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ORIGINAL STUDIES

Rehabilitation in elderly females with osteoporosis

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Abstract
Background. Osteoporosis, the most common type of metabolic bone disease, is a public health problem worldwide, affecting more than 200 million people. It is estimated that 30 to 50% of postmenopausal women suffer from it. Prevention and treatment of osteoporosis involves more than simply taking medication. Physical training (weight-bearing, flexibility and balance exercises) and adequate intake of calcium and vitamin D are essential to bone health and vital to avoiding falls and fractures.
Aims. We evaluated in our study the efficacy of a complex rehabilitation program, based on 12 weeks aerobic training, for reducing symptoms and improving the quality of life in elderly females with osteoporosis.
Methods. The study was a randomized controlled trial including two groups of patients (E - study group and C - control group), homogeneous in terms of biographical, clinical and functional features. All patients underwent complete assessment - clinical, imaging and functional.
Results. Clinical and functional parameters had a significant modification (VAS, Up and Go test, and MiniOQLQ - Physical function) in females who performed the rehabilitation program.
Conclusions. The rehabilitation program, based on kinetic measures, mainly aimed at maximizing functional ability and quality of life in females with osteoporosis. Our study is an initiation for the development of an evidence-based practice in the correct rehabilitation of females with osteoporosis.
Key words: osteoporosis, physical training, rehabilitation program

Introduction

The International Osteoporosis Foundation (IOF) defined osteoporosis as a disease characterized by a decrease in the density and quality of bones. This disorder is a public health problem worldwide, affecting more than 200 million people and is characterized by an increased risk of fragility fractures (Barrios-Moyano & De la Peña-García, 2018). According to the statistics released by the World Health Organization (WHO), it is estimated that 30 to 50% of postmenopausal women suffer from osteoporosis. It mostly affects women after the age of 50, the women/men ratio being 3:1, 4:1. Because the tendency of aging in the population was noticed in relation to the increase of life expectancy (the number of persons over 60 years old will reach 1 billion in 2020) (Kamide et al., 2009), the number of osteoporosis people is estimated to increase.

The most common generalized bone disease in humans, osteoporosis, is characterized by low bone mass, deterioration of bone tissue and disruption of bone microarchitecture, compromised bone strength and an increase in the risk of fracture (Kerr et al., 2009). Primary or idiopathic osteoporosis accounts for more than 75% of all osteoporosis cases and represents involution osteoporosis (Kamide et al., 2009). The bone loss rate depends on the type of bone: trabecular or cortical. The loss of cortical bone starts after the age of 40 and is linear, registering an annual loss of 0.5-1% in both genders. The reduction of trabecular bone starts between 30-35 years and is linear in men and women before menopause (1-4% per year). After menopause, an acceleration of bone loss occurs, reaching up to 10% per year (Kamide et al., 2009). Despite the fact that fragility fractures cause many problems, bone fractures are a significant social and economic health problem and are associated with significant morbidity and mortality (Figliomeni et al., 2018), osteoporosis is still underdiagnosed and undertreated (Kerschan-Schindl, 2016). The clinical diagnosis combines evidence of fragility fractures with measurement of bone mineral density (BMD) that is correlated with bone strength, skeletal load-bearing capacity, and fracture risk. BMD can be measured in different projections and locations. Dual-energy X-ray absorptiometry (DXA) is the method that is most often used to measure BMD (Bergh et al., 2018). The widely used WHO definitions compare patient BMD to norms expressed as a gender and ethnic group-matched T-score, the number of standard deviations from the mean BMD. Osteoporosis is defined as a T-score at any site of

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-2.5 or lower, while osteopenia is defined as a T-score between -1 and -2.5 (Ram Hong & Wan Kim, 2018).

Another frequently used method for indirect evaluation of bone quality is the WHO fracture risk assessment tool (FRAX), which focuses on the prediction of future fracture risk (Bergh et al., 2018). The FRAX questionnaire is created for predicting the risk of fractures, such as clinical spine, wrist, proximal humerus, and hip fractures, during the coming 10 years (Kanis, 2002).

