Effects of Ballroom Dancing in Patients with Parkinson's Disease: A Systematic Review

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Abstract

Objective: To summarize the results from randomized controlled trials (RCT) that evaluated the effects of ballroom dancing on motor and non-motor symptoms of Parkinson's Disease (PD).

Data source: PubMed and PEDro databases were searched in March 2017. The limits of the searching were: Parkinson* AND danc* as text words AND clinical trial as publication type.

Methods: Inclusion criteria required that articles were (a) published in peer-reviewed journals, (b) RCT assessing the effects of ballroom dance on motor and non-motor manifestations of PD, (c) published between 2007 and 2017, (d) have a score equal or higher than 5 in the PEDro scale.

Results: A total of 7 RCT met the inclusion criteria, involving 242 participants with PD. Age ranged between 63 and 69 years, more than 50% were male and the Hoehn and Yahr stage was I-III. Intervention consisted of one hour of Argentinian Tango (AT) twice a week for different time durations. From all measured motor manifestations, only balance was improved by AT. Non-motor symptoms were barely evaluated. The studies presented important limitations and were very heterogeneous, which difficulted their comparison.

Conclusions: There is emerging evidence about the beneficial effects of AT on balance, one of the most important factors associated with falls in PD. Further studies are needed using larger sample sizes, patients with all stages of PD, long-term outcomes, and recommended tests to measure both motor and non-motor symptoms of PD.

Keywords: Parkinson's Disease; Physiotherapy; Argentinian Tango

Introduction

Parkinson's disease (PD) is the second most common neurodegenerative disease affecting mainly the elderly population. It is rare before the age of 40, but has a prevalence of 1% in the population over 60 years [1]. It is estimated that 1.2 million people live with PD in Europe [2].

The disease affects the basal ganglia that are involved in the extrapyramidal circuit of movement control; more precisely, there is a lack of dopamine production from the substantia nigra [3].

The main symptoms are bradykinesia, rigidity and tremor at rest, and later in disease progression, postural instability. There are other associated symptoms, among which, cognitive and psychiatric changes and difficulty performing double tasks are particularly relevant. Altogether leads to a progressive loss of autonomy and Quality of Life [4].

The basis of pharmacological treatment is levodopa, an exogenous analog of the endogenous dopamine. It improves the symptoms of the disease but the results are often not satisfactory, with progression of the disease over time. Postural instability, for example, an extremely relevant symptom of PD, is not modified by levodopa therapy [5]. Postural instability affects Quality of Life and leads to falls, traumatic complications such as fractures, gait insecurity and therefore loss of autonomous gait.

There are other complementary treatments to pharmacological therapy which play a very important role in the symptomatic treatment of the disease such as physiotherapy and physical activity. Dancing, and especially ballroom dancing, has raised a great interest in the last years as proved by the growing number of published works [6-13]. Studies by Positron Emission Tomography (PET) have shown that dancing activates the basal ganglia, which are affected in PD [14]. In addition, external auditory stimuli have been shown to facilitate movement rhythmicity in patients with PD [15]. Based on these results, it has been suggested that ballroom dancing can improve motor symptoms of PD due to: i) the physical activity that involves dancing, which can improve muscle movement and stretching; ii) the frequent changes in direction and speed, which can be a good training to improve postural instability; iii) the presence of a dancer partner, which can help to maintain balance. Besides, it is an activity that stimulates the cognitive function, since it is necessary to learn new steps and apply them, which implies planning and performing complex movements [9,12,16]. Since it is a social activity, it can also improve the mental state of often socially isolated and depressed patients, their well-being, and their Quality of Life [9,12,16].

Currently, the recommendations on the use of ballroom dancing in the treatment of PD users are in a low level of evidence [17]. With this systematic review, we aim to synthesize and evaluate the results from ballroom dancing interventions on motor symptoms and Quality of Life of patients with PD.

