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EFFECT OF RESISTANCE EXERCISES ON HANDGRIP STRENGTH IN POSTMENOPAUSAL WOMEN WITH OSTEOPENIA/OSTEOPOROSIS

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Abstract: *The present study aimed to verify the effects of a 12 months resistance training using the Bulgarian method by contrast (6 reps x 70% of 1RM + 6 reps x 50% of 1 RM) on handgrip strength in women with postmenopausal osteopenia/osteoporosis. Ten women with postmenopausal osteopenia/osteoporosis (over 50 years old) were distributed into two groups: exercise group (EX) (n = 5) and control group (C) (n = 5). Handgrip strength were measured before and at the end of the study using hydraulic hand dynamometer. Exercise group (EX) showed an increase by 12% at the end of the study for the dominant hand (p = .039) and by 10.53% for the non-dominant hand (p = .041). The control group showed a decrease in handgrip strength by -2.14% for the dominant hand (p = .018) and by -3.65% for the non-dominant hand (p = .038).*

Key words: *osteoporosis, osteopenia, resistance training, handgrip strength.*

1. Introduction

Osteoporosis is the most common disease that affects adults, especially the elderly. It is different from osteomalacia because it results from the diminution of the bone matrix and not due to deficient calcification. In the case of osteoporosis, the activity of cells called osteoblasts is lower than normal, and as a consequence the rate of bone formation decreases [6], [15], [25], [26], [27].

Bone loss occurs in "quiet" and progressive. Often, there are no symptoms until the first fracture occurs [17], [19].

Osteoporosis affects millions of people worldwide, being more common among women, where the incidence is much higher after the onset of menopause worldwide [7], [5], [22], [23], [45].

Osteoporosis affects about 40% of women and 20% of men at some point in life [38], [8].

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Postmenopausal osteoporosis appears as a consequence of osteoclast resorption in the presence of estrogenic deficiency and exaggerated inflammation, being associated with fractures in the vertebrae and hip [4], [1].

Bone mass loss is more accelerated in menopausal women because the rate of bone remodelling increases in favour of osteolysis, as a consequence of estrogenic deficiency. Estrogenic causes the lifespan of osteoclasts to increase, and that of osteoblasts to decrease [11], and as estrogenic production decreases and calcium absorption decreases in the intestines, as a consequence of reduced calcitonin production, a hormone that inhibits bone demineralization [24], [42].

2. Objectives

The present study aimed to verify the effects of a 12 months resistance training using the Bulgarian method by contrast (6 reps x 70% of 1RM + 6 reps x 50% of 1 RM) on handgrip strength in women with postmenopausal osteopenia/osteoporosis.

3. Material and Methods

Ten women with postmenopausal osteopenia or osteoporosis (over 50 years old) were distributed into two groups: exercise group (EX) (n = 5) and control group (C) (n = 5). All women underwent the same treatment: alfacalcidol 0.5 µg. The training program included exercises such as seated hip abduction, seated machine dip, seated back extension, standing hip flexion, standing hip extension, seated hip adduction, horizontal leg press, prone hamstring curls, seated knee extension, bodyweight squats, Scott bench biceps curls using the Bulgarian method by contrast (6 reps x 70% of 1RM following by 6 reps x 50% of 1RM) over a period of 12 months. The training program was conducted over a period of one year (2018 – 2019), twice a week. Each training session lasted approximately 50 minutes, and the sessions took place in the gymnasium of *Stefan cel Mare* Suceava University – Faculty of Physical Education and Sport. The subjects had a period of two weeks of familiarization with the exercises and learning the correct technique of execution, and in these two weeks the intensity used was 40% of 1RM with a number of 12 – 15 repetitions for each set. Subsequently, in the third week the intensity increased to 50% of 1RM, followed by the fourth week to use the specific method (6 x 50% of 1RM + 6 x 70% of 1RM).

