Ivan Uher*[1]
Milena Pullmannová Švedová[1]
Mirianna Brtková[2]
Jan Junger[2]

EFFECT OF A RESISTANCE TRAINING ON FUNCTIONAL FITNESS IN ELDERLY MEN

UČINEK VADBE ZA MOČ NA FUNKCIONALNO TELESNO PRIPRAVLJENOST STAREJŠIH MOŠKIH

ABSTRACT

This study determined the effectiveness of a three-month program of regular exercises for the improvement of the functional performance of elderly men. The 30 subjects, aged 65–69, who took part in this trial were assigned either to an exercise group or a control group. The following variables were measured with the Senior Fitness Test (SFT test): muscular strength of lower and upper body, aerobic endurance, flexibility of lower and upper body, agility/dynamic balance and body-mass index. In the exercise group, 15 subjects completed the training program to the end of the trial; they showed significant performance improvement in lower and upper body muscular strength, aerobic endurance, agility/dynamic balance, but minimal or no significant performance improvement in lower and upper body flexibility, while the control subjects showed minimal or no improvement in all SFT subtests.

Keywords: senior fitness test, elderly, functional performance, strength

[1] University of P. J. Šafarika in Košice, Slovakia

[2] Faculty of Sport, University of Prešov, Slovakia

Corresponding author:

University of P. J. Šafarika in Košice
Medická 6
040 01 Košice, Slovakia
E-mail: ivan.uher@upjs.sk

IZVLEČEK

V raziskavi smo ugotavljali učinke trimesečnega programa redne vadbe na izboljšanje funkcionalne zmogljivosti starejših moških. V poskusu je sodelovalo 30 merjencev, starih od 65 do 69 let, ki so bili razporejeni v primerjalno ali vadbeno skupino. S testom za ugotavljanje telesne pripravljenosti starejših (Senior Fitness Test, SFT) smo izmerili naslednje spremenljivke: mišična moč spodnjega in zgornjega dela telesa, aerobna vzdržljivost, prožnost spodnjega in zgornjega dela telesa, gibljivost/dinamično ravnotežje in indeks telesne mase. V vadbeni skupini je 15 merjencev izvedlo vadbeni program in na koncu raziskave so se pri vadečih zelo povečali mišična moč v spodnjem in zgornjem delu telesa, aerobna vzdržljivost in gibljivost/dinamično ravnotežje, medtem ko je bilo izboljšanje prožnosti spodnjega in zgornjega dela telesa minimalno ali neznačilno; v kontrolni skupini pa je bilo v vseh podtestih SFT izboljšanje minimalno ali ga sploh ni bilo.

Ključne besede: test ugotavljanja telesne pripravljenosti starejših, starejši, funkcionalna zmogljivost, moč

INTRODUCTION

In developed countries, the elderly population has been growing faster than any other age group in its population (Ettington, 2008). As the population ages, the trend of health problems and functional disability increases (Fielding et al., 2002). Most of us would agree that quality of life in later years depends to a large degree on being able to do the things we want to do, without pain, for as long as possible (Mann, 2008). As we are living longer, it is becoming increasingly important to pay attention to our physical condition. The decline in muscle strength associated with aging carries with it significant consequences related to functional capacity. Often concurrent with increased physical impairment is a decreased ability to perform functional tasks such as climbing stairs, standing up from a chair and doing basic household chores; all of which are tasks that require a threshold of muscular strength (Nelson et al., 1994). Exercise is an accessible form of prevention of physical decline. Research studies over the previous two decades have produced compelling evidence supporting the feasibility and the benefits of targeted physical program for older adults (Cotton, Ekeroth, Yancy, 1998; O'Brien Cousins, 1998; Spirduso, Francis, & MacRae, 2005).

