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# Assessment of risk factors associated with the level of physical activity in childhood and at the time of the survey in postmenopausal women with osteoporosis and vertebral body fractures

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*Today, discussions are continuing on the effect of regular exercise in childhood in preventing bone loss in postmenopausal women, as well as the positive effect of physical exercise (PE) in the prevention of osteoporotic fractures in older age groups.*

***Purpose:*** *to assess risk factors associated with the level of physical activity (PA) in childhood and at the time of the examination in postmenopausal women with osteoporotic and vertebral body fractures.*

***Material & Methods:*** *in a one-time study examined 115 postmenopausal women aged 50–89 years. For analysis, the patients were divided into two groups: I (control) group – persons without any osteoporotic fractures in history (n=84), II (main) group – patients with vertebral body fractures at the level of the thoracic and lumbar spine (n=31). With the help of a specially developed questionnaire, the authors evaluated the characteristics of the PA of patients at different age periods of life and at the time of the survey.*

***Results:*** *no significant differences were found in the frequency and types of sports in childhood between groups, depending on the presence of vertebral body fractures. The majority of patients with vertebral fractures (85,7%) began regular exercises of PA in childhood with the age of 10 years (41,7% in the control group, p=0,04), and in 57,1% of individuals the duration of these exercises was 1–4 years and did not differ from the control group. The frequency, type and duration of physical activity classes and the duration of physical therapy procedures, as well as the level of daily physical activity, did not significantly differ in women depending on the presence of vertebral body fractures, although the proportion of people who worked on a regular basis in sections was significantly higher among patients with vertebral fractures (41,9%) compared with individuals without fractures (10,7%, p=0,0002). In addition, the proportion of women in the control group who were physically active 6 or more hours per day was significantly higher (14,3%) compared with the corresponding indicator of the main group (3,2%, p=0,04).*

***Conclusion:*** *women with vertebral fractures were more often practiced regularly in sections and less physically active than those without fractures. The duration, regularity and age of starting sports in childhood can affect the risk of vertebral fractures in postmenopausal women, requires further study.*

**Keywords:** *physical activity, childhood, postmenopausal women, osteoporosis, vertebral fractures.*

## Introduction

Discussions about the effects of regular exercise in childhood in preventing bone loss in postmenopausal women [1–3], as well as the positive effect of moderate exercise in the prevention of osteoporotic fractures in older age groups [4–7], continue to this day. Some reviews of literary sources indicate the absence of a long-term protective effect of physical activity (PA) and regular physical exercise (PE) in childhood and adolescence on bone health in adults, which, in particular, may also be due to the lack of promising long-term studies [2]. However, given the results of recent studies that the development of osteoporosis in adults is associated with the formation of a peak in bone mass in childhood and adolescence, it is obvious that special attention should be paid to primary prevention of osteoporosis at an early age, contributing to the formation of a maximum peak in bone mass during maturation of the skeleton. It is important to develop in children and adolescents an understanding of the importance of a healthy lifestyle, regular exercise and adequate physical activity for the effective prevention of osteoporosis and its complications [3; 8].

According to the results of a meta-analysis [9] on the effect of regular PA or sports on the state of bone tissue in various groups of subjects, it was found that a slight positive effect of physical activity is observed only in boys in the pre- or early puberty (relative risk (RR) – 0,17; 95% confidence interval (CI): 0,02–0,32), but not for girls in puberty (RR=0,01; 95% CI: –0,18–0,17), boys (RR=0,10; 95% CI: –0,75–0,95) and adolescent girls (RR=0,21; 95% CI: –0,53–0,97), premenopausal women (RR=0,00; 95% CI: –0,43–0,44) and postmenopause (RR=0,00; 95% CI: –0,15–0,15).