Peak bone mass is determined largely by genetic factors, with contributions from nutrition, endocrine status, physical activity and health during growth (Khosla & Riggs, 2018). The induction of osteoporosis is due to a number of factors, the most important being age and sex (especially after menopause). Several other factors may interfere either as helping factors as it happens in primitive osteoporosis, or as prevailing factors like in secondary osteoporosis. Lack of exercise or inadequate physical activity (sedentary life, prolonged immobilizations) is mentioned as one of the many factors that reduce bone resistance (Kamide et al., 2009).

Osteoporosis is a potentially debilitating disease in which bones that were once strong become thin, fragile and prone to breaking. So, the risk of fractures is increased, causing various degrees of disability, pain, immobility, and reducing quality of life (Rizzoli, 2018). If some bone loss is inevitable, osteoporosis and further bone loss can be prevented, controlled, slowed and managed. All medication in association with regular physical exercises (weight-bearing exercises, posture, flexibility and balance support exercises) is the cornerstone of fracture prevention. Physical exercise may be an efficient option for autonomous fracture prevention during increasing age (Kemmler et al., 2015).

Appropriate rehabilitation programs are essential for all patients with osteoporosis and can be based on home environment and activities of daily living to obtain and maintain patient's independence and to reduce the personal and socioeconomic impact of the disease (Bonner et al., 2003).

Hypothesis

Taking into consideration the previous recommendations for osteoporosis management, we evaluated in our study the efficacy of a complex rehabilitation program, based on 12 weeks of aerobic training, for reducing symptoms and improving the quality of life in female patients with primary osteoporosis.

Material and methods

We mention that we obtained the approval of the Ethics Committee of the University of Medicine and Pharmacy of Craiova No. 131/16.05.2017 and a signed informed consent from all the subjects participating in the study. Our research was performed on 38 randomized female patients, median age 70.5 years, range 62–77 years (C - control group, 17 females; E - study group, 21 females), all diagnosed with primary osteoporosis without severe osteoporosis or a recent history of fragility fracture.

Research protocol

a) Period and place of the research

We conducted our study during the period June 2017 - November 2018 in the Rehabilitation Department of the "Filantropia" Hospital Craiova.

b) Subjects and groups.

The study was a randomized controlled trial including two groups of patients (E - study group and C - control group), homogeneous in terms of biographical, clinical and functional features (Table I).

All patients underwent complete assessment – clinical, imaging and functional.

Clinical evaluation of the studied patients was carefully performed. Diagnosis was established clinically based on patient's history and physical examination, and was supported by imaging assessment (X-ray examination of the vertebral dorsal spine, lumbar vertebral dual-energy X-ray absorptiometry – DXA).

c) Tests applied

Functional assessment was performed with the following scales and tests:

- VAS (Visual Analog Scale) for pain is a one-dimensional measure of pain intensity, which has been widely used in clinical trials; it is a continuous scale formed by a horizontal or vertical line, usually 10 centimeters (100 mm) in length, anchored by 2 verbal descriptors, one for each symptom extreme. Using a ruler, the score is determined by measuring the distance (mm) on the 10-cm line between the "no pain" anchor and the patient's mark, providing a range of scores from 0–100. A higher score indicates greater pain intensity (Jensen et al., 2003).

- Timed Up and Go test - it was used to determine how quickly (seconds) some daily activities can be performed at a comfortable speed: rise from a chair; walk as quickly as possible at a comfortable and safe pace to a line on the floor three meters; turn round; walk back to the chair and sit down. In the starting position the patient is sitting in a chair (seat height approximately 45 centimeters) with his feet resting on the floor. The arms of the patient rest on the arms of the chair. If necessary the patient may use a walking aid. The patient has to be able to walk without the help of others. Two test trials were performed with a 1-min interval between trials and we used the shortest time in the study. The normative reference values are 8.1 seconds for 60–69 years, 9.2 seconds for 70–79 years and 11.3 seconds for 80–89 years. All these aspects are mentioned in the medical literature (Bohannon, 2006).

