

The impact of dance on balance and posture control in Parkinson's disease – a systematic review

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Abstract

Background: Parkinson's disease (PD) is a progressive neurodegenerative disease of the extrapyramidal system where the etiopathogenesis is not fully understood. Previous research has shown that undertaking a variety of physical activities by patients with PD has a beneficial effect on improving muscle strength, balance, mobility, and independence. Also, dance as a form of therapy has beneficial effects and can significantly increase muscular endurance and overall fitness of patients.

Aims: The aim of this systematic review was to evaluate the impact of training incorporating dance/elements of dance on balance and postural control in people with PD.

Material and methods: A systematic review of randomized controlled trials published from 2007 to May 2021 was performed. PubMed and Web of Science were searched using the keywords: ("dance therapy" OR "dance movement therapy" OR "choreotherapy") AND ("Parkinson's disease" OR "Parkinson's" OR "Parkinson's syndrome"). Eight out of 17 articles were selected for analysis after methodological quality assessment using the PEDro scale.

Results: The results of the study showed that several weeks of therapy incorporating dance or elements of dance improved motor skills, gait, elimination of freezing, balance, cognitive function, and non-motor symptoms such as mood, psychological symptoms, and quality of life.

Conclusion: The analysis of the results of selected papers suggested that dance and its elements can be used as one form of long-term movement therapy. Choosing the type of dance and appropriate music allows patients with PD to maintain the established intensity of their movements. Dancing improves mental health and is better tolerated, than exercise therapy on a treadmill or cycloergometer, by individuals PD.

Key words

balance, Parkinson's disease, posture control, dance.

Introduction

Parkinson's disease (PD) is the second most common neurodegenerative disease after Alzheimer's disease [1] and the incidence worldwide ranges from 12 to 230 cases per 100,000 annually [2,3]. In Poland, the current number of patients ranges between 60 and 70 thousand [2,3]. PD is a progressive neurodegenerative disease of the extrapyramidal system [2] where the etiopathogenesis is not fully understood [4]. The clinical manifestations of PD are associated with neurodegeneration of dopaminergic neurons of the dark matter and striatum (extrapyramidal nervous system) [2,4] leading to a drastic reduction in dopamine levels [5,6]. Furthermore, there are numerous biochemical changes including an increase in oxidative stress, free radicals, and a decrease in antioxidant substances like glutathione in the central nervous system (CNS) of patients with PD [7]. Reduced levels of brain-derived neurotrophic factor (BDNF) in blood and CNS, which is responsible for neuronal growth, neurogenesis, neuroregeneration, and modulation of plasticity in the CNS in patients with PD, have been observed [8,9]. Decreased levels of BDNF in blood correlate with motor impairment in individuals with PD. Characteristic clinical manifestations of Parkinson's disease include resting tremor of the arms, legs, lips, and jaw [2,3,10]; muscle rigidity of the limbs, trunk, and face [2,3,10]; bradykinesia along with hypokinesia; impaired motor coordination, balance, and postural instability [2,10]; akinesia as well as postural symptoms that can impede daily functioning [10]. The difficulties in diagnosing and treating PD persist to this day. Diagnosis is mainly based on clinical symptom criteria [11,12] employing a variety of scales, which are score-based assessments of neurological symptom severity made by a neurologist [2]. The most commonly used assessment scales are: Unified Parkinson's Disease Rating Scale (UPDRS) [13,15,16] and Hoehn and Yahr Scale (HY) [2].

Despite intensive research, the causes of PD remain unknown, and treatment remains symptomatic focusing on increasing dopamine levels in

the CNS, which results in a reduction of neurological symptoms and halts the progression of the disease. Levodopa being one of the primary drugs used in the pharmacotherapy of PD [3]. Unfortunately, long-term use of levodopa is associated with the risk of developing motor complications and fluctuations [2]. In addition to pharmacotherapy, patients must undergo physical rehabilitation to improve mobility and performance of daily activities.

