ORIGINAL ARTICLE

Effectiveness of *tai chi* elements for improving balance and functional efficiency of elderly patients. Preliminary reports

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
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Abstract

Background and Study Aim: Overload and degeneration of the lumbar spine is a growing problem in an aging society. One of the therapy options is the use of tai chi elements in rehabilitation programs, which can be an effective addition or alternative to standard rehabilitation therapies. The aim of this study is the answer the question whether introducing exercises containing elements of tai chi positively affects the improvement on the balance and quality of life of older people.

Material and Methods: The study included a group of 48 (26 women and 22 men) divided into two equal groups. In the control group (CG, n = 24), a rehabilitation program was applied using general rehabilitation. In the experimental group (EG (n = 24) , exercises with elements of tai chi were additionally used. Clinical assessment was performed twice (before and after therapy) using the Roland-Morris Disability Questionnaire (RMDQ) and the Berg Balance Scale (BBS).

Results: Before the start of therapy, no statistically significant differences were found between the pairs of variables: RMDQ CG 5.83 ±0.69- and EG 5.96 ±0.91 points; BBS CG 44.83 ±1.58- and EG 50.25 ±1.62 points. After the end of therapy, the difference in the obtained results of RMDQ was not statistically significant (p = 0.58), in the case of BBS the difference was statistically significant (p <0.001).

Conclusions: Both methods of rehabilitation used proved effective in improving the balance and functionality of elderly patients. The addition of elements containing tai chi had comparable effectiveness to the classic rehabilitation program taking into account the results in the RMDQ.

Keywords: free exercises • functional rehabilitation • individual exercises • individual psychotherapy

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INTRODUCTION

Tai chi is a specific martial art with a centuries-old tradition [1]. The specificity concerns, above all, slow movement sequences, which are referred to as movement meditation [2]. Scientific research has repeatedly explored the pro-health aspects of actively practicing *tai-chi*, especially in the context of mental health [3-6]. Effective aspects of the *tai chi* program implementation have also been demonstrated in the context of improving self-esteem, quality of life and positive neurological changes in women with breast cancer [7]many women with breast cancer still live with suboptimal health and quality of life. This randomized control trial aimed to determine the effects of the Tai Chi Qi Qong program on self-esteem, fatigue, cortisol, and quality of life in Thai women with breast cancer. The sample included 30 Thai women with breast cancer who, after treatment completion, routinely visited the breast clinic in a university hospital, Bangkok, Thailand. The participants meeting eligibility criteria were randomly assigned into an experimental group and received the program, in addition to usual care, and the control group received only usual care (n = 15 per group. The health benefits of systematically practicing *tai chi* in people with multiple sclerosis have also been confirmed [8].

Modern medicine is dealing with an aging society where more and more elderly people suffer from degenerative disease of the lower spine and chronic muscle overload in this area. The most common reasons for this disease are incorrect body posture and work-related lumbar spine overload. It is a condition that causes pain and reduces the quality of life of patients [9-12]with the inclusion of Tai Chi, dictated by the programme's goal. Material/Methods: The research covered a group of 40 patients suffering from degenerative joint diseases, undergoing a comprehensive rehabilitation programme at the Rehabilitation Centre in Krzeszowice, Poland. The research group comprised 30 women and 10 men. The mean age for the group was 63.5±8.0 years. A Polish adaptation of the Arthritis Impact Measurement Scale-2 (AIMS-2. It is reported in the literature that this is one of the most common reasons for being absent from work. As a result, we are dealing with the burden of the healthcare system and with the economic consequences of spending a lot of money on treating this disease [13]. The subject of physical activity with the use of *tai chi* is currently widely covered in the literature. Such exercises are used in patients with various ailments, but mostly they concern elderly and middle-aged people. Exercises in the use of *tai chi* are subjected to patients with type 2 diabetes in order to maintain the proper level of physical activity in this type of disease [14]. It is also suggested to use these exercises to improve memory [15]. In addition to activities aimed at treating certain disease entities, *tai chi* is also used in prophylactic activities, especially in the case of cardiovascular disorders [16]. Increasing the quality of life of the elderly is the subject of numerous scientific studies [17-20]. It has been proven that spine diseases significantly affect lifestyle, quality and comfort [21-23]. Currently, medicine and physiotherapy have many methods of treating back pain and neutralizing their causes. Contemporary methods are based on: electrotherapy, magnetotherapy, hydrotherapy, massage, ultrasound and manual therapy [24, 25]. Searching for effective methods of treating diseases related to overload and degeneration of the spine, attention was paid to the art of *tai chi* originating in China, which includes gentle exercises, both strengthening and stretching, and balance exercises. Improving balance and functional fitness is a special challenge of modern physiotherapy.

