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Effectiveness of physical exercise for improving static and dynamic balance in patients with osteoporosis

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Abstract

Background: Osteoporosis is a metabolic disease widely spread both worldwide and in our country, being a major public health problem, with serious social and psychological consequences, by the huge costs involved, as well as by its high morbidity.

Aim: We intend to prove the effectiveness of using physical exercise for improving static and dynamic balance in patients with osteoporosis.

Methods: Our research includes 8 women aged between 50 and 70 years, diagnosed with postmenopausal osteoporosis. The patients were evaluated before and one month after the physical exercise program, using the "Timed Up and Go" Test and the Berg Balance Scale.

Results: All patients included in this research experienced improvements in postural stability, static and dynamic balance.

Conclusions: After performing a one-month program of specific physical exercise, with a frequency of 3-4 times a week, the risk of falls decreases, increasing the static and dynamic balance.

Key words: *physical exercise, balance, osteoporosis*

Rezumat

Fundamentare: Osteoporoza este o boală metabolică cu o largă răspândire atât pe plan mondial cât și în țara noastră, fiind o problemă majoră de sănătate publică, cu grave consecințe pe plan social și psihologic, atât prin costurile uriașe pe care le presupune, cât și prin morbiditatea ridicată.

Scop: Ne propunem să demonstrăm eficacitatea utilizării exercițiilor fizice în ameliorarea echilibrului static și dinamic la pacienții cu osteoporoză.

Metode: Am luat în studiu 8 femei cu vârstă cuprinsă între 50-70 de ani diagnosticate cu osteoporoză postmenopauză. Pacientele au fost evaluate, înainte și la o lună, de la efectuarea unui program de exerciții fizice, cu ajutorul testului "ridică-te și mergi" și scalei Berg.

Rezultate: Toate pacientele incluse în acest studiu au înregistrat îmbunătățiri în ceea ce privește stabilitatea posturală, echilibrul static și dinamic.

Concluzii: Efectuarea timp de o lună a unui program de exerciții fizice specifice, cu o frecvență de 3-4 ori pe săptămână, determină scăderea riscului de căderi, crescând echilibrul static și dinamic.

Cuvinte cheie: *exerciții fizice, echilibru, osteoporoză*

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Introduction

Osteoporosis is a global public health issue. Osteoporosis is estimated to affect approximately 75 million people in Europe, the United States and Japan. Studies have shown that in 2000 the number of fractures caused by osteoporosis was of 3 790 000 [1].

In Europe, the total costs for treating the fractures caused by osteoporosis amounted to approximately 31.7 billion Euros. Females are more prone to osteoporosis, this disease affecting 60% of females and 30% of males aged over 60 [2].

Currently, osteoporosis is considered by the World Health Organization (WHO) to be one of the major diseases of our times. Following the research carried out, the WHO estimates that in the next 20 years, the number of people affected by this disease will double. In fact, the forecasts for 2050 estimate an increase in the incidence of osteoporotic fractures of 240% in women and 310% in men [3].

Over the past few years, progress has been made in understanding the pathophysiological mechanism of this disease. Sophisticated technologies have added important information on bone and geometric mineral density measurements, as well as on the mechanical properties of the bone. New bone indices have been developed based on biochemical and hormonal measurements in order to investigate bone metabolism [4]. Although it is clear that medicines are an essential element of therapy, beyond medication there are other interventions in the treatment of the disease.

Several experimental studies have shown that practicing certain exercises has beneficial influences on bone mass. Certain factors such as compressive forces combined with the traction force determined by muscle contraction, as well as with the gravitational force, stimulate osteogenesis [5]. At the compressive stress points, osteogenesis is caused by a piezoelectric effect: bone compression produces a negative potential at the site of compression and a positive potential in another region of the bone. It has been shown that minimum amounts of current passing through the bone determine the osteoblastic activity at the negative pole of the current flow, which may explain the intensification of osteogenesis in the compression areas [6].

In this paper, we intend to prove the effectiveness of using physical exercise programs for improving static and dynamic balance in patients with osteoporosis.

Material and methods

Our research includes 8 women aged between 50 and 70 years, diagnosed with postmenopausal osteoporosis or osteopenia.

The individuals participating in the research were selected in compliance with the following criteria:

- all participants in the research are female;
- the participants' age is between 50 and 70 years;
- all patients have been diagnosed with type-1 osteoporosis or osteopenia;
- none of the participants in the research suffered fractures caused by osteoporosis or of an etiology other than osteoporosis;
- the duration of menopause is of at least 2 years;
- the patients do not have other conditions that could represent contraindications for physical activities.

In table I we presented the general characteristics of the subjects included in the research.