Physical rehabilitation is an important part of the treatment of individuals with PD but despite numerous studies, very few of them meet the requirements of Evidence-Based Medicine (EBM) causing, the lack of a key unified physical therapy to counteract the symptoms of this disease [14]. Previous research has shown that undertaking a variety of physical activities by patients with PD has a beneficial effect on improving muscle strength, balance, mobility, and independence in performing daily activities, and also slows the progression of the disease [9]. Physiotherapy, psychotherapy, bath exercises, music therapy, hippotherapy, and aromatherapy are used to improve the motor skills of patients with PD [2]. The applied therapy should improve motor activity, flexibility, speed, agility, endurance, and motor coordination, muscular strength, and be adapted to the patient's capabilities taking into account age, duration of the disease, physical fitness, physical capacity [2] as well as the mental health of the patient [17]. Numerous existing studies have shown that increased prolonged physical activity and endurance training, rather than one-time short-term exercise, reduces muscle tension and skeletal muscle stiffness, reducing motor and cognitive impairment in people with PD [8,19]. Moreover, intensive training processes cause biochemical changes in the CNS such as an increase in BDNF release, levels of antioxidant factors, a decrease in inflammatory factors and free radicals [7,20,30]. Research conducted on animal models of PD demonstrated that endurance training increased levels and activity of ty-

rosine hydroxylase and dopamine concentrations in the extrapyramidal system [21,20]. The long-term training process resulted in a decrease in the heart rate of so-called resting bradycardia along with an increase in cardiac output capacity in patients with PD [22]. Increasingly, researchers are suggesting that prolonged intense exercise on a cycloergometer or treadmill causes neurological improvement through changes in the CNS in individuals with PD [23]. Unfortunately, the often-lengthy training process is cumbersome and discouraging for PD patients, thus appealing forms of physical rehabilitation are being sought. It seems that dance as a form of rehabilitation can be a good form of improvement helping to maintain the planned exercise intensity and being safe for patients with PD. Research suggests that dance as a form of therapy has beneficial effects on proprioception and spatial-motor coordination (maintaining proper balance, gait rhythm, and motor coordination) and can significantly increase muscular endurance and overall fitness of patients [18,24,25,26].

Aims

The aim of this study was to evaluate the impact of dance/elements of dance, as a form of rehabilitation, on balance, postural control, and neurological status of PD patients.

Material and methods

A literature review was performed by searching PubMed and Web of Science in accordance with the PRISMA strategy [28] (**Figure 1**). Articles were searched using a keyword combination algorithm: ("dance therapy" OR "dance movement therapy" OR "choreotherapy") AND ("Parkinson's disease" OR "Parkinson's" OR "Parkinson's syndrome"), published between 2007 and 2021.

Articles, demonstrating up-to-date evidence, published in either English or Polish, conducted in accordance with the principles of scientific research and Evidence-Based Medicine (EBM) recommendations, were included in this paper.

Inclusion criteria were as follow: 1) conducting randomized clinical control trials (RCTs); 2) studies focusing on the use of dance as rehabilitation to evaluate its effects on balance and postural control; 3) undergoing dopaminergic pharmacotherapy for PD patients. Exclusion criteria were: language other than Polish or English; people treated with deep brain stimulation; articles with scores lower than five on the PEDro scale; lack of information on the severity of the disease.

The quality of the selected articles was assessed using the 11-point Physiotherapy Evidence Database (PEDro) scale. [27]. The PEDro scale is composed of 11 items that analyze various aspects regarding the methodology of conducted research. One point was given for each criterion that was met. The final sum of points indicates the methodological quality of the article: 0 - 3 low quality article, 4 - 5, medium quality article, 6-10 high quality article.

Results

Eighteen articles (14 from PubMed, 4 from Web of Science) were found in PubMed and Web of Sciences databases in accordance with the PRISM search strategy. Eight articles [17,18,29,30,31,32,33,34] that met the inclusion and exclusion criteria were eligible for the study. The analysis of the study was carried out in accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) standards (**Figure 1**). Articles were evaluated with PEDro scale: two articles [18,29] scored 5/10 points, and six [17,30,31,32,33,34] scored 6/10 points.

