Osteoporosis and exercise

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ABSTRACT
The disease of osteoporosis in recent years is advancing so rapidly that it is estimated that by 2020 USA will become affected about 61 million people. It is an asymptomatic disease and therefore do not allow early diagnosis. Statistics has shown that 10% of patients suffering from an osteoporotic fracture, eventually die from their fracture.

The aim of the present study is to evaluate if it is possible to have a positive effect in prevention and treatment of osteoporosis and by other factors, such as exercise. The findings recorded in this, based on the findings of several studies. In this particular article there is an attempt to answer the following questions: (1) How exercise affects bone growth; (2) What are the results of aerobic exercise on bone density? (3) Effects of anaerobic training in osteoporotic persons; (4) Which of the two types of exercises, aerobic or anaerobes are more effective for the treatment of osteoporosis, and what is the ideal workout?

The conclusion is that exercise, especially anaerobic can be a very useful tool in both the prevention and the rehabilitation of osteoporosis.

Keywords: Osteoporosis; exercise

INTRODUCTION
In nowadays Osteoporosis is a widespread disease that is increasing in frequency and severity. Particularly in developed countries, where the average life expectancy has increased. According to the definition given in the 1996 World Congress of Amsterdam “Osteoporosis is a systemic skeletal disease, characterized by low bone mass and micro architectural deterioration of bone tissue structure, with a consequent increase in bone fragility and susceptibility to fractures”.

In addition, osteoporosis has been described as “silent” and “insidious” disease because it is asymptomatic, so the diagnosis many times follows the induction of a fracture that actually cannot be justified by the mechanism of causation. But then the bone mass is already reduced by 30%. For this reason men and women after the age of 50 should be submitted to the examination of the measurement of bone density.

Osteoporosis is distinguished in primary, which is divided in postmenopausal for women and in senile for men, and in secondary, which occurs as a side effect of a treatment therapy in conditions such as diabetes, Crohn’s Cushing, multiple myeloma, etc.

In USA it is estimated that 44 million people suffer from osteoporosis, which is expected to reach 61 million by 2020. 30% of them are men, which debunks the myth of “female condition”. Osteoporotic fractures come up 1.5 million each year, with 10% of fractures to die with in the first year. The areas, which fractures occur most is the spinal column with 50%, hip with 20% and wrist with 15%. The restoration of all these fractures burdens the American state budget with 17 billion dollars per year, which is not an insignificant amount1.

In the case that someone has been diagnosed with osteoporosis, the first thing that will happen is the administration of medication. The drugs used today are
divided into three categories, depending on how they impact on bone mass. In the first category are listed those which act primarily on osteoclasts as estrogen, tibolone, calcitonin and bisphosphonates. In the second are found those which act primarily on osteoblasts as sodium fluoride and anabolic steroids and finally in the third medicines that contribute to positive calcium balance and these are calcium, vitamin D and theiasides.2

However, despite the undeniable value of medications, in recent years more and more studies show the value of exercise for prevention and rehabilitation of osteoporosis. Exercise is a key factor to bone. The skeleton is made so not only to withstand the charge, but also to be nourished by it. Hence a rehabilitation program regarding osteoporosis except medications should include exercise. At this point, however, the following questions arise: (1) Effects of exercise on bone growth? (2) What is the effect of aerobic exercise on bone mineral density? (3) Effects of anaerobic training in osteoporotic individuals? (4) Which of the two types of exercises, aerobic or anaerobic is more effective for the treatment of osteoporosis? and what is the ideal workout?

I. EFFECT OF EXERCISE ON BONE MINERAL DENSITY

Before referring to the effect of exercise on bone mineral density, it should be discussed a reference to the concept of peak bone density and other factors that may lead to the onset of osteoporosis. Today, scientists around the world have started a campaign on these factors, because it has become clear to everyone that the treatment of osteoporosis begins with prevention, with other words the caring for achieving high peak bone density. This care should start from the first years of life.

With the term “peak bone density” we refer to the maximum achievement of bone density during the life, which is related to bone metabolism. The peak bone density is achieved around the 30th year for men and 25th for women. The achievement of very high peak bone density reduces the likelihood of developing osteoporosis in later life, contrary to achieving low peak bone density that leads probably after the fourth decade of life in osteoporosis.

