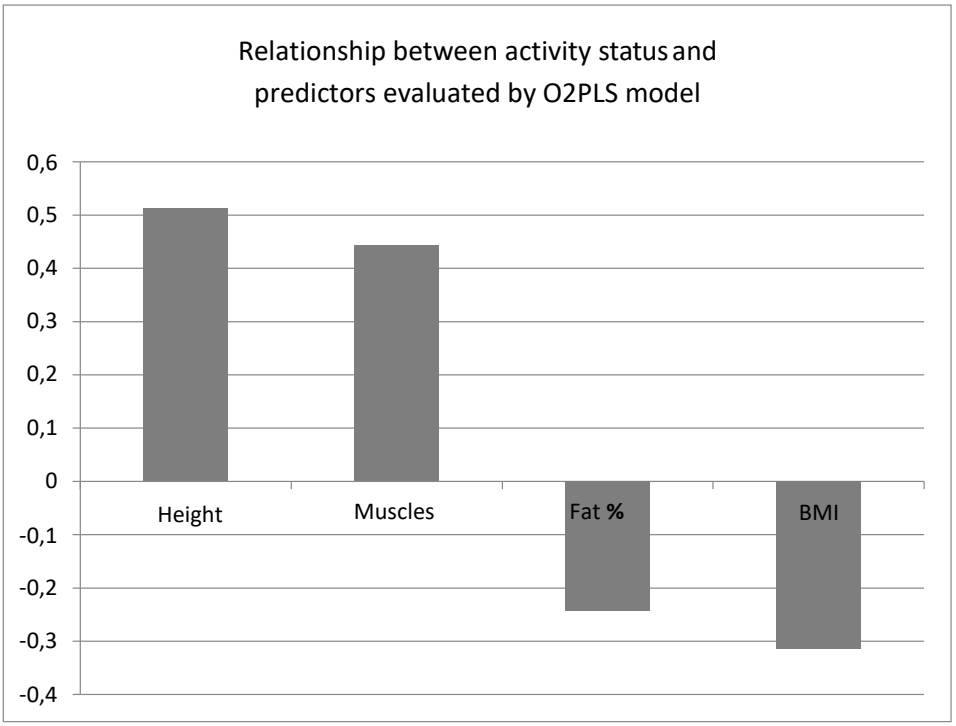

Fig. 1 Graph of the relationship between activity status and variables (n = 81)

Evaluation of balance and gait results according to Tinetti

The group of active seniors shows significantly better initial data evaluation in all parameters. The output data did not show statistically significant improvement in both groups. The evaluation in Table 5 shows significant differences between the experimental and control groups.

Prediktor	R	t-statistics
Tinetti Walk	0,93	10,72
Tinetti Score	0,631	5,78

Tab. 5 Comparison of input data between control and experimental groups

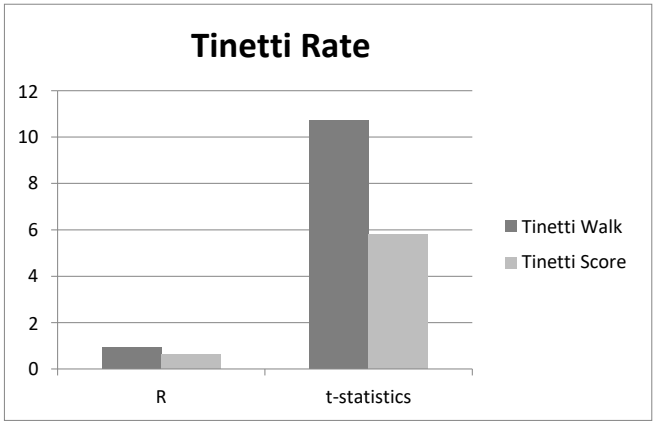

Fig. 2 Tinetti rating chart

Seniors from the experimental group who had a better score at baseline did not have a significantly better score at baseline. Probably there was a significant improvement in balance and gait in probands who did not have an entry score as high and vice versa, a deterioration in the outcome of seniors who achieved the best results in the entry measurement. Taking into account the differences between the two groups, they could have approached each other and the result of the evaluation of the whole population did not change statistically. These results do not support the hypothesis H1.

