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ORIGINAL ARTICLE

IGF-1 LEVELS AND MUSCLE STRENGTH IN ELDERLY WOMEN WITH MUSCULOSKELETAL DYSFUNCTION TREATED WITH KINESIOTHERAPY

NÍVEIS DE IGF-1 E FORÇA MUSCULAR EM IDOSAS COM DISFUNÇÕES MÚSCULO-ESQUELÉTICAS TRATADAS COM CINESIOTERAPIA

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ABSTRACT
This study aimed to evaluate IGF-1 levels and muscle strength in elderly women with musculoskeletal dysfunctions who underwent kinesiotherapy. **Method:** The research was quasi-experimental. Sample: 70 sedentary elderly women, aged 68.52 ± 4.62 years-old and BMI 27.96 ± 4.01, divided into two equal groups: the intervention group, which underwent 12 weeks of exercise (EG), and the control group (CG). Serum levels of IGF-1 were evaluated through Chemiluminescence method and muscle strength by using the one-repetition maximum test (1RM) in flexion movements (FM) and hip extension (HE), shoulder flexion (SF) and shoulder extension (SE) . **Results:** SPANOVA revealed that the EG presented a significant increase in IGF-1 (A% = 19.09, p = 0.03). There was a significant increase in muscle strength in EG in the movements of SF (A% = 27.88, p <0.05), EO (A% = 56.2, p <0.05), CF (A% = 50.00, p <0.05) and SE (A% = 55.29, p <0.05), while the CG did not present any differences in IGF levels and strength. **Conclusion:** Kinesiotherapy increased IGF-1 levels and muscle strength in elderly women with musculoskeletal dysfunctions.
Keywords: Elderly. IGF-1. Muscle streng.

INTRODUCTION

The elderly population continues to grow, thus, it becomes necessary to establish methods of slowing down or preventing morbidity in the aging process and maintaining the quality of life (OMRAN, 2001; CHANG et al., 2004).

Regarding the elderly, increased impairment can often be related to degenerative joint disease. Osteoarthritis, or osteoarthritis, is the most common type. In general, after the fifth decade of life, these changes will be present nearly in the entire population, and their signs are manifested earlier in women than in men. Thus, when affected by degenerative joint disease, the elderly gradually loses their functional capacities, because of pain, muscle weakness, or limited joint motion range (HORN, 2006).

The incidence and cost of osteoporosis are also increasing among the elderly population, in such a way that more than half of people aged over 50 years-old are at risk of being affected by these conditions, often silently and without diagnosis (MEEKS, 2005.) Currently, osteoporosis is considered, in developed countries, one of the most common and serious health problems in the elderly population, especially when it comes to women (WORLD HEALTH ORGANIZATION, 1994).

Since 1995, the American College of Sports Medicine (AMERICAN COLLEGE OF SPORTS MEDICINE, 1995) has been seeking to establish the relationship between physical activity, physical exercise and osteoporosis, through knowledge about factors such as intensity, frequency and duration of the exercises used as a method for preventing and treating the pathology.

Physical activity is considered a practical measure for preventing osteoporosis (NGUYEN; CENTER; EISMAN, 2000), and it also increases bone mineral accretion due to the mechanical stress

caused by the exercises (AUAD et al., 2007).

Muscle strength is an important aspect of functional capacity and, during the aging process, its maintenance is essential, for it is vital for health, functional capacity and independent living (RAMOS, 2003).

Although different exercise programs are effective in improving both muscle strength and functional capacity, it is not clear what kind of exercise program is more effective in increasing physical performance and promoting quality of life and, also, which muscle group is most benefited from such exercises (EYIGOR; KARAPOLAT; DURMAZ, 2007).

In this sense, kinesiotherapy uses strength exercises of high intensity that can surely increase muscle strength and functional capacity (BROSE; PARISE; TARNOPOLSK, 2003; BROSE, TARNOPOLSKY, 2003), which have been successfully used to increase strength in elderly people (TRAPPE et al., 2001). This is because resistance exercise promotes increased neuromuscular activation through the recruitment of motor units and the hypertrophy of existing muscle fibers (PAGE et al., 2005).

Strength exercises of high intensity also alter basal levels of hormones related to musculoskeletal adaptation, such as the insulin-like growth factor-1 - IGF-1 (Raastad et al., 2001.)

Vale et al. (2009) compared strength exercise in high and low intensity in elderly people and observed that strength exercises of high intensity promote anabolic effects on them, showing significant increases in IGF-1 levels. In addition, Hatfield et al. (2010) observed a significant increase in IGF-1 levels in resistance exercises in trained men and women.