Table 1 provides information about the authors, the number of investigated patients, the applied interventions, and the results of the study. Each participant taking part in the study was randomly assigned to different groups.

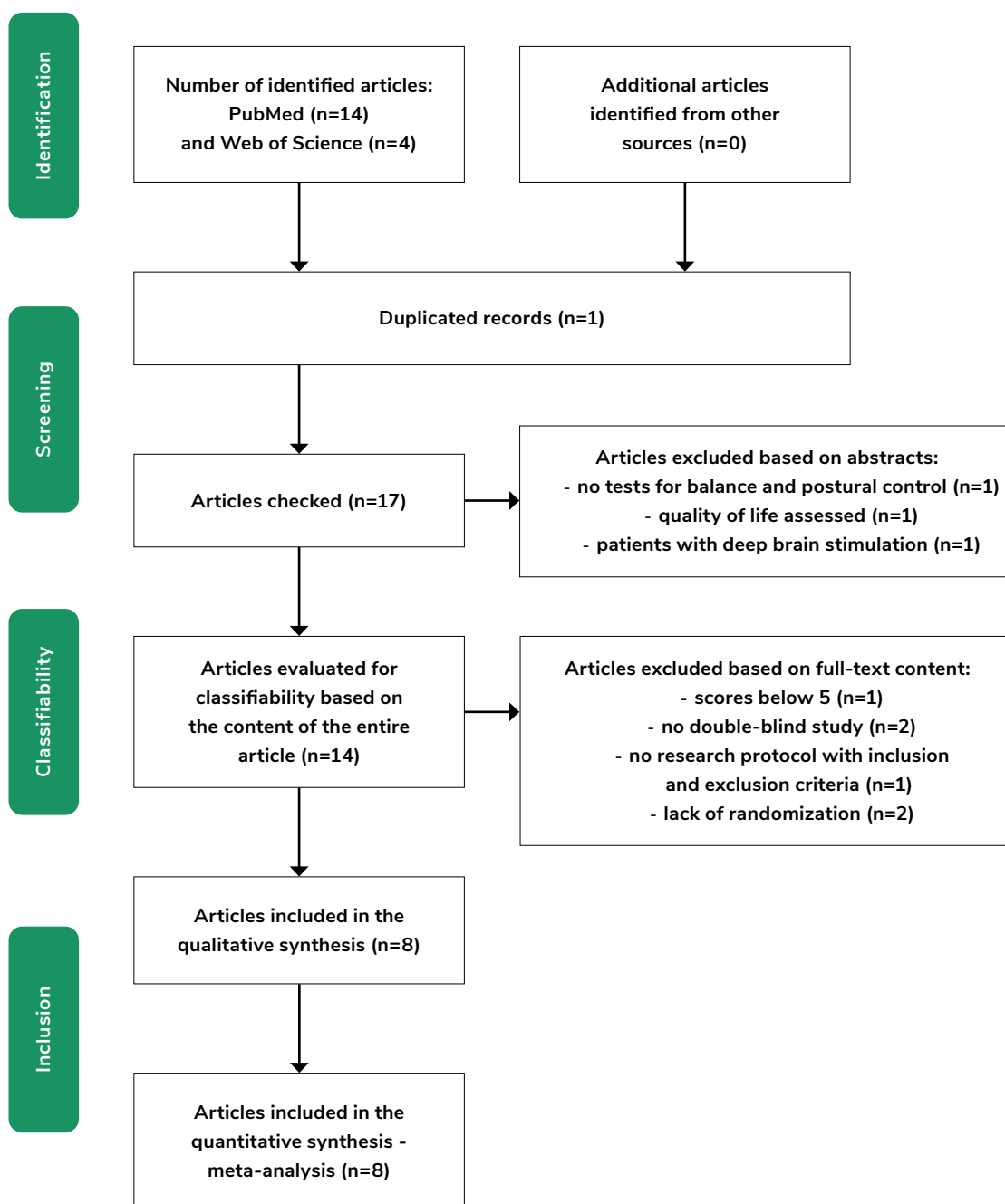


Figure 1. PRISMA flow chart for search strategy.

