

EFFECTS OF A ONE-YEAR EXERCISE PROGRAM ON MUSCLE POWER IN OLDER WOMEN

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Abstract: *Aging is accompanied by a loss of muscle mass, the quality of which clearly affects the quality of life in older adults and their ability to perform daily routines. Appropriately, selected physical intervention may significantly influence muscle atrophy. The aim of the study is to evaluate the effect of a one-year intervention multimodal exercise program, carried out twice a week, on the muscle strength of upper and lower limbs in older women. The research group consisted of 65 older women (average age 63. ±3.52). Muscle strength was assessed using tests from the Senior fitness test battery (Rikli, Jones, 2001). After completion of the intervention exercise program, we recorded an increase in lower limb muscle strength of 30.72% and in upper limb muscle strength of 14.32%.*

Key words: *functional fitness, physical abilities, percentile norms, older women*

1. Introduction

With increasing age, older people experience so called external physical expressions and changes that differentiate them from young people. This phenomenon is often referred to as an aging phenotype. These expressions tend to have common general features but, on the other hand, their temporal manifestation, extent and completeness of manifestation are rather individual [6]. While the proportion of muscle mass in people aged between 20 and 30 years is about 30% of body weight, between the age of 70 and 80, it is only 15% [5]. In

addition to these visible changes, qualitative changes appear, too. With increasing age, the amount of muscle mass is reduced which results in gradually decreased muscle strength and faster onset of fatigue in an older person; moreover, it often leads to reduction of physical activity which is the other reason for muscle mass loss [7], [9]. At an advanced age, sarcopenia also occurs. It is a loss of muscle fibers which can be considered as a quantitative indicator and causes lowered strength quality. Until the age of 65, strength decreases by 18-23% and between the ages of 80 and 90 it decreases by 37 % up to 50% [14], [7].

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Muscle strength is important at every stage of life and its importance increases with age. Muscle strength is needed to perform everyday activities such as shopping, cooking, housekeeping and is the basis for maintaining functional independence [1], [12]. Several studies have shown that appropriately, chosen physical exercises may remarkably reduce age-related changes and influence the amount and quality of muscle mass [11].

In the past, strength training was not recommended for seniors. However, at present we know that gains in strength and muscle mass from aerobic endurance training is small and thus it is necessary to include resistance training which is especially important for keeping functional fitness. Strength training in older adults contributes to maintaining a good functional state and independence from the environment and reduces difficulties associated with carrying out everyday tasks. Many times, the lack of a senior's self-sufficiency is not caused by low cardiorespiratory capacity but rather by a low strength level, especially in lower limbs [12], [13]. The adaptive ability of muscle fibers is not negatively influenced by age; therefore, it is possible to maintain or to increase muscle strength in older people, too. Even at the age of 60-90 years, an increase of muscle strength in men and women may achieve up to 180% of the original value [6].

All the benefits resulting from strength training depend on the training stimulus. There is not an unambiguous model for designing the most optimal training program. Hunter based on meta-analysis and the authors' own research, suggests performing 2-4 series with 8-15

repetitions at intensity of 60-80% [3]. Each muscle group should be loaded 2- to 3-times per week but no more than 3-times per week. Hamar reported that more than one series of exercises does not lead to a proportional increase of the training effect and, especially among older people, it increases the risk of overloading some structures of the locomotive system due to insufficient recovery [2]. The study was supported by VEGA project No. 1/0706/17 – The relationship between physical activity and obesity among older women.

2. Methods

The research group consisted of older women from Prešov, Slovakia, who were interested in participating in the ProSenior exercise program for one year. The program includes aerobic activities, strength exercises and exercises focused on joint mobility and flexibility. The exercise program was carried out twice a week. One exercise session lasts for 45-60 minutes. The average age of the tested women was 63 years (± 3.52). Data on the strength of upper and lower limbs were obtained using motor performance tests from the Senior Fitness Test battery (SFT) [10]. To be more specific, we used the *Chair Stand Test* for identification of lower limb strength. To indicate the muscle strength of upper limbs, we used the *Arm Curl Test*.

Input measurement (t_0) of each participant was carried out before participation in the exercise program. Output measurement (t_1) took place after the completion of the one-year exercise program.

Testing of muscle strength took place between 2009 and 2017 (t_0 , t_1 – February of the particular year) at the gym of the Faculty of Sports, keeping all the requirements set by the Senior Fitness Test Manual. To assess the collected data, normality tests and the Shapiro-Wilk test were used. To verify the hypotheses, we used the paired t-test. The results were assessed at level of 5% significance. The data were statistically processed using the SPSS 15.0 for Windows statistical program. Intra-individual evaluation of changes in performances achieved in motor tests were carried out on the basis of percentage increase; moreover, the performances were also compared with percentile norms for the American population.