IGF-1 is an important modulator of muscle growth, and its levels vary, increasing at puberty and declining to lower levels at aging (CRUZAT et al., 2008) (TERRES-SPEZIALE; POLANCO, 2005). Among the anabolic hormones, IGF-1 is considered an important anabolic agent (BIKLE et al., 2002) (TORRES-ALEMAN et al., 2010) and is highly related to muscle mass and strength exercise (CARREL; ALLEN, 2000), however, its secretion decreases with aging (KOSTEK et al., 2005).

Seeking to fill the knowledge gaps presented, this study aimed to evaluate IGF-1 levels and muscle strength in older women with musculoskeletal disorders treated with kinesiotherapy.

METHODS

A quasi-experimental study was carried out with 70 sedentary elderly women, randomly subdivided into two equal groups: EG (n = 35 elderly inserted into a kinesiotherapy program) and CG (n = 35 elderly women who constituted the control group). It was used a population of 123 elderly residents of a shelter in Teresina, Piauí state (Brazil), who presented osteoarthritis and / or osteoporosis. The power of the experiment was estimated at 80%.

The adopted inclusion criteria were: the elderly should have musculoskeletal dysfunction (tendinopathies, osteoarthritis, and osteoporosis), be physically able and independent in the performance of daily physical activities and not having performed regular physical activity for at least the last twelve months. This research excluded elderly women who presented any kind of chronic condition that could harm or impede them from doing strength exercises (cardiopathies, diabetes, arterial hypertension or uncontrolled asthma) or any musculoskeletal conditions that could serve as an intervening factor in the practice of the activity (recent fracture, use of prosthesis, fibromyalgia), neurological problems, use of medications that could cause

disturbances of attention and presence of aches that impeded the training performance.

This research is in accordance with the Ethical Principles for Medical Research Involving Human Subjects set forth in the Declaration of Helsinki (WORD MEDICAL ASSOCIATION, 2008). The subjects of the study signed an informed consent and the research project was approved, in Rio de Janeiro, Brazil, by the Ethics Research Committee of the Castelo Branco University, protocol # 0165/2008.

In order to characterize the sample, it was collected anthropometric measures of body mass and height and calculated the body mass index (BMI). For that, the following equipment were used, respectively: a digital scale with a resolution of 100g, FILIZOLA brand, PL150 Personal Line model (Brazil), a professional stadiometer, SANNY brand (Brazil), and a skinfold caliper, LANGE brand (USA), with 1 mm resolution and constant pressure 10g/mm2. All collection points obeyed the requirements of International Standards for Anthropometric Assessment (ISAK).

Subsequently, serum levels of IGF-1 were evaluated, through a closed vacuum system by using cotton, 70% alcohol, disposable and sterile needle, disposable syringe (10 ml), and tourniquet and sterile tube without anticoagulants. These procedures were performed by a laboratory of clinical analysis through Chemiluminescence Method. The collection was made at 07:30, after 12 hours of fasting, at the residence of the participants. Then, the conservation procedures of the recipients were performed and the material was sent to the clinical analysis laboratory.

Aiming to determine the maximum muscle strength, it was performed the one-repetition maximum test (1-RM), which presents objectivity of r = 0.92 (GOTO et al., 2004), representing an excellent reproducibility of the test, with an acceptable margin of error at the beginning and at the end of the intervention period.

Each subject was oriented to perform a series of movements with the motor gesture that would be used in the test (hip flexion and extension, shoulder flexion and extension). There were three minutes of break before the first attempt. There was one repetition in each attempt. The number of attempts took into account the response of the elderly woman and the weight was increased or decreased until reaching 1RM. In each attempt, executed or not, it was given a five-minute break. A lower load was given whenever an attempt had not been performed.

The experimental group underwent a week of adaptation to the exercises used during the specific treatment stage followed by 12 weeks of kinesiotherapy, in the form of resistance exercises: shoulder flexion and extension and hip flexion and extension. The program used was the alternated type per body segment, following the order of the resistance exercises for the shoulder flexors, hip flexors, shoulder extensors, hip extensors, all performed on the same day. Dumbbells and shin guards were the equipment used, Physicus® brand (Brazil).

The frequency was three times a week, on alternate days. Three series of eight to ten repetitions were performed, with breaks of one to two minutes between the series and the exercises. The load was between 75 and 85% 1RM.

A perceived exertion scale for resistance exercises OMNI-RES (ROBERTSON et al., 2003) was used to control the intensity of the exertion throughout the intervention period. The average score obtained on the scale was 7.82 ± 2.52. The speed of implementation ranged from slow to moderate. Stretching exercises were performed before and after training.

At the end of the intervention period the subjects underwent, once more, blood collection for analysis of IGF-1 and the 1RM test to evaluate maximum muscle strength, following the same protocol described above, while the control group was oriented not to practice any physical activity during the experiment.

After obtaining the research results and finishing the proposed experimental period, the

control group underwent the same intervention as the experimental group.