- 6 MWD (six minute walking distance). This test assesses the walking capacity during a 6-minute period; the patient is instructed to walk back and forth along a 20-m corridor and to cover the maximum distance possible in 6 minutes, taking rests as needed. The maximum distance covered is recorded. Examiners provide standardized encouragement every 30 seconds, by telling individuals "you're doing well, keep up the good work." Two trials should be performed at baseline, approximately 20 minutes apart. During the rest interval, participants can sit down. If an assistive device is used, the type of device is recorded.

This test is used in clinical trials because it provides useful information of functional capacity in patients with various disorders (Casanova et al., 2011).

- MiniOQLQ (Mini-Osteoporosis Quality of Life Questionnaire) - we used this scale as a single assessment of independence and to review the progress of a patient over time; it contains 10 items and measures five important domains: symptoms, physical function, activities of daily living, emotional function, leisure activities. The mini-OQLQ includes the two items with the highest impact scores in each of the five domains from the original OQLQ instrument. Each item is associated with a 7-point scale in which a rating of 7 represents the best possible function and a rating of 1 represents the worst possible function (Madureira et al., 2012).

After complete evaluation, all females were trained for 12 weeks (inpatient – 2 weeks and outpatient – 10 weeks). We applied a *complex rehabilitation program* that covered the following compartments: hygienic-dietetic and educational (for risk factors – avoidance of tobacco use and excessive alcohol intake, adequate intake of milk derived food and healthy diet), medication (calcium, vitamin D and bisphosphonate medications), electric measure (only one procedure of electrotherapy – TENS for pain management), kinetic, massage adapted for each patient at all times.

We designed a *kinetic program*, defining the following:

- assistance rehabilitation constituent;
- optimal exercises in the kinetic program applied in relation to the prevention of bone loss and the global clinical-functional status;
- optimal number of rehabilitation meetings and also the rhythm for as much as complete recovery of the patient.

The *objectives of the kinetic program* applied to our patients were:

- body posture correction and postural control;
- muscle strengthening and preservation of skeletal muscles;
- improvement of functional abilities (especially gait) and decrease in the risk of falling;
- improvement of quality of life.

Patients were trained 3 days a week, for 12 weeks. Every day, each patient attended two kinetic sessions (*a.m.* - strength and physical conditioning training programs and *p.m.* - coordination and balance exercises). Both trainings were performed as individual treatment in an outpatient setting with the same duration and frequency, as follows: 36 treatment sessions of 60 minutes each, 3 days a week, for 12 consecutive weeks. On the other days of the week, all studied females performed regular brisk walking for 20 minutes and stair climbing – 2 or 3 floors, daily.

A.m. exercises. In the first week, all patients performed a.m. lower limb and upper limb joint mobilization, 2 sets of 10 repetitions, then conventional resistance exercises 2 sets of 12 repetitions at 50% of the one-repetition maximum (1 RM) (for plantar-/dorsi-flexion, knee extension and flexion, hip abduction, trunk extension, in this order). A rest interval of three minutes was allowed between exercises and sets. After two weeks, patients performed the same exercises, but 3 sets of 10 repetitions, for joint mobilization and 2 sets of 12 repetitions at 60% of 1RM, and in the last 2 months patients performed resistance exercises at 75% of 1 RM. There was a linear progression of exercise intensity, and 1 RM was determined very cautiously to avoid vertebral fractures in our studied patients. We used exercises based on isotonic resistance and progressive resistance training (belt exercises, dumbbells and weighted vest). Before and after the strength training session, each patient performed stretching exercises for all main muscle groups. The heart rate was monitored.

