Issue Rehabil. Orthop. Neurophysiol. Sport Promot. 2022; 40: 27–34. ISSN 2300-0767
DOI: 10.19271/IRONS-000172-2022-40

ORIGINAL ARTICLE

EFFICACY OF AI CHI METHOD IN THE TREATMENT OF CHRONIC LOW BACK PAIN IN OLDER ADULTS – A PILOT STUDY REPORT

SKUTECZNOŚĆ METODY AI CHI W LECZENIU PRZEWLEKŁYCH ZESPOŁÓW BÓLOWYCH DOLNEGO ODCINKA KRĘGOSŁUPA U OSÓB STARSZYCH – BADANIE PILOTAŻOWE

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ABSTRACT

Introduction

Low back pain (LBP) has now become a serious medical problem, but it is also an economic one, often leading to the physical disability of patients. Exercise therapy in an aquatic environment, including the Ai Chi method, is an increasingly popular preventive intervention in LBP. So far, however, only a few studies have evaluated the clinical usefulness of Ai Chi for the elderly with this problem.

Aim

This study is a preliminary analysis of the effectiveness of the Ai Chi method for the treatment of chronic LBP in people over 60 years of age.

Material and methods

The research material consisted of 20 women aged 66.95 ± 3.76 years, diagnosed with chronic LBP, treated using the Ai Chi method. In an aquatic environment, the patients performed a series of slow and broad movements of the arms, legs and trunk combined with deep breathing (ten sessions for two weeks). The following research methods were used: the Fullerton Fitness Test, the grip strength test using a dynamometer, and pain intensity assessed using a visual analogue scale (VAS).

Results

The application of the Ai Chi method contributed to an improvement in physical fitness and a reduction in pain sensation in the exercising women. There were no significant changes in the measurements of the strength of the upper limbs.

Conclusions

Ai Chi may be an effective method for reducing pain and improving lower body strength, flexibility, dynamic balance and endurance in older patients with chronic LBP.

Keywords: low back pain, functional fitness, elderly, Ai Chi

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Authors reported no source of funding
Authors declared no conflict of interest

Date received: 29th August 2022
Date accepted: 7th September 2022

STRESZCZENIE

Wstęp

Wstęp. Zespół bólowy dolnego odcinka kręgosłupa (ZBDOK) stał się obecnie nie tylko poważnym problemem medycznym, ale także ekonomicznym, prowadzącym często do niepełnosprawności ruchowej chorego. Terapia ruchowa w środowisku wodnym, w tym metoda Ai Chi, jest coraz bardziej popularną formą zachowawczej interwencji w ZBDOK. Dotychczas jednak badań oceniających kliniczną przydatność Ai Chi u osób starszych z tym schorzeniem jest niewiele.

Cel

Niniejsze badanie jest wstępną analizą skuteczności metody Ai Chi w terapii przewlekłych ZBDOK u osób powyżej 60. roku życia.

Materiał i metody

Materiał badawczy stanowiło 20 kobiet w wieku 66,95±3,76 lat ze zdiagnozowanym przewlekłym ZBDOK, usprawnianych metodą Ai Chi. Pacjentki wykonywały w środowisku wodnym serię powolnych i szerokich ruchów ramion, kończyn dolnych i tułowia połączonych z głębokim oddychaniem (10 spotkań w ciągu dwóch tygodni). Zastosowano następujące metody badawcze: test sprawności ruchowej Fullertona, pomiar siły chwytu za pomocą dynamometru oraz intensywność bólu oceniana wizualną skalą analogową VAS.

Wyniki

Zastosowanie metody Ai Chi przyczyniło się do poprawy sprawności fizycznej i zmniejszenia odczuwania bólu u ćwiczących kobiet. Nie stwierdzono istotnych zmian w pomiarach siły kończyn górnych.

Wnioski

Ai Chi może być skuteczną metodą w zmniejszeniu bólu, a także w poprawie siły dolnej części ciała, elastyczności, równowagi dynamicznej i wytrzymałości u starszych pacjentów z przewlekłym ZBDOK.