Achieving the ultimately bone density depends on hereditary factors up 80%, by hormonal factors e.g. if there are hormonal disorders affecting skeletal development. Also very important role in the development of bone density plays a calcium rich diet during childhood and adolescence (800-1200 mg Ca per day). Finally, increased activity at these ages contributes decisively to skeletal development. Therefore, the more correct way of life we follow the higher bone density will succeed.

Many studies in athletes, but also in other well-exercised persons showed a positive effect of exercise in achieving high peak bone density. The research Courteix et al5 in girls before puberty, showed significant differences in bone mass between those who were gymnastics athletes and those who exercised less than 3 hours a week. These differences were about the diaphysis and epiphysis of the radius, lumbar spine and the femoral neck with percentages 15.5%, 33%, 11% and 15.5% respectively.

Moreover, Zanker et al6 studied the differences in bone density between boys and girls who exercised regularly and others that did not exercise. All children in the study were aged 7-8 years, and did not differ significantly from each other in height and weight. The one team exercised for 8-10 hours a week for 3 years. After this time the measurements performed showed that the bone density in the spine, pelvis, hands and feet, in children exercisers was 8-10% higher than in the children of the other team. Among boys and girls who did not exercise there were no differences.

However, apart from the factors that help in skeletal development we have also other factors that lead to the appearance of osteoporosis and are divided into two categories, i.e. (a) those that do not change and (b) those that are changing. The first includes gender, age, body type, heredity and the white race. A study of Jeng et al7 showed that women in the first 5 years following menopause lose annually 2-3% of their bone mass, while after this period the loss rate drops to 1%. By the age of 80 years it is estimated that their bone density has been reduced by half.

With regards to the factors that do not change, interesting are considered to be the findings of the research conducted by Center et al8 that showed the connection between age and body type with the risk of developing osteoporosis. The results showed that between 60-69 years the chances were 14% for women and 6% for men, between 70-79 years 37% and 14% respectively and at ages 80-89 the rates were 61% and 24%. Moreover, people of small stature and low birth weight have greater risks comparing to taller and more portly persons. These observations are valid for both sexes.

The second category of factors refers to poor nutrition of calcium (less than 800 mg daily) and vitamin D, to smoking, to excessive alcohol and caffeine consumption, use of corticosteroid drugs, to sedentary lifestyle and prolonged immobilization.9 In the same survey of Center et al8 demonstrated that women and men who had a high intake of calcium daily (over 710 mg) had higher bone mineral density at the femoral neck by 2.5% compared with their peers who had low calcium intake. Also, the men observed greater bone mass at the lumbar spine.

Concerning the exercise, the research of Friedlander et al10 studied the effect of exercise on bone mineral
density among 127 young women aged 20 to 35 years. Subjects were divided into two groups: the first consisted of aerobic exercises and strength training, while the second ordinary activity of individuals. The measurements were made after two years and showed a significant increase in bone mineral density in the first group, namely 2.5% at the spine, 2.4% at the femoral neck, 2.3% at major trochanter and 6.4% in the heel.

The effect of the exercises on bone mineral density was studied a few years later by Sievanen et al11 in women of different ages, from 20 to 65 years. They split into three age groups 25 to 30, 40 to 45 and 60 to 65, but all followed the same exercise routine which was 3 times a week high intensity exercise, such as brisk walking and light jogging. Also created another 3 control groups in the same age, which had to continue their normal activity. After 12 months the bone density of all groups was measured and found that women who exercised had higher total bone density by 1.8% and 5% at the femoral neck, comparing to the other age groups with no activity. The above research has shown that the benefits of exercise are similar in both the younger women and the oldest, giving the conclusion that it is never too late for someone to join a fitness program.

Furthermore, the benefits of the exercise on the bone mineral density of the elder women are also confirmed by another research conducted by Kontulainen et al12. The survey involved 65 premenopausal women, of whom 34 were the exercise group and the other 31 the comparison group. The exercises given in the first group were of high intensity, such as bounces and resistance exercises with about 105% of their weight. The results obtained after 18 months of practice showed an increase in bone density in the first team at various points, such as the femoral neck by 1.2% in the lumbar spine of 1.7%, 0.7% in the patella, the pineal gland 2.2% of the femur to the tibia and finally 3.3%.

