EFFECTS OF A 12-WEEK MULTIMODAL EXERCISE PROGRAM ON FUNCTIONAL FITNESS OF OLDER ADULTS

Róbert **KANDRÁČ,** Lenka **TLUČÁKOVÁ,** Pavol **ČECH**

Faculty of Sports, University of Prešov, Prešov, Slovakia

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- performance capacity,
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- physical activity,
- movement.

Abstract:
The purpose of the present study was to determine the effect of a 12-week multimodal exercise program on functional fitness parameters of older adults. A sample of 21 elderly women aged 61.67 ± 2.92 years living in the city of Presov performed Senior Fitness Test designed to assess lower- and upper-body strength, aerobic endurance, lower- and upper-body flexibility, agility and dynamic balance. The elderly women participated in the exercise program ProSenior over 12 weeks. The program consisted of two exercise sessions performed in the morning hours. Participation in a 3-month exercise program exerted positive effect on all examined parameters of functional fitness. The frequency of one exercise session at higher exercise intensity combined with minimally one aerobic activity seems to be sufficient to affect lower- and upper-body strength.

INTRODUCTION

The population curve is changing all over the world including Slovakia. More people reach higher average life expectancy and the number of elderly people is increasing. Slovak women live longer compared to their male counterparts. However, women live in bad health [27]. Over the last few years, we have come across the term successful aging, which refers to physiological and psychological characteristics of and individual rather than population average [14]. Most of aging-associated factors may be positively affected by regular exercise [3, 4, 7, 8, 12, 23, 26, 28]. Among important terms used in the field of physical activity and inactivity of older people is the term 'functional fitness', which includes components such as lower and upper body muscle strength, lower and upper body flexibility, aerobic endurance, motor agility/dynamic balance, and body-mass index [26]. Physical training is important in delaying the crossing of the threshold to physical dependence. It provides the individual with the power to positively influence their own health and functional abilities as they age [23]. Bates et al. in their pilot study confirm positive changes in functional fitness through special strength training applied once weekly [3]. Small gains in health, or even a reduction in the rate of decline in functional capacity, can make a tremendous difference in older adults' quality of life by preserving their ability to execute activities of daily living [16].

The issue of successful aging in elderly population is becoming topical especially with regard to positive effect on social functioning. We assume that aging does not have to be a negative process, but positive experience.

THE AIM OF THE WORK

The aim of the present study was to determine the effect of a 12-week multimodal exercise program on functional fitness parameters of older adults.

THE MATERIAL AND THE METHODOLOGY

The experimental group of physically active elderly women (EG) was created using the snowball sampling technique. The EG consisted of 21 elderly women aged 61.67 ± 2.92 years living in the city of Presov.

The elderly women participated in the exercise program ProSenior over 12 weeks (February 2008 – May 2008). The program consisted of two exercise sessions performed in the morning hours (9 a.m.). The design of the exercise program adhered to the recommendations of the American Council on Exercise [2], American College of Sports Medicine [1] and American Heart Association [18]. We attempted to design a multimodal exercise program by implementing resistance exercise: circuit training performed on resistance machines, body weight exercises and free-weight exercises, aerobic exercise: aerobics, tae-bo, Latin-American dancing and flexibility exercise: stretching exercises in the warm-up and cool-down part of the exercise session and spinal exercises. The exercise program did not include exercise for coordination development as we hypothesized positive synergic effect of resistance, aerobic and flexibility exercise on motor coordination.

Functional fitness was measured using the Senior Fitness Test – SFT [20] designed to assess lower- and upper-body strength, aerobic endurance, lower- and upper-body flexibility, agility and dynamic balance.

The collected data were processed using the Shapir-Wilk test in order to evaluate data distribution. To determine the changes in particular parameters, paired samples T-test was used. The statistical significance was set at $p<.05$. The procession and evaluation of data was carried out using the statistical software SPSS 16.0.

RESULTS AND DISCUSSION

The average baseline test scores in tests T2, T3 and T5 were classified as above-average. However, the baseline test scores in tests T1, T4 and T6 were categorized as average. Three-month exercise resulted in improved T1 test scores, which changed to above-average. The pre-testing and post-testing BMI index values showed the elderly participants were overweight (see Table 1).