In particular, the benefits of strength training include increased muscle and bone mass, muscle strength, flexibility, dynamic balance, self-confidence, self-efficacy and self-esteem. Exercise also helps reduce the symptoms of various chronic diseases such as arthritis, depression, type 2 diabetes, osteoporosis, sleep disorders, and heart disease (Shephard, 1997; Wolf et al., 1996). Although sufficient evidence exists to recommend that older people should exercise, and the findings just described suggest that exercise can increase function in the elderly, further study is required to elucidate its role in improving, maintaining function, alongside efforts to achieve that goal in the senior population. In this study, we have attempted to address these issues by undertaking a cross-sectional controlled exercise program trial with 30 elderly men from Vancouver Canada. Our aim was to assess the effect of strength training on the major components associated with independent functioning in later years.

METHOD

Participants

The participants were independently living men, 65–69 years of age, who volunteered to participate in the program.

Instrument and procedure

This study took place in the community where the seniors lived. Before the start of physical training, participants completed the PAR-Q physical activity readiness questionnaire (Corbin & Lindsey, 1997). With the goal of preventing unnecessary medical examination, while at the same time helping participants to be reasonably certain that regular exercise was appropriate for them, the Par-Q questionnaire was developed in British Columbia, Canada by the Ministry of Health and the Department of National Health & Wealth in 1994. Participants had to answer the seven questions that would indicate whether they should check with their doctor before start program. These questions included, 'Has your doctor ever said that you have a heart condition? Do you feel pain in your chest? Do you lose your balance because of dizziness? Do you have a

bone or joint problem? Are you taking any medication? Do you know of any other reason why you should not do physical activity?'

Those who answered in the negative to all questions were able to join the exercise program. Others were advised to speak to their doctors. In our study, 13 of the 30 actually did consult their doctors, who approved their participation in the training program. Consequently, our participants were randomly assigned either to an exercise or to a control group.

Using these volunteers in the study results in a sample of convenience, rather than a sample that is a true representation of the entire population of interest; convenience samples are almost always healthier and more highly functional than the population as a whole. However, we can say that characteristics of our volunteers were considerably similar to other volunteer groups of older adults (Rikli & Jones, 2001). Volunteers did not participate in any organized form of physical activity in the last five years prior the recruitment to our program.

Exercise program

The experimental subjects participated in approximately an one-hour exercise session, three times a week (Mondays, Wednesdays and Fridays, alternative day on Saturday), for three months, from May until July. Training sessions consisted of 10 minutes warm up on stationary bicycles, followed by a strength training program on the resistance machines targeting large muscle groups, and five to seven minutes of flexibility exercises targeting larger muscles groups on the end of the session.

Our training program began with five basic exercises leg press, chest press, compound row, abdominal curl and back extension. After two weeks, we gradually added new exercises during the following 10-week period. (hip adduction, hip abduction, triceps extension, biceps curl, chest crossover, lateral raise, leg extension, leg curl).

When participants successfully completed 12 repetitions with good form during two consecutive workouts, we increased exercise weight load by 2.5 pounds (double progressive program) and slightly decreased exercise repetitions. Movement speed was set at 2–4 s (concentric vs. eccentric movement), training effort at 75% of 1RM, which represents about 8–12 controlled repetitions in company with 50–70 seconds of high-effort anaerobic exercise with 1.5–2 minutes rest between selected exercises.

We began our strength training program with one set of each exercise; we progressively added a second set to some exercises (legs, arms and chest) to stimulate more muscle development.

Exercises were undertaken in group activities, with emphasis on social interaction and enjoyment. The comparative subjects continued their daily home routine, without participating in any organized physical activity.

Assessment procedures

Assessments were made before subjects began the exercise program and after a three-month period. The assessment included seven functional fitness performance tests: chair-stand test, arm curl test, six-minute walk test, chair sit-and-reach test, back scratch test, eight-foot up-and-go test, assessment of height and weight (these are subtests of SFT test). Each subject test session took approximately 20 minutes. The same person assessed all tests.

With the chair-stand test, we assessed lower-body strength by instructing the participant to sit on a chair. When signalled, the participant rises to a fully standing position, and then returns to a fully seated position. The score is the total number of stands completed in 30 seconds.