Table I. Research participants

N.P	Age	Sex	W	H	BMI	Smoker	Coffee
SD	51	F	69	1.61	26.62	NO	YES
NM	61	F	115	1.64	42.76	NO	YES
SM	70	F	82	1.68	29.05	YES	YES
KN	56	F	90	1.68	31.89	NO	YES
SR	53	F	110	1.65	40.40	NO	YES
AM	55	F	88	1.68	31.18	NO	YES
BM	65	F	78	1.65	28.65	YES	YES
ML	56	F	75	1.66	27.22	YES	YES

Legend: W=weight (kg), H= height (m), BMI= body mass index (kg/m²)

All patients included in the study received medicine therapy and an exercise program for 1 month. In order to observe the changes determined by the practice of physical activities, as well as for the purpose of adjusting or changing of the physical activity programs, the patients were subjected to an initial and final evaluation, 1 month after the beginning of the research.

The evaluations consisted of:

- discussions with the patients, anamnestic data;
- measuring height, weight and body mass index;

- clinical examinations;
- static and dynamic balance tests;
- the “Timed Up and Go” Test;
- the Berg Balance Scale;

The Berg Balance Scale is a 14-item that the patient must perform. According to the way in which they are performed, each task is rated by 0-1-2-3-4 (0-unable to perform, and 4 - performs without any difficulty).

The evaluation of the dynamic balance was carried out using the “Timed Up and Go” Test. The “Timed Up and Go” Test is very commonly used in the elderly. Basically, it takes place as follows: the patient sits on a chair, he/she is ordered to stand up (without support), to walk 6-10 meters, to turn around and sit back on the chair. The duration of these actions can be timed.

The exercise program was carried out over a period of 1 month with a frequency of 3-4 times a week, during which the main objectives pursued were:

- to improve postural stability;
- to improve the body coordination, control and balance function;
- to correct posture and body alignment;
- to increase muscle strength.

The exercise program focused on balance exercises using the balance board, walking on rough ground, various lower limb coordination exercises, postural muscle toning exercises, maintaining various postures and exercises in these positions with changes in the support base and variations in the height of the center of gravity [7, 8].

Results

At the end of the research, all parameters were systematized, statistically processed and compared with the initially recorded values. Regarding the Berg Balance Scale, the results obtained are presented below (table II). A score of 0-20 means a high risk of falling, 21-40 a medium risk of falling, and 41-56 a low risk of falling. It can be noticed that after a month of physical exercise, the balance improved in all subjects, and at the final evaluation they presented a low risk of falling.

Table II. Results of balance evaluation using the Berg Balance Scale

Subject	Initial evaluation	Final evaluation	Difference
S.D.	52	53	1
N.M.	50	52	2
K.N.	40	45	5
S.M.	22	26	4
Ş.R.	49	51	2
A.M.	52	52	0
B.M.	39	43	4
M.L.	40	45	5

After analyzing the data recorded for the patients, we can say that the subjects’ balance has improved significantly following the application of the physical exercise program (p=0.01) (table IV).

In order to evaluate the patients’ dynamic balance we used the “Timed Up and Go” Test, whose results are presented in table III.

Table III. Results of the “Timed Up and Go” Test

Subject	Initial evaluation (seconds)	Final evaluation (seconds)	Difference (seconds)
S.D.	16	15	-1
N.M.	16.38	15.40	-0.98
K.N.	22.06	21.10	-0.96
S.M.	26.30	25	-1.3
Ş.R.	15	15	0
A.M.	15.25	14.30	-0.95
B.M.	19.15	18.28	-0.87
M.L.	20.45	19.45	-1

Table IV. Effect of the intervention on balance

Test	Initial evaluation	Initial evaluation	p
The Berg Balance Scale (points)	43.00 +/-10.16	45.88 +/-8.92	0.01
The “Timed Up and Go” Test (seconds)	18.82 +/-3.97	17.94 +/-3.76	< 0.05

Following the application of the one-month physical exercise program, we noticed a significant improvement in the dynamic balance (table IV).

Discussion

Osteoporosis is a widespread disease worldwide and is a largely debated topic in numerous studies. After completing the physical exercise program, the subjects included in our research improved their static and dynamic balance.

Similar results to our research were reported by Marcu RI et. al. in a study evaluating the effectiveness of an exercise program on the functionality and quality of life in women with postmenopausal osteoporosis [9]. In this sense, the patients followed exercise programs aimed at increasing spine mobility, muscle strength, as well as improving the static and dynamic balance. The evaluation was carried out at the beginning of the study and 6 months after.

Another study stressing the importance of physical exercise programs in patients with osteoporosis is the one published by Harada A. [10] which, in addition to diet and medicine treatment, proposes exercises for strengthening postural muscles (lumbar, abdominal muscles, etc.), exercises for posture correction, muscle stretching exercises, but also Tai Chi.

The importance of physical exercise in women suffering from osteoporosis has been recently shown in another paper that presented the results of 12 months of Pilates exercises, showing a significant increase in the speed of ultrasound at the calcaneus level, thus indicating the increase of bone density and elasticity [11].

Conclusions

The results obtained following this research allow us to conclude that after a one-month program of specific physical exercise, with a frequency of 3-4 times a week, the risk of falls decreases, increasing the static and dynamic balance.

Balance training includes exercises for toning postural muscles, balance and coordination exercises, and posture correction exercises. These types of exercises improve stability and can help prevent falls that are so dangerous in people suffering from osteoporosis.

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