Słowa kluczowe: osoby starsze, sprawność funkcjonalna, ból dolnego odcinka kręgosłupa, Ai Chi

Introduction

Due to the increasing worldwide frequency of low back pain (LBP) syndromes in adults, this is a significant challenge for medical care. It is assumed that in 10–15% of cases, it is non-specific and chronic. In patients aged over 65, the incidence rate of chronic LBP varies from 20 to 25 %. Although patients use various forms of pharmacotherapy or physiotherapy, the effectiveness is sometimes insufficient, often leading to long-term motor disability (Balagué *et al.* 2012; Vadalà *et al.* 2020).

The American College of Physicians (Qaseem *et al.* 2017) recommendation is based on a review of randomised studies and meta-analyses. It provides guidelines for physicians treating back pain syndromes. On the first line, it recommends physical exercises, multidisciplinary rehabilitation, acupuncture, and relaxation techniques that help reduce stress. These recommendations are based on moderate-quality evidence.

The section on aqua therapy includes movement exercises conducted in water. The rehabilitation process using water therapy methods in the elderly with chronic LBP mainly aims to reduce pain, improve the range of motion,

and strengthen muscles and balance (Nonn-Wasztan *et al.* 2019). The development of general physical fitness also contributes to the better psychosomatic state of patients (Beissner *et al.* 2012; Baena-Beato *et al.* 2013; Ku *et al.* 2020).

The Ai Chi method is a set of specific movements performed in water, originally derived from Tai Chi (exercises performed on land) in association with Zen shiatsu and the Watsu concept (Ku *et al.* 2020) Ai Chi exercising, combined with proper breathing techniques, is a form of gentle and continuous movement of the upper and lower limbs leading to the involvement of the whole body for active work (Camilotti *et al.* 2015; So *et al.* 2019. A recent systematic review (Dunlap *et al.* 2021) included papers published in English, Spanish, and Portuguese from January 1993, the year Ai Chi was developed, to May 28, 2020. The main criterion was using one standardised test to assess balance, pain, functional mobility, or QOL. Twenty-two articles have been included in the final evaluation, of which only 11 were randomised controlled study designs. The effectiveness of Ai Chi exercises was analysed in 710 subjects ranging from 20 to 75 years, most often diagnosed with Parkinson's disease (7 publications). The other publications included in the review mainly concerned mainly adult patients with multiple sclerosis (2 publications), the elderly at the risk of falls or with balance deficits (3 publications), fibromyalgia (3 publications) and LBP (2 publications). The authors point to the need for further research due to the heterogeneity between all the studies (in population, comparison intervention, and outcomes), making it impossible to put forward an unequivocal assessment of the effectiveness of Ai Chi. However, the qualitative analysis of the current evidence shows that Ai Chi positively influenced balance, pain, and functional mobility compared to land-based exercises and similar to the types of aquatic therapy. The method may benefit adult patients with neurological diseases such as Parkinson's, multiple sclerosis, chronic stroke and balance deficits, and chronic pain disorders such as fibromyalgia and LBP.

Using the Ai Chi concept for treating patients with LBP, rehabilitation is about ensuring the proper functioning of the whole body by strengthening and stabilising all the elements involved in the movement. The exercises are designed to activate the postural muscles, such as the deep abdominal muscles, the pelvic floor muscles, the paraspinal muscles, and the superficial muscles: the abdominal obliques, gluteus and latissimus dorsi muscles, that allow the correct body posture to be maintained (Psycharakis *et al.* 2019). This is of great importance, especially for the elderly, as improved postural control may reduce the risk of falls (Ku *et al.* 2020).

Aim

The study aimed to analyse the potentially beneficial therapeutic effect of the Ai Chi method as a type of water gymnastics for older adults with chronic LBP.