Table 1. Pre- and post-testing level of functional fitness parameters and their comparison with normative scores for American population

		N	Minimum	Maximum	*M*	*SD*	Assessment
T1	I	21	10	21	15.29	2.98	Normal
	II	21	11	28	20.29	3.60	Above normal
T2	I	21	16	25	19.67	2.57	Above normal
	II	21	19	32	24.52	3.20	Above normal
T3	I	21	89	154	121.71	19.49	Above normal
	II	21	86	163	126.19	20.25	Above normal
T4	I	21	-3.5	9.5	4.25	3.32	Normal
	II	21	-2.0	9.1	4.68	2.73	Normal
T5	I	21	-2.2	4.9	1.95	1.44	Above normal
	II	21	-2.4	5.1	2.18	1.68	Above normal
T6	I	21	4.2	5.9	4.83	.51	Normal
	II	21	3.5	6.0	4.72	.52	Normal
BMI index	I	21	21.2	35.2	28.10	4.47	Overweight
	II	21	20.8	36.2	27.88	4.36	Overweight
Age	I	21	58	69	61.67	2.92	-

Note. *N* - number of participants, *M* - arithmetic mean, *SD* - standard deviation, T1 - Test of lower-body strength, T2 - Test of upper-body strength, T3 - 2-minute step test, T4 - Test of lower-body flexibility, T5 - Test of upper-body flexibility, T6 - Test of dynamic balance and agility, I – pre-testing, II – post-testing after 3 months of exercise

Table 2. Changes in the level of functional fitness parameters

	M	*SD*	t	df	*p*
T1I - T1II	-5.000	2.683	-8.539	20	.000**
T2I - T2II	-4.857	2.175	-10.236	20	.000**
T3I - T3II	-4.476	19.916	-1.030	20	.315
T4I - T4II	-.4286	1.9784	-.993	20	.333
T5I - T5II	-.2238	1.0202	-1.005	20	.327
T6I - T6II	.1048	.3956	1.214	20	.239
BMII - BMIII	.2238	.7949	1.290	20	.212

Note. *M* - arithmetic mean, *SD* - standard deviation, t - t value, df - degrees of freedom, ** - level of statistical significance $p<.01$, I – pre-testing, II – post-testing, T1 - lower-body strength, T2 - upper-body strength, T3 - 2-minute step test, T4 - lower-body flexibility, T5 - upper-body flexibility, T6 - Dynamic balance and agility, BMI - BMI index

Following 3 months of exercise, there were positive changes in lower- and upper-body strength, aerobic endurance, lower- and upper-body flexibility and dynamic balance. Statistically significant difference between baseline and outcome measures was found only in lower- and upper-body strength (see Table 2).

Three-month multimodal exercise improved lower- and upper-body strength. The positive effect of exercise on lower- and upper-body strength was observed in all participants (see Figure 1 and 2). The lower-body strength improved 32.7% and upper-body strength 24.7%.