Handgrip strength was measured before and at the end of the study using hydraulic hand dynamometer (JAMAR). Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS, Inc., Chicago, IL, USA) version 20. The Wilcoxon test was used for within-group comparisons and between-group comparisons of difference scores and/or percent changes were performed using the Mann-Whitney U test. A p value < 0.05 was considered statistically significant. The effect size (r) was also calculated.

4. Results and Discussions

At the baseline, there were no significant differences among all variables (Table 1). For the handgrip strength (dominant hand) the exercise group presented a higher mean value (Δ% = 12%) after 12 months (M = 30.4, SD = 1.8) compared to the initial results

(*M* = 27.4, *SD* = 1.8), *Z* = -2.06, *p* = .039, *r* = -0.92. In contrast, the group that did not take part in the exercise program showed a decrease (Δ% = -2.14%) at the end of the study (*M* = 27.4, *SD* = 2.1) compared to the baseline (*M* = 28, *SD* = 2.7), the difference being statistically insignificant, *Z* = -1.34, *p* = .18, *r* = -0.60.

At the final test, the results were significantly different between the two groups, *U* = -2.11, *p* = .035, *r* = -0.67 (Figure 1).

Baseline results for the exercise and control groups Table 1

	Exercise (*n* = 5)	Control (*n* = 5)	*U*	*p*	*ES*
Weight (kg)	67.2±3.7	65.2±6.5	-0.95	.34	-0.30
Height (cm)	160.0±6.0	156.4±4.4	-1.27	.21	-0.40
BMI	26.2±1.3	26.6±1.9	-0.42	.68	-0.13
Handgrip (D)	27.4±1.8	28.0±2.7	-0.53	.60	-0.16
Handgrip (ND)	26.6±2.2	27.4±2.7	-0.74	.46	-0.23

Note. Results are presented as mean and standard deviation (±); D = dominant hand; ND = non-dominant hand; BMI = body mass index; ES = effect size.

For the same test, but for the non-dominant hand, the physically active group showed an improvement in handgrip strength (Δ% = 10.53%) at the end of the 12 months (*M* = 29.4, *SD* = 1.7) compared to the initial test (*M* = 26.6, *SD* = 2.2), the difference being statistically significant, *Z* = -2.04, *p* = .041, *r* = -0.91. The control group registered a decrease (Δ% = -3.65%) at the end of the study (*M* = 26.4, *SD* = 2.1) compared to the baseline (*M* = 27.4, *SD* = 2.7), *Z* = -2.07, *p* = .038, *r* = -0.93. At the end of the study, the difference between the two groups was significant, *U* = -2.11, *p* = .035, *r* = -0.67.

Many articles and meta-analyses demonstrate the beneficial effect of strength training on the elderly and postmenopausal women [3], [41], [14], [32], [35].

The results of a meta-analysis state that 60% of 1 RM loads produce the greatest increase in muscle strength for beginners, while 80% of 1 RM loads produce the most obvious increase in muscle strength in trained individuals [37].

In the case of the elderly, the strength training conducted with intensities of 85% - 95% of 1 RM with a number of 4 series, improves the functional capacity and leads to the prevention of falls. Also, this type of training leads to the increase in size of type II muscle fibres, as well as to the increase in their number [44].

Regarding the acute answers, an important finding is that when working with loads between 50% and 90% of 1 RM, the rest of 3 - 5 minutes between sets allows a greater number of repetitions and a greater number of sets during a training session. In addition, with regard to the chronic adaptations, the rest of 3 - 5 minutes between sets produces greater increases in absolute strength, due to the intensities and volumes used during the training.