Modern literary data confirm that jumping exercises increase the mineral content of bone in prepubertal children, and bone

mineral density (BMD) is higher in adolescent athletes who engage in wagon-and-sexual exercises. Aerobic exercises in combination with strength (for strengthening muscles) and exercises to improve coordination increase BMD indicators, reduce the severity of back pain, improve coordination of movements and quality of life in young women and premenopausal women, and also prevent falls, which is especially important for postmenopausal women and older men. The authors also note that the sport and the type of exercise that is used must differ according to the life cycle [1, 10–13]. Thus, multi-purpose complexes of physical therapy (PT) and individually selected PE in accordance with the life cycle are important strategies for the prevention of osteoporosis and vertebral body fractures.

**Purpose of the study:** assess the risk factors associated with the level of physical activity in childhood and at the time of the examination in postmenopausal women with osteoporosis and vertebral body fractures.

## Material and Methods of the research

On the basis of the Ukrainian Scientific Medical Center for Osteoporosis Problems, the State Institution "Institute of Gerontology named after DF Chebotarev NAMS of Ukraine" in a one-time study, 115 postmenopausal women aged 50–89 years were examined. This study was approved by the Ethics Committee of the State Institution "Institute of Gerontology named after DF Chebotarev NAMS of Ukraine", all patients signed informed consent to participate in the study. The surveyed completed questionnaires independently under the control of the researcher. For analysis, two groups were identified: the first (control) group was women without any osteoporotic fractures in the history (n=84), the second (main) group – patients with fractures of the vertebral bodies at the level of the thoracic and lumbar spine (n=31) The features of the menstrual function (age of menarche, menopause, duration of the postmenopausal period), body composition (height, weight, body mass index) and using a specially designed questionnaire (table) were studied. The features of the PA of patients in different age periods of life and at the time of the survey (sports, PA, duration and regularity of classes, type of PE, body position during the day).

Analysis of the anamnestic parameters showed no significant differences in the age of menarche (respectively, in the control and main group women, 13,7±1,4 and 13,8±1,5 years (t=0,46; p=0,64)) the age of menopause (49,3±4,7 and 48,6±4,3 years, respectively (t=1,08; p=0,28)) and the duration of postmenopause (respectively 17,1±9,1 and 19,1±8,2 years (t=1,65; p=0,10)).

When analyzing the indicators of objective examination, we found reliable low growth rates in patients with vertebral fractures compared with the corresponding control indicators (155,9±6,2 and 158,0±5,6 cm (t=2,59; p=0,01)). Also significantly lower were the indicators of body weight (respectively 69,6±13,4 and 80,4±15,7 kg (t=5,10, p=0,000001)) and body mass index (respectively 28,6±4,7 and 32,2±5,9 conventional units (t=4,62, p=0,000006)). Obviously, a decrease in growth is associated with the presence of vertebral body fractures, and low body mass index is an independent factor of osteoporotic fractures, which is consistent with the results of existing literature sources [14; 15].

The statistical processing of the results of the study was carried out using the "STATISTICA-10.0" program package. The differences between the groups were established using Student's criterion, $\chi^2$ test, and a comparison test of two proportions. A critical level of significance was considered $p<0,05$.

## Results of the research

When analyzing the frequency (%) of sports or any type of PA in childhood and young age, we did not establish significant differences between groups depending on the presence of vertebral fractures (control group – 28,6%, main group – 22,6% (p=0,52)). However, when assessing the regularity of sports in childhood and young age, a tendency was established (according to the results of a comparison test of two

**Questionnaire on the level of physical activity**

| № | Question | Possible answers | | |
|---|---|---|---|---|
| 1. | Did you play sports or any kind of physical activity in childhood and young age? (school, institute, etc.) | No | Yes | |
| 2. | **a)** What sports (physical activity) did you do? **b)** How long? (weeks, months, years). **c**) At what age did you start playing sports?<br>**a**_____<br>**b**_____<br>**c**_____ | | | |
| 3. | Do you do any kind of physical activity (gymnastics, yoga, walking or sports) at the moment? | No | Yes | |
| 4. | What type of physical activity do you do? _____ _____ | | | |
| 5. | How much time (minutes) does one procedure take for your physical activity? | Write _____ | | |
| 6. | How long have you been doing? (weeks, months, year) | Write _____ | | |
| 7. | How much time per day are you physically active, without taking into account sports or special gymnastics? | Write _____ | | |
| 8. | Type of physical activity you perform most often? (underline or write) | easy – walking, dusting, washing dishes | medium – floor washing, hand washing | heavy – move furniture, work in the country |
| 9. | Types of Exercise Are You Using More? (underline or write) | walking, running, swimming, biking, etc. | exercises with loads | flexibility exercises, increased coordination |
| 10. | In what position, most often, is your body during the day? (underline) | standing | sitting/lying | in motion |