Material and methods

The research consisted of 20 women aged 66.95 ± 3.76 (median 66) years from the Day Stay Ward in the Rehabilitation Orthopaedic and Rehabilitation Hospital in Poznań. A specialist doctor prescribed general improvement exercises in water for the patients to increase the range of movements in their joints and improve the muscle strength of both postural and limb muscles, generally called water gymnastics. The inclusion criteria were: female gender, age 60 years or older, diagnosed by a specialist neurologist, neurosurgeon or orthopaedic surgeon, with a non-specific, chronic LBP syndrome lasting more than three months, without changes in the neurological examination. The exclusion criteria were: acute and specific spinal pain syndromes or exacerbation of pain in the last three months, epilepsy, mental disorders, uncontrolled hypertension, an implanted cardiac pacemaker, and contraindications for water therapy. None of the examined women underwent any other physiotherapeutic

procedures while undergoing the described treatment in water or within six months from the start of the study.

The research was conducted in the hospital swimming pool. The dimensions of the pool are 12.30 m × 7.80 m and a depth of 1.10 m to 2.30 m. The water temperature was 32 degrees Celsius. Rehabilitation in the water included ten sessions of activities lasting 30 minutes daily from Monday to Friday (not at the weekend) for two weeks. The study group started each session with ten minutes of free-flowing movement. In the main part of the session, the patients practised the Ai Chi concept for 15 minutes and ended with a five-minute relaxing swim. In the study protocol, for the Ai Chi exercises, 14 basic positions performed individually were used, combining the four main groups of exercises: breathing in water, movements with the upper limbs, moves with the lower limbs and coordinated movements of the upper and lower limbs (Ku *et al.* 2020).

Examples of the Ai Chi exercises performed in this study and their role in improving movement in LBP are:

1. Rocking leg swing – involves swinging the lower limb while simultaneously moving the upper limbs. This exercise helps to improve balance and coordination and strengthens the muscles that play an essential role in locomotion.
2. Soothing – alternating flexion and extension of the upper limbs in the transverse plane (horizontal flexion), with simultaneous torso rotation. This exercise helps to stabilise the body by training the deep muscles of the torso and the upper limbs.
3. Floating – involves alternating flexion and extension of the shoulder joints. This exercise requires the practitioner to concentrate on breathing and maintaining balance in an unstable aquatic environment.
4. Half leg swing – incomplete lower limb swings while simultaneously moving the upper limbs. This exercise helps to improve balance and coordination and strengthens the muscles of the lower limbs.
5. Freeing – consists of performing alternating horizontal flexion and rotation of the torso in the shoulder joint. The exercise requires the practitioner to concentrate on breathing and maintaining balance in an unstable aquatic environment. Its task is to strengthen the upper limbs and the torso muscles.
6. Stationary trunk – includes adduction and abduction of the upper limbs while simultaneously performing a half-turn around the body axis. Cross-over walk – consists of performing abduction and visiting the upper limbs while taking a step to the side. Both exercises require concentration on maintaining balance in an unstable aquatic environment. These exercises are for improving motor coordination and maintaining orientation in space.
7. Side trunk swing – involves horizontal flexion and extension of the shoulder joint. This strengthens the muscles of the upper limbs.

The following research tests were performed before and after the therapy: the Fullerton Fitness Test, the grip strength test and the assessment of pain intensity using the VAS scale.

The Fullerton Fitness Test (also known as the Senior Fitness Test) -was performed according to the required procedure (Różańska-Kirschke *et al.* 2006). It includes six component tests, indirectly assessing the strength of the upper and lower body muscles, aerobic endurance, motor coordination, and body balance. It was carried out after a few minutes of warm-up. In the beginning, each examined person was asked to perform each movement accurately, adjusted to their abilities. Each task was thoroughly demonstrated and discussed with the patients. The following order of tasks was used:

1. Arm curl – assessment of upper body strength.
2. 30-second chair stand – assessment of lower body strength.
3. Back scratch – assessment of the flexibility of the upper body.

4. Chair sit-and-reach – assessment of the flexibility of the lower body.
5. 8-foot up-and-go – evaluation of selected aspects of motor coordination with particular emphasis on dynamic balance.
6. 2-minute step-in-place – determination of exercise endurance.