DISCUSSION

Due to changes in body composition, muscle and fat content, BMI measurements are less reliable for the elderly. For the age over 65 years, the optimum BMI is considered to be in the range of 24-29, ie in the range of lightweight.

BMI alone does not indicate the cause of overweight, while a low value may indicate low muscle mass. This would partly elucidate the claim that mildly overweight seniors have a longer life expectancy, compared to the BMI indicating normal weight (Riboli et al., 2002). Especially regular physical activity prevents loss of muscle mass and development of sarcopenia. Increased prevalence (about 20%) of sarcopenia is often associated with a nutritional disorder and a higher percentage of body fat. Malnutrition is a frequent phenomenon among seniors and is linked to long-term institutionalization.

Further studies could evaluate the effects of appropriate nutritional interventions on the treatment and prevention of sarcopenia (Nasimi, 2019).

By comparing the results from anthropometric examination it is clear that the experimental group shows more favorable values from the health point of view compared to the control group. The intervention program has shown a significant effect on the favorable change in the ratio of adipose tissue and muscle mass in the control group, even such a short intervention program can have a positive effect on the structure of body composition. In the experimental group seniors showed optimal results at the beginning of the research, so it can be assumed that no significant change could have occurred. At the same time we cannot neglect the results of the initial examination in active seniors from the experimental group, where the previous physical activity proved to be an important factor affecting the ratio of muscle and fat tissue. Research confirms that even physically active seniors can achieve physical composition parameters similar to the general population.

By comparing the resulting difference in input and output data for both groups, we wanted to verify the change in the equilibrium level. We expected that the intervention program would disturb the balance of both groups in terms of improving the balance. The results showed a very significant difference in the input data when evaluating equilibrium, gait, and the sum of both parameters in favor of the experimental group. The output data did not show a statistically significant change.

In terms of statistical significance, it cannot be said that after the intervention program, the elderly groups would improve significantly in the area of physical balance. We could therefore argue that the intervention program did not have such a significant expected effect. During the program, we could observe positive changes in seniors during exercises aimed at improving balance skills. Seniors' own feelings that they are able to handle difficult exercises have also supported our expectations.

Based on observations in exercise units, we can see that there has been a shift in the seniors in terms of improving their balance, but these changes have not been statistically significant. The question remains, what is more important with regard to our research.

Gillespie (2012) confirms the impact of intervention exercise programs and home interventions on reducing the risk of falling in persons over 65 years of age.

CONCLUSION

The main objective was research into the balance of seniors and research into the effects of the intervention program on the balance of active seniors living in Prague at home.

Hypothesis H1: After application of the intervention program, there will be a significant improvement in the Tinetti test results in the experimental group of seniors, it has not been confirmed.

Although hypothesis 1 was not confirmed, after the intervention program both groups of seniors improved significantly in the area of physical balance. During the program, we could observe positive changes in seniors during exercises aimed at improving balance skills. Seniors' own feelings that they are able to handle difficult exercises have also supported our expectations. The question remains, what is more important with regard to our research.

Research findings show that the "Living in Balance" intervention program is also suitable for seniors living in nursing homes. The research has shown the health and social benefits of the intervention program.

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CONTACT

Eliška Froňková
College of Physical Education and Sport PALESTRA, Prague Czech Republic

Jiří Kajzar
College of Physical Education and Sport PALESTRA, Prague Czech Republic
e-mail: kajzar@palestra.cz

Milada Krejčí
College of Physical Education and Sport PALESTRA, Prague Czech Republic
e-mail: krejci@palestra.cz

Martin Hill
Institute of Endocrinology, Prague, Czech Republic
e-mail: mhill@endo.cz

Miroslav Tichý
College of Physical Education and Sport PALESTRA, Prague Czech Republic
e-mail: mirtich@seznam.cz