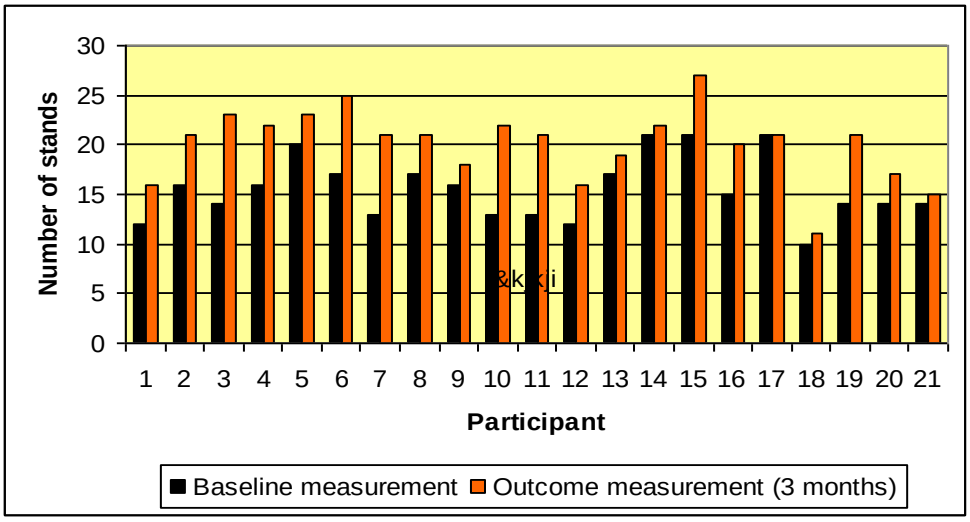

Figure 1. Chair Stand Test

After three months of exercise, there was improvement in aerobic endurance, however, not statistically significant (see Table 2). The improvement yielded 3.7%. We assume this was influenced especially by exercise frequency (1 exercise session per week) and intensity of aerobic exercise (11th - 12th degree on the Borg exertion scale, which equals 60-65% of physical exertion.

There were statistically insignificant improvements in lower- and upper-body flexibility after 3-month exercise. Overall, lower-body strength improved 10 % and upper-body strength 11.4%. This finding is not surprising because the volume of exercise performed for flexibility development: (1) stretching exercise maintaining maximal stretch for 10-15 seconds two or three times and (2) spinal exercises (10 repetitions) with transition to maximal stretch applied at the beginning and at the end of the exercise session amounting to total time of 10-15

minutes is considered minimal for maintaining and developing flexibility in elderly people according to ACSM and AHA [18].

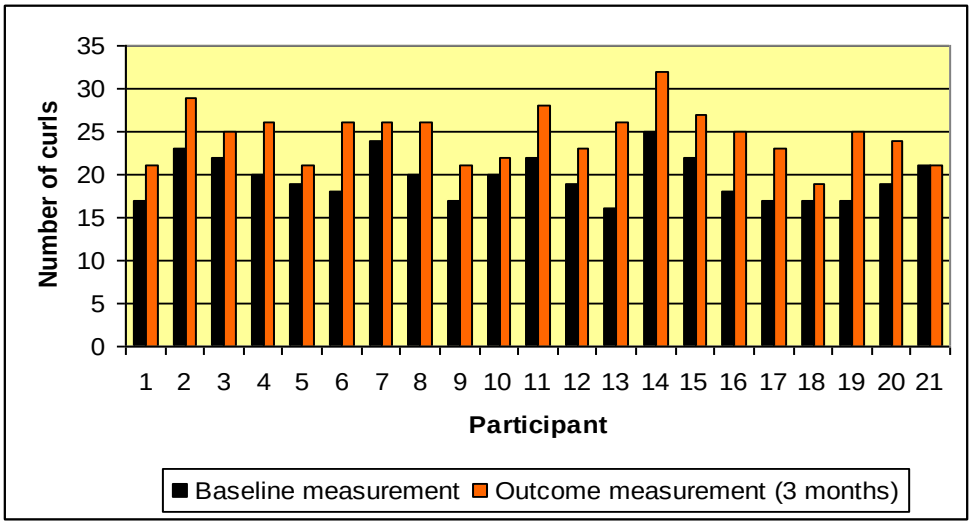

Figure 2. Arm Curl Test

The improvements in dynamic balance following 3 months of exercise were not statistically significant, when the improvement equaled 2.2%. There was significant improvement in 11 participants and moderate decrease in 10 participants (see Figure 6). It should be noted that test score averages in baseline and post-test measurements were classified as average.

Although BMI is not a direct measure fatness, and it is not sensitive to redistributions of fat, it can be used as a proxy for relative fatness and is a more accurate measure of total body fat than weight alone [24]. The BMI changed after 3 month of exercise. The initial values were classified participants in the overweight category. At baseline, 6 participants demonstrated normal weight, 7 participants were overweight, 7 participant showed 1st degree obesity and 1 participant 2nd degree obesity. At outcome measurements, 5 seniors demonstrated normal weight, 8 participants were overweight, 7 participants demonstrated 1st degree obesity and 1 participant showed 2nd degree obesity.