Table 1. Summary of the research.

Authors	Number of subjects	Intervention	Outcome
<p>Hackney M.E. and Earhart G.M. [30]</p> <p>Aim: The study aimed to determine whether people with PD would benefit more in terms of functional mobility if they participated in tango classes with or without partners.</p>	<p>The 39 subjects (28 men and 11 women) with mild to moderate forms of PD were qualified.</p>	<p>Dance group with partner: (n=20); Dance group without a partner: (n=19). Tango dance classes lasted for one hour, twice a week, over a period of 10 weeks.</p>	<p>Both groups improved significantly in terms of balance in the BBS, free walk and brisk walk after the test. Both groups also improved significantly in terms of single-leg stance time, leg-by-leg stance time, number of steps per minute, and percentage of the double-support phase of the excursive and cornered leg during post-intervention walking. Two measurements, the 6-minute walk test (p = 0.028; critical level p = 0.025) and percentage of leg transfer phase during gait (P = 0.041; critical level P = 0.025) were close to statistical significance after testing and reached statistical significance one month after intervention. Step length during gait showed nearly significant main effects over time (P = 0.051). Those in the non-partner group had longer strides than those in the partner group.</p>
<p>Hackney M.E. and Earhart G.M. [18]</p> <p>Aim: Comparison of the effects of tango, waltz / foxtrot with no intervention on motor control in PD patients.</p>	<p>The study included 58 participants, of which 10 dropped out (34 men and 14 women) with mild to moderate PD.</p>	<p>Waltz/foxtrot group: (n=17); Tango group: (n=14); Control group: (n=17). Classes were held twice a week for 1 hour each for 13 weeks for a total of 20 sessions.</p>	<p>Significant improvements in motor activity, BBS, 6MWT and step back in terms of length for the tango dancing group and waltz/ foxtrot compared to the control group.</p>
<p>Hackney M.E. et al. [29]</p> <p>Aim: Comparing the effects of two interventions: tango classes and exercise classes.</p>	<p>The study included 19 participants (12 men and seven women) with idiopathic PD.</p>	<p>Tango group: (n=9); Exercise group: (n=10). Classes were 20 hours per hour for 13 weeks.</p>	<p>Both the tango and exercise groups improved in the parameters of Part III of the UPDRSIII scale. The tango group improved in the parameters assessed by the BBS scale; the TUG test compared to the exercise group.</p>

<p>Hashimoto H. et al. [31]</p> <p>Aim: Investigate the effectiveness of dance on motor function, cognitive function, and psychological symptoms of PD.</p>	<p>A total of 46 (12 men and 32 women) with mild to moderate PD were qualified.</p>	<p>Dance group: (n=15) performed one 60-minute session per week for 12 weeks. Aerobics, jazz, tango, movements from classical ballet behind focusing awareness on the body and gravity control, improvisation of pantomimic movements were used. Exercise group: (n=17) performed one 60-minute session per week for 12 weeks. Control Group: (n=14) no activities were performed.</p>	<p>Comparing the results before and after the intervention, the dance group showed a large improvement in TUG scale (ES = 0.65, p = 0.006), number of steps (ES = 0.66, p = 0.005), BBS (ES = 0.75, p = 0.00) compared to other groups.</p>
<p>Kunkel D. et al. [32]</p> <p>Aim: Investigate the feasibility of using a blended dance program at the Dance Center for PD patients, examining participant perceptions and exploring primary and secondary outcomes, which will be incorporated into the planning of a larger Phase III study to address questions of efficacy.</p>	<p>A total of 51 people (25 men and 26 women) with diagnosed PD indicating mild to moderate severity of Parkinson's disease were qualified.</p>	<p>Dance group: (n=35) Classes were one hour long, twice a week for 10 weeks. Six dances were taught: three ballroom dances (ballroom foxtrot, waltz and tango) plus three Latin American dances such as cha cha, rock and roll and rumba. The control group: (n=15) continued usual care, which typically included medications, medical clinic visits and routine nurse visits.</p>	<p>The results of 6MWT test indicated a tendency for those in the dance group to increase the distance traveled by an average of 20 m (SD= 32), while the control group decreased the distance by an average of 1 m (SD= 18) between baseline and three months.</p>
<p>Rocha P. et al. [17]</p> <p>Aim: Investigating the feasibility of two dance programs for PD individuals aimed at improving mobility, balance, gait and quality of life.</p>	<p>The study included 21 subjects (8 men and 13 women) with idiopathic PD with scores ranging from I-IV on the modified Hoehn and Yahr scale.</p>	<p>Argentine Tango group: (n=10); Mixed therapeutic dance group: (n=11) (tap, creative dance, Irish dance were used). Classes lasted 1 hour per week with an instructor for 8 weeks. In addition, participants had to perform a home dance program independently for 40 minutes over the same period.</p>	<p>In the Argentine tango group, there were statistically significant differences between the baseline and post-intervention scores for mobility, balance and mobility disability. In the mixed dance group, there was improvement in freezing of gait before and after the intervention. There were no significant differences between the groups for any secondary outcome.</p>