P.m. exercises. The coordination exercises applied p.m. were represented by the following sequences of exercises:

1. exercises for axial mobility (head extension, shoulder flexion, trunk extension, in this order) associated with muscle relaxation and diaphragmatic breathing to increase the range of motion of the neck and trunk. The exercises for active mobilization were represented by Kabat diagonals (flexion and extension first diagonals, flexion and extension second diagonals for each side and both sides); each patient performed 10 exercises without resistance; breathing was synchronized with the Kabat diagonal. In the sitting position, the patient performed exercises for the scapulohumeral joint and the elbow joint, for the trunk and upper limbs, and finally, for the trunk and lower limbs.
2. exercises to improve balance and coordination – heel raises and toe pulls, compensatory strategies such as hip strategy and step strategy, including corrective and tandem walks and obstacle course;
3. gait training, using appropriate assistive devices for ambulation and walking on different surfaces for all studied patients.

In the kinetic hall, soft music was played for relaxation.

d) Statistical processing.

Statistical analysis was performed using Microsoft Excel (Microsoft Corp., Redmond, WA, USA), together with the XLSTAT add-on for MS Excel (Addinsoft SARL, Paris, France) and IBM SPSS Statistics 20.0 (IBM Corporation, Armonk, NY, USA) for data processing. To describe the numerical data used in the present study, we used the following statistical indicators: arithmetic mean and standard deviation, and spread indicators - minimum, maximum, median, quartiles (percentiles).

Because the study involved a numerical comparison between 2 groups of patients that did not have a normal (Gaussian) distribution, verified with the Anderson-Darling normality, the nonparametric Mann-Whitney test was primarily used, alongside Student's t test, to detect significant differences between the values in the compared data series.

Results

The two groups (C - control and E - study) were compatible in terms of structure. The percentage differences were not statistically significant when comparing the distribution for residence **(**p $\chi^2 = 0.148$**)** (Table I).

Table I

Patients' demographic data

Group	Urban	Rural	Age (years)	
C Control group 17 females	10 (58.82%)	7 (41.17%)	Minimum	62
			1st quartile	66
			Median	70
			3rd quartile	74
			Maximum	77
E Study group 21 females	13 (61.90%)	8 (38.09%)	Minimum	62
			1st quartile	67
			Median	70
			3rd quartile	73
			Maximum	77

Comparing the age distributions for the two patient groups with the Mann-Whitney test did not result in statistically significant differences (pMW=0.953).

The mean values and standard deviations of the studied paramaters for the two studied groups at the initial and final assessment are presented in Table II.

For each parameter, the Mann-Whitney and Student t test for means were used in order to compare initial and final p values for the study and the control group.

VAS

Performing the Mann-Whitney and Student t test for means, to compare initial and final VAS for the study and the control group, we found no statistically significant difference between the two groups, for the initial evaluation, the result being p = 0.43 > 0.5; for the final evaluation we found a statistically significant difference between the two groups, the result being p = 0.015 < 0.5. When performing the Student t test for means, to compare VAS differences for the study and control groups, we found a statistically significant difference between the two groups, the result being p = 0.011 < 0.5, meaning the decrease was greater for the study group.

The Timed Up and Go test

Performing the Mann-Whitney and Student t test for means, to compare initial and final TUG for the study group and the control group, we found no statistically significant difference between the two groups, for the initial evaluation, the result being p = 0.287 > 0.5; for the final evaluation we found a statistically significant difference between the two groups, p = 0.010 < 0.5. When performing the Student t test for means, to compare TUG differences for the study and control patients, we found a statistically significant difference between the two groups, the result being p = 0.048 < 0.5, meaning the decrease was greater for the study group.

The 6 MWD

Performing the Mann-Whitney and Student t test for means, to compare initial and final 6MWD for the study group and the control group, we found no statistically significant difference between the two groups for the initial evaluation, the result being p = 0.775 > 0.5, or for the final evaluation, p = 0.302 > 0.5. When performing the Student t test for means, to compare miniOQLQ differences for the study and control patients, we found no statistically significant difference between the two groups, the result being p = 0.256 > 0.5.

MiniOQLQ

Performing the Mann-Whitney and Student t test for means, to compare initial and final TUG for the study group and the control group, we found no statistically significant difference between the two groups, for the initial evaluation, the result being p = 0.340 > 0.5; for the final evaluation we found a statistically significant difference between the two groups, p = 0.048 < 0.5. When performing the Student t test for means, to compare miniOQLQ differences for the study and control patients, we found a statistically significant difference between the two groups, the result being p = 0.007 < 0.5, meaning the decrease was greater for the study group.