For the data analysis, descriptive statistics techniques were used (average, standard deviation and minimum and maximum values). The normality and homogeneity of variance of the data were verified through Shapiro Wilk and Levene tests, respectively. All data were evaluated through Analysis of Variance Split-Plot (SPANOVA). When significant differences in SPANOVA were verified, it was used the t-Student test to determine the differences within the groups (pre-test and post-test). It was used the level of $p < 0.05$ for statistical significance. The SPSS 14.0 program was used for data processing.

RESULTS

Tables 1 and 2 display comparative data of both groups EG and CG, characterizing them on the basis of the variables analyzed in this study.

Table 1 - Anthropometric descriptive data of the groups

	Age (years)	Body Mass (kg)	Height (m)	BMI (kg.m^2)
EG	68.52±4.68	63.99±46.00	1.51±1.40	28.05±20.83
CG	67.52±7.34	67.45±7.07	1.59±0.05	26.96±4.01

Table 2 - Descriptive data of IGF1 variables and muscle strength in EG and CG

		Pre		Post	
	Variables	**Average**	**SD**	**Average**	**SD**
EG	IGF1	103.38	19.99	123.11 *#	18.32
	SF	4.52	0.84	5.78*#	0.94
	SE	3.38	1.02	5.28*#	1.04
	HF	5.16	0.98	7.74*#	1.14
	HE	5.10	1.02	7.92*#	1.13
CG	IGF1	106.43	26.84	104.22	24.81
	SF	4.11	1.71	4.11	1.49
	SE	2.76	1.64	2.61	1.39
	HF	4.87	1.69	4.70	1.65
	HE	5.17	1.81	5.20	1.82

Legend: SF=shoulder flexion; SE=shoulder extension; HF= hip flexion; HE=hip extension; *intragroup significant difference ($p<0.05$); # intergroup significant difference ($p<0.05$).

It is observed that the EG presented significant increases in IGF-1 levels and in all tests of muscle strength from pre to post-test. The same did not occur with the CG. In the intergroup comparisons, the EG showed values significantly superior to the CG in all variables analyzed during the post-test.

Figures 1 and 2 present the comparisons of the variations in IGF1 levels and muscle strength in 1RM test between the EG and CG after the intervention period. It is observed that the EG obtained the significant percentage increases with kinesiotherapy, when compared to the CG.

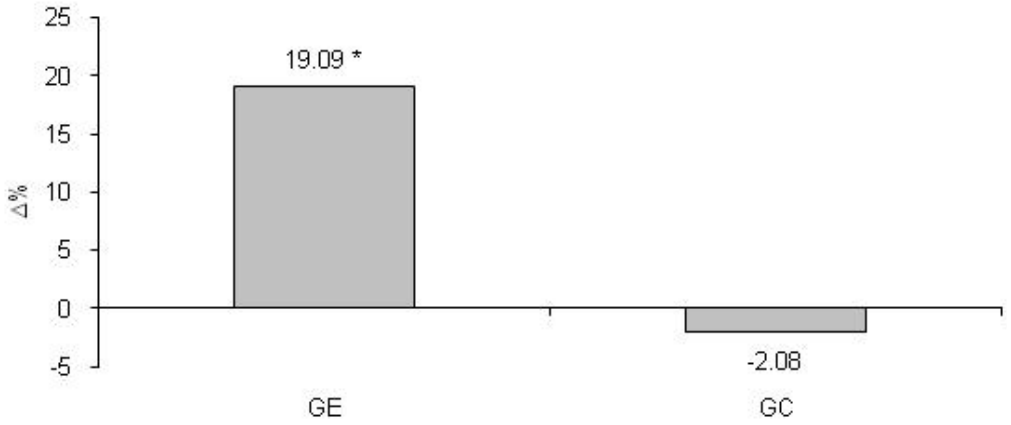

Figure 1 - Variation in IGF1 levels after kinesiotherapy
*p<0,05; GE vs GC.

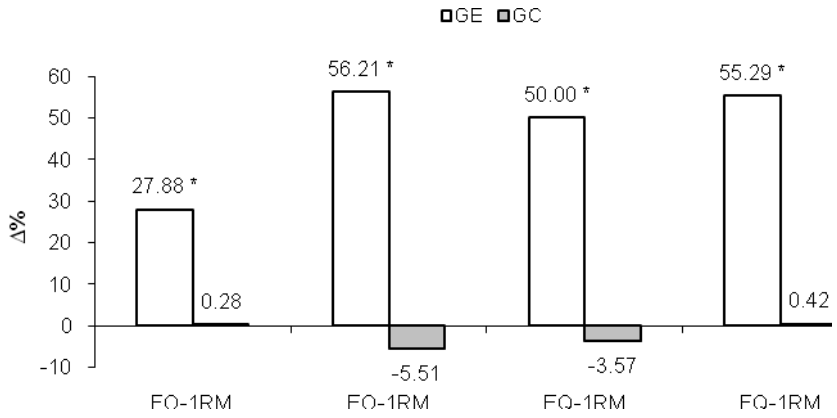

Figure 2 - Changes in muscle strength in the 1RM test after intervention kinesiotherapy.
*p<0,05; GE vs GC

