

Taijiquan in the prevention of symptoms of Parkinson's disease - a comparative analysis of research results

Authors' Contribution:

- A Study Design
- B Data Collection
- C Statistical Analysis
- D Data Interpretation
- E Manuscript Preparation
- F Literature Search
- G Funds Collection

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abstract

The primary symptom in Parkinson's disease (PD) is a progressive disorder of motor functions. Despite constant pharmacological treatment, the patient's daily functioning ability diminishes, leading to deterioration in the quality of life. Clinical and experimental studies show that systematic use of physical exercise delays the build-up of motor impairments in Parkinson's disease by prolonging patients' functional independence and thereby improving their quality of life. Systematic physical activity, such as resistance, balance, and stretching exercises (elements of aerobics, Nordic walking, dance, tai chi, or the use of Taijiquan martial arts), is considered as possibly useful therapy in symptomatic treatment of PD.

In this paper, based on available literature, it was shown that thanks to appropriately selected Taijiquan techniques (Chinese martial arts and movement) can significantly improve the quality of life of people with PD, improve their mobility, and hence reduce the incidence of falls. However, it should be remembered that it could only be part of therapy, in the prevention and treatment of PD symptoms, and not create it.

Access to the literature of the subject, which is largely in Chinese, may constitute a limitation of this study.

Key words Parkinson's disease, movement, treatment, Taijiquan

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INTRODUCTION

Parkinson's disease (Lat. *paralysis agitans*) was first described in 1817. It is a disease of the nervous system, caused by a gradual disappearance of nerve cells in some regions of the brain [1], and it belongs to neurodegenerative diseases. Parkinson's disease is called a spontaneous disease, the underlying cause of which is the genetic conditioning and the influence of external factors, e.g. substances present in the environment, in food or arising during infections and other diseases [2, 3]. It is important to distinguish between the cause of the disease and its mechanisms, which are the basis for the disease and its symptoms [4]. Due to an undefined cause, the nerve cells responsible for the production of dopamine, which is the main catechol neurotransmitter in the brain, are damaged (Figure 1). By stimulating specific receptors, dopamine participates in the regulation of such processes as interpreting emotional stimuli, learning and remembering, maintaining posture and moving around [2]. Diagnosis is mainly based on a clinical examination and the presence of the disease symptoms, such as hand or leg tremor (mainly at rest), muscular stiffness, lack of balancing on the limbs (first on the side of the appearance of symptoms), slower movements and postural disorders, which are mainly manifested as the tilt of the figure forward - "stooping" [3].

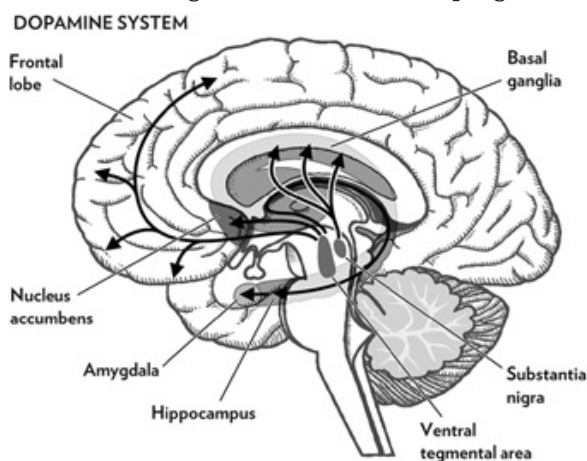


Fig. 1. A diagram of the brain in the sagittal plane showing the dopaminergic system [5]

Studies show that the prevalence of Parkinson's disease ranges from 120 to 180 per 100,000 people in the general population, which is 1.2 to 1.8 per mille. It is estimated that in Poland the number is about 80,000 people. Epidemiological studies indicate a slight predominance among men [4, 6].

A patient with Parkinsonism should lead an active lifestyle as long as possible and not quit professional work. Performing general improvement exercises, those improving defective posture, coordination and respiration, is recommended. The effort must always be adapted to the patient's current capabilities. One of the most important elements of the fight against symptoms of Parkinson's disease, in addition to pharmacological treatment, is systematic physical activity, which affects the relatively smooth functioning in the family environment and at work and also helps to adapt to new conditions arising from the disease [7, 8]. Such exercises affect the skeletal and the muscular systems; they restore self-confidence, increase self-esteem and help overcome psychophysical infirmity [9].