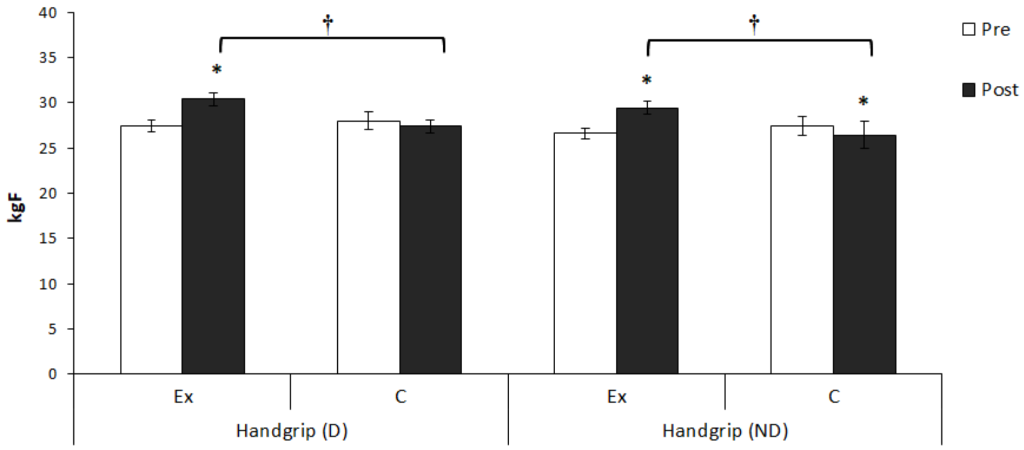

Fig. 1. *Pre and post-test results with 95% confidence interval regarding handgrip strength test. The symbol (*) indicates intra-group difference (p < .05) and the symbol (†) indicates inter-group difference (p < .05)*

In addition, with regard to the chronic adaptations, the rest of 3 - 5 minutes between sets produces greater increases in absolute strength, due to the intensities and volumes used during the training. Similarly, there were higher levels of increased muscle power during workouts that used longer breaks between 3 and 5 minutes, compared to short 1-minute breaks between sets. In contrast, some experiments have shown that when the maximum force is tested, rest intervals of 1 minute may be sufficient between repeated tests; however, from a psychological and physiological point of view, the inclusion of rest intervals from 3 to 5 minutes could be safer. When the goal of training is muscle hypertrophy, the combination of moderate intensity sets with short rest intervals of 30-60 seconds might be most effective due to maintaining higher levels of growth hormone during workouts [39].

And from the point of view of muscle hypertrophy, strength training that used more sets led to a more obvious increase in muscle mass compared to workouts that used a single set [10], [30], [36], [40].

For older women, increased volume training (3 sets per exercise) leads to similar changes in strength and muscle mass, with changes in low volume strength training (1 set per exercise), both workouts being performed twice a week [9], [34], [35].

Weights can be safely used, movements can be learned easily and allow for exercises that may be more difficult when exercising with free weights, such as knee extension. Fitness devices stabilize the body and limit the movements of other joints that are not related to the effort. Both the physical exercises performed on specific devices and those with free weights increase the muscular strength. For beginners and those with intermediate level it is recommended to use both free weights exercises and exercises on the apparatus [28], [29].

In conclusion, studies conducted that aimed to increase muscle strength and hypertrophy in the elderly, as well as women suffering from osteoporosis, recommend using both free weights (dumbbells) and exercises performed on special devices. It is recommended to use compound exercises (which require multiple joints) as well as isolated exercises that require only one joint. The execution of the movement should be slow-moderate (not fast), the load being between 60% - 80%, 1 - 3 sets per exercise with a number of 8 - 12 repetitions in a series, with a pause of 1 - 3 minutes between evenings, and the training frequency should be 2-3 times a week [20], [21], [31], [2], [12], [13], [16], [18], [33], [43].

5. Conclusions

The results showed that exercise group (EX) improved handgrip strength compared with control group (C) for the dominant hand (+12% vs. -2.14%, $U = -2.11$, $p = .035$, $r = -0.67$) and also for the non-dominant hand (+10.53% vs. -3.65%, $U = -2.11$, $p = .035$, $r = -0.67$).

This pilot study shows that resistance training can improve handgrip strength among women with postmenopausal osteopenia or osteoporosis.

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