Methods

Eligibility criteria

This review was limited to peer-reviewed articles of randomized clinical trials assessing the effects of ballroom dance on motor and non-motor manifestations of Parkinson disease (PD). Articles had to be published between 2007 and 2017 and have a score equal or greater than 5 in the PEDro scale.

Database search

Studies were identified by searching the electronic PubMed and PEDro databases between the dates of 6th and 8th of March 2017. The limits of the searching were: Parkinson* AND danc* as text words AND clinical trial as publication type.

Data items

The following information was taken from the included studies: the year of publication, number of participants, characteristics of the participants (age, sex, severity of disease), type, frequency and duration of intervention, control intervention, tested outcome variables and the described effects. Collected parameters included a) parameters assessing motor manifestations: motor severity, balance, gait, falls; b) parameters assessing non-motor manifestations: cognitive measures, depression, fatigue and Quality of Life.

Assessment of methodological quality

The quality of the studies was assessed through the PEDro scale. Articles had to have a score equal or greater than 5 to be included in the study.

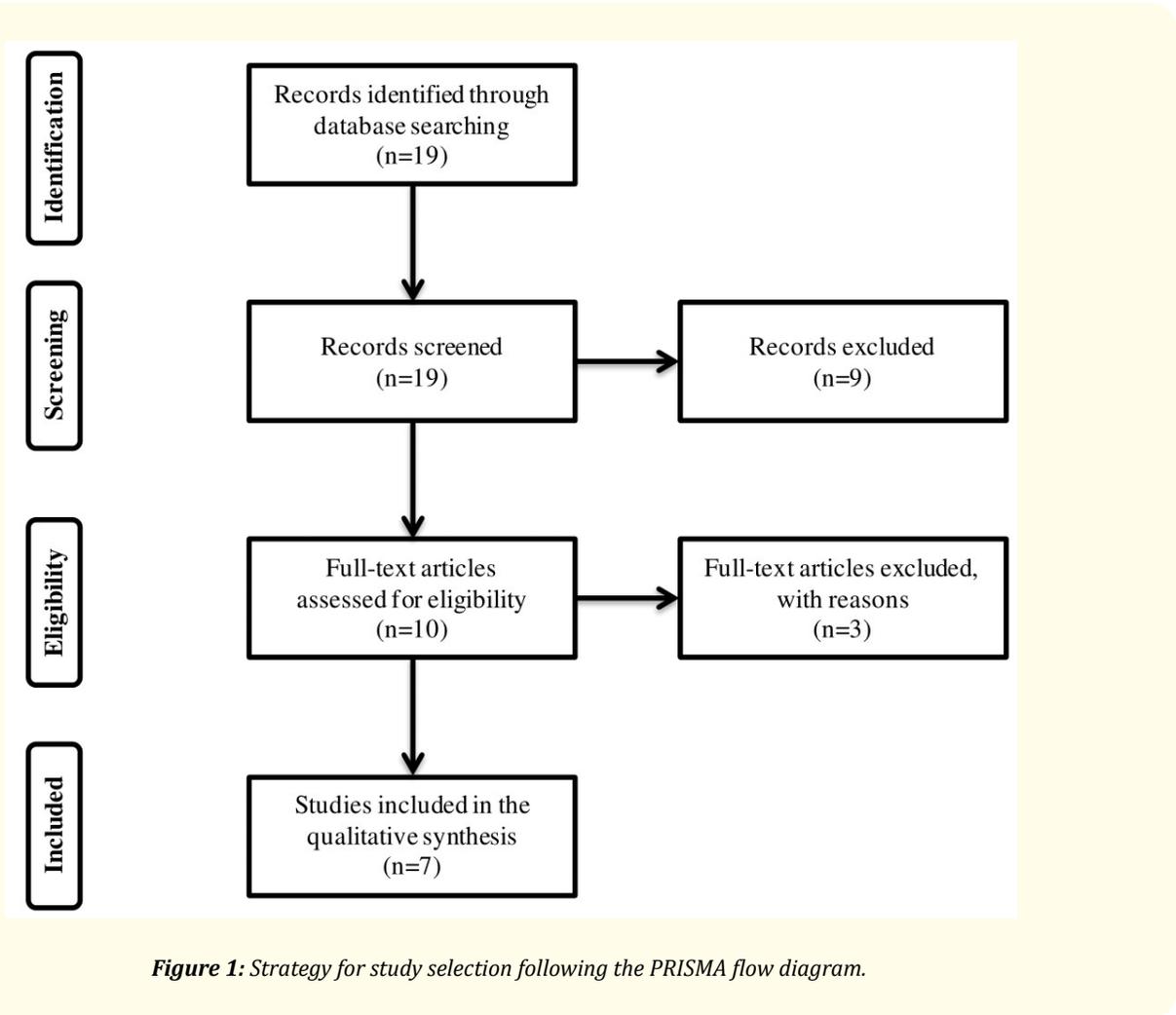This systematic review was written following the PRISMA guideline [18,19].

