

Review

Study on the impact of the therapeutic swimming on elderly women diagnosed with osteoporosis

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ABSTRACT: Introduction The adult woman has a complex of endocrine metabolic changes that can influence and cause various disorders in the body regarding the decrease of functional and regulatory capacities. The involuntary changes in a woman's aging highlight both the appearance and the functionality. In this sense, we intend to conduct a study on morphological changes, parameters that represent risk factors in the development of osteoporosis. Studies by Kanis (1) and Munshi (2) show that maintaining adequate bone mass as well as ensuring adequate muscle tone can prevent osteoporosis, and a pronounced incidence of the onset and development of chronic degenerative pathologies can promote fractures. **Material and method.** In connection with the elucidation of this aspect, we will use the Frax estimation method, which is based on the introduction of values obtained from medical evaluations. Regarding the study, we propose to the subjects a therapeutic swimming program to avoid the occurrence of osteoporotic fractures. **Results and discussions.** Regarding the field of factors favoring the estimation of a fracture in the items regarding cortisone treatments, alcohol consumption, digestive problems, minor traumas, the investigated subjects answered with No 100%. In order to obtain objective results, the study will continue for a period of 1 year, the intermediate tests will be performed after 4 months from the beginning of the work program and at the same time the program will undergo changes, depending on the results obtained from the evaluations. **Conclusions.** The implementation of this water exercise program will lead to adaptive changes in the direction of limiting the unevolutionary processes of senescence.

Keywords: elderly women; osteoporosis; estimate; physical activity, therapeutic swimming

1. INTRODUCTION

The modern concept proposes the optimal health term for all age groups, by practicing various physical activities, which beneficially influence the body in order to maintain and improve the quality of life. Regular physical activity can maintain or optimize morpho-functional abilities at optimal physiological parameters. The health effects of exercise, especially in water (3), lead to positive changes in both the somatic and psycho-emotional fields. Bone health is characterized by a permanent process of remodeling, achieving a balance between destruction and bone formation. During menopause in women, the balance changes by reducing the formation of new bone, indicating bone loss, with a risk of osteoporosis and fractures (4).

Intrinsic factors (genetics, bone condition in young people) and extrinsic factors (physical activity, nutrition, drug use) are involved in decreasing bone mass. Osteoporosis prophylaxis begins in adolescence. Exercise, body weight control, bone health, healthy eating are important for the future adult. If we talk about minerals, calcium is an important element because the skeleton contains 99% of the total calcium in the body, the rest being in plasma and extracellular fluid (5).

There are studies in the literature (6), which show that there are reference intervals, by age groups, regarding the serum concentration of magnesium. A diet rich in magnesium may play a role in preventing, along with aging, weight loss, muscle strength (7).

Another element that intervenes in biological systems is iron, an essential trace element. It is found in a high percentage in hemoglobin, which has the role of transporting O₂ and CO₂ between the lungs and tissues, and in regulating blood pH. Iron plays an important role in metabolic processes, especially when there is a balance between the two oxidation states (Fe²⁺ and Fe³⁺) (8).

In addition to calcium, vitamin D and iron, there are other micronutrients (copper, selenium) that help prevent osteoporosis. Bone health can be influenced by increasing the amount of intake of fruits and vegetables, which contain micronutrients and are useful for bone remodeling. Ensuring a balanced diet supplemented with exercise also have a prophylactic effect on osteoporosis (5,9). Alkaline diet correlates with age, physical activity and protein intake to help prevent muscle loss (10).

Ensuring an optimal intake of calcium, through diet or medication, can have a positive effect on bone mass and thus can reduce the risk of falling and fracture (11).

In our society, the attention paid to the elderly in the direction of prevention, estimation of health status is not sufficiently addressed. In connection with the elucidation of aging processes, experts note that the involution of the human body depends on a number of factors (genetic, environmental, pathological).

Dr. Mircea Dumitru states in his book that there is an "early aging between 40-60 years and accelerated aging after 60-65 years", and the WHO specifies the age category between 60-74 years as elderly (12).

Menzel's study suggests that bioactive molecules released by adipose tissue (adipokines) may provide a possible link between bone health and adipose tissue. Although it is initially thought that leptin may influence osteoblast differentiation in bone marrow stromal cells, recent studies suggest that the new adipokine or chemerin or gene 2 may influence bone health (13).

