ISSN – 1844 – 9131, eISSN 2601 – 341X Volum XIII issue 1/ 2020

RESISTANCE TRAINING PROGRAM ON MUSCLE STRENGTH IN POSTMENOPAUSAL WOMEN WITH OSTEOPENIA/OSTEOPOROSIS

Iulian Ștefan HOLUBIAC[1]
[1]Stefan cel Mare University of Suceava, Romania

Keywords: osteoporosis, osteopenia, strength training, muscle strength

Abstract

The aim of this study was to evaluate the effect of 3 months of strength training on muscle strength in postmenopausal women with osteopenia/osteoporosis. Fourteen women (57.4 ± 3.2 years old) with postmenopausal osteopenia or osteoporosis were distributed into two groups: strength training group (STG) (n = 7) and control group (C) (n = 7). The training program included exercises such as seated hip abduction, seated machine dip, seated hip adduction, prone hamstring curls, seated knee extension, over a period of 3 months. Results: At the end of the study, the results of 14 subjects were analyzed. There were significant improvements for 1 repetition maximum (RM) in the strength training group (STG) for hip abductors (p = .017), triceps extension (p = .017), hip adduction (p = .016), knee flexion (p = .018) and knee extension (p = .002). For the control group (C) there were no significant difference compared to the baseline results for any of the tests. Conclusion: Resistance training program for women with postmenopausal osteopenia/osteoporosis improves muscle strength for the main muscle groups.

Introduction

Muscle mass, strength and physical function are known to decline with advancing age (Cruz-Jentof, et al., 2019), but can partly be counteracted with strength training (Borde Ron, Tibor Hortobágyi, & Urs Granacher, 2015), (Bechshøf, et al., 2017). Osteoporosis is a systemic skeletal condition characterized by decreased bone mass and deterioration of bone tissue microarchitecture (Costa, și alții, 2016), (Hou, și alții, 2018), (Phipps, Mitlak, Burr, & Allen, 2019, p. 389). Osteoporosis is the most common disease that affects adults, especially the elderly. It is different from osteomalacia because it results from diminished bone matrix and not from poor 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 (Guyton & Hall, Textbook of Medical Physiology, 2006, pg. 992-993), (Li, și alții, 2009), (Chen, și alții, 2014), (Li, și alții, 2015), (Li, și alții, 2015). With age, muscles and joints pain can make their presence felt, as a consequence of the degenerative process in the body. These symptoms can also be found in osteoporosis (Brown, 2015). Acute pain is usually due to compression fractures that can go unnoticed on x-ray up to 4 weeks after it has occurred. Also, pain and skeletal deformities associated with osteoporosis, decrease muscle strength. Weak muscles in the back extensors relative to body weight or flexion force of the spine increase the possibility of suffering a compression fracture in the spine (Gimigliano, 2018).

Methods

Fourteen women sedentary women (57.4 ± 3.2 years old) with postmenopausal osteopenia/osteoporosis, non-smokers, who had no contraindication for practicing physical exercises were included in the study. The subjects were divided into two groups: strength training group (STG) (n = 7) and control group (C) (*n* = 7). The subjects from the experimental group participated in a resistance exercise program, carried out twice a week. The control group did not participate in any physical activity during the three months. The subjects in the experimental group had a period of two weeks of familiarization with physical exercises, during which intensities of 40% and respectively 50% of a maximum repetition were used. One maximum repetition (1RM) test was performed to determine the training load. Starting from the third week, the intensity used was 70%, the subjects performing 2 sets x 10 repetitions for each exercise. Maximum strength was assessed using the one-repetition maximum test (1-RM) in all exercises. One week before 1-RM test subjects were familiar with the technique and procedures. On the day of testing, subjects warmed up for 10 minutes, performed stretching exercises for muscle groups involved, and performed specific movements for the exercise test. The training program included exercises such as seated hip abduction, seated machine dip, seated hip adduction, prone hamstring curls, seated knee extension (table 1).