Discussions

Rehabilitation of our patients was performed by a multidisciplinary team, as it is mentioned in the medical literature (Kerschan-Schindl, 2016) and included adequate pain management, daily mobilization, specific training of muscles and coordination, instruction on how to avoid falls, nutrition and lifestyle modifications, and psychosocial assessment.

We recommended as part of patient rehabilitation the TENS procedure for control of low back pain, because effective pain management is a cornerstone for subsequent physical training. Pain relief can be obtained by the use of a variety of physical methods, like in our study, pharmacological and behavioral techniques (Gillespie et al., 2010).

Our studied patients were diagnosed with primary osteoporosis before we started our work, so we had the value of lumbar BMD previously established in the endocrinology department. So, we did not perform the FRAX scores, as we usually did in postmenopausal women. FRAX scores were significantly higher in patients with fragility fractures and can be useful in choosing the right patients for bone density testing, thus using an expensive test judiciously (Bansal et al., 2018). Seeing that the FRAX tool showed low sensitivity and specificity in identifying reduced bone quality in the lumbar spine (Bergh et al., 2018), we understood why it is important to evaluate lumbar BMD in order to optimize treatment strategies. The value of lumbar spine BMD was not reevaluated because the length of our study was 3 months

Table II

The studied parameter values

Studied parameter	Study (E) Group		p	Control (C) Group		p
	Initial (M ± SD)	Final (M ± SD)		Initial (M ± SD)	Final (M ± SD)	
VAS	8.19 ± 0.60	4.19 ± 0.60	<0.001	8.00 ± 0.87	4.24 ± 0.44	<0.001
TUG (seconds)	12.67 ± 1.49	8.95 ± 1.20	<0.001	13.18 ± 1.38	9.59 ± 1.12	<0.001
6MWD (meters)	393.57 ± 18.92	430.51 ± 20.11	<0.001	395.84 ± 17.54	427.62 ± 20..95	<0.001
miniOQLQ	3.28 ± 0.44	4.49 ± 0.15	<0.001	3.42 ± 0.43	4.40 ± 0.13	<0.001
S	0.99 ± 0.18	1.21 ± 0.06	<0.001	1.05 ± 0.17	1.23 ± 0.07	<0.001
PF	0.43 ± 0.10	0.63 ± 0.05	<0.001	0.41 ± 0.14	0.65 ± 0.06	<0.001
EF	0.86 ± 0.28	1.19 ± 0.03	<0.001	0.99 ± 0.15	1.19 ± 0.02	<0.001
ADL	0.47 ± 0.07	0.76 ± 0.14	<0.001	0.44 ± 0.05	0.71 ± 0.13	<0.001
L	0.53 ± 0.06	0.64 ± 0.07	<0.001	0.52 ± 0.04	0.62 ± 0.04	<0.001

VAS = Visual Analog Scale, for pain; TUG = Timed Up and Go test; 6MWD = 6-minute walking distance; MiniOQLQ = Mini-Osteoporosis Quality of Life Questionnaire; S = symptom items, PF = physical function items, ADL = activities of daily living items, EF = emotional function items, L = leisure activity items and previous medical data, a meta-analysis of randomized controlled trials, reported that physical training based on resistance exercises three times a week for 1 year proved to maintain or increase BMD in postmenopausal women (Ram Hong & Wan Kim, 2018; Gomez-Cabello et al., 2012). In the last five years, the lumbar spine trabecular bone score has been mentioned – a novel texture parameter for the assessment of trabecular bone microarchitecture based on spinal DXA images through the measurement of pixel gray-level variations (Silva et al., 2014). This novel parameter permits to study the impact of physical training on the trabecular bone compartment, such as volumetric BMD. It is recognized that DXA does not capture the bone quality (Ram Hong & Wan Kim, 2018).