DISCUSSION

Both EG and CG showed data distribution and normality, emphasizing that the BMI in both groups was above the standard recommended by the World Health Organization (WORLD HEALTH ORGANIZATION, 2000) for the elderly (BMI = 22-27), categorizing the elderly women of the present study as overweight / obese, a condition that has been progressively increasing in the elderly population worldwide (ZAMBONI et al., 2005). Such data corroborate those reported by Mello, in which approximately 50% of elderly women were overweight / obese (Mello, 2008).

There was a significant increase in blood levels of IGF 1 in EG in this study. These data corroborate the study of elderly women engaged in various activities. In this research, in order to compare the serum levels of IGF-1, four groups of subjects aged between 63 and 78 years, 6 months were studied: control group (n = 10), dance group (n = 30), meditation group (n = 28) and training group (n = 30). The group training with dumbbells showed a significant increase ($p < 0.05$) in IGF-1 levels when compared to the others, which led to the conclusion that intense motor activities promote an increase in the concentration of IGF-1 in elderly women (Dantas et al., 2008).

Another study suggests that two out of three IGF gene polymorphisms influence the muscle phenotypic responses to strength training in black and white elderly people (Hand et

al., 2007), which is also related to the increase in muscle strength in GE .

By analyzing the CG, it was observed no reduction in the basal levels of IGF, which is justified by the reduced production of anabolic hormones, such as testosterone, growth hormone and IGF-1, impairing the ability of skeletal muscle to incorporate amino acids and synthesize proteins. The loss of muscle mass in the elderly directly results in decreased strength and may contribute to the high incidence of accidental falls among the elderly and compromise the quality of life (Deschenes, 2004).

Evidence suggests the existence of a relationship between the decrease in growth hormone (GH) and IGF-1 and changes related to body composition and physical performance in aging. Thus, the age-dependent decline in serum levels of GH and IGF-1 can promote brittleness, contributing to the loss of muscle mass and strength. Preclinical studies showed that the infusion of angiotensin II produced a significant reduction in body weight accompanied by decreased IGF-1 muscle levels (GIOVANNINI et al. 2008). Another study suggests that the effect of IGF-I on muscle function depends on the levels of interleukin-6 (IL-6) (Barbieri et al. 2003).

The significant increase in muscle strength within the EG in the shoulder flexion, shoulder extension, hip flexion and hip extension is associated with the fact that a program of prolonged total strength training lead to gains in overload and maximum power in the muscles of the upper and lower limbs, due to neuromuscular adaptations and / or improvement of age-related endocrine deficiencies (IZQUIERDO et al., 2001).

Frail elderly can respond vigorously to resistance training with musculoskeletal remodeling and significant increase in muscle area, which is possible with resistance training in combination with an adequate amount of energy (Singh et al., 1999). Resistance exercise programs of moderate and high intensity provide beneficial effects on cognitive functions (CASSILHAS et al., 2007) and can also be an excellent tool for maintaining muscle strength in women, during the post-menopause period (Meeuwsen; SAMSON; Verhaar, 2000 .)

The decreased muscle strength presented by the GC is related to the loss of muscle mass and increased fragility in the elderly. Between 25 and 65 years of age, there is a substantial decrease in lean body mass or fat free mass 10-16%, due to the losses in bone mass, skeletal muscle and total body water, which occur with aging. The main causes identified as responsible for this selective loss of muscle mass are decreased levels of growth hormone and physical activity level of the individual (MATSUDO; MATSUDO; BARROS NETO, 2008).

To improve the quality of life it is important to increase the muscle strength of the elderly at sufficient levels so that they can carry out the activities of daily living and prevent the occurrence of falls and bone fractures. The muscles generate mechanical stress, which contributes to the maintenance of other musculoskeletal tissues, and provide amino acids that assist in the process of tissue repair and maintenance of acid-base balance (Goldspink, 2007).

The strength training is considered a promising intervention to minimize the loss of muscle function and deterioration of muscle structure, which are associated with advanced age. This intervention results in improvements in functional abilities and health in the elderly, increasing muscle mass and power, and bone mineral density (HURLEY; ROTH, 2000).

CONCLUSION

It is concluded that kinesiotherapy through strength exercises induced an increase in the IGF-1 levels and muscle strength in shoulder flexion and extension and hip flexion and extension in elderly women with musculoskeletal disorders. This is the reason why such treatment is recommended to prevent muscle atrophy and sarcopenia associated with aging.

Studies are recommended to evaluate other treatment methods and an extended intervention period.

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