<p>Solla P. et al. [33]</p> <p>Aim: The purpose of this study was to evaluate the effects of Sardinian folk dance (Ballu Sardu, BS) on functional performance and motor and non-motor symptoms in PD participants.</p>	<p>There were 20 qualified individuals (13 men and 7 women) with diagnosed PD.</p>	<p>Exercise group (n=10): received usual care (medical therapy) and a 12-week BS dance program; Control group (n=10): did not do any specific exercise program, maintained habitual activities and continued usual care consisting of medical therapy alone.</p>	<p>Analysis of variance with repeated measures showed significant time interactions for UPDRS Part III and functional variables such as 6MWT, BBS, FTSST, TUG (all, $p < 0.001$) and gait analysis parameters (stride length, $p = 0.031$; gait speed, $p = 0.049$; and gait fatigue index (GFI), $p = 0.005$)</p>
<p>Volpe D. et al. [34]</p> <p>Aim: Assessing the feasibility of a randomized control trial of Irish set dancing versus routine physiotherapy in people with mild to moderate PD.</p>	<p>A total of 24 (13 men and 11 women) with mild to moderate PD were qualified.</p>	<p>Irish dance group: (n=12) Classes were held once a week for 90 minutes over a period of 6 months. Physiotherapy group: (n=12) classes were held once a week for 90 minutes over a period of 6 months. These sessions included exercise, stretching, strength training, balance training, postural re-education, and gait training.</p>	<p>Statistical analysis of the scores of 1) UPDRS part III showed improvement in neurological/motor status in the Irish dance group ($F(1, 23) = 6.35, p = 0.019$). 2) TUG test values showed improvement in the Irish dance group ($F(1, 23) = 8.938, p = 0.007$) and 3) the Irish set dance group achieved better scores on the BBS scale ($F(1, 23) = 4.254; p = 0.051$), although these were not significantly different from standard therapy.</p>

Abbreviations: PD, Parkinson's disease; UPDRSIII, Unified Parkinson's Disease Rating Scale Part-III; 6MWT, 6-minute walking test; BBS, Berg Balance Scale; FTSST, Five Times Sit-to-Stand Test; TUG, Timed Up-and-Go; GFI, Gait fatigue index.