Table 1. The Weekly Exercise Program

Exercise	Volume and intensity	Rest
Seated Hip Abduction	2 sets: 10 x 70%	90’’
Seated Machine Dip	2 sets: 10 x 70%	90’’
Seated Hip Adduction	2 sets: 10 x 70%	90’’
Prone Hamstring Curls	2 sets: 10 x 70%	90’’
Seated Knee Extension	2 sets: 10 x 70%	90’’

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS, Inc., Chicago, IL, USA) version 20. The data were expressed as the mean and standard deviation (SD) for each variable. The Shapiro-Wilk test was used to test the normality of the data and Levene's test was used to assess the equality of variances. The Wilcoxon test was used for within-group comparisons and between-group comparisons of difference scores changes were performed using the Mann-Whitney U test. A p value < .05 was considered statistically significant. At the baseline, there were no significant differences among all variables (table 2).

Table 2. Baseline Characteristics for Strength Training and Control Groups

	STG (n = 7)	Control (n = 7)	p
Age (years)	57 (4.3)	57.7 (2.0)	.79
Height (cm)	161.9 (7.7)	158 (3.4)	.43
Weight (kg)	65.9 (9.9)	59.7 (10.2)	.37
BMI (kg/m^2)	25.2 (3.6)	23.9 (3.5)	.70
BMD Spine	0.765 (0.057)	0.776 (0.050)	.52
Tscor Total (Spine)	-2.6 (0.5)	-2.5 (0.5)	.56
Hip Abduction (kg)	21.7 (3.0)	22 (2.8)	.89
Triceps Extension (kg)	15.7 (1.9)	15.9 (2.1)	.89
Hip Adduction (kg)	31.9 (2.7)	30.4 (2.1)	.33
Knee Flexion (kg)	11.9 (2.1)	12.6 (1.9)	.43
Knee Extension (kg)	22.7 (2.6)	22.9 (2.2)	.84

Note. Results are represented as mean and standard deviation (SD); BMI = Body Mass Index; BMD = Bone Mineral Density.

There were no statistically significant differences between the two groups at the beginning of the study in any of the variables. At the end of the study, the ST group showed a significant increase in muscle strength for the hip abductors (*M* = 26.3, *SD* = 3.3) compared to the baseline (*M* = 21.7, *SD* = 3.0), *p* = .017. The control group showed a decrease at the end of the study (*M* = 21.6, *SD* = 2.6), compared to the baseline (*M* = 22, *SD* = 2.8), but the difference was not statistically significant, *p* = .51. Between the two groups, at the level of the hip abductors, the difference was statistically significant at the end of the study (*p* = .021) (figure 1).

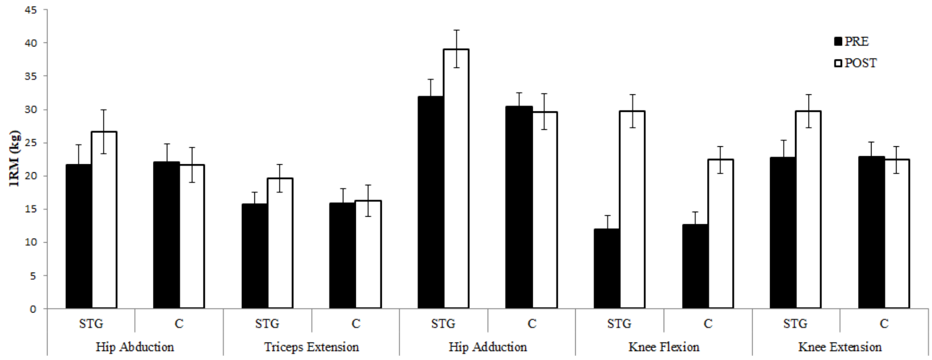

Fig. 1. Pre and post-test results with 95% confidence interval regarding 1RM tests