Finally, according to Blanchet et al9, the active women reach menopause at an older age, than those who are sedentary, which is very important, because the more slowly the menopause starts the slower will be the loss of bone tissue due to the reduction of estrogen. Therefore, the exercise should have a more prominent role in our daily life because it has a positive impact in many ways on the health of our bones.

II. EFFECT OF AEROBIC EXERCISE ON BONE MINERAL DENSITY

In the previous chapter we dealt with the effect of exercise on overall development of bone density and prevention of osteoporosis. In this section we will present the effect of aerobic exercise in people with osteoporosis. By aerobic exercise we mean prolonged, repetitive rhythmic isotonic exercise that uses as energy source oxygen and aerobic oxidation of lipids and carbohydrates. Such exercises are walking, jogging, cycling, dancing and swimming.

Several studies have been conducted through years on samples of postmenopausal women so as to examine the contribution of exercises on osteoporosis issues. In 1996 Bravo et al13 conducted such an investigation on a sample of 142 postmenopausal women in Canada, aged 50-70 years, with low bone density. The survey lasted one year. The participants were divided into two groups, one that had regular exercise and one that continued with usual activities. For the first group training exercise would be 3 times a week, for 1 hour and included walking intensity from 60 to 70% of Max HR. The measurements were made after 12 months with DXA and showed an increase of 0.83% in the mean BMD.

Several studies followed examining the effect of different types of exercises such as the one conducted by Kohrt et al14 who studied the effect of exercise with vibration, e.g. walking, jogging, climbing stairs, for 11 months in women aged 60 to 74 years. The groups were again 2, the exercise and the control team. The exercises given were walking and jogging. During the first 2 months the exercise team did 30 min of walking (without preheating and recovery) with an intensity of about 70% of Max HR. After this time duration was increased to 45 and the tension in 80% to 85% of Max HR. Also, after 3 months they added running. The exercise team had to run the one of the 3 rounds in order to increase the reaction of the ground on the skeleton. The frequency of training started at 3 times a week and ended at 5. The measurement of bone mineral density in the 2 groups was by DXA. After 11 months the total bone mineral density in the first group had increased by 2% in the spine, specifically 1.8% in the lumbar spine and 6.1% in the thigh. In the control group there were no significant changes.

Furthermore the effect of walking, the easier and affordable for everyone exercise, since it requires neither special skills nor any equipment was studied by Yamazaki et al15. More specifically they studied the effect of moderate walking in postmenopausal women with osteopenia - osteoporosis aged 49 to 75 years. For the purposes of this study, they took 32 women who were the exercise team and another 18 that were the comparison group. The study lasted 1 year. The exercise which had to do the first group was walking at an intensity of 50% of maximum oxygen uptake for at least 1 hour and at a frequency of 4 times weekly. The bone density of the two groups in the O2-4 was measured by dual-energy X-ray absorptiometry (DXA) at the beginning of the investigation, at 3, at 6, at 9 and 12 months. Results showed that bone density increased by 0.47 % and 1.71 % after the first 6 and 12 months, respectively, in the exercise group. In contrast, in the
second group, bone density decreased by 0.45 % and 1.92%, respectively in the same period.

Similar are the results of Kemmler et al16 also in postmenopausal women with osteopenia. The survey involved 95 women with an average age of 55 years. Of these women, 54 were the exercise team and the remaining 41 the control group. The study lasted 14 months. During this time, the first group exercised 4 times a week. Also, both groups were taking calcium supplements (about 1500 mg daily). The duration of each session was about 60 to 70 minutes, while the intensity of the exercise after the first 7 months increased.

Measurements were made again in the lumbar spine at the beginning and end of the study. In the first group, bone density increased by 1.3% in average, while the at the hip, bone density remained stable. In contrast to the control group, BMD decreased in lumbar spine 1.2% and at the hip 0.8%. Therefore, exercise for people with osteoporosis has a double benefit, because from one side the bone mass is not reduced and on the other side it increases the existing one.