Hackney and Earhart [30] compared the effect of dancing with (group 1) or without (group 2) a partner on functional mobility. There were 39 individuals enrolled in the study, who were divided into two groups (group 1-n=15, group 2-n=16). The study revealed that both groups significantly improved their body balance as assessed by the Berg Balance Scale (BBS), and 12 out of 15 participants in Group 1 and 14 out of 16 subjects in Group 2 improved Comfortable walking velocity and Fast walking velocity. Both groups also improved one-leg stance time, tandem stance time, the number of steps per minute (fast cadence) and the percentage of the double support phase of the lead and trail leg during gait (fast double support percentage) after the training. All evaluated trial parameters except for the one-leg stance

test remained unchanged after one month. Two measurements, the 6-minute walk test (6MWT) ($p = 0.028$; critical level $p = 0.025$) and walking swing phase percentage ($p = 0.041$; critical level $p = 0.025$) were close to statistical significance at post-intervention testing and reached statistical significance one month after the intervention. The comfortable stride length during gait was significantly affected by the time at which this test was performed ($p = 0.05$). Those in the no-partner group had longer strides than those in the group with partners. The results demonstrated that the effects were comparable in both groups, but participants who were in the group with a partner expressed greater satisfaction with the classes and a desire to continue.

Hackney and Earhart [18] evaluated the effect of different types of dance such as tango, waltz/foxtrot on motor control in patients with PD when compared to a control group. The study included 58 individuals who were divided into 3 groups and introduced to a different type of dance. Significant improvements were observed in motor activity assessed using the BBS and 6MWT scales, as well as in backward step length both in tango and waltz/foxtrot training groups, when compared to the control group.

In their study, Hackney et al. [29], subjected one group of PD patients to tango practice and another group to various exercises (breathing, resistance stretching, and agility). There were 19 participants taking part in the study (12 males and 17 females). Both tango and exercise generated improvements in motor activity assessed using Part III of the UPDRS scale (tango participants before: 30.6 ± 1.3 , after: 22.6 ± 1.3 ; $p=0.001$, the exercise group before: 28.2 ± 1.2 , after: 20.6 ± 1.2 ; $p=0.001$). Individuals in the tango group had significantly improved body balance evaluated with the BBS scale (before: 46.8 ± 1.0 , after: 50.6 ± 1.0 ; $p=0.01$; $ES=0.90$) when compared to the exercise group, which showed no improvement (before: 45.4 ± 0.9 , after: 47.1 ± 0.9 ; $p=0.20$; $ES=0.27$). In the Timed Up-and-Go (TUG) test, the tango group demonstrated a tendency toward improved time (before: 10.7 ± 0.4 s, after: 9.8 ± 0.4 s; $ES=0.37$) when compared to the exercise group (before: 11.7 ± 0.4 s; after: 11.8 ± 0.4 sek; $ES=0.02$). Ultimately, the researchers found that patients dancing tango gained more benefits from this form of training than the exercise group.

Hashimoto et al. [31], evaluated the effects of dance on motor and cognitive functions along with psychological symptoms in patients with PD in three study groups: 1) those who danced tango, 2) those who underwent exercise, and 3) a control group-no additional intervention. Forty-six people (12 females, 36 males) were eligible to take part in the study. Tango group showed significant improvements in time on the TUG

test, number of steps and body balance assessed using the BBS scale after the intervention, when compared to baseline. In contrast, the exercise group showed improvements in TUG scale values and the number of steps. A comparison of the effect of the dance intervention between all three groups showed a clear impact on the number of steps, performance time on the TUG test and balance on the BBS test. This effect was greater in the dance group than in the exercise group and resulted in a longer stride when walking as well as better and stable balance. Neurological status as assessed by the UPDRS scale improved in patients with PD in the dance group after the intervention when compared to the exercise and control groups. This improvement was found to be greater than in the other 2 groups. The authors found that dance had a significant effect on the subjects' motor functions, cognitive functions, and mental health. In addition, it was the only intervention that resulted in an alleviation of the general symptoms of the disease, with a significant impact on psychiatric symptoms.

Kunkel et al. [32], used various types of dance such as foxtrot, waltz, tango, cha-cha-cha, rock and roll, and rumba in their study. They explored the possibility of using these dances as a type of rehabilitation for patients with PD. Fifty-one people diagnosed with mild to moderate severity of Parkinson's disease were examined. The results of the 6-MWT test after 3 months of rehabilitation revealed a tendency for those in the dance group to increase the distance covered by an average of 20 m (standard deviation of 32 m), while the group of patients who did not undergo rehabilitation (control) decreased the distance by an average of 1 m (standard deviation of 18 m) compared to the baseline values before rehabilitation ($p = 0.106$). Dance classes are a promising form of intervention for people with PD, not only because of the high level of activity but also the derived enjoyment.