The aim of this study is the answer the question whether introducing exercises containing elements of *tai chi* positively affects the improvement on the balance and quality of life of older people.

Tai-Chi, Qigong – are traditional and popular Far Eastern systems serving in the maintaining and improvement of physical and psychic Health [41].

Balance maintaining – is an important part of sensomotorical exercises in physiotherapy of aging patients [42].

Functional efficiency – is an important skill for good quality of life of aging people [43].

Training session – *noun* a period of time during which an athlete trains, either alone, with a trainer or with their team [44].

MATERIAL AND METHODS

Participants

The study included 48 patients (26 women and 22 men) referred for rehabilitation due to overload and degenerative disease of the lower spine. They

were divided into two equal groups control group (**CG**, n = 24: including 14 women and 10 men), In the experimental group (**EG** (n = 24: 12 women and 12 men). Age and somatic characteristics of patients in both groups is presented in Table 1.

Study design

CG patients performed a rehabilitation program was applied using general rehabilitation, while EG patients exercises with elements of *tai chi* were additionally used.

People selected for the study had to meet the inclusion criteria for the study and were matched to ensure comparability of groups. The relatively small size of the studied groups resulted from the fact that the study included patients who moved independently without orthopaedic appliances, who scored a minimum of 9 points on the AMTS (Abbreviated Mental Test Score). This test was performed by a qualified physiotherapist. The research was carried out at the ORNR 'Krzeszowice', Rehabilitation Centre.

Inclusion criteria for the study: age over 60, diagnosis of osteoarthritis of the lumbar spine.

Criteria for exclusion from the study: schizophrenia, dementia, Parkinson's disease, Alzheimer's disease, stroke neurological diseases: multiple sclerosis, amyotrophic lateral sclerosis, muscular dystrophy, constant intake of painkillers, diabetes, unstable coronary artery disease and unstable blood pressure, acute period of rheumatic diseases, inflammatory bowel diseases. after surgical, neurosurgical and orthopaedic procedures within 6 months before therapy. nervous system diseases, muscle diseases, inflammatory rheumatic diseases such as rheumatoid, ankylosing and psoriatic arthritis, previous operations on the spine and limbs, including arthroscopy, intervertebral disc conflict with nerve roots with symptoms radiating to the lower limb, severely obese and / or serious abdominal diseases,

During the interview, patients were asked about the presence of certain diseases typical of the elderly. Thanks to this information, it was possible to predict the appearance of disease symptoms during tests, such as fatigue or weakness. All subjects from both groups had the maximum score on the Activities of Daily Living (ADL) scale. The highest scores were obtained by all subjects in Lawton's Instrumental Activities of Daily Living scale (IADL). According to this information, the respondents from both groups did not differ significantly in terms of independence in performing basic and complex daily activities.

Instruments

The clinical evaluation was carried out twice: before the start of the rehabilitation camp and on the last day of therapy. Two research tools were used for its implementation: The Roland-Morris Disability Questionnaire (RMDQ) – a questionnaire for subjective assessment by the patient of the degree of disability caused by ailments from the lower spine. It consists of 24 questions about the everyday life of patients. The maximum number of points to be obtained is 24, which means the maximum level of disability [26]: Berg's Balance Scale (BBS) – containing 14 activities used to assess the balance of the examined person. Tasks are rated on a scale from 0 to 4 where the maximum rating means the ability to perform the task independently and 0 the inability to complete it [27-29].

The examination was performed by one qualified physiotherapist in order to avoid the subjectivism of the assessment.

Table 1. Distribution of data on age, height, weight and BMI in the control and experimental groups.