For the elbow extensors, ST group showed an improvement in muscle strength at the end of the study (*M* = 19.6, *SD* = 2.1), compared to the initial results (*M* = 15.7, *SD* = 1.9), the difference being statistically significant, *p* = .017. Also, for the control group there was an improvement in muscle strength at the end of the study (*M* = 16.3, *SD* = 2.4), compared with the baseline results (*M* = 15.9, *SD* = 2.1), but the increase was not statistically significant, p =. 083. At the end of the study, there was a significant difference between the two groups (*p* = .030). The ST group showed an increase in muscle strength at the hip adductors level at the end of the study (*M* = 39.1, *SD* = 2.8), compared to the initial results (*M* = 31.9, *SD* = 2.7), the increase being statistically significant, *p* = .016. Between the two groups, the difference was statistically significant at the end of the study (*p* = .002). The group that participated in the exercise program showed an improvement in muscle strength in the knee flexors after 3 months of training (*M* = 11.9, *SD* = 1.1), compared to the baseline results (*M* = 21.1, *SD* = 3.8), the increase being statistically significant, *p* = .018. Within the control group, there was a decrease in muscle strength in the knee flexors, but the difference was not statistically significant (12.4 ± 2.0 vs. 12.6 ± 1.9, p = .65). There was a significant difference between the control group and the experimental group at the end of the study regarding the muscle strength at the level of the knee flexors (p = .002). Muscle strength at the knee extensors increased after 3 months of participation in the exercise program (M = 29.7, SD = 2.5), compared to the initial values (M = 22.7, SD = 2.6), the increase being statistically significant, p =. 017. The control group showed a very small decrease in muscle strength at the knee extensors, a statistically insignificant difference (22.4 ± 2.0 vs. 22.9 ± 2.2, p = .33). At the end of the study, the experimental group recorded a higher mean compared to the control group, the difference being statistically significant at the end of the study (p = .002).

Conclusion

Strength training, performed twice a week for three months, using five exercises per training session, and each exercise being performed in two sets of ten repetitions with an intensity of 70% of 1RM, leads to improvements of muscle strength in women with osteoporosis / postmenopausal osteopenia.

Bibliography

1. Bechshøf, Rasmus Leidesdorff, Nikolaj Mølkjær Malmgaard-Clausen, Bjørn Gliese, Nina Beyer, Abigail L. Mackey, et al. (2017). Improved Skeletal Muscle Mass and Strength after Heavy Strength Training in Very Old Individuals. *Experimental Gerontology*, *92*, 96-105.
2. Borde Ron, Tibor Hortobágyi, & Urs Granacher. (2015). Dose–Response Relationships of Resistance Training in Healthy Old Adults: A Systematic Review and Meta-Analysis. *Sports Medicine, 45*(12), 1693-1720.
3. Brown, S. E. (2015, Mai 11). *Nature's tips on bone loss — 6 signs and symptoms of bone health* . Retrieved Martie 12, 2018, from BetterBones: https://www.betterbones.com/bone-health-basics/natures-tips-on-bone-loss-6-signs-and-symptoms-of-bone-health/
4. Chen, C., Cheng, P., Xie, H., Zhou, H.-D., Wu, X.-P., Liao, E.-Y., și alții. (2014). MiR-503 Regulates Osteoclastogenesis via Targeting RANK. *Journal of Bone and Mineral Research*, *29*(2), 338-347.