Rocha et al. [14], analyzed mobility, balance, gait, and quality of life in PD patients after incorporat-

ing two dance programs. The first group danced Argentine tango, while the second group underwent therapeutic rehabilitation involving various types of dance such as tap dance, creative dance, and Irish dance. Twenty-one subjects (13 females, 8 males) were eligible to take part in the study. In the Argentine tango group, statistically significant differences were observed in the assessment of neurological status, mobility, balance, and motor disability after the rehabilitation process. In the mixed dance group, there was an improvement in freezing of gait after the intervention.

Solla et al. [33], used Ballu Sardu (BS) folk dance as a form of rehabilitation that can influence functional fitness, motor, and non-motor symptoms. Twenty people with PD participated in the study. The results revealed that those in the group with the exercise and BS program obtained significantly better scores on the UPDRS Part III and 6MWT tests (by 72.4%) and in the BBS balance test demonstrated a significant main effect of time ($F=32.184$; $p < 0.001$). Improvements were observed in the Five Times Sit-to-Stand Test (FTSST), the amount of time it took participants to complete the test decreased only in the BS group (-31.6%). The TUG test showed a significant reduction in the time required to complete the test (BS group: -26.4%; $p < 0.001$) (all, $p < 0.001$), and gait analysis parameters (stride length, $p = 0.031$; gait speed, $p = 0.049$; and gait fatigue index - GFI, $p = 0.005$) in the BS dance group when compared to the control group. The results of this study demonstrated that people with PD, participating in a dance-based BS program, showed significant improvements in various aspects, as well as functional performance in gait and non-motor symptoms when compared to the exercise group.

Volpe et al. [34], compared the use of Irish set dancing with routine physiotherapy. Twenty-four people with mild to moderate forms of Parkinson's disease were enrolled in the study. Statistical analysis of UPDRS Part III scale scores showed improved performance in the Irish dance group ($F(1,23) = 6.35$, $p = 0.019$). Paired t-tests demon-

strated improvement in both the physiotherapy group ($t(11) = 5.841$, $p < 0.001$) and the Irish dance group ($t(11) = 12.46$, $p < 0.001$). Statistical analysis of the TUG test results showed improvement over time in the Irish dance group ($F(1,23) = 8.938$, $p = 0.007$). Paired t-tests indicated improvement in both the physiotherapy group ($t(11) = 5.841$, $p < 0.001$) and the Irish dance group ($t(11) = 9.666$, $p < 0.001$). The Irish dance group demonstrated improved balance evaluated with the BBS scale ($F(1,23) = 4.254$; $p = 0.051$) although this was not significantly different from the standard therapy. The Irish dance group made significant improvements in the Freezing of gait Questionnaire (FOG) scores ($p = 0.0001$). In their conclusion, the authors stated that Irish set dancing is safe, simple, and enjoyable, reducing disabilities and improving patient's quality of life.

Discussion

The systematic review covered 8 articles. The aforementioned studies, with various aims, used dancing as a form of rehabilitation for people with Parkinson's disease. Many different types of dance have been used as treatment in these studies, with some using a single type of dance during the intervention [29,30,33,34] and others using several [17,18,31,32]. The papers included dances such as: Ballu Sardu [33], ballroom dance [32], foxtrot [18,32], waltz [30,32], Argentine tango [17,18,29,32], cha-cha-cha [32], rock and roll [32], rumba [32], aerobics [31], jazz [31], movements from classical ballet with a focus of awareness on the body and control of the gravity [31], improvisation of pantomimic movements [31], Irish dance [17,34], tap dancing [17], and creative dance [17]. All studies indicated positive effects of dance as an intervention. The research was performed on patients with mild to moderate PD, moving independently similar to training processes on cyclergometers or treadmills [7, 22, 20,23]. Dance as an unconventional therapy method can serve as an effective way of improvement in individuals with PD, although only recently has it begun to be

thoroughly researched and used in rehabilitation [17,18–34].

