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## EFFECTS OF TAI CHI ON CHANGES IN CONCENTRATION OF MARKERS OF BONE TURNOVER IN ELDERLY MEN

### INTRODUCTION

It is estimated that in men below the age of 70 there may be a decrease in bone mass of up to 25% [7]. Fractures occurring in consequence of osteoporosis (fractures of neck of iliac bone, in particular) lead to serious complications and often cause death [10]. The assessment of fracture risk is based on the identification of skeletal and clinical factors of the risk of osteoporosis, among which the rate of bone reconstruction is analysed. The assessment of the rate of bone turnover is possible thanks to the so-called "markers of bone turnover", the concentration of which in urine and blood serum is determined. The levels of biochemical markers of bone turnover are thought to be sensitive detectors of activity of all reconstruction processes which take place at a given time in the skeleton. They may be used as a method of predicting fractures or changes in bone mass resulting from treatment and monitoring of the applied therapy [2]. They make it possible to discover changes in bone tissue metabolism over months and even weeks.

Apart from the diet, physical activity (PA) is the basis of many prevention and health education programmes for seniors. PA has been found to have a good effect on the increase of bone mass, which probably explains the effect of mechanical bone load [9]. PA programmes recommended for elderly people diagnosed with osteoporosis include forms of PA which are attractive, available, of moderate intensity, having an effect on the increase of muscular mass, improving balance and not presenting a risk of falls [6]. The relatively low intensity of physical effort and safety of exercises make Tai Chi a popular form of recreation, but also a form of exercise for a more demanding social group, namely the elderly [8].

The aim of the work was to study the effect of Tai Chi exercises on changes in concentration of selected markers of bone turnover in elderly men.

### METHODS

The subjects consisted of a group of 90 men aged over 60 ( $\bar{x} = 68.83 \pm 5.84$  years), living in their own households in Poznań. All the subjects volunteered to take part in the study; the selection for the exercise (n=35) and non-exercise groups (n=55) was random.

The concentration of markers of bone turnover was determined in samples of blood serum from blood taken from the basilic vein in a fasting state, between 8 am and 9 am. The following parameters were analysed: marker of bone-formation process – osteocalcin – OC (measured by ELISA immunoenzymatic test made by Metra Biosystems, USA) and the indicator of bone resorption: C-terminal telopeptide of type I collagen (ICTP) (measured by radioimmunoassay using a test made by Orion Diagnostics, Finland). The tests were carried out before the start of the training programme (the 1<sup>st</sup> date of tests) and after its completion (the 2<sup>nd</sup> date of tests).

In the experimental group a four-month Tai Chi training programme was carried out with exercise sessions taking place twice a week for 45 minutes.

### RESULTS

No statistically significant differences were found between the exercise and control groups before the beginning of the experiment in terms of age and basic somatic characteristics (Table 1).

**Table 1.** Somatic characteristics of the Tai Chi group and control group before the start of the training procedure

Variables	Tai Chi group, n=35	Control group, n=55	Level of p
Age [years]	68.69±5.70	69.49±6.21	0.5981 <sup>NS</sup>
Height [cm]	169.74±6.63	170.37±5.87	0.5919 <sup>NS</sup>
Weight [kg]	81.05±13.25	83.35±11.31	0.3151 <sup>NS</sup>
BMI [kg/m <sup>2</sup> ]	28.02±3.58	28.69±3.57	0.2187 <sup>NS</sup>

<sup>NS</sup> not statistically significant

On the basis of the statistical analysis significant changes ( $p \leq 0.001$ ) were found in the values of ICTP between the two dates of tests in the experimental group (Table 2). No differences in concentrations of ICTP were found in the control group. Statistically significant changes ( $p \leq 0.001$ ) were also found in the OC values in the exercise group.

influence of muscle contractions there is an increase in stresses in bone tissue, stream electric potentials are generated and, as a consequence, bone turnover is stimulated. The obtained results indicate a positive effect of Tai Chi on bones.

**Table 2.** Values of concentration of ICTP and OC in Tai Chi and control groups on two dates of tests

Tested parameter	Tai Chi group			Control group		
	$\bar{x}_1$	$\bar{x}_2$	Level of p	$\bar{x}_1$	$\bar{x}_2$	Level of p
ICTP [ $\mu\text{g/l}$ ]	3.295	2.985	0.002***	3.066	3.001	0.376 <sup>NS</sup>
OC [ng/ml]	9.729	8.780	0.003***	9.060	8.309	0.318 <sup>NS</sup>

<sup>NS</sup> not statistically significant

\*\*\*  $p \leq 0.001$

## DISCUSSION

Tai Chi is considered to be an exercise form which strengthens the muscular apparatus and improves balance in the Falls Management Exercise Programme (FaME) recommended by the Ministry of Health of the United Kingdom [11]. Three-month long study programmes on usefulness of Tai Chi conducted by Wolfson et al. [12] showed an improvement in muscular strength of lower limbs. It is also believed that Tai Chi improves deep sensibility and kinesthetic reflexes [4]. However, relatively few authors have discussed the effect of Tai Chi on the improvement of the bone tissue. The decrease in ICTP concentration, which we noted in our study, indicates the lowering of the rate of degradation of bone tissue. The lowering of OC concentration may be an effect of the fact that the process of bone resorption is linked to the process of bone-formation [3]. Other authors also noted a decrease [1] or lack of change in concentration of osteocalcin [5] after an exercise programme. The lowering of the concentration of both markers of bone turnover most likely results from the effect of stresses and pressures arising as a result of muscle work [9]. Under the

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