5. Costa, A. L., Silva, M. A., Brito, L. M., Nascimento, A. C., Barbosa, M. d., Batista, J. E., et al. (2016). Osteoporosis in primary care: an opportunity to approach risk factors. *Revista Brasileira de Reumatologia English Edition, 56*(2), 111-116.
6. Cruz-Jentof, Alfonso J, Gülistan Bahat, Jürgen Bauer, Yves Boirie, Olivier Bruyère, et al. (2019). Sarcopenia: Revised European Consensus on Definition and Diagnosis. *Age and Ageing, 48*(1), 16-31.
7. Gimigliano, F. (2018). Osteoporosis. In D. X. Cifu, & H. L. Lew, *Braddom's Rehabilitation Care: A Clinical Handbook, 1st Edition* (pp. 238-243). Virginia: Virginia Commonwealth University.
8. Go JL, Rothman S, & Prosper A. (2012). Spine infections. *Neuroimaging Clin N Am, 22*(4), 775-772.
9. Guyton, A. C., & Hall, J. E. (2006). *Textbook of Medical Physiology*. Philadelphia: Elsevier Inc.
10. Hou, Y.-C., Wu, C.-C., Liao, M.-T., Shyu, J.-F., Hung, C.-F., Yen, T.-H., et al. (2018). Role of nutritional vitamin D in osteoporosis treatment. *Clinica Chimica Acta, 484*, 179-191.
11. Li, C.-J., Cheng, P., Liang, M.-K., Chen, Y.-S., Lu, Q., Wang, J.-Y., și alții. (2015). MicroRNA-188 regulates age-related switch between osteoblast and adipocyte differentiation. *The Journal of Clinical Investigation, 125*(4), 1509-1522.
12. Li, H., Xie, H., Liu, W., Hu, R., Huang, B., Tan, Y.-F., și alții. (2009). A novel microRNA targeting HDAC5 regulates osteoblast differentiation in mice and contributes to primary osteoporosis in humans. *The Journal of Clinical Investigation*.
13. Li, R., Liang, L., Dou, Y., Huang, Z., Mo, H., Wang, Y., și alții. (2015). Mechanical Strain Regulates Osteogenic and Adipogenic Differentiation of Bone Marrow Mesenchymal Stem Cells. *BioMed Research International*.
14. Phipps, R., Mitlak, B. H., Burr, D. B., & Allen, M. R. (2019). Pharmaceutical Treatments of Osteoporosis. In D. B. Burr, & M. R. Allen, *Basic and Applied Bone Biology* (pp. 389-410). Indianapolis: Academic Press.

ANTRENAMENT DE DEZVOLTARE A FORȚEI MUSCULARE LA FEMEILE CU OSTEOPENIE / OSTEOPOROZĂ POSTMENOPAUZĂ

Cuvinte cheie: osteoporoză, osteopenie, antrenament de forță, forță musculară

Rezumat

Scopul acestui studiu a fost de a evalua efectul antrenamentului de forță de 3 luni asupra forței musculare la femeile cu osteopenie / osteoporoză postmenopauză. Paisprezece femei (57,4 ± 3,2 ani) cu osteopenie / osteoporoză postmenopauză au fost distribuite în două grupe: grupa de antrenament de forță (STG) (*n* = 7) și grupa de control (C) (*n* = 7). Programul de antrenament a inclus exerciții cum ar fi abducția șoldului din așezat, extensia coatelor din așezat, adducția șoldului din așezat, flexia genunchiului din decubit ventral, extensia genunchiului din așezat, pe o perioadă de 3 luni. Rezultate: La sfârșitul studiului, au fost analizate rezultatele a 14 subiecți. Au existat îmbunătățiri semnificative pentru 1 repetare maximă (1RM) în grupul de antrenament de forță (STG) pentru abductorii șoldului (*p* = .017), extensia coatelor (*p* = .017), adducția șoldului (*p* = .016), flexia genunchiului (*p* = .018) și extensia genunchiului (*p* = .002). Pentru grupul de control (C) nu au existat diferențe semnificative în comparație cu rezultatele inițiale pentru niciunul dintre teste. Concluzie: Antrenamentul de dezvoltare a forței pentru femeile cu osteopenie / osteoporoză postmenopauză îmbunătățește forța musculară pentru principalele grupe musculare.