Nevertheless, researches have shown that not all aerobic exercises are effective to increase bone density, and in particular we referred to cycling, diving and swimming. The reason is that these exercises are not engaged in bone loading through which the skeleton grows. Nichols et al17 studied the bone density in cyclists of different ages and compared it with their peers. The survey involved 27 cyclists of about 50 years, 16 young cyclists and 24 who did not exercise at all. These individuals were asked to continue their workouts or their normal lives. Cyclists trained on average 4 to 5 times a week and total from 12 to 15 hours. The measurement of bone density by DXA was at the low back, at the hip, femoral neck and the whole body. The results showed that the young cyclists had the same bone density to those of the control group, while the older cyclists had about 10% less BMD at all points. So if cycling doesn’t help in healthy individuals, we can assume that in osteoporotic individuals may even have a negative effect.

Silva et al18 measured the bone density of divers compared with people who did not dive. Diving is a sport in which we have a reduction of the effect of weight on the joints by 90%. This situation is similar to the immobilization in bed and is associated with a significant decrease in bone mass. The survey involved 66 divers and 47 people in the control group. The average age for the 2 groups was 34. The measurements were made by DEXA and showed that the divers had 4.6% lower bone density, a very big difference. Also, Courteix et al5 compared the bone density between 18 prepubertal girls who did floor exercises and 10 girls who did swim. The swimmers made workout from 8 to 12 hours a week, while the gymnastics from 10 to 15. Bone density was measured by DXA and showed significant differences in various parts of the body. Specifically, girls gymnastics had increased BMD at the radius by 33%, at the low back by 11% and at the femoral neck by 15% compared to the swimmers. Thus it becomes clear that cycling, diving and swimming don’t help fighting osteoporosis, which is why a fitness program for increasing bone density should include exercises against gravity, such as walking, running and dancing.

III. EFFECTS OF ANAEROBIC EXERCISE ON BONE MINERAL DENSITY.

In recent years there have been many researches of the effect of anaerobic exercise on bone mineral density. As anaerobic exercises we mean exercises with resistance e.g. with weights or bands, and exercises without resistance, but short term e.g. the rebounds.

Kohrt et al14 studied the effect of exercise in which the load is not coming from the ground, but the joints, e.g. resistance exercises. The study involved 39 postmenopausal women aged 60 to 74 years, who were divided into two groups, the exercise team and the control group. The study lasted 11 months during which the first group exercised 2 times a week. The exercises were for all the major muscle groups and seats (excluded in those who had orthopedic problems). For each exercise, participants had to perform 2-3 sets of 8 to 10 repetitions. When they managed this, exercise’s intensity was increased. The total duration of the project was about 60min. Their bone density measured after 11 months with DXA and showed an increase in BMD at the whole body by 1.6%, in the lumbar spine by 1.5%, and by 5.1% in the femur. There was no change at the femoral neck. Finally, in the control group there was no change, neither positive nor negative in their bone density compared to what they had 11 months ago.

Snow et al19 studied the effects of anaerobic exercise in 18 postmenopausal women with an average age of 65. Of those 18, the 9 were enrolled in the exercise program and the other 9 in the control program. The study lasted 5 years during which the mean exercise group exercised 3 times a week for 32 weeks a year. The exercises included exercises with weights for all the major muscle groups (shoulders, chest, extensors-flexors of the torso, legs and arms) and rebounds. The 2 groups did not differ much in height, weight, in the years after menopause and their bone density. After 5 years they were measured by DXA, which showed significant differences between the 2 groups. Changes related to femoral neck, greater trochanter and the hip and were 1.54%-0.24% and-0.82%, respectively. In the control group the decrease was multiple and more specifically it was -4.43% for the femoral neck, -3.43% for the great trochanter and -3.89% for the hip. Therefore,
the resistance exercises cannot increase at all points the bone density, but significantly they can reduce the rate of loss of bone tissue.

The research by Snow and Maddalorrorro20 showed up an increase in bone density after 6 months of exercise. Participants were men and women aged about 53 years. Participants were 64 in total and they all joined in a program for 24 weeks of exercise. The exercises which given to them were for all the major muscle groups (back, chest, shoulders, torso, legs, arms) either with free weights or with machinery. Each muscle group did 3 sets of 10 to 12 repetitions. Exercise intensity gradually increased. So, for the first 3 weeks, the intensity reached 40% of maximum muscle strength, 50% for the next 6 and finally 60% for the next 15 weeks. The duration of each workout was 75min. After 6 months their bone density was measured by DXA and found a 1.3% increase of the BMD in the lumbar spine and 1.9% increase in the BMD in the greater trochanter for men and 2% for women.