***Figure 1:** Strategy for study selection following the PRISMA flow diagram.*

Results

Study selection

Based on the described search strategy, PubMed and PEDro databases provided a total of 19 studies. There were no duplicates. Of these, 9 studies were excluded after preliminary screening of titles and abstract because they didn't use ballroom dancing (n = 4), they were not RCT (n = 3), they didn't assess motor functions or Quality of Life (n = 1) or it was an ongoing study (n = 1). Thus, 10 potentially eligible articles were retrieved for detailed evaluation. Of these, 3 studies were excluded: one study was not a randomized study, one study included different types of dancing with and without partner and one study had a control group that followed the same dancing lessons as the tango group but with no partner. Thus, a total of 7 RCT were included in the review. PEDro scale ranged from 5 to 7.

Study characteristics

Characteristics of patients: The included studies involved 242 participants with PD (Table 1). The mean age of the participants ranged between 63 and 69 years and more than 50% of them were male. PD had been diagnosed between 3 and 11 years ago and the Hoehn and Yahr stage was I-III. All patients were on PD medication.

N	Age (years)	Sex, male (%)	Disease duration (years)	Hoehn and Yahr stage	Intervention	Duration of intervention	Study
Total: 33						12 wk (24 lessons; 2/wk)	Romenets 2015 [13]
18	63.2 ± 9.9	67	5.5 ± 4.4	1.7 ± 0.6	Tango		
15	64.3 ± 8.1	47	7.7 ± 4.6	2.0 ± 0.5	Exercise		
Total: 10						24 months (2/wk)	Duncan 2014 [6]
5	69.6 ± 6.6	80	6.6 ± 7.5	2.4 ± 0.4	Tango		
5	66 ± 11.0	80	11 ± 3.9	2.3 ± 0.2	No intervention		
Total: 52						12 months (2/wk)	Duncan 2012 [7]
26	69 ± 1.9	58	5.8 ± 1.1	2.6 ± 0.1	Tango		
26	69 ± 1.5	58	7.0 ± 1.0	2.5 ± 0.1	No intervention		
Total: 48						13 wk (20 lessons; 2/wk)	Hackney 2009 [10]
14	68.2 ± 1.4	79	6.9 ± 1.3	2.1 ± 0.1	Tango		
17	66.8 ± 2.4	65	9.2 ± 1.5	2.0 ± 0.2	Waltz/foxtrot		
17	66.5 ± 2.8	71	5.9 ± 1.0	2.2 ± 0.2	No intervention		
Total: 61						13 wk (20 lessons; 2/wk)	Hackney 2009 [11]
14	68.2 ± 1.4	79	6.9 ± 1.3	2.1 ± 0.1	Tango		
17	66.8 ± 2.4	65	9.2 ± 1.5	2 ± 0.2	Waltz/Foxtrot		
13	64.9 ± 2.3	85	8.7 ± 1.3	2 ± 0.1	Tai Chi		
17	66.5 ± 2.8	71	5.9 ± 1.0	2.2 ± 0.2	No intervention		
Total:19						13 wk (20 lessons; 2/wk)	Hackney 2007 [9]
9	72.6 ± 2.2	67	6.2 ± 1.5	2.3 ± 0.7	Tango		
10	69.6 ± 2.1	60	3.3 ± 0.5	2.2 ± 0.6	Exercise		
Total: 19						13 wk (20 lessons; 2/wk)	Hackney 2007 [8]
9					Tango		
10					Exercise		