In physical activity programs in people with Parkinson's disease, the emphasis should be on a variety of physical activities. Stretching exercises and those increasing the range of motion in joints, as well as exercises affecting postural stability are a very important element of the therapy. Abandoning them may result in declining fitness in basic life activities. Martial arts are increasingly used in the prevention of Parkinson's symptoms. Studies show an improvement in postural stability in patients with mild to moderate severity PD. Selected techniques with stretching and rotations using rhythmic shifts of the centre of gravity as well as harmonious and slow movements affect the increase in gait speed and the length of steps; they reduce the number of falls and improve the patients' mobility [10, 11].

TAIJIQUAN AS A PHILOSOPHY AND MARTIAL ART

Taijiquan is a Chinese martial art and movement [12]. There are many ways of spelling this expression, e.g. taiji ortaichi. It means "the highest peak", but the original translation is "the top of the roof, causing one part to be darkened and the other illuminated". In turn, the expression "Taiji" with the addition of the "quan" element, also recorded as "chuan", means "taiji fist", a martial art based on the concept of taiji [13].

There are many Taijiquan varieties or styles; however, each of them has the same roots. Historically, it is derived from the concept of the existence of Yin and Yang, which was first described by Laotse in the book *Dao De Jing* in the 4th century BCE and in 1122 BCE, in the *Book of Changes (Yijing)*. The exact way in which this concept gave birth to Taijiquan is unknown [14].

An essential element of the Taijiquan philosophy is the existence of energy – Qi. According to the general definition, it is universal energy, including heat, light and electromagnetic energy. The narrow definition speaks of the energy flowing in the human body. It is believed that Qi circulating in the body is inherently bioelectric [12]. When practicing Taijiquan, positions and their sequences should be selected in such a way that the Qi energy can freely flow in energy channels, the so-called meridians (see Fig. 2).

In Taijiquan training, all methods of shaping endurance are used. An example is the continuous method, both monotonous and variable, to improve the long-term (aerobic) strength. The intermittent method, both repetitive and interval, is equally popular.

Strength training in Taijiquan is carried out in accordance with the methods described above. Training with one's own body weight and doing low positions, one can train to the limit of one's capabilities or this can be a short-term effort. It should be remembered that the difficulty in training with one's own body weight mainly lies in the position taken during the performed exercise. In Chinese martial arts, the choice of positions is huge; hence, the degree of difficulty varies. Therefore, they can be adapted to the appropriate strength training techniques. Resistance training in which a training partner functions as resistance is an equally popular way to develop strength in Taijiquan. Resistance exercises combined with other exercises improve muscle strength, influence postural disorders, reduce the incidence of falls and slowing down of movement, and improve the quality of life [15, 16, 17, 18].

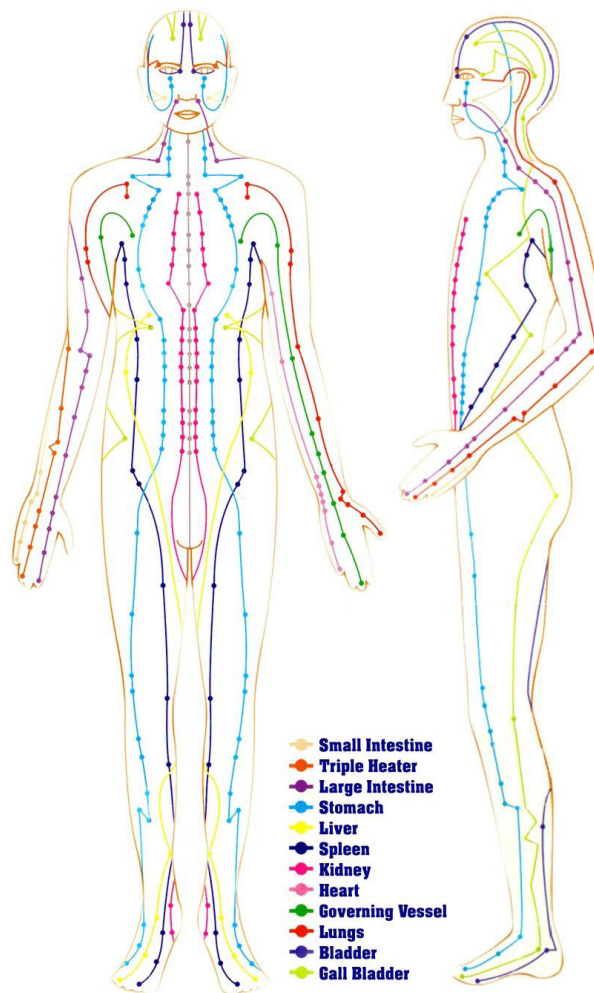


Fig. 2. The flow of Qi energy in the main meridians of the human body
Source:http://theamt.com/meridian_chart_and_map_of_meridians_meridian_points_acupoints.htm