Going et al21 showed that the increase of bone density is proportional to the magnitude of the resistance, e.g. the higher resistance the better increase in bone mineral density. This discovery is very important because it will set better the size of the resistance strength training programs. They proved in their research on postmenopausal women that exercise with the biggest gains in BMD, were seats with extra weight.

Finally, Kemmler et al22 studied 83 postmenopausal women with osteopenia and found that resistance training increases bone density. The study lasted 26 months. The women were divided into 2 groups of 50 and 33 individuals respectively, where the first 50 had to exercise and the second 33 to resume normal activity. Neither of the two groups was taking drugs acting on bone metabolism. The frequency of the exercise was 2 times per week and lasted 60 to 70 minutes. The program included one session in which the exercises were on machines with pulley and one were the exercises were isometric with rubber bands, dumbbells and weights vests. The exercises on machines were for all the key muscles. The first three months, the intensity was set at 50% of maximum power with 2 sets of 20 reps and the next at 69% of maximal muscle strength with 2 sets of 15 repetitions. The duration of each repetition was 5 sec. After 7 months the exercise machines were divided into 2 periods. In the first (12 weeks) the intensity reached the 70 to 90% of maximum muscular strength and 4 to 5 weeks in subsequent 50%. The periods alternated between them. As for the other exercises 12 to 15 different isometric exercises were given, from 2 to 4 sets each, mainly for the muscles of the trunk and thigh. Each isometric contraction lasted from 6 to 10 seconds, followed by relaxation for 15 to 20sec. Moreover, were given 3 different exercises with a belt, from 2 to 4 sets each of 15 to 20 repetitions per set. After 7 months the exercises were replaced by exercises with vest and weights which remained until the end of the program. After 26 months, the bone density of the 2 groups was measured by DXA. In the exercise group the BMD was increased at the waist by 0.7% and at the hip was reduced by 0.3%. The corresponding values for the control group was -2.3% and -1.7%.

However in recent years there have been studies on the effect of Tai Chi Chuan on the bone mineral density. The Tai Chi Chuan is a form of exercise that comes from China, combining martial arts and yoga. The Tai Chi Chuan emphasizes in breathing, in dance exercises and exercises that release the body and make it more flexible. The overgrowth of the muscle has no place in the theory of Tai Chi Chuan. Qin et al23 sought to evaluate the possible effects that Tai Chi Chuan may have on bone mineral density in postmenopausal women.

For this purpose they studied the bone density of 34 women aged 50 to 59 years. Among these, 17 did Tai Chi Chuan the last 4 years, while the remaining 17 served as controls. Bone density was measured by the DXA in the beginning of the study and after 12 additional months of practice Tai Chi Chuan for women in the first group. The results were really impressive. The bone density in the exercise-training group was increased by 10 to 14% in the lumbar spine, femur and tibia compared with the members of control group. This is the first study showing that frequent practice with Tai Chi Chuan techniques can reduce the increase in BMD in postmenopausal women.

Furthermore, Chan et al24 showed that the exercises of Tai Chi Chuan can reduce the rate of loss of bone tissue after the age of 50. The survey involved 132 healthy women, of whom 67 participated in exercise team and the other 65 formed the control group. The frequency of exercise was 5 times a week, 45 minutes at a time for 12 months a year. After this time the measurement of BMD showed a decrease in bone density in both groups, but with the difference that in the exercise group the rate of loss was 2.5 to 3.5 times lower than in the control group. Therefore, Tai Chi Chuan has a positive effect on bone density and therefore it would be a good exercise program for the treatment of osteoporosis to include such exercises.