Variable	Control group n = 24			Experimental group n = 24		
	Me	Q1	Q3	Me	Q1	Q3
Age [years]	65.00	64.00	67.00	65.00	63.25	67.75
Height [m]	1.70	1.65	1.77	1.70	1.65	1.78
Weight [kg]	76.00	70.50	86.25	77.00	70.50	89.50
BMI [kg/m^2]	25.75	24.72	29.21	26.77	23.79	30.58

Me median, **Q1** first quartile, **Q3** third quartile

Procedure

The programme of general rehabilitation lasted two weeks, which coincides with the refunding available within the Polish National Health System. Participants were asked to advise one of the investigators if they had an increase in pain for which they wished attention. Program performed by the CG and EG.

All patients taking part in the general rehabilitation program had the same procedure algorithm applied to them:

- free exercises (strengthening the postural muscles: stomach, gluteal and dorsal muscles);
- individual exercises (using neurophysiological methods individually adapted for functional deficiency) conducted by certified therapists;
- the exercises were done daily for a one hour period;
- individual psychotherapy (1 hour sessions once a week).

Additional program for patients of the EG

In the experimental group, elements of *tai chi* were additionally used. All *tai chi* sessions were conducted as a group treatment The patients received 10 *tai chi* sessions over 2 weeks (40 minutes duration of each session). The program consisted of three components:

- a warm-up and stretch;
- specific elements of *tai chi* containing the following exercise positions: the bear, the crane, the deer, the tiger and the monkey;
- cool down.

The classes were conducted by a certified instructor with a 1st degree in martial art (certification was gained from the Polish Society of Kickboxing in Warsaw, Poland). Global movements strategies were used in these exercises, which are later transferred into functional movements in everyday activities. Particular attention was paid in a strengthening of trunk activities through the simultaneous mobility and fluency of limb movements. An important component in the exercises was synchronized breathing which aids relaxation as well as fluidity in movement, also influencing pain management and control.

The research was approved by the Scientific Research Ethics Committee of University of Warmia and Mazury in Olsztyn, Poland (Decision No. 9/2018).

Statistical Analysis

Statistical analysis was performed with the use of IBM SPSS Statistics v.26. In order to check the normal distribution, the Shapiro Wilk test was performed. Due to the lack of a normal distribution of the obtained data, non-parametric tests were used. Additionally, during the statistical analysis, the Wilcoxon test was performed for the CG and EG in order to compare two pairs of measurements taken in one group before and after the therapy. The Mann-Whitney U test was also performed to compare the results before and after treatment between the control and experimental groups. In the statistical analysis, the Spearman correlation test was also carried out in order to check the existence of correlation between the studied variables. The statistical analysis was rounded to two decimal places. All analyses were performed with a significance level of $p<0.05$.

RESULTS

Before the start of therapy, in the CG the mean score obtained by patients in the RMDQ was 7.96 ±0.75points and in the BBS 39.63 ±1.13 points. EG, the mean results were 8.04 ±0.75 points and 39.96 ±0.81points, respectively. The results of U-Mann-Whitney test was between the entire control and experimental group ($p = 0.67$ in RMDQ and in 0.31 BBS). The results of U-Mann-Whitney test was not statistically significant either before or after therapy: before ($p = 0.67$ in RMDQ and in 0.31 BBS); after (p-value 0.42 and 0.37 respectively in RMDQ and in 0.56 and 0.12 BBS). In all cases, no statistically significant differences were found between the pairs of variables CG versus EG before therapy in the general sense (Table 2) and taking into account gender (Table 3).

After the end of the two-week rehabilitation camp in the CG the mean score obtained in the RMDQ was 5.83 ±0.69 points and in the BBS it was 44.83 ±1.58 points. In the experimental group EG practicing *tai-chi* exercises, the patients scored an average of 5.96 ±0.91 points in the RMDQ and 50.25 ±1.62 points in the BBS (Table 4 and 5). The difference (checked by the U-Mann-Whitney test) in the obtained results of PMOQ

Table 2. Distribution of results in the used questionnaires before the therapy.