Flexibility means the ability to move in the maximum range (maximum amplitude). When it comes to shaping flexibility in people who can do active exercises, passive exercises are pointless [19]. In training flexibility in martial arts, both static (bridges, splits) and ballistic training (circling, kicks, and swings) are used [14].

In Taijiquan training, creativity is of great importance [14]. An adept must show initiative in practical actions. He should be able to find a way out of different situations based on the knowledge gained from previous trainings. This is important during free fight training. Work is more difficult because it is done in changing conditions, and one should constantly focus on finding the best solution to get out of trouble [12].

Just like in martial arts training, in Parkinson's disease falls are very common and dangerous. Therefore, balance skills and ability to shape it play a very important role both in Taijiquan and in Parkinson's disease. Both in rehabilitation and in Taijiquan training, exercises that shape protective reactions are conducted in parallel to balance exercises [19].

TRAINING WITH THE APPLICATION OF TAIJIQUAN TECHNIQUES IN PATIENTS WITH PARKINSON'S DISEASE IN THE LIGHT OF RESEARCH

In 2005, Venglar [20] conducted a study on the impact of Taijiquan training on people suffering from Parkinson's disease. He analysed two subjects in one group practicing the Yang style. Participant "A" had suffered from Parkinson's for 20 years and in the Hoehn and Yahr scale he suffered from the 2nd stage of the disease, while in participant "B" the disease had been diagnosed 5 years before the test and, according to the above-mentioned scale, the stage of the disease was defined at 2.5. For two months, 60-minute trainings were conducted once a week. In addition, the patients were encouraged to take individual trainings lasting up to 90 minutes per week, and they were provided with additional materials in the paper or audio-visual form. All tests carried out on patients took place before and after the program, as well as after a month and two months of observations.

In the test of stretching, an improvement was noted in both participants. Unfortunately, there is no information on the type of test used in the study. Time in the test "get up and go" after two months since the end of the intervention only improved in participant "A". Both participants improved their balance on the ABC (Activities-Specific Balance Confidence) scale: participant "A" from 31% to 51% and participant "B" from 72% to 78%. Unfortunately, the study was poorly designed. There was no accurate information on the results of all tests, and the number of participants in the study was insufficient.

In 2006 Kluding and McGinnis [21] conducted a more precise study, unfortunately also only on two patients. Participant "A" had been sick for 4 years and was in the third stage of the disease, while participant "B" had been ill for 3 years and suffered from the second stage. The intervention was divided into three one-month parts. During the first month, physiotherapists conducted classes aimed at improving balance. The trainings took place twice a week and lasted 60 minutes. In the second month, patients started training in open fitness centres, supervised by qualified instructors. Taijiquan sessions began in the third month of intervention. Twice a week physiotherapists conducted classes whose duration was not specified. Four movements of the Beijing Taijiquan style, based on the Yang family style, were practiced, such as "beginning" (Taiji Qi Shi), "parting wild horse's mane" (Ye Ma Fen Zong) or "grasp sparrow's tail" (Lan Que Wei) with the right and the left upper limb. Patients were evaluated before and after the program, and for 8 months afterwards. Unfortunately, the observation for 8 months after the program consisted only of a phone conversation.

Patients showed a significant improvement in limb strength and balance. Due to improved balance, an increase in the functional range, a decrease in the "get up and go" test time and an increase in the Berg balance test score were noted. It is worth noting that after 8 months, participants were still physically active. Unfortunately, due to a combination of three interventions, it is impossible to determine exactly what effect Taijiquan training itself had on the patients.