3. Results and Discussion

The use of the Senior Fitness Test enabled us to identify the current state of strength abilities and to compare the results with norms for the American population since norms for the Slovak population have not been created yet. In the senior category, only maintaining the level of muscle strength of upper limbs is considered as a success because it tends to decrease faster with age than the strength of upper body muscles [14]. In our research, we focused on the evaluation of the effect of physical activity on qualitative aspects of muscle fibers. Foreign studies aimed at monitoring the effect of intervention exercise programs for seniors have so far suggested the duration of the intervention from 6 weeks to 2 years mostly; however, most often, authors prefer short-term studies (12

weeks) which hardly allowed us to confront our results. In Table 1, basic characteristics of the monitored group and categorization of participants into particular performance categories before and after completion of the 12-month exercise program are presented.

In T1 test, which is considered to express the rate of muscle strength of lower body muscles, which are important for carrying out daily routines, the tested senior adults achieved, in the input measurements, 17.09 repetitions on average, while in the output measurements, the value was 22.33 repetitions on average; as a percentage, it made up an average increase of 30.72% which shifted the average result of the whole group from the average category to the above-average category. However, changes in performance after the intervention program did not reveal any statistical significance. Nevertheless, we believe that, from the practical perspective, it can be considered a remarkable increase (30.72%), although Kalvach et al. reported that, in this age category, it is even possible to achieve up to 180% increase from the original value of muscle strength [6]. In our opinion, it depends on the entry level of muscle strength, which was high in our participants.

A similar increase (+5 repetitions) was also recorded by [8], who implemented a strength intervention program among 70-year-old women for 12 weeks. In this case, the increase was reported as significant.

From the beginning of the exercise program, we decided to use an individual approach to older women and tried to

respect their health limitations. In our work, intra-individual assessment is very important in addition to evaluation of the whole group. We focused on comparison with norms for the American population, which is the range between the 25th and 75th percentile.

After the completion of the intervention program, we recorded an improvement by at least 1 repetition and maximally by 15 repetitions in 60 participants (92.30%). In 5 participants (7.69%), we recorded a lower performance by one, two or three repetitions in the given test. This decrease

appeared in those women who, in the input measurement, reached above-average values compared to the norm, at the level of 90th and 100th percentile.

Already in the input measurements, 37 (56.92%) older women met the standard and 27 (41.54%) older women were in the above-average category. After the completion of the intervention exercise program, a significant shift appeared as performances of 60 older women were assessed as above-average (Table 1).

Basic characteristics of the research group (n=65)

Table1

Test	min		max		x		Result of the group		Results of individual			t-test
	t ₁	t ₂	t ₁	t ₂	t ₁	t ₂	t ₁	t ₂	category	t ₁ (%)	t ₂ (n)	
T1	11	13	24	30	17.09	22.33	Average	Above-average	Below-average	01.54	00.00	1.4203
									average	56.92	07.69	
									Above-average	41.54	92.31	
T2	15	16	28	34	21.15	24.18	Above-average	Above-average	Below-average	01.54	00.00	7.3116
									average	32.31	10.77	
									Above-average	66.15	89.23	

Legend: *min.* – minimal performance, *max.* – maximal performance, *x* – average performance, *T1* – Chair Stand Test, *T2* – Arm Curl Test, *t₁* – input measurement, *t₂* – output measurement

From the perspective of health, it is important to pay attention to the above-average category which reaches the rank of the 25th percentile and lower. These values may be associated with the risk of loss of functional mobility and self-sufficiency; moreover, it can indicate those so called “risk” participants in the exercise program who should be provided with specific intervention and health recommendations for specific exercises [4], [10].

In our research group, we only identified one participant who did not meet the required standard for the particular age

category in the entry tests of lower limb muscle strength. After completing the exercise program, she also moved to the standard category with her performance.

In the second test (T2), we recorded a high level of upper limb muscle strength in our participants in comparison to norms for the American population. The tested older women performed 21.15 repetitions of one-handed biceps curl with a dumbbell on average, whereby this performance in the motor test was ranked in the category over the 75th percentile. Despite apparent improvements in the older women’s performances, it can be noted that after

participation in the exercise program, no statistically significant changes in performances in this test were found. Input measurements in the range between the 25th and 75th percentile were reached by 21 older women, while results over the 75th percentile were found in 43 older women. Only one older woman was below the 25th percentile. After a year, we recorded an increase in muscle strength in 58 (89.23%) older women and an average increase of 14.32 % (3.03 repetitions). In seven older women, we found a decreased performance by one to five repetitions.

4. Conclusions

The results of the study confirmed that physical activity of adequate intensity performed with respect to specifics of an aging body is important for maintaining the quality of muscle tissue in older women. In spite of high entry values in comparison to the American population, after a one-year intervention program, there were noticeable, but no statistically significant, changes in the level of strength abilities of lower limbs (+30.72%) and upper limbs (+14.32%). Implementation of an intervention multimodal exercise program twice a week appears as an effective tool in fighting sarcopenia and in increasing or keeping the quality of life of older women.

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