Research tool	Control group n = 24			Experimental group n = 24			Between groups
	Me	Q1	Q3	Me	Q1	Q3	p
RMDQ	8.00	7.00	8.75	8.00	7.25	9.00	0.67
BBS	44.00	43.00	44.00	44.00	43.25	44.75	0.31

RMDQ Roland-Morris Disability Questionnaire, **BBS** Berg Balance Scale, **Me** median, **Q1** first quartile, **Q3** third quartile

Table 3. Distribution of results in both genders in the used questionnaires before the therapy.

Research tool	Control group n = 24						Experimental group n = 24						Difference between	
	Women			Men			Women			Men			W	M
	Me	Q1	Q3	Me	Q1	Q3	Me	Q1	Q3	Me	Q1	Q3	p	p
RMDQ	8.00	7.00	9.00	8.00	7.00	8.25	8.00	7.25	9.00	8.00	7.25	8.75	0.42	0.37
BBS	44.00	43.00	44.00	43.00	43.00	45.00	44.00	43.25	44.75	44.00	43.25	44.75	0.56	0.12

RMDQ Roland-Morris Disability Questionnaire, **BBS** Berg Balance Scale, **Me** median, **Q1** first quartile, **Q3** third quartile, **W g**roup of women, **M** group of men

was not statistically significant (p = 0.58). In the case of BBS, the difference was statistically significant (p <0.001) (Table 4). The same relationships were noted with the division into sex (Table 5).

The results of the Wilcoxon test revealed a statistically significant difference between CG and EG found before and after differentiated therapy. The differences apply to both RMDQ (p<0.001) and BBS (p<0.001) results.

The strong correlation (measured by the Spearman method) between the points obtained before the therapy in the RMDQ and the BBS is statistically significant in both groups. Along with the increase in the level of disability (based on the results of

Table 4. Distribution of results in the used questionnaires after the therapy.

Research tool	Control group n = 24			Experimental group n = 24			Between groups
	Me	Q1	Q3	Me	Q1	Q3	p
RMDQ	5.50	5.00	7.00	6.00	5.00	7.00	0.58
BBS	49.00	48.00	50.00	54.00	53.00	56.00	**<0.001**

RMDQ Roland-Morris Disability Questionnaire, **BBS** Berg Balance Scale, **Me** median, **Q1** first quartile, **Q3** third quartile

Table 5. Distribution of results in the used questionnaires after the therapy.

Research tool	Control group n = 24						Experimental group n = 24						Between groups	
	Women			Men			Women			Men			W	M
	Me	Q1	Q3	Me	Q1	Q3	Me	Q1	Q3	Me	Q1	Q3	p	p
RMDQ	5.00	5.00	6.00	6.50	5.00	7.00	5.00	5.00	7.00	6.00	6.00	6.75	0.74	0.82
BBS	49.00	48.00	49.25	49.50	47.00	50.00	55.00	53.25	56.00	53.00	53.00	54.75	**<0.001**	**<0.001**

RMDQ Roland-Morris Disability Questionnaire, **BBS** Berg Balance Scale, **Me** median, **Q1** first quartile, **Q3** third quartile, **W** group of women, **M** group of men

RMDQ), the number of points obtained on the BBS decreased: CG r = −0.64 (p<0.001); EG r = −0.96 (p<0.001).

In both the control and experimental groups, the average drop in the number of points in the RMDQ was similar and amounted to approximately 2 points. A significant difference in the results was recorded in the BBS, where the increase in the number of points obtained was almost twice as high in the experimental group than in the control group, which did not use exercises containing elements of *tai chi*. Based on the Mann-Whitney U test results not found statistically significant difference between the decrease in the number of points in the RMDQ between the study groups (p = 0.43), while found the difference in the increase in the number of points in the BBS in the CG and EG was statistically significant (p<0.001) (Table 7).

DISCUSSION

Currently, rehabilitation is looking for new methods of dealing with degenerative disease and overload of the lumbar spine. Diseases related to this area are more and more frequent due to the lifestyle associated with a sitting position, low physical activity and an aging society where these diseases are associated with the natural process of tissue wear [30]. Lack of physical activity in patients changes the concept of mobilization. Previously, mobilization was associated mainly with the therapist's action on the patient's soft tissues. Currently, mobilization is associated with mobilization of the patient to physical activity [31].