The next study of the impact of Taijiquan on patients suffering from Parkinson's disease was conducted in 2007 by Li et al. [22]. The basic training program

consisted of six parts of the form based on the traditional Yang style. These movements were as follows: “waving with hands in the clouds (right and left hand)” (Zuo / You Yun Shou), “parting wild horse’s mane” (Ye Ma Fen Zong), “step up, punch down” (Jin Bu Zai Chui), “twin fists strike opponent’s ears” (Shuang Feng Guan Er), “repulse the monkey” (Nian Hou), “grasp sparrow’s tail (right and left hand)” (Zuo / You Lan Que Wei). A training session lasted 90 minutes and consisted of a warm-up, learning the basic forms of Taijiquan and the cool-down after the training. 17 patients participated in the study. The average time of illness was 3.7 years. 12 participants had the 1st stage of the disease, 4 people suffered from the 2nd stage, and 1 from the 3rd stage. The intervention lasted for a week during which five trainings took place.

The evaluation of the results was divided into subjective and objective. The first one included interviews with patients. They felt that the exercise program contributed to improving their balance and confidence in their body. They also enjoyed the short intervention time. Objective evaluation included physical tests. Fast walking time at a distance of 50 feet (15.24 meters) improved by 14%. Similarly improved was the “get up and go” test result. The functional range improved by 13% compared to the initial test. The results of all tests were collected 1 or 2 days before the start of the intervention and 1 day after the end of the study. Unfortunately, the unification of the whole group made the results unreliable, and the short time of the research limited the final findings.

A year later Hackney and Earhart [23] conducted a study with one blind group, which significantly improved its credibility. The intervention group involved 17 people training a shortened Yang style, consisting of the first and second circle. These were people in the second stage of the disease suffering from the disease for 8.7 ± 4.7 years. The control group involved 16 people at the same stage of the disease, whose disease duration was 5.5 ± 3.3 years. A total of 20 training sessions were conducted over 13 weeks. The trainings took place twice a week and lasted 60 minutes. The subjects were at least 40 years old, able to stand for 30 minutes and walk at least 3 meters without assistance. They were diagnosed with an idiopathic form of Parkinson’s disease.

In Berg’s balance test, the Taijiquan group showed greater improvement than the group without intervention. They also showed improvement in the UPDRS scale, in the third part concerning the examination of the musculoskeletal system. Compared to the control group, people practicing Taijiquan showed slight changes in the “get up and go” test and during a 6-minute walk. This group also improved the gait profile, the length of step and the speed of walking backwards. None of the groups showed improvement in the test of standing on one leg and walking forwards. The gait characteristics were examined with a use of five-meter instrumentation – a computerized walkway. Participants were asked to walk forward and backward at a normal pace, doing three trials in each direction. The result was the average of the obtained results. After the intervention, all active participants completed a questionnaire. In this subjective study, most of the participants practising Taijiquan reported that they were satisfied with their participation in the program and noticed improvement in their physical fitness. All participants were evaluated by specialists who did not participate directly in the research by watching tests in video recordings. Four participants from the intervention group did not complete the research. One withdrew in the 4th week due to hospitalization

unrelated to the topic, and one withdrew after 5 weeks citing low intensity of training. Two more participants had a problem with transport and did not complete the whole training cycle, appearing only sporadically every few days. At the end of the study, there were 13 people in each group. Final results apply only to these 26 people. It should be noted that a longer study time could increase the benefits of Taijiquan training, such as the quality of gait and the frequency of falls.

In 2009, Hackney and Earhart [24] repeated the study of the effects of Taijiquan training on Parkinson's disease, comparing it with dance. Subjects were divided into four groups. In the first one, professional dance instructors conducted 30-minute waltz classes and the same number of foxtrot classes. This group comprised 17 people suffering from Parkinson's disease for 9.2 ± 1.4 years, and the severity of the disease was 2 according to the Hoehn and Yahr scale. The second group attended tango classes. These were 14 people suffering for 6.9 ± 1.3 years from 2.1 stage of the disease. The third group trained Taijiquan - 37 Yang style positions, according to Chen Man-Ch'ing. The group consisted of 13 people suffering from the disease for 8.7 ± 1.3 years at stage 2. The last group was a control group of 17 people not subject to any intervention. The average time of the disease was 5.9 ± 1.0 years with the stage of its severity at 2.2. The therapy lasted 13 weeks. The trainings took place twice a week and lasted 60 minutes. In total, there were 20 trainings sessions. The initial examination took place one week before the tests, and the final examination one week after the end of the tests.

There were no visible differences between the first and the last assessment in the waltz/foxtrot, Taijiquan and control groups. Based on PDQ-39 (39-Item Parkinson's Disease Questionnaire), the tango training group showed a significant improvement in mobility and in the quality of life. Unfortunately, for unknown reasons, 14 patients did not complete the study. The description of the study's randomization is unclear.