With age, there is an increase in "fatty tissue, changes in the joints due to osteoarthritis, brittle bones due to osteoporosis, muscles are affected by degenerative processes that change their trophicity and muscle mass" (14). Regular exercise in adults and the elderly has an anti-inflammatory and antioxidant effect on the autonomic nervous system, a fact demonstrated by Matei D. et al. in 2022 in a systematic review of the literature of the last 10 years. The recommendations for moderate-intensity exercise for most individuals are 30 min / day 5 days / week, they improve physiological and functional abilities as it increases the expression of antioxidant enzymes in serum levels (15). The number of diseases with known inflammatory etiology in the elderly is constantly increasing, including asthma, osteoporosis, cancer, atherosclerosis, type 2 diabetes, obesity, cardiovascular and neurodegenerative diseases. Onu I. et al. demonstrated in a 2011 systematic study that serum biomarker values in regular exercise addicts change, showing that chronic inflammation is limited due to activation of the immune system that will increase the level of anti-inflammatory myokine IL-6. They concluded that exercise in adults and the elderly is a clinical tool, due to improved cardiorespiratory, metabolic, musculoskeletal function, thus stimulating immunity and antioxidant capacity, resulting in reduced incidence of acute and chronic inflammatory diseases (16). Author Gabriela Negrișanu considers that lack of exercise is manifested by "bone not subjected to physiological use quickly loses BM", also "sedentary lifestyle and lack of exercise contribute to the decrease of BM (bone mass)" (17).

In the same context, the author Mihai Constantinescu presents in "Kinesiotherapy in Geriatrics Gerontology", among the theories of aging, the theory of connective tissue: connective tissue contains collagen, elastin and pseudo-elastin (it is a degrading factor). With age, the amount of elastin decreases, which plays an important role in tissue elasticity. Due to the dehydration of aged tissues, calcification of elastin occurs in the elderly "(18). There are studies that have found that physical activity contributes to healthy aging, reducing disability (19). The results of Su's study suggested that swimming can have an

effect on bone mineral density in postmenopausal women if the swimming time is between 3 and 6 hours. Therapeutic swimming can stimulate osteoblasts through muscle movement and the effect of water pressure on the bone (delays bone loss), stimulates increased estrogen secretion, can increase bone mass and can promote osteogenesis, reducing bone loss (20).

There are also studies who confirmed that the practice of therapeutic swimming influences bone density as well as the level of bone turnover markers, such as CTX, a bone resorption marker. (21). Schoell 's study confirms that weight loss in older adults is associated with reduced bone mineral density in the femoral neck (22).

A randomized study published in 2015 evaluated the effect of physical activity on morbidity in an elderly population, highlighting the preventive effect for chronic diseases and their role in improving the quality of life and ensuring active aging (23). As shown in one study, the FRAX score may provide data on a possible risk of fracture that could occur at the vertebral and invertebral level in the next 10 years.

Determining the risk of fracture is also useful in identifying patients in need of therapy, as well as in assessing the cost-effectiveness of applied therapy (24). Current research shows that in untrained people, if they start exercising two, three times a week, even in combination with stretching or myofascial release techniques, after a certain time there is an obvious improvement in morph abilities and parameters functional, issues confirmed by (25).

As physical capacity begins to decline from the age of about 45, then there is a risk of installing pathogenic mechanisms on various devices and systems in the body.

Hypothesis: We will start from the premise that by implementing an aquatic program as well as the evaluation with the help of the Frax program, in the life of the elderly, we will prevent the eventual traumas at the level of the locomotor system.

The aim is to estimate fractures by the Frax method, to develop a model therapeutic swimming program for a group of elderly women to prevent and reduce bone thinning. Material and method: The clinical study was carried out on an outpatient basis at the Railway Hospital Iasi - Specialty Ambulatory of Suceava, the patients being under the guidance of PhD. S. Silișteanu, the patients underwent the evaluation of bone densitometry with an Osteo-densitometer, and the practical part was performed at the Swimming and Physiotherapy Complex Suceava, under the guidance of physiotherapists E. Vizitiu and M. Constantinescu. The proposed research sample consisted of 10 patients following the regulation of the SARS COV-2 pandemic context. The period in which the first part of the study took place was from 01 10 2021 - 05 02 2022. To carry out this study we aimed at:

- inclusion criteria are: patients aged 60-75 years; diagnosed with osteoporosis; without decompensated diseases (respiratory, cardio, neuro, digestive, renal)
- exclusion criteria: persons under 60 years of age and over 75 years of age; with comorbidities; uncooperative.