proportions: p=0.10) to more frequent regular sports activities among women in the control group (27,4%) compared with the corresponding indicator of the main group (12,9%).

In evaluating the types of exercises that the respondents were engaged in in childhood (cyclic exercises, sports types of games), there were also no significant differences between the groups depending on the presence of vertebral body fractures. 58,3% of the control questionnaires and 57,1% of the main group (p=0,96) were engaged in cyclical sports in childhood. The corresponding indicators for playing sports games amounted to 33,3% for the control and 28,6% for the main group (p=0,84). However, when assessing difficult coordination exercises that were performed in childhood, it was found that women in the control group were significantly less likely (p=0,01) to do this type of exercise (45,8%) compared with patients of the main group (100%).

In addition, when assessing the duration of sports activities in childhood among patients who were engaged in them, there were also no significant differences in groups depending on the presence of vertebral body fractures. So, 1–4 years were studied by 50,0% of women in the control group and 57,1% of those in the main group (p=0,74), 5–9 years – 37,5% of the control group and 42,9% of patients in the main group (p=0,77). However, in the control group, we identified 12,5% of persons who had been engaged for more than 10 years, whereas in the main group no women were found whose duration of PA classes in childhood would be more than 10 years.

When analyzing the indicator of the age at which they started studying various types of PA in childhood, it was found that its average was 8,9±2,4 years for the control group and 7,3±1,8 years for patients of the main group (p=0,11), although it did not differ significantly depending on the presence of vertebral fractures. However, an analysis of the distribution of the examined by age, from which regular PE began in childhood, found significant differences between the groups. Thus, in the control group, 41,7% of women started classes from 5 to 9 years old, whereas in the main group the corresponding figure was 85,7%. From 10 years of age, 58,3% of the examined control and 14,3% of the main group of patients (p=0,04).

In assessing the level of physical activity (physical therapy exercises, including in sections) at the time of the survey, we did not establish significant differences between groups depending on the presence of vertebral body fractures. The results of patients with vertebral fractures (67,7%) did not differ from those in the control group (66,7%; p=0,91). However, among the patients of the main group, there was a significantly higher proportion of people working on a regular basis in the sections (respectively, 41,9% of the examined) compared with 10,7% of women in the control group (p=0,0002).

When analyzing the frequency of various types of PA, we also found no significant differences between groups depending on the presence of vertebral body fractures. Thus, 19,0% of the main and 21,4% of patients in the control group (p=0,84) were engaged in cyclic sports. Also, no significant differences were found in the proportion of the surveyed who were involved in coordination types of physical exercises (physical therapy, yoga, Pilates) between the control groups (96,4%) and the main group (100%).

When assessing the duration of physical therapy exercises among the surveyed, who gave a positive response regarding regular classes, it was found that its average was 5,3±5,2 years for the control group and 5,6±12,8 years for patients in the main group and not significantly different depending on the presence of vertebral fractures. The distribution of patients depending on the duration of physical therapy exercises also did not reveal significant differences between groups depending on the presence of vertebral fractures. So, it was revealed that 1% of women studied for 1–4 years, 80,4% of the control group and 61,9% of the main group, 5–9 years – 8,9% of the examined patients and 28,6% of patients of the main group, more than 10 years – 9,5% of women in the control group and 10.7% of patients in the main group.

In addition, no significant differences were found between the groups and when analyzing the duration of exercise therapy procedures. Thus, in the majority of patients (75,0% of the control and 85,7% of patients in the main group), the duration of a single exercise therapy was 10–30 minutes, and 25,0% of the control and 14,3% of the patients in the main group did exercise therapy regularly during 45–60 minutes (p=0,30).