In 2011, Kim et al. [25] conducted a study of a 10-person group of people suffering from Parkinson's disease for 40 ± 28.9 months at stage 2.95 ± 0.5 . The basic intervention program was to teach 12 fundamental movements from the Yang Taijiquan style. In each 60-minute training session, these movements were repeated approximately six times. The sessions consisted of 10-minute warm-up, 40-minute proper part and 10-minute post-workout cool-down. For rehabilitation purposes, easy to learn and execute items were selected. The intervention lasted 12 weeks and the trainings took place 3 times a week. Tests on patients were performed one week before the start of exercises and one week after the intervention.

In their study, Kim et al. focused on assessing the effect of Taijiquan on the change in the patients' centre of gravity. They performed an anterior-posterior (A-P) as well as medial-lateral (M-L) balance test. The displacement of the centre of gravity was described as the sum of the shift between the minimum and the maximum A-P or M-L. In the lateral deflection, it was ensured that the foot opposite to the direction of movement would not detach from the ground. A significant difference was found in the study of the deflection in the centre of gravity before and after Taijiquan training, in both planes. Participants manifested an improvement of 122% in the A-P deflection and

130% in the M-L deflection compared to the initial test. Unfortunately, the study participants were recruited from communal housing facilities, which may not be representative of the entire population. They were few of them and the duration of the intervention was short. Participants were not observed after the intervention to check the permanence of changes that had taken place. It is also important that neither the time nor the quality of gait were studied after training. There was also no control group to compare the results with a non-Taijiquan group.

The effect of Taijiquan training on people suffering from Parkinson's disease in a group of 195 people was conducted in 2012 by Li et al. [26]. The patients were divided into three groups. In the first group, some movements integrated with the Yang style were practiced. The second group participated in trainings focused on strengthening muscles used for balance and walking. In the third group, low intensity exercises in standing and sitting positions were performed, mainly stretching. People in the first and the second groups suffered for 8 ± 9 years and in the third group for 6 ± 5 years. In 84% of the subjects the stage of the disease was 2 or more with a median of 2.5. The intervention lasted 24 weeks. The patients were tested at the beginning of the study, in the third and the sixth months of the study, and three months after the intervention. They practiced twice a week for 60 minutes; altogether 48 training sessions took place. The results of the study were divided into basic and secondary effects. The first one included postural stability indicators, such as limiting the initiated motion in order to move the centre of gravity without falling, as well as the directional control tested by comparing directed motion with free movement. The secondary effects included checking the length of the step and speed of walking, the "get up and go" test, UPDRS III and the number of falls. The Taijiquan group showed a slightly better improvement than the other groups in basic effects. They also showed better results than group 3 in secondary effects and surpassed group 2 in the step length and in the functional reach test. They also had a lower frequency of falls compared to the group training mainly stretching, but not compared to the group training muscle strength. The effects of Taijiquan maintained for 3 months after the intervention. Unfortunately, the study did not involve a blind group without intervention, so there is a risk of a placebo effect. The author did not explain why 19 participants did not complete the study and why there were no complete data regarding measurements in 10 participants. Due to the lack of a blind control group, it is difficult to assess the effectiveness of Taijiquan training.

In 2013, Amano et al. [27] conducted two randomized studies on 45 people with control groups. In the first project, the Taijiquan group consisted of 12 people who practiced the first 8 movements of the shortened form of the Yang style. These were people suffering from Parkinson's disease for 7 ± 7 years at the severity stage of 2.3 ± 0.4 . The control group consisted of 9 people who practiced Qigong where they learned meditation and controlling "Qi" energy. They suffered from the disease for 2.2 ± 0.4 years, and the disease severity was around 2.2 ± 0.4 . In the second project, the Taijiquan group consisted of 15 people who trained just as subjects in the first project. The patients had been ill for 8 ± 5 years, and the stage of the disease was 2.4 ± 0.6 . The control group was not subjected to any intervention. It involved 9 people suffering from Parkinson's disease for 5 ± 3 years at 2.4 ± 0.4 stage of the disease. Both projects lasted 16 weeks. In the first project, training sessions took place

twice a week for 60 minutes. In total, 32 training sessions were held. In the second project, training sessions took place 3 times a week for 60 minutes, and the sum of the trainings was 48. The Taijiquan groups in both projects slightly improved their UPDRS score in part III. Examining such elements as gait rhythm, its speed, step length and gait asymmetry, the authors concluded that the combination of both projects showed that 16 weeks' Taijiquan training was ineffective in improving these determinants or in reducing disability in the UPDRS scale. The authors did not describe the methods of randomization of the study. In both projects, each group was small, and the subjects were aware of the purpose of the intervention, which is why the results might have been a placebo effect.