The evaluated parameters were: weight, height, BMI, Frax estimation method. The following tools were used for this purpose; scale, thali-meter, BMI table, Frax estimator.

The patients received osteoporotic treatment according to the specialist's instructions. In the study we used means of therapeutic swimming, for 4 months 3 sessions per week, starting from the first stage, the first stage of the program includes a duration of 35 minutes, and in the third, 60 minutes. In order for the work schedule to be a therapeutic means, it is important to select, adapt, dose and rhythm of performing the exercises. In the first stage of the program, auxiliary materials were used, giving them up until the third stage, respecting the principle from simple to complex, from easy to difficult. In order to obtain positive results, we will take into account the observance of certain basic rules and principles in which the subjects must have, a suitable equipment for the

activity, to participate consciously and actively in all movements, to have continuity in carrying out the work schedule. the proposed exercises.

The objectives of the program.

1. Identifying aspects regarding predisposing / etiopathogenic factors in the one-minute test items;
2. Identify how patients responded to the incidence of risk factors regarding the estimation of the fracture;
3. Identification of the health elements of therapeutic swimming on elderly women.

Statistical analysis

The data obtained were processed using Microsoft Excel programs, averaging (x); standard deviation (α); coefficient of variability (Cv%)

Results and discussion:

In the "1 minute test", the subjects answered under the same conditions referring to the items of the test.

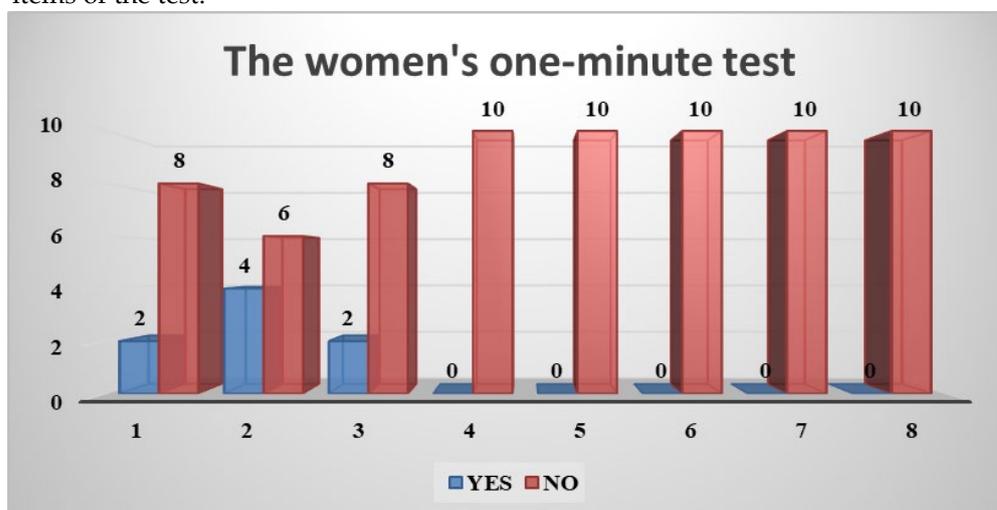


Diagram No. 1 Osteoporosis risk assessment

Referring to the first objective, the frequency of responses was 20% YES and 80% NO regarding the history of family trauma. Regarding the mention of personal antecedents, the frequency score was 40% Yes and 60% No. Another plan investigated was the functional status regarding the onset of menopause before the age of 45, the frequency score was 20% Yes and 80% No. (diagram 1)

Regarding the field of factors favoring the estimation of a fracture in the items regarding cortisone treatments, alcohol consumption, digestive problems, minor traumas, the investigated subjects answered with No 100%.