   Grip strength was measured using a pneumatic pear dynamometer. The patient squeezes the dynamometer bulb using the maximum force of their dominant hand. The device shows pressure readings in psi which is the British measurement system (1 psi = 0.070307 kg /cm²) (Reséndiz *et al.* 1991).

Using a ten-point VAS scale, the patient determines subjective pain sensation from 0 to 10, where 0 is no pain, and 10 is unbearable pain. The scores in this range were assessed as follows: 1–2, mild pain; 3–4, moderate pain; 5–6, severe pain; 7–8, very severe pain; and 9–10, unbearable pain (Scarano *et al.* 2021).

Statistical calculations were made using the Statistica v12.5 PL statistical package. The distribution of results was examined with the Chi-square test. Due to the characteristics of the results, the non-parametric Wilcoxon test was used. This compared the group of related variables before and after therapy (significance level of $p < 0.05$).

Results

Improvement in the clinical assessment of patients was noted after ten sessions using the Ai Chi method. The average pain level in the subjects before the therapy was assessed as severe, while it decreased significantly to a moderate level after the treatment. Interestingly, all participants reported an improvement in their VAS scores. A statistically significant improvement in physical fitness, measured by the Fullerton Fitness Test, was seen in five of the six elements. However, no relationship was noted between exercising in water and the results of the muscle strength of the dominant upper limbs measured with a dynamometer. Also, the number of forearm flexion movements performed with a 2 kg weight in a sitting position did not change significantly after Ai Chi training for the subjects. The results are presented in Table 1.

Discussion

Aquatic exercises are commonly used in physiotherapeutic programmes for various ailments. Based on scientific evidence, patients with chronic LBP belong to this group of disorders (Rainville *et al.* 2004; Waller *et al.* 2009; Kamioka *et al.* 2010). The unique value of aquatic therapy is due to the physical properties of water. One of the most

Table 1. Results of diagnostic tests before and after therapy for the study group.

Component test	Tested parameter	Ai Chi (x ± SD)		
		Before	After	Difference
		Fullerton Fitness Test		
Arm curl	Upper body strength	16.95 ± 4.34	20.00 ± 4.63	3.05 ± 1.75
30-second chair stand	Lower body strength	14.00 ± 4.31	16.16 ± 4.81*	2.16 ± 1.98
Back scratch	Upper body flexibility	−5.68 ± 9.71	−3.26 ± 10.27*	2.42 ± 5.73
Chair sit-and-reach	Lower body flexibility	−0.11 ± 4.90	1.76 ± 3.90*	1.87 ± 4.29
8-foot up-and-go	Complex coordination, agility and balance	7.13 ± 1.44	6.47 ± 1.61*	−0.66 ± 0.81
2-minute step-in-place	Exercise endurance	64.95 ± 22.39	82.53 ± 23.40*	17.58 ± 19.53
		Dominant hand muscle strength		
Pear dynamometer	Hand flexor strength	14.03 ± 1.98	14.50 ± 1.81	0.37 ± 1.39
		Pain scale		
VAS	Pain level	5.94 ± 1.85	3.70 ± 1.89*	−1.94 ± 2.18

*Statistical significance was marked at $p < 0.05$ between pre- and posttreatment results.

important is the water's buoyancy, which reduces gravity's effects. The aquatic environment can be considered microgravity. Many authors have documented the improvement of static and dynamic parameters in patients, thanks to long periods spent in a microgravity environment (better postural control, proprioception and increased walking speed) (Baroni *et al.* 2001; Marinho-Buzelli *et al.* 2015; Kurt 2018). The aquatic environment also reduces joint strain when exercising (Gomes Neto *et al.* 2020). In addition to the buoyancy of the water, it is worth emphasising its other unique properties, such as hydrodynamic and hydrostatic pressure, temperature, thermal conductivity and resistance. The hydrostatic pressure of water supports breathing, especially exhalation, increasing the vital capacity of the lungs. The water temperature helps patients to relax and to reduce pain. The warm water in the pool dilates blood vessels and improves the blood supply to internal organs and muscles. The natural resistance of water supports muscle strength, increasing the overall effectiveness of the training (Kurt 2018).