Table 1: *Summary of the characteristics of RCTs evaluating the effects of ballroom dancing on Parkinson disease.*

wk: Week

Intervention characteristics: Intervention consisted of one-hour of Argentinian Tango (AT) twice a week for 12, 13 weeks (short duration) or 12 or 24 months (long duration). Two studies included also a group of waltz/foxtrot dancing (Table 1) [10,11]. Control intervention consisted of physical exercise in 3 studies [8,9,13] or no intervention in 4 studies [6,7,10,11]. One study included also a group of Thai-Chi [11]. One of the studies of Hackney., *et al.* described four groups: AT groups with PD versus healthy elderly, exercise groups with PD versus healthy elderly; we interpreted the exercise group with PD as control group for the purpose of this review [8]. In all studies, PD patients danced with a partner with no PD.

No differences in age, UPDRS-III, Hoehn and Yahr stage scale or time with PD were described between intervention and control intervention groups.

Follow-up: Five studies assessed the outcome parameters at baseline (before intervention) and after the intervention period [8-11,13]. Two studies included one [7] or two [6] additional assessments in the middle of the intervention period.

Outcomes

Whereas five studies conducted the outcome assessment while the participants were on their regular medication [8-11,13], two studies were done while the individuals were off their medication for at least 12 hours [6,7].

From the seven studies, only two applied intention to treat analysis [6,13]. Outcomes referred to motor symptoms, balance, gait, falls, cognitive measures, health-related Quality of Life, depression and fatigue. Tables 2 and 3 summarize the main results for the most important outcomes.

Motor severity (UPDRS-3)	Balance	Functional mobility (TUG)	Dual Task TUG	Endurance (6MWT)	Gait velocity	FOG	Study
Not improved	↑ mini-BESTest score 0.7 ± 2.2 points	↓1.3 ± 1.6 s	↑0.4 ± 0.9 score	-	-	Not improved	Romenets 2015 [13]
↓20 points	↑ mini BESTest scores 7 points	Not improved	↓3 s	Not improved	Comfortable forward and backward walking velocity not improved.	Not improved	Duncan 2014 [6]
↓12.8 points	↑ mini-BESTest score 3 points	-	-	Not improved	↑ forward walking velocity 0.05 m/s ↑ dual task walking velocity 0.1 m/s Fast as possible forward and backward walking not improved.	Not improved	Duncan 2012 [7]
Not improved	↑ BBS score 4 points.	Not improved	-	↑50 m	Forward walking velocity not improved. ↑ backward walking velocity +0.1 m/s	Not improved	Hackney 2009 [10]
-	-	-	-	-	-	-	Hackney 2009 [11]
Not improved	Not improved (BBS)	Not improved	-	-	-	Not improved	Hackney 2007 [9]
-	Functional Reach and One leg stance tests not improved.	-	-	-	Forward walking and dual task walking velocities not improved.	-	Hackney 2007 [8]

Table 2: Summary of the results for each of the motor tests in the ballroom dance group (AT and/or Waltz/Foxtrot) at the end of the study.

The table gives the difference between the tests at the end of the study and at baseline if the test is significantly better for the ballroom dance than for the control group at the end of the study (interaction group by time statistically significant).