When analyzing the types of PE that the patients use regularly during their exercises, exercise therapy also revealed no significant differences between the groups depending on the presence of vertebral fractures. Thus, in the control group, aerobic (cardio) exercises were performed by 37,5% of the examined individuals, whereas in the main group the corresponding representative was 28,6% (p=0,51). Anaerobic (strength) exercises were regularly performed by 55,4% of women in the control group and 47,6% of patients in the main group (p=0,58). Flexibility and coordination exercises were regularly performed by 39,3% of women without vertebral body fractures and 42,9% of patients with vertebral fractures. (p=0,74).

When analyzing the duration of the daily activity (excluding physical therapy classes), we have not established reliable differences in women, depending on the presence of fractures of the vertebral bodies. 28.6% of control women and 38,7% of the subjects in the main group were physically active for 1–2 hours per day (p=0,30), 3–5 hours – 57,1% of the control subjects and 58,1% of the patients the main group (p=0,92). Only the proportion of women in the control group who were physically active 6 or more hours per day (14,3%) was more reliable than the corresponding indicator of the main group (3,2%) (p=0,04).

When assessing the level of physical activity that patients use in their daily activities, we found that in 75,0% of women without vertebral fractures and 80,6% of people with vertebral body fractures, physical activity was mild or moderate (dusting, washing dishes, washing floors, washing by hand), while 25,0% of patients in the control group and 19,4% of patients in the main group are engaged in performing difficult types of work (working in the country, moving furniture, etc.) (p=0,50).

In assessing the position of the body, in which patients are most often found during the day (standing, sitting, lying, or in motion), we have not established significant differences depending on the presence of vertebral body fractures. The women of the main group (32,3%) and the control group (44,0%) were equally sedentary (sitting or lying, standing), and 67,7% of the examined patients with vertebral fractures

and 56,0% of patients without fractures anyway were regularly in motion (p=0,24).

## Conclusions / Discussion

To date, the lack of physical activity has been identified as the fourth leading risk factor for global mortality (6% of deaths worldwide) [16]. It has been established that immature lifestyle is observed in people regardless of age and leads to the development of many diseases, in particular, disorders of the locomotor system, premature aging and death. It has now been proven that regular PE (strength, stretching and coordination exercises), as well as walking, reduce back pain, need for analgesics, increase muscle strength, improve coordination of movements and quality of life with osteoporotic fractures [12; 17].

It has also been established that exercise and exercise at young age influence the strength of bone tissue. The process of bone mass accumulation and the rate of mineralization in the age group of 19 to 23 years of age among students regularly engaged in sports, and their peers who lead a sedentary lifestyle, vary significantly. Density of the bones is determined by the specifics of the training activity and increases with the increase of sports skills. The highest dynamics of the rate index of ultrasound propagation was established at athletes (4041,17±82,89 $m \cdot s^{-1}$ at 19 years to 4065,13±90,75 $m \cdot s^{-1}$ at 23 years, respectively ($p < 0,05$)), which is related both to the specifics of motor activity and the nature of physical activity (speed-force, cyclic, complex coordination, etc.). Smaller, though reliable, it was in gymnasts (respectively, from 4012,11±128,26 to 4030,94±104,50 $m \cdot s^{-1}$; $p<0,05$), weightlifters (from 3931,30±137,55 to 3967,11±137,55 $m \cdot s^{-1}$; $p<0,05$) and wrestlers (from 3865,50±71,25 to 3930,63±89,33 $m \cdot s^{-1}$; $p<0,05$). The corresponding figure for students not involved in sports, was respectively: from 4012,09±110,02 $m \cdot s^{-1}$ in 19 years to 4058,30±117,98 $m \cdot s^{-1}$ in 23 years; $p<0,05$) [3].