The analyzed articles were evaluated as being on an average methodological quality level and some, due to lack of randomization, were rejected, because during rehabilitation and especially long-term rehabilitation, patients' preferences should be taken into account [17,18,29–34]. Random assignment to groups fails because more people will not complete a study that lasts for a longer period (a month or several months). A similar problem occurs in long-term rehabilitation processes using endurance training on treadmills or cycloergometers [8,22,23]. The reviewed papers used scales and functional tests such as UPDRS, 6MWT, BBS, FTSST and TUG demonstrating the patients' condition before, after and in some cases also at the time of intervention [32,33]. Similar evaluation methods were used for patients undergoing endurance training on treadmills or cycloergometers [7,23]. Training incorporating dance/elements of dance produced similar positive neurological changes as assessed by the UPDRS scale and the 6MWT, BBS, FTSST and TUG functional tests [17,18,29–34]. The changes generated by the rehabilitation process in both cases depended on the time and intensity of the training process. Dance training seems to be more enjoyable and non-uniform for PD patients than exercise on a treadmill or cycloergometer. The choice of music makes it easy to dictate the pace at which the movement is performed, while in the process of endurance training, it is necessary to supervise and report on the pace maintenance, which is more difficult.

The outcomes of the selected articles demonstrated that the type of dance does not matter, rather the duration and intensity to induce neurological improvement in PD patients. There are many types of dances that could be used in unconventional methods of rehabilitation for people with PD [14,31–34]. According to the above studies, dance or its elements used in interventions can have many benefits, not only physical, but

also psychological and social. It is worth considering the possibility of combining traditional physiotherapy along with an additional physical activity, such as dance, and examining the impact of such intervention on patients. This of course comes with certain risks, such as falling down, and thus the possibility of additional injuries that may worsen patient's condition. Among the research surrounding the topic of this paper, there is a large number of studies with low credibility, thus it is worthwhile to delve deeper into the issue and conduct more extensive research.

Therapy incorporating dance/elements of dance with a choice of music, or either partner (PD patient or healthy person) or single form can be tailored to the neurological condition of a patient with PD in order to ensure greater safety. In physical therapy, it is mandatory to install protective equipment to prevent patients from falling especially on a treadmill. Such precautions entail an increase in the cost of therapy due to the need to provide specialized equipment and rooms where this type of therapy can be conducted. Therefore, not all rehabilitation clinics undertake exercise therapy on a treadmill. Whereas, during dance, the other person provides security. Secondly, while dancing it is easier to maintain the set intensity of movement throughout the training session. In physical therapy, it is the physiotherapist who controls and motivates to perform the movement at the appropriate intensity, which is usually not an easy task [14,22,23,31–34].

In conclusion, the literature reviewed in this paper was diverse in terms of methodological quality. Most of the articles scored 5 or 6 out of 10 on the PEDro scale. The selected papers covered several weeks to several months of research. Future research should include appropriate dance selection along with an increase in the size of the study population as well as a combination of methods that can improve the rehabilitation outcomes of people with PD. The results of the analyzed studies suggest that several weeks of therapy using different types of dance or its elements

improves motor skills, gait, elimination of freezing, balance, cognitive function, and non-motor symptoms such as mood, psychological symptoms and quality of life similarly to treadmill and cycloergometer training processes.

Conclusions

Dance or elements of dance can be used as one form of movement therapy and the selection of

the type of dance and appropriate music allows PD patients to maintain the planned intensity of their movements. Dance/elements of dance improve mental health and are better perceived than exercise therapy on treadmills or cycloergometer. Matching the type of dance and form with or without a partner (sick or healthy) to the neurological condition of a patient with PD is a safer and less costly form of rehabilitation than exercise therapy on a treadmill or cycloergometer.

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