The length of our study will not allow determining the physical training effect in preventing some loss of BMD, particularly in the lumbar spine. The benefits of aerobics, weight-bearing, and resistance exercises have been explored extensively over the past two decades and are generally less than 2% (Hamilton et al., 2010).

We performed in our patient conventional radiographs of dorsal and lumbar spine segments, for the differential diagnosis of low back pain. This imaging detail is used in clinical trials and represents a useful means for the assessment of bone-specific treatment effects in postmenopausal women with osteoporosis (Dimai et al., 2018).

The evolution of the studied parameters is in accordance with other studies, but the changes were statistically significant only for VAS and TUG tests, which suggested the efficiency of the rehabilitation program for the functional status of gait and balance (Behrens et al., 2017).

The miniOQLQ improved in both groups, but the physical function item significantly improved in females that performed the kinetic program. This result confirms the complex impact of kinetic measures in osteoporosis management. A Cochrane review evaluating the benefits of physical therapy interventions for improving quality of life in patients with osteoporotic vertebral fractures found inconsistent results and stated that the quality of evidence was very low (Dohrn et al., 2017).

Musculoskeletal system health represents an important aspect for people with chronic diseases worldwide, especially in elderly persons and particularly in females with osteoporosis (Ram Hong & Wan Kim, 2018). The two components of the musculoskeletal system – bone and muscle – are strongly interconnected by anatomic, metabolic and chemical aspects, so correct osteoporosis diagnosis is made in accordance with sarcopenia (Curtis et al., 2015). Age-related loss of bone and muscle mass occurs almost simultaneously, and the loss of muscle mass is predominantly detected in type II fibers (the entire bone-muscle unit is reduced to 50% in elderly adults as compared with young adults) (Ji et al., 2015). These chronic diseases – osteoporosis and sarcopenia – are widely considered public health problems and are associated with physical disability because the quality and fine structures of the bones are deteriorated. Exercise training has been indicated as an optimal strategy for conservation of musculoskeletal health and function in all persons, because it is a low-cost and safe non-pharmacological measure (Ram Hong & Wan Kim, 2018; Beck et al., 2017).

In the last decades, a lot of clinical trials have been conducted regarding the importance of physical training and exercises in the management of osteoporosis patients. When establishing the kinetic program in our studied patients, we took into consideration the following aspects:

1. Mechanical load induced by exercise training increases the muscle mass, produces mechanical stress in the skeleton and enhances osteoblast activity, with different osteogenic effects (Fleg, 2012; Palombaro et al., 2013) and may be an efficient option for autonomous fracture prevention during increasing age (Kemmler et al., 2015).

2. Regular walking has little or no effect on prevention of bone loss; despite the benefits of regular walking on aerobic fitness, adiposity and cardiometabolic factors, walking alone is insufficient to optimize musculoskeletal health (Ma et al., 2013). We took walking as a means for reducing and breaking up the sitting time; this aspect may also help attenuate muscle loss.

3. The resistance exercises performed target the major muscle groups attached to the hip and spine; the intensity and type of resistance exercises should be individualized depending on the functional status and ability of patients (Stewart et al., 2014). Traditional progressive resistance training is effective for improving muscle mass, size and strength, but it has mixed effects on muscle function and falls, which may be due to the common prescription of slow and controlled movement patterns (Daly, 2017). In our study we recommended an exercise session based on two sets of one exercise for each major muscle group of the lower limbs and extensor spine at a target intensity of 12 repetition maximum (RM), 3 days a week, as it was indicated in other studies and in the WHO global recommendation for older patients aged over 65 years (***, 2010). We respected the current exercise guidelines for osteoporosis (moderate-intensity exercises - 70% to 80% one RM, eight to 15 repetitions; our patients performed 75% one RM, 12 repetitions), albeit this type of exercise is insufficient to generate mechanical strain to promote an osteogenic response, but it is safe, without increasing the risk of injury or pain (Giangregorio et al., 2014). We paid great attention to the spine muscles, because the back extensor strength was the most significant contributor to spinal mobility, which had a strong effect on quality of life in patients with osteoporosis. Twelve years ago, it was demonstrated that low-intensity back-strengthening exercise was effective in improving the quality of life and back extensor strength in patients with osteoporosis (Hongo et al., 2007). Over and above, stronger back extensor muscles have been shown to decrease the risk of vertebral fractures independently of pharmacotherapy (Hourigan et al., 2008). Therefore, we included in the physical program this type of exercise - strengthening exercises for back extensors – with good results for our patients.