**IV. COMPARISON OF AEROBIC AND ANAEROBIC EXERCISE IN THE TREATMENT OF OSTEOPOROSIS. INDICATIVE PROGRAMS OF EXERCISE FOR OSTEOPOROTIC INDIVIDUALS.**

In the previous two chapters we referred to several studies which aimed to investigate the effect of aerobic or anaerobic exercise on bone mineral density of people
with osteopenia/osteoporosis. In this chapter we will attempt a comparison between two forms of exercise in order to establish which type of exercises is more effective in increasing bone density. In the international literature there are few studies that directly compare the aerobic to anaerobic exercise, because they focus on each one separately or combined aerobic and anaerobic exercises. However, several researchers have suggested that the resistance exercise (anaerobic) is more effective in increasing or maintaining bone mass in relation to the endurance (aerobic).

The study of Turner et al26 showed that resistance exercises and garden chores were more effective than other activities such as walking, jogging, cycling, dancing, and swimming. Participants were 3310 women, of which 1474 (45%) were 50 to 64 years old and 1836 (55%) were 65+. The average age was 69 years. These women were asked to complete a questionnaire of the physical activity they had last month. In the first place was gardening, walking in the second and gymnastics in the third, followed in descending order by cycling, dancing, aerobics, swimming, jogging and exercises with dumbbells. After the completion of the questionnaires, the measure of the bone density of all women with DXA followed. The results showed that women who did exercises with dumbbells or occupied with gardening had higher bone density than the rest. Followed by those who made dancing or walking, while in last place were those who made swimming, biking, jogging and free gym.

Kerr et al27 compared the bone density among women who exercised anaerobic, and in women not exercising at all. The survey involved 126 postmenopausal women with an average of 60 years which were split into three different groups, i.e. the group of empowerment, group of endurance and the control group. The study lasted 2 years and during this exercise intensity increased. In all groups calcium supplement was 600 mg/day. The exercises, which were given to team empowerment, were for triceps and biceps of the arms, flexors and extensors of the hip, the back and the calf. All exercises included 3 sets of 8 reps. In-group strength was walking and cycling for 40 minutes whilst the control group carried on with their usual exercises. The frequency of training for both groups was 2 times a week. After 2 years of bone density, the 3 groups were measured by DEXA and showed an increase in BMD in the subtrochanteric region by 1.1% and the total hip by 0.9% for the group of empowerment. Indeed, the greatest benefit on bone density was achieved over the first 6 months. In contrast, the group of endurance and the control group had a decrease in bone mass in the subtrochanteric area so that the difference in bone density between the empowerment group and the other two groups reached 3.2%. Thus, the anaerobic exercises proved more effective.

Nevertheless, even though there are no review studies that directly compare the aerobic to anaerobic exercise, there are many individual studies, in which results showed that people who were involved and enrolled in programs with exercises of resistance had a greater increase in their bone density than those of endurance or other training programs.

Snow et al19 studied 40 postmenopausal women aged 65 to 79 divided into two groups, the exercise team and the control group. The study lasted 1 year, when the exercise team followed a program of resistance of high intensity. For preheating they did 1 set of 14 repetitions at an intensity of 40% of maximal muscle strength. Then they did 2 sets of 7 reps, but with an intensity of 80% of maximum power. The frequency of training was 3 times per week under scientific supervision. After completing the survey, measurements were made using DEXA, and showed an increase in bone mineral density by 2.5% in the lumbar spine and 0.41% at the hip.

Similar are the results of Kerr et al27 in a study conducted involving 56 postmenopausal women aged 40 to 70 years. They were also divided into two groups. At the exercise group, there were given resistance exercises for all major muscle groups (biceps-triceps, forearm, quadriceps, hip abductors-adductors, hip flexors-extensors). For each exercise they would perform 3 sets of 8 reps, with an intensity of 40% of the maximal muscle power for the first time and then reaching 60%. The frequency was 3 times per week. One year after the investigation was completed, the bone density of women for both groups was measured by DXA and it was found that in the exercise group the BMD increased by 2.5% in the lumbar spine and 0.41% at the hip.

Lord et al28 studied the effect of aerobic exercise on bone density in 179 women aged 60 to 85 years, who were divided on the exercise and the control team. The training program consisted of 5min preheating exercises to warm up and 15min recovery, 35min fast walking and stretching. The frequency of training was 2 times per week at the beginning and gradually reached 4. The study lasted 12 months. After this time bone density of the two groups was measured with DXA and it was found that in the exercise group the bone density in the lumbar spine had increased by 0.83%, while in the hip it was reduced.