The arm curl test measured upper-body strength from a seated position, with the participant holding the 8 lb (3.63 kg) weight on the dominant side of his body. From the down position, the weight is curled up (flexion). The score is the total number of arm curls executed in 30 seconds.

We assessed aerobic endurance with the six-minute walk test in which the subjects were instructed to walk for six minutes around the 50-yard course (45.7 m) trying to cover as much ground as possible if possible, but without being concerned if they felt an urge to slow down or stop. The score is total distance covered when all the walkers stopped.

We assessed lower-body (primary hamstring) flexibility with the chair sit-and-reach test. From the sitting position with arms out stretched, hands overlapping, and middle fingers even, the participant slowly bends forward at the hip joint reaching as far forward as possible toward or past the toes. The score is the distance from the tip of the middle fingers to the top or past the shoe to the nearest half inch (1.27 cm).

We assessed upper-body (shoulder) flexibility with the back scratch test. From the standing position, the participant places his preferred hand down the middle of the back as far as possible. Participants place their other arm around the back of the waist, reaching up the middle of the back as far as possible in an attempt to touch or overlap the extended middle fingers of both hands. The score is the distance of overlap or distance between the tips of the middle fingers to the nearest half inch (1.27 cm).

We assessed agility and dynamic balance 8-foot up-and-go test. From a sitting position, when signalled, the participant gets up from the chair, walks as quickly as possible around either side of a cone; the distance between chair and cone is 8 feet (2.44 meter). The score is the time participant takes to cover the distance. Assessment of body mass index (BMI) was recorded by height to the nearest half inch (1.27 cm), weight to the nearest pound (0.454 kg).

Statistical analysis

All variables were considered continuous because measurements varied within a certain scale. Means and standard deviation were used to describe the data. Group characteristics were analyzed with the use of the Mann-Whitney U-test. The significance level was set at 5%. The findings were compared to the SFT test normative, respectively criterion standards reported in percentile tables.

RESULTS

Analysis of the results indicated that significant changes in functional ability occurred in the experimental subjects compared to control, except flexibility where no significant effect was observed. Measures of body-mass index (BMI) were calculated in both groups, but (as expected) no statistical changes were recorded. In the chair stand pre-test, no relevant differentia were found between experimental and control group. In the post-test, significant improvements were found in experimental group: a 35% improvement, i.e. from 10.7 to 13.2 chair stands. This improvement

represents a shift from the below average to the normal range in (SFT test performance chart). In the control, no significant changes were found.

In the arm curl pre-test, no relevant differences were found between the groups. However, in post-test indicative gains were found in experimental group: a 40% improvement, i.e. from 13.7 to 17.0 repetitions. That improvement also represents change from the below average to normal range. The control group did not exhibit meaningful changes.

In the eight-foot up-and go, and the six-minute walk tests, no significant changes were found in pre-test in either experimental and control groups. However, in post-test measures meaningful changes were found in experimental group in both tests from 5.74 s to 5.15 s and from 543 yards to 632 yards, respectively; which equal about 20% improvement, i.e. an improvement that represents shift from below average to the normal range in the North American population. In both the flexibility chair sit-and-reach test and the back scratch test, no significant changes were observed in both examined groups; these findings represents normal range in North American population. Beside other factors, the flexibility findings were attributed to the short duration of the intervention, which may not have provided adequate improvements. After the completion of 12 weeks of regular strength training on the machines involving most of the major muscle groups, our participants improved their muscle strength by an average of more than 40%. These findings correspond with some similar studies (Carter et al., 2002; Evans & Rosenberg, 1991; Westcott & Baechle, 2007).