4. Multidirectional training is essential in physical training in osteoporosis patients because bone adapts to unidirectional movement, so diversification of loading is required. So, we combined aerobic physical training with brisk walking, to provide our patients with an optimal musculoskeletal status and to prevent fractures (Ram Hong

& Wan Kim, 2018). Balance and coordination exercises are fundamental for the reduction of fall and fracture risk in older patients with or without chronic disorders. Today, targeted multimodal programs incorporating traditional and high-velocity resistance exercises, weight-bearing impact exercises and challenging balance/mobility activities appear to be most effective for optimizing musculoskeletal health and function (Daly, 2017). In post-menopausal women with osteopenia and osteoporosis, neuromuscular power is a more important determinant of postural control than muscle strength or size, so the integration of power or speed training into fall prevention and balance training programs in post-menopausal women with low bone mass is promoted (Stolzenberg et al., 2018). Since most osteoporotic fractures occur during a fall, fall risk reduction is an important measure to inhibit a new fracture. This important objective in the management of osteoporotic patients is mentioned in the guidelines for the diagnosis and management of osteoporosis in 2013 (Kanis et al., 2018).

The complex rehabilitation program performed is substantiated not only by physical training but also by educational aspects, nutrition and medication prescribed. An interaction was evidenced between exercise and various nutritional factors, particularly protein and some multinutrient supplements, on muscle and bone health in the elderly (Daly, 2017).

In our study, the number of patients who had exercise adherence in osteoporosis management was greater compared to those without compliance to physical training. In most clinical trials it is mentioned that adherence to exercise is poor and the main facilitator and barrier to exercise is still unclear; also, methods to promote and measure exercise adherence were unsatisfactory (Rodrigues et al., 2017). Maybe the future can change this negative aspect for quality of life in osteoporosis females. The mean values of subscales in MiniOQLQ proved that a complex rehabilitation program, based on physical training – a multipurpose exercise program, improved self-care maintenance behaviors and quality of life in osteoporosis females. Our results were similar to those of other studies (Basilici Zannetti et al., 2017; Kemmler et al., 2015; Wen et al., 2017).

We recommended a home training program and several interventions for all studied patients to preserve bone strength, improve physical function and lower the risk of subsequent falls, as mentioned in the medical literature (Larsen et al., 2004). These include: prescription for assistive devices for improved balance with mobility, training for the performance of safe movement and safe activities of daily living, including posture, transfers, lifting and ambulation, an adequate intake of calcium and vitamin D, lifelong participation in regular weight-bearing and muscle-strengthening exercise, cessation of tobacco use, identification and treatment of alcoholism, and treatment of risk factors for falling.

Conclusions

1. The anatomic, biomechanical and functional connections between bone and muscle have a complex implementation in the pathology aspect - osteoporosis and sarcopenia often coexist and have similar health consequences with regard to disability, falls, frailty and fractures.

2. All management programs in osteoporosis females should include exercise and adequate nutrition, particularly with regard to vitamin D, calcium and protein, individually tailored and using the adequate type and dose of the prescribed forms.

3. Regular physical activities are well known for their many benefits, both in the short and long term. A multimodal kinetic program is an important component of the rehabilitation program; proper exercises improve physical performance/function, bone mass, muscle strength and balance, and they reduce the risk of falling.

4. A significant and complex impact of osteoporosis is counteracted by physical and kinetic measures that can reduce disability, improve physical function, self-care, and lower the risk of subsequent falls in patients with osteoporosis.

Conflicts of interest

No conflicts of interests.

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