Although Taijiquan training is recommended for people suffering from Parkinson's disease [27, 28, 29, 30, 31, 32, 33, 34], the studies described above have shown conflicting results of the effectiveness of this training for Parkinson patients. Despite the fact that the majority of the discussed results [20, 21, 22, 23, 25, 26] confirm the effectiveness of Taijiquan, only two of these studies had a stronger methodological quality with the Jadad scale score 3. These studies consisted of two case reports, two studies of individual groups and two randomizations. The cases described by Kluding and McGinnis [21] and by Venglar [20] confirm that their participants improved balance and strength of the lower limbs and obtained better results in the reach test and "get up and go" test. However, in the study by Kluding and McGinnis [21], many interventions were used; therefore, any improvement in patients cannot be attributed to Taijiquan alone. It should be remembered that a study in which there were no blind groups and the participants of the intervention were evaluated by their therapists, not external specialists [22], might raise doubts as to its objectivity.

In all the described studies using Taijiquan training as a rehabilitation method, the Yang style was used. Perhaps this is due to its great popularity among elderly people, as among others Liu and Frank [11] think. This style is a combination of free and graceful movements, and the transition from one position to another always takes place in a standing position, so it is easy and safe also for people suffering from Parkinson's disease. Other styles, such as Chen, use more rapid and explosive movements that require more energy during training, which makes them unsuitable for people with Parkinsonism [35].

The aim of the comparative analysis presented in this paper is to demonstrate that the use of Taijiquan techniques has a positive effect on supporting the treatment of patients with Parkinson's disease. Researchers Venglar [20], Kluding and McGinnis [21], or Li et al. [22] indicated that the use of Taijiquan techniques had a significant impact on improving balance. Venglar [20], Kluding and McGinnis [21], Li et al. [22], Amano et al. [27] and Kim et al. [25] showed that Taijiquan training improved the results of the stretching test to varying degrees. Patients manifested significant improvement in functional reach tests in different directions. The results of the "get up and go" test improved in the studies by Kluding and McGinnis [21], Li et al. [22], Hackney and Earhart [23]. In psychological terms, patients had a better frame of mind and greater self-confidence after the study conducted by Kluding and McGinnis [21], Li et al. [20], or Hackney and Earhart [32]. Increased strength was noted

in patients in the study by Kluding and McGinnis [21]. Li et al. [20] noticed a significant improvement in the quality and speed of walking in patients undergoing intervention.

By contrast, Amano et al. [27] believe that Taijiquan is ineffective in improving the initiation of walking or in reducing disability on the UPDRS scale. According to Li et al. [26], the group did not reduce the frequency of falls compared to the group practicing only strength training. Hackney and Earhart [23] proved that Taijiquan training did not improve balance in the test of standing on one leg. In addition, their research shows that the subjects did not manifest improvement in the quality and speed of walking forward.

LIMITATION

It should be noted that Taijiquan is a Chinese martial art, and thus research on its impact on individual diseases is largely conducted in the cradle of its creation. Unfortunately, due to this fact some literature on the subject is published in Chinese, which makes the analysis of the research material much more difficult.

CONCLUSIONS

In the light of research, Taijiquan training has an impact on supporting the treatment of patients with Parkinson's disease, because it:

- improves balance,
- reduces the frequency of falls,
- increases muscle strength,
- improves the quality and speed of walking,
- increases the reach,
- decreases time in the "get up and go" test,
- improves physical efficiency,
- improves well-being and increases self-confidence.

Due to the very wide set of Taijiquan movements, regardless of the style, no definitive recommendations have yet been made on the movements which should be performed. In neither of the studies in which the taught sequences were named, was it compared which ones were more suitable for people suffering from Parkinson's disease. It can be assumed that differences in the results of individual interventions were the effect of learning different sequences of movements.

After a detailed analysis of the problem, it can be concluded that Taijiquan training is an effective method supporting the treatment of Parkinson's symptoms. However, it should be remembered that it could only be part of therapy and not create it. There is a need for more detailed research on its effectiveness.

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