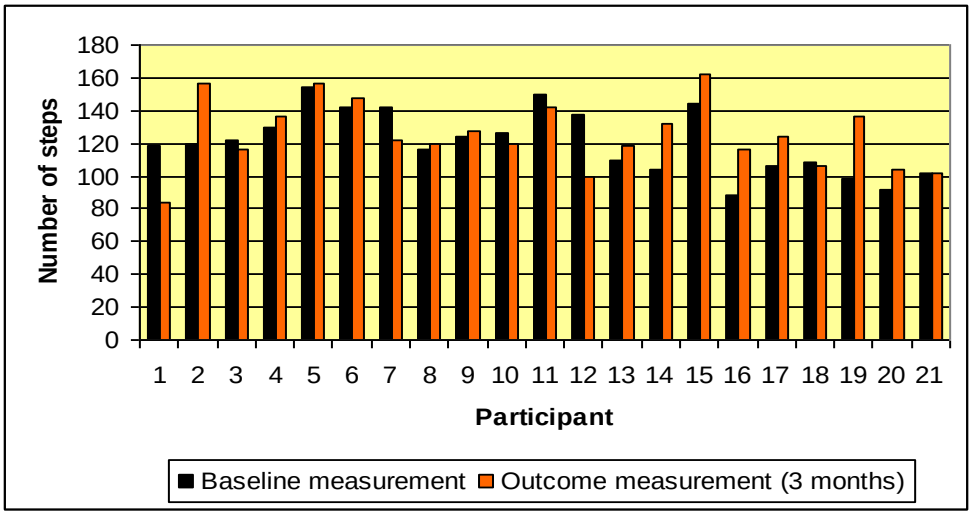

Figure 3. 2-Minute Step test

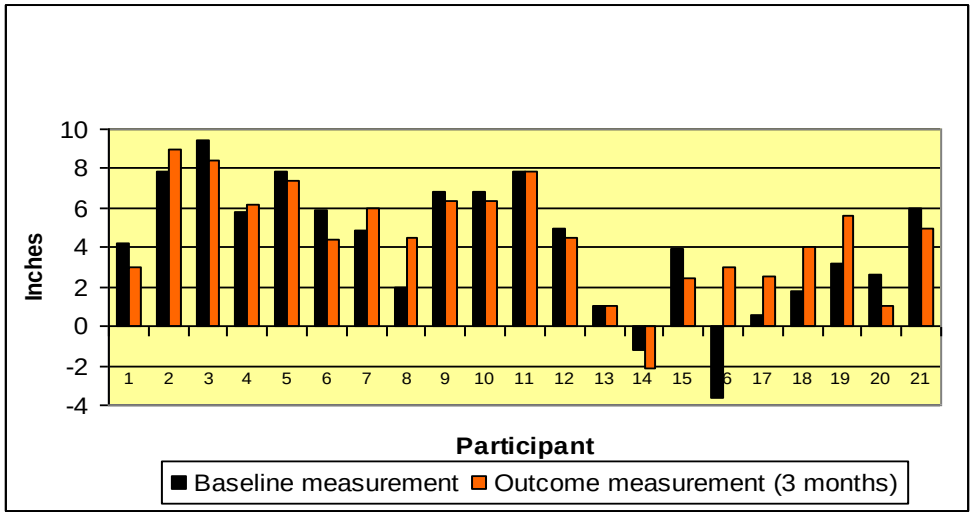

Figure 4. Chair Sit-And-Reach Test

Consistently with the results of previous studies, 3-month exercise improved lower- and upper-body strength. We hypothesize that this improvement was the result of the complex effect of resistance and aerobic exercise, which involved large muscle groups. Fahlman et al. reported that multimodal and resistance programs exerted similar effects on strength and functional abilities in elderly people. The most effective exercise frequency in women is exercising twice per week, which may be associated with longer recovery period following exercise [11]. DiFrancisco-Donoghue [10] reported that participation in exercise once per week equaled exercise participation twice per week.

The multimodal exercise program did not exert statistically significant effect on aerobic endurance. We may assume that higher intensity of aerobic exercise (13th – 16th degree of the Borg scale equaling 70-85% of physical exertion recommended by ACSM and AHA [18] would probably have increased the effectiveness of exercise. This finding is consistent with the investigation of Swoap et al. [25], who monitored the effect of exercise intensity on aerobic endurance in elderly people. Over 26 weeks, two groups of participants perfomed two types of exercise at different intensities (80-85% or 65-70%). The participants who performed exercise at higher intensity reported greater changes in aerobic capacity compared to their counterparts performing lower-intensity exercise. Shepard reported that the magnitude of response to aerobic exercise depends on training and on the individual level of aerobic fitness. However, he also stated that the effect of higher-intensity exercise did not differ from that with higher volume of exercise [22].