Table 1: SFT test results in experimental and control group after completion of weight training program

	Experimental group N=15				Control group N=15				Mann-Whitney U-test p<0.05	
	X	SD	Min.	Max.	X	SD	Min.	Max.	z	p
Age	67.0	1.46	65.0	69.0	66.8	1.36	65.0	69.0	0.248	0.803
Height (in)	67.3	1.88	64.0	71.0	68.3	2.92	63.0	73.0	-1.265	0.205
Weight (lb)	165.9	11.0	155.0	186.0	164.2	12.3	145.0	187.0	0.186	0.851
BMI	25.6	1.95	23.0	30.0	24.8	2.75	21.0	29.0	0.995	0.319
T1	10.73	1.22	9.0	14.0	10.93	1.16	9.0	13.0	-0.705	0.480
T2	13.73	1.03	12.0	15.0	13.93	1.03	12.0	15.0	-0.560	0.575
T4	-0.17	1.47	-2.0	2.5	-0.07	2.0	-3.0	3.0	-0.103	0.917
T5	-5.03	1.41	-7.0	-3.0	-5.0	1.35	-7.0	-3.0	-0.663	0.506
T6	5.74	0.52	5.10	6.50	6.02	0.51	5.10	6.50	-1.368	0.171
T7	543.6	28.2	490.0	585.0	538.3	25.1	485.0	570.0	0.394	0.693
V1	13.2	1.15	12.0	16.0	11.1	1.25	9.0	14.0	3.7538*	0.0002*
V2	17.0	1.49	15.0	20.0	14.1	1.19	12.0	16.0	4.2515*	0.0000*
V4	0.03	1.01	-2.0	1.5	-0.17	1.89	-3.0	2.5	0.4563	0.6482
V5	-4.50	1.10	-6.5	-3.0	-5.1	1.35	-7.0	-3.0	0.3066	0.1914
V6	5.15	0.45	4.40	6.00	5.82	0.60	4.50	6.50	-3.1316*	0.0017*
V7	632.6	42	555.0	700.0	548.6	18.7	505.0	570.0	4.2930*	0.0000*

* statistical significance

DISCUSSION

Research over the previous ten years has produced compelling evidence supporting the feasibility and the benefits of physical activity programs (Buková, 2002; Spirduso et al., 2005; Westcott & Baechle, 2007). In spite of that, in order to create effective training programs, many questions have to be answered regarding the type and size of sample. A convenience sample is always are healthier and higher functioning than the general population. We can broadly categorize the older population into five distinct categories: the physically elite, the physically fit, the physically independent, the physically frail, and the physically dependent (Rikli & Jones, 2001). Despite the fact that each level describes individual capabilities, individual differences are profound; there certainly are many individuals who will be difficult to categorize (i.e. fit well in particular category except for one ability). Furthermore, temporary setback such as sickness, injury or mood fluctuations can lower one's functional fitness.

All that can create difficulty in choosing appropriate assessment tools. It seems logical that for any given dose of exercise, training responses will be greatest in those who are unfit. It is not easy to motivate people. Research investigating the effect of strength training is many times quite conservative in terms of the intensity of the prescription (Fielding et al., 2002). Young biological age, favourable lifestyle, the socioeconomic status of the subjects, discomfort, measurement technique and other supporting factors limit generalizations to wide populations. All of the above can greatly influence administration and interpretation of the research findings. Our training influenced improvement in strength, endurance, agility, and balance. Thus, the benefits of regular exercise contribute to improvement of functional fitness. These findings are concurrent with other authors (Zhu & Chodzko-Zajko, 2006).

Selective review of the exercise studies in older adults indicates a 20% to 150% improvement in strength after completion of the strength training program (Westcott & Baechle, 2007). In our training program, we applied a sensible progression, i.e. a 2.5-pound weight increase after 12 correctly completed repetitions. By doing so, we minimized the risk of injury and maximized training progression. We believe this form of approach is suitable for the beginners to become used to exercise technique on the machines, to become accustomed to the environment, to become motivated before moving to another so-called maintenance phase of exercise routine regiment.

We speculate that our subjects, after initial establishment of training routine with the proper professional supervision, should be capable of successfully completing and tolerating a high-velocity training program that would result in the creation of higher functional reserve. We still have to determine the best model and exercise prescription using a multi-factorial approach that will consequently confer the most benefits for older adults (Zhu & Chodzko-Zajko, 2006).

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