Table 1 Calculation of BMI statistical indices and estimation of a fracture according to the "FRAX fracture risk calculation tool"

Statistical indicators BMI Hip fracture Major osteoporotic fracture

Statistical indicators	BMI	Hip fracture	Major osteoporotic fracture
x	26.78	2.32	7.00
α	1.87	1.86	2.24
Cv%	6.97	80.03	32.00

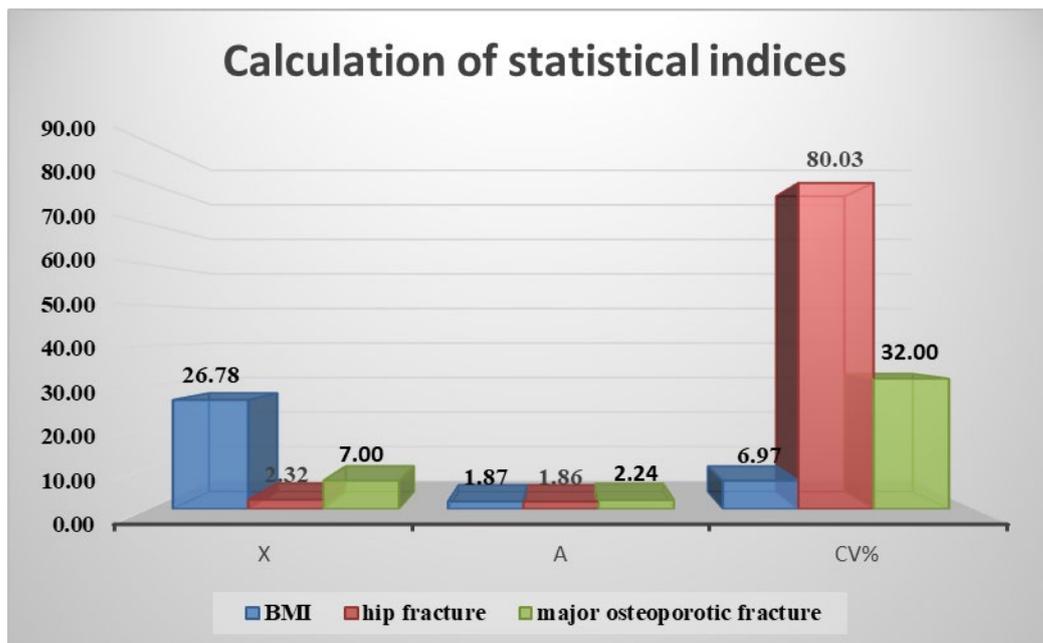


Chart No. 2 BMI and Estimating a Fracture

The BMI test shows a group average of 26.78 uc compared to normal values (between 18.50 and 24.99 - normal weight). (table no.1; diagram 2)

This value indicates an overweight status, which exceeds the maximum allowed values. For hip fracture, the assessment tool shows us an average estimate of 2.32 uc and an estimate of 7.00 uc of major osteoporotic fracture (diagram 3).

The intervention plans calculated by the Frax fracture estimation tool show us the degree of risk of a fracture over a period of 10 years. This approach helped us to establish the elaboration of the program.

Intervention threshold: major fracture

Probability of a 10-year fracture

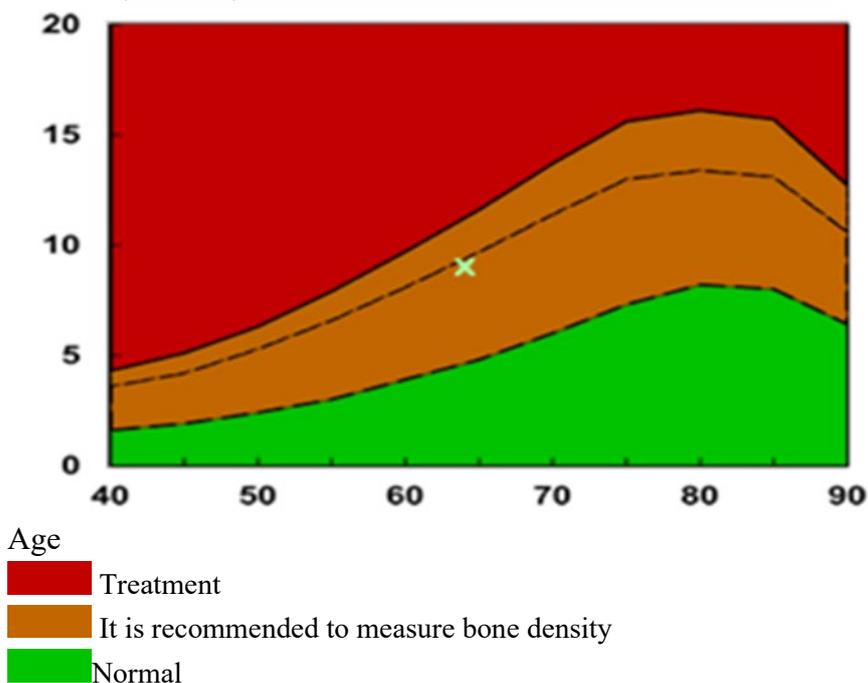


Diagram no. 3 Graphic evaluation model of the Frax Instrument

The intervention plans calculated by the Frax fracture estimation tool show us the degree of risk of a fracture over a period of 10 years. This approach helped us to establish the elaboration of the program.