The use of the *tai chi* method fits very well with the changing definition of mobilization. Our own research shows an improvement in the assessment of balance based on the BBS scale, which was noted in the experimental group covered by the tai chi program. Statistical analysis showed two times higher values than in the control group. This proves the positive influence of tai chi on the patients' balance. Hu et al. [32] described the biomechanical mechanism of *tai chi* which prevents falls among the elderly. Similar conclusions were reported by Kittichittipani and Kusoom [33]. The introduction of the two-week *tai chi* program did not cause statistically significant changes in RMDQ. This may be a consequence of too short a therapy, as scientific research carried out by Qin et al. [34] showed the opposite tendency.

Many authors pay attention to the effectiveness of *tai chi* exercises. Deng and Xia [35] in their work they compared two cohort groups: one group consisted of people training *tai chi* for at least 4 years, and the second group was matched to them, consisting of people who had no contact with *tai chi* [35]. Then, the condition of the lumbar spine, including bones and soft tissues, was assessed radiographically. According to the results of the study, the people training had significantly less degenerative tissue changed. Similar studies were performed by Wong et al. [36], who performed static stability studies in their research. The experimental group consisted of patients who regularly practiced *tai chi* from 2 to 35 years. Compared to those who had no contact with the sport, seniors who regularly practiced *tai chi* showed better stability. The results of the authors' study were also confirmed in other studies.

Nguyen and Kruse [37] conducted a similar study where an experimental group of seniors was subjected to 6 months of *tai chi* training. The clinical study was performed using The Falls Efficacy Scale (FES), Pittsburgh Sleep Quality Index (PSQI), and Trail Making Test (TMT) were

Table 6. The difference of points obtained before and after therapy in the studied groups.

Research tool	Direction of change	Control group n = 24			Experimental group n = 24			Between groups
		Me	Q1	Q3	Me	Q1	Q3	p
RMDQ	difference of point number	−2.00	−1.00	−3.00	−2.00	−1.00	−3.00	0.43
BBS		5.00	4.00	7.00	10.50	9.00	11.75	**<0.001**

RMDQ Roland-Morris Disability Questionnaire, **BBS** Berg Balance Scale, **Me** median, **Q1** first quartile, **Q3** third quartile

used as primary outcome measures. Older people who did not train *tai chi* had statistically significantly worse results than those after six months of training [37]. These observations are also confirmed by the study by Li et al. [38]. The subjects of the experimental group were subjected to *tai chi* training for 12 months. Regular exercise had an impact on the balance in the studied group of elderly people, but an interesting conclusion was that it had no effect on muscle strength.

Balance and fitness of the elderly is a very interesting field of knowledge and requires further research. Based on the research to date, it can be concluded that *tai chi* can be for seniors not only an attractive form of physical activity, but also a way to maintain a good quality of life, improve well-being and prevent degenerative diseases. *Tai chi* can also be used to prevent falls, which are also a serious problem in geriatrics [39]. It can therefore be concluded that a number of positive aspects that characterize *tai chi* significantly increase the quality of life. Positive values contributing to the improvement of balance, reduce back pain, which is confirmed by scientific research [40]. Therefore, the applied *tai chi* program contributed to the improvement of balance, which could have an impact on reducing or eliminating back pain, which significantly increases the comfort of everyday life.

LIMITATIONS OF THE STUDY

The limitations of the study may be a small sample of people taking part in the study. In addition, the tools used are subjective, which may interfere with the objective assessment of the patient's condition. However, in the above study, the authors primarily set themselves the goal of getting to know and investigate the subjective opinions of patients about their health, and to check how the applied therapy will affect self-esteem and sense of health.

CONCLUSIONS

Exercises with the use of *tai chi* elements can be an interesting proposition as part of the rehabilitation of the elderly. The addition of elements containing *tai chi* had comparable effectiveness to the classic rehabilitation program taking into account the results in the RMDQ-Roland-Morris Disability Questionnaire (a drop in the number of points after treatment means an improvement in the result and thus a better condition of the patient). In the case of Berg Balance Scale (increasing the number of points obtained after the therapy means an improvement in the patient's condition), patients obtained better results in the group practicing *tai chi*, which suggests a positive influence of this sport on the improvement of stabilization in the elderly and may be an alternative to the classic rehabilitation procedure.

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