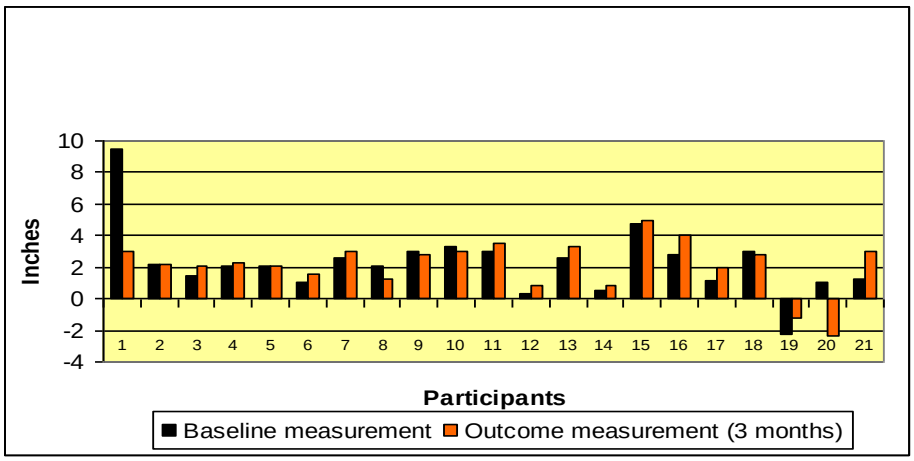

Figure 5. Back Scratch Test

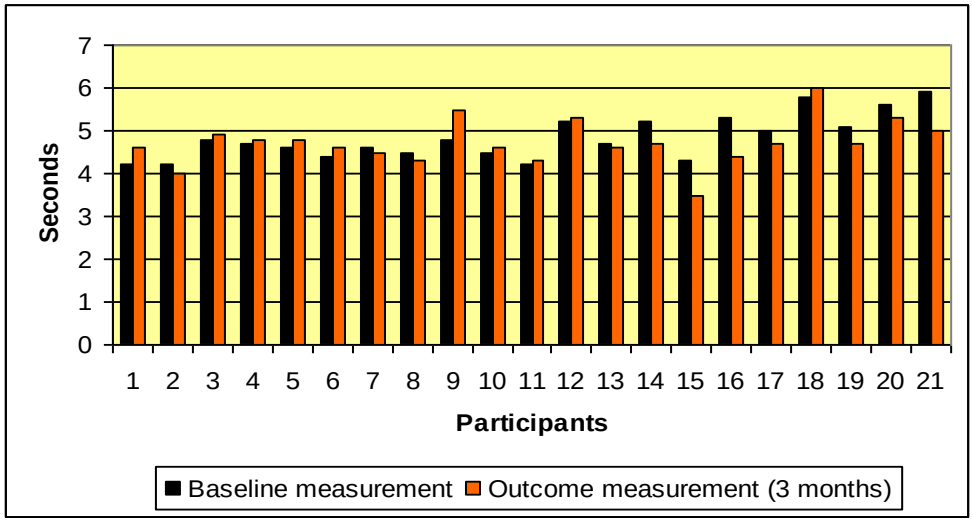

Figure 6. Foot Up-And-Go Test

We assume that achieving greater improvements in flexibility requires increase in exercise frequency at the rate of 5 times per week. Therefore, we advised the participants to performs flexibility exercise at home, which was welcome by some participants who carried out flexbility exercise prior to the commencement of the exercise program (n = 9). Most of the participants failed to perform these exercises due to lack of time or due to preference of group exercise. The participants realized the benefits of home-based exercise, however with little effect. The exercise program motivated them to participate in organized exercise twice a week excluding the effect of home-based exercise. Flexibility together with muscular strength and endurance (so-called muscular fitness) is required for the execution of most activities of daily living [19]. Decrease in flexibility leads to the origination of health problems, reduction in basic and instrumental activities of daily living and the progression of disabilities [8, 9, 13, 17]. Due to the reasons mentioned, the applied exercise program resulted in little improvements in flexibility.