In studying the relationship between the level of PA in 15, 18 and 23 years and the rates of BMD in 3454 young people (men and women), it was established [18] that the level of PA in a young man of 15 years was reliably related to the parameters of the lumbar spine BMD ($\beta$=0,061 $g \cdot cm^{-2}$; 95% RR: 0,02–0,11). In addition, a dose-dependent positive effect of PA on BMD indicators in young men aged 18 years was revealed. Men aged 23, who were in the two highest apartments for PA, had significantly higher BMD indices in all anatomical parts of the spine compared with men who were in the quartile itself. High rates of BMD in men aged 30 years were among those whose PA levels were high in at least one age group (18 or 23 years) compared with physically inactive peers in both groups. Women with a high quartile for PA at 23 had higher BMD at the level of the femoral neck at 30 ($\beta$=0,02; 95% RR: 0,001–0,04).

Indicators of BMD and the risk of fractures were studied in a study of M. Tveit et al. [19] football players who are players are retired (30 years after the end of their career) compared to age control. It was established that in male football players 30 years after the completion of a football career, the Z indicator at the level of the entire skeleton was 0,4 SD (0,1–0,6), the lower limbs – 0,5 SD (0,2–0,8 ), femoral neck – 0,3 SD (0,0–0,5), and the level of all fractures, respectively, 0,6 SD (0,4–0,9), any low-energy fractures – 0,4 SD (0,2–0,9). The authors indicate that the results suggest that regular PE at a young age have a significant effect on bone strength and risk of fractures in old age, and proper PA for young people can reduce the burden of fractures in older age groups.

In a review by R. M. Bielemann and sang [20] analyzed the relationship between PA during life and the indicators of mineral density and bone tissue saturation in young people. Positive associations between PA level and bone mass were found to be more pronounced in men than in women at the level of weight loading anatomical sites (lumbar spine and neck of the femur) than at the level of the entire skeleton, and when measurements of the level of PA were conducted from adolescence to an adult's life than when evaluated only during one of the aforementioned periods of life. However, the authors note the impossibility of a joint analysis of the included studies for their heterogeneity and the use of various tools for assessing the level of PA.

Another literature review by M. S. Zulfarina et al. [21] also confirmed the positive relationship between PA and the formation of a peak in bone mass in adolescents with high changes in the bones, however, as noted by the authors, its strength may differ depending on gender and measurement sites.

To date, due to the lack of promising long-term studies, the estimated long-term sustained protective effect of PA and PE in children and adolescents on the strength of BT in adulthood has not been fully established [2; 19; 21], therefore, studies on the relationship between sports in childhood and the state of BT in postmenopausal women remain important and necessary.

The purpose of this work was to study the risk factors associated with the level of physical activity in childhood and at the time of the survey in postmenopausal women with osteoporosis and vertebral body fractures.

We have not established significant differences in the frequency and types of sports in childhood between groups, depending on the presence of vertebral body fractures. The majority of patients with vertebral fractures (85,7%) began regular exercises of PA in childhood with the age of 10 years (41,7% in the control group, p=0,04), and in 57,1% of individuals the duration of these exercises was 1–4 years and did not differ from the control group. The frequency, type and duration of physical activity classes and the duration of physical therapy procedures, as well as the level of daily physical activity, did not significantly differ in women depending on the presence of vertebral body fractures, although the proportion of people who worked on a regular basis in sections was significantly higher among patients with vertebral fractures (41,9%) compared with individuals without fractures (10,7%, p=0,0002). In addition, the proportion of women in the control group who were physically active 6 or more hours per day was significantly higher (14,3%) compared with the corresponding indicator of the main group (3,2%, p=0,04).

The limitations of this study are its design (one-moment, not longitudinal), sample size, inclusion of only female population, and analysis conducted only in individuals with one type of osteoporotic fractures (fractures of vertebral bodies), does not allow making reliable conclusions about the long-term effects of PA rate of loss bone tissue and the risk of fractures in older persons and requires a full study.

The study showed that women with vertebral fractures are more often regularly engaged in PE in sections and less physically active compared to those without fractures. The duration, regularity and age of starting a sport in childhood may influence the risk of vertebral fractures in postmenopausal women, requires **further study.**

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