Following the estimates obtained, a program of means specific to therapeutic swimming was developed to target its objectives (table no. 2).

Table no.2 Therapeutic swimming program – model

Working hours - Model			
Objectives: Observation of patients' health status at physiological parameters, especially weight status; Motivation and awareness of patients to exercise in the water; Increasing physical qualities (mobility, strength and endurance of the body); Improving proprioceptive abilities.			
Stage I (2 weeks)	3 sessions / week	time: 35 minutes	volume 200-300 m
goals	<ul style="list-style-type: none"> • Accommodation with the aquatic environment • Favoring the amplitude of movement at the joint level • Learning the basics of swimming 		
Exercise to get used to water and learn the basics T ⁰ water 28.5 ⁰ - 29.5 ⁰	<ul style="list-style-type: none"> • static exercises • dynamic exercises Auxiliary swimming pool devices (pool swimming floaties, belt, swimming pool noodles)	<ul style="list-style-type: none"> • Floating the body (floating on chest, and then floating on back) • walking, running, and jumping • Sliding the body on the water with the help of the physiotherapist 	
Stage II (6 weeks)	3 sessions / week	time: 40 minutes	volume 300-400 m
goals	<ul style="list-style-type: none"> • Maintaining a normal weight status • increase proprioceptive capacity 		
Exercises for stability, balance and coordination T ⁰ water 28.5 ⁰ - 29.5 ⁰	<ul style="list-style-type: none"> • static exercises • dynamic exercises Auxiliary swimming pool devices (belt, kick boards, pool swimming noodles)	<ul style="list-style-type: none"> • Sequences of movements performed with the lower limbs • Sequences of exercises performed with the upper limbs • Coordination of the upper limbs with that of the lower limbs • Stretching exercises 	
Stage III (8 weeks)	3 sessions / week	time: 60 minutes	volume 400-500m
goals	<ul style="list-style-type: none"> • Increasing physical capacity • Development of muscle strength 		
Exercises for endurance and strength T ⁰ water 28.5 ⁰ - 29.5 ⁰	<ul style="list-style-type: none"> • static exercises • dynamic exercises Auxiliary swimming pool devices (swimming fins, water dumbbells)	<ul style="list-style-type: none"> • Traveling at different distances (25,50,100,150,300 m) in the back stroke style and free style • Sequences of exercises for upper limbs, torso and lower limbs with different water dumbbells) 	

The program was based on the one-minute test and the estimates obtained by the Frax fracture estimator.

In order to obtain objective results, the study will continue for a period of 1 year, the intermediate tests will be performed after 4 months from the beginning of the work program and at the same time the program will undergo changes, depending on the results obtained from the evaluations.

The current study included a small number of patients, which does not allow a prediction to be made that can be applied to the general population, requiring the inclusion of a larger number of patients over a longer period of time.

Conclusions:

1. By using the 10-year fracture estimation tool "Frax" a fracture prediction was made in which it is found that any favored factor checked can influence the final result;
2. The correlation between BMI and the risk of hip fractures, as well as major osteoporotic fractures is obvious, and the change in BMI upwards or downwards leads to an increase in the data on the estimate made by Frax;
3. By using the means of therapeutic swimming applied to women, after menopause it is essential to maintain a morphophysiological status that ensures stability in order to prevent fractures.
4. Based on the final result, BMI indicates an overweight status to the people under study, which leads us to apply other assessment tests as well as the introduction of new aquatic exercises.
5. Osteoporosis is considered a public health problem not only in our country (26), but also in Europe, which involves early diagnosis to ensure the implementation of prevention programs and to optimize therapeutic strategies (27-34).

Conflict of Interest

The authors declare that they have no conflict of interest.

Patient Consent

All the patients gave the informed consent for the study. 41 / 17.09.2022

Author contribution

All authors with equal contribution.

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