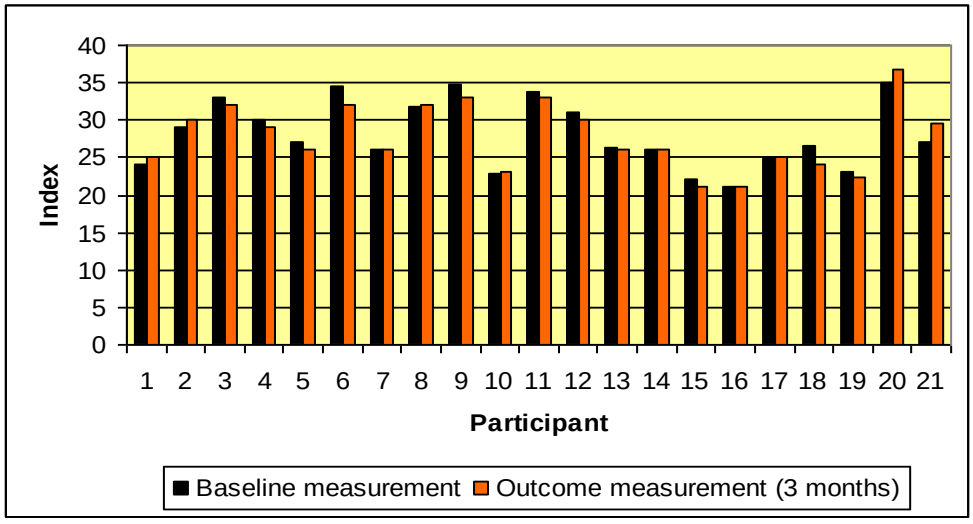

Figure 7. Body Mass Index

Insignificant improvements in dynamic balance and agility may have resulted from not implementing specific balance exercises into the exercise program. We hypothesized that the effect of aerobic exercise (aerobics, tae-bo and Latin-American dancing), resistance and

flexibility exercise would considerably affect its level. As reported by Rogers et al. [21], balance depends on the sensory input and organization, muscular strength, coordination of activity, level of attention, disease and medications. The decrease in at least one of these factors leads to negative balance scores. Physical activity may eliminate several negative factors by preventing falls, so frequent in elderly people.

The finding that exercise program did not significantly change the BMI scores in participants who were overweight or obese was not surprising. This may be attributed to low frequency and medium intensity of exercise frequency. Those participants who wanted to reduce their weight were advised to increase the volume of aerobic exercise outside the exercise program. Jurkovičová [15] concluded that prevention is the most effective tool for fighting overweight and obesity. This should become priority of public health care, whose main pillar should be the change in one's lifestyle through change in eating habits and increase in the volume of physical activity. The issue of obesity in elderly women has been researched by Bortz and Singh [5] who concluded that obesity-inducing factors in elderly people differ and include genetic and environmental effects. The storage of redundant energy in adipose tissue may occur only if energy intake chronically overweighs energy output. Besides long-term aerobic activity and adjustment of eating habits is resistance training an important tool for fighting obesity. Resistance training improves the regional fat tissue disposition (even in unchanged weight) and considerably increases the resting energy output compared to aerobic training.

CONCLUSIONS

The present study extends evidence related to positive effects of physical activity on the parameters of functional fitness in elderly women. Participation in a 3-month exercise program exerted positive effect on all examined variables. The frequency of one exercise session at higher exercise intensity combined with minimally one aerobic activity seems to be sufficient to affect lower- and upper-body strength.

Therefore, we recommend implementation of various forms of aerobic activity into exercise programs in order to both activate various muscle groups and to motivate participants to exercise. Stereotypical exercise may, after some time, become demotivating and may lead to dropping out of the exercise program. Therefore, it would be appropriate to organize seminars and lectures on different topics related to every-day life, aging process, healthy eating habits, home-based exercise, handling stressful situations and communication.

We consider the Senior fitness test an appropriate diagnostic tool of motor abilities in elderly women with designing norms for Slovak population, through which the Senior Fitness Test would become an applicable diagnostic tool in Slovakia as well.

From the social aspect, it would be appropriate to support and create conditions for participation in regular exercise and organized physical activity for elderly people due to the fact that positive benefits for society through improvement in overall physical and mental functioning of senior citizens is unquestionable.

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