In addition, anaerobic exercise has better results even from studies that combined aerobic to anaerobic exercise. Prince et al29 studied 168 women in Australia aged 45 to 60 years. In the exercise group they were asked to train 4 times per week for 1 hour, during which two hours walking with intensity at 60% of MaxHR and other two hours of resistance exercise with intensity
from 40 to 50% of maximal muscular strength. The study lasted 1 year. After the survey, they measured the bone density of all women and found that in the exercise group BMD increased by 1.79% in the lumbar spine, which was fairly good, but not as high as the surveys with only resistance exercises.

Also, we should not forget the amazing results that had in the bone density, the exercise training Tai Chi Chuan, which is an anaerobic exercise. We remind that the research of Qin et al23 showed that women who exercised for 4 consecutive years with Tai Chi Chuan had higher bone density by 10% compared with those who did not exercise at all. Therefore, a program dealing with osteoporosis should primarily include anaerobic exercises, and secondarily aerobic exercises, which certainly help to improve the physical conditions of people.

Also, another advantage of anaerobic exercise against aerobic is that it greatly increases muscle strength. Studies have shown that strength training in people with osteoporosis reduce by 25% the risk of falling, which is very important because one of the unpleasant consequences of osteoporosis is fractures, which lead to a reduction in the quality of life of individuals and sometimes even to death30.

Wolf et al31 studied the effect of Tai Chi Chuan for the elderly and found that frequent Tai Chi Chuan training increases muscle strength, improves balance, posture and flexibility, and reduces the risk of falls by 47.5%. Finally Campell et al32 commended to women over 80 years old to exercise at home for 2 years. After the 2 years, women who exercised had a 31% less falls than those that did not exercise.

Nevertheless, it should always be in mind that the results of the exercise are not permanent, but temporarily and they can be lost at a faster rate than the one acquired. Indeed, according to Giangregorio and Blimkie33 even if someone restarted exercise, bone density will increase, but at a slower pace and will not reach the levels they were before the interruption of exercise.

The survey of Kontulainen et al12 involved 64 women who were divided in the exercise group and the control group. In the exercise team there were given rebounds, isometric exercises and resistance exercises. The program lasted 18 months and after completion bone density for both groups was measured by DXA. In the exercise group, bone density increased by 2.3% for the lumbar spine and 1.8% for the femoral neck. However, measurements made 3.5 years after the cessation of exercise showed a significant decrease in BMD in both the low back and the femur, with prices to be similar to those of the control group. Therefore, exercise for the prevention and treatment of osteoporosis should be constantly present in our everyday life and not temporarily, because only then we will obtain its benefits.

At the end of this paper and after the presentation of the findings of several researches conducted under the scope of defining the significance of the role that specific types of exercise play in the prevention and rehabilitation of osteoporosis and for the better understanding of the context of these findings, we present an illustrative exercise program for people with osteoporosis, which includes anaerobic exercises3 and is divided into three parts as follows:

RECOMMENDED EXERCISE PROGRAM FOR PEOPLE WITH OSTEOPOROSIS
a) Warm up for 5min just to push up the heart rate
b) Various exercises with or without resistance.
   • Box step.
   • Heel pressures.
   • Torso rotations.
   • Cross steps.
   • Deadlift knees.
   • Abdominals.
   • Shoulder exercises with dumbbells.
   • Hand exercises (quadriceps-triceps) with dumbbells.
   • Leg exercises (quadriceps, abductors, adductors) with dumbbells.
   • Balance exercises
   c) Recovery exercises with lower intensity to drop the heart beats and stretching of all major muscles that will participate in the main program.

GENERAL INSTRUCTIONS
• The exercises will be taught by competent professionals.
• Frequent communication between the professional and the individual athlete.
• The volume level initially will depend on the skills of the person.
• The intensity of exercise increases by increasing the number of repetitions and the external resistance.
• Finally the frequency of the program should be at least 2 times a week.

In conclusion, exercise and particularly anaerobic can be a very useful tool for both the prevention and rehabilitation of osteoporosis. In terms of prevention, it should be clear to everyone that the more we move and exercise from our childhoods the better health we ensure for our bones throughout our lives. Finally, the exercise along with the medication can be a strong combination to reduce bone loss and improve the quality of life of osteoporotic individuals.

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