The United Kingdom National Institute of Health and Care Excellence recommends exercise training in all its forms for treating -LBP (National Guideline Centre 2016). However, it is not yet proven which form of exercise is the most effective (van Middelkoop *et al.* 2010). The in-water exercise was found to provide a similar (Baena-Beato *et al.* 2013) or greater (Bello *et al.* 2010; Dunlap *et al.* 2021) improvement than traditional out-of-water therapies and may be more appropriate for people with LBP, particularly in the primary stages of rehabilitation and for those who have difficulty performing exercises on land (i.e., significant pain ailments) (Bressel *et al.* 2011). Therefore, water exercises are commonly recommended for older adults with chronic LBP (Psycharakis *et al.* 2019).

In the latest systematic review (Dunlap *et al.* 2021), which presents results for treating patients with chronic LBP, only two studies used the technique of Ai Chi water exercises. In one publication, the effectiveness of the Ai Chi and acupuncture methods for the treatment of chronic LBP was assessed (Camilotti *et al.* 2015). The authors showed there was a significant improvement in both groups of subjects compared to the control group (people not exercising) in terms of pain (evaluated using a VAS) with a large size effect and disability (measured on the Oswestry scale) with a moderate effect size following the Ai Chi. The second preliminary report compared this method to the Bad Ragaz ring (using proprioceptive neuromuscular rehabilitation) in patients with LBP (So *et al.* 2019). Both forms of rehabilitation improved the degree of disability of the respondents, measured by the Roland-Morris questionnaire with a small effect size for Ai Chi therapy. Additionally, the Ai Chi group was conducive to improved balance control.

The results of our research indicate a similar influence of the Ai Chi method for reducing pain in the elderly with chronic LBP. The fluidity and continuity of movements combined with proper breathing increase relaxation and thus may reduce pain. Improvements were also noted in the level of physical fitness, measured by the Fullerton Fitness Test, which included lower body strength, flexibility, balance, coordination, and endurance. Ai Chi exercises, combined with breathing, activate the whole body. Gentle, continuous movements begin from the upper limbs, through the torso and lower limbs, with a variable base of body support. In addition, patients stand in water up to the level of their shoulders, and when exercising, they must also overcome the natural resistance of the water. Hence, this may increase strength and endurance, especially in the lower body (So *et al.* 2019). Since an aquatic exercise programme has minimal strain on the joints and a lower risk of falls, it may be particularly effective in preventing disability in older adults with chronic pain and limited mobility. It has been proven that even an hourly water therapy programme once a week can significantly reduce the risk of disability among the elderly. Therefore,

it has been specifically recommended for those who have difficulty exercising on land (Iwasaka *et al.* 2019).

This study has some limitations. The group involved in the study was a small sample size. Due to the specific inclusion criteria, only a narrow group of responders qualified for the study. Ai Chi is still a new method in Poland, so testing the efficacy of treating LBP in older patients is still limited. The research should also include a control or reference group, increase the number of therapeutic sessions administered to each patient, and monitor the effects of the therapy in the long term. The potential benefits of exercising for patients with LBP can be increased with a more extended exercise programme. Due to the physical properties of water and the existing physiological reactions to exercising in water, it is worth continuing research in this direction.

Conclusions

The results show that the Ai Chi method may effectively treat people over 60 with chronic LBP. After ten sessions of Ai Chi over two weeks, the authors recorded a significant reduction in pain assessed using the VAS scale. In addition, there was a significant improvement in lower body muscle strength, flexibility, dynamic balance, complex coordination and endurance measured using the Fullerton Fitness Test. In older people, it is essential to maintain a good fitness level for as long as possible, so Ai Chi may be one of the methods that can positively influence the health of practitioners. However, the need for further research into Ai Chi's efficacy is indicated.

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