UPDRS-3: Unified Parkinson's Disease Rating Scale; MiniBESTest: Balance Evaluation System Test; BBS: Berg Balance Scale; TUG: Time Up and Go; FOG: Freezing of Gait

Cognition, depression, mood	Activity of daily-living (UPDRS-2)	Quality of Life (DDQ-39)	Study
MoCA not improved. BDI not improved. AS not improved. KFSS not improved	-	Not improved	Romenets 2015 [13]
↓ UPDRS-1 score 2 points	↓ score 5 points	-	Duncan 2014 [6]
UPDRS-1 not improved.	Not improved	-	Duncan 2012 [7]
-	-	-	Hackney 2009 [10]
-	-	Improved only in Tango.	Hackney 2009 [11]
-	-	-	Hackney 2007 [9]
-	-	-	Hackney 2007 [8]

Table 3: Summary of the results for each of the non-motor tests in the ballroom dance group (AT and/or Waltz/Foxtrot) at the end of the study.

The table gives the difference between the tests at the end of the study and at baseline if the test is significantly better for the ballroom dance than for the control group at the end of the study (interaction group by time statistically significant).

MoCA: Montreal Cognitive Assessment; BDI: Beck Depression Inventory; AS: Apathy Scale; KFSS: Krupp Fatigue severity scale; PDQ-39: Parkinson's Disease Questionnaire

Motor severity: Motor severity (i.e., rigidity, tremor, gait, postural instability, bradykinesia) was measured with the Unified Parkinson's Disease Rating Scale 3 (UPDRS-3) in five studies. Only the two studies of Duncan., *et al*. demonstrated a significant reduction in the UPDRS-3 in the AT group when compared with the control group [6,7]. This improvement was already present after 3 months of dancing in one of the studies [6] and after 12 months in the other one (no measurements were made before in this last one) [7]. In one of the studies of Hackney., *et al*. UPDRS-3 did not change in the dance groups of Tango or Waltz/Foxtrot but it worsened in the control group through the follow-up of the study [10].

Balance: Balance was measured mainly with the Mini-BESTest or the Berg Balance Scale. Balance was improved in the dancing group (Tango and Waltz/Foxtrot) when compared with the control group in four of six studies [6,7,10,13].

Gait related measures

- Time Up and Go (TUG): Functional mobility was only reduced in one of the four studies that assessed TUG [13].
- Dual Task TUG: Dual Task TUG improved in the two studies that assessed it [7,13].
- 6-minute walk test (6MWT): Walking endurance, measured with the 6MWT, was only improved in one of the three studies that assessed it [10]. The other two studies did not find an improvement for ballroom dancing but the control group worsened over the time of the study [6,7].
- Gait velocity: Gait velocity was measured mainly with an electronic walkway of 4.87-5 m (GAITRite). From the four studies evaluating gait velocity, Tango group was faster at forward walking and dual task walking in Duncan., *et al.* [6] and at backward walking in Hackney., *et al* [10]. This last work also found that dance groups experienced a decrease in forward single support time and backward support time and an increase in backward stride length.

- Freezing of gait (FOG): FOG was measured with the FOG questionnaire. Ballroom dancing did not improve FOG in any of the five studies that assessed it. However, it increased in the control group in one study [6].

Non-motor outcomes: Cognition, depression, mood, activity of daily-living and Quality of Life were measured in four studies. Cognition, depression and mood (UPDRS-1) and activity of daily-living (UPDRS-2) were improved in one study [7]. Quality of Life was improved in the Tango group and not in the Waltz/Foxtrot or Tai Chi groups from Hackney., *et al.* [11] Finally, all participants found enjoyment and fun in practicing AT and were willing to continue with the classes after the end of the studies.

Discussion

This review summarized the current clinical research on the effectiveness of ballroom dancing on motor and non-motor symptoms of PD. In total, we found 7 RCT that investigated this question. Regarding motor outcomes, balance was clearly improved by AT and this improvement was identified early in time with only 20 lessons of AT [10]. This result is very important because balance is one of the most important factors associated with falls in PD, as it is demonstrated by the high predictive values of the Mini BESTest and BBS for falls [20]. Reducing the risk of falls can have a direct impact in the Quality of Life of PD patients (i.e. gain in autonomy, gait steadiness) and costs of the Health System (i.e. fractures associated with falls). Moreover, since levodopa therapy has limited effects on balance, AT could play a very important role not only to improve balance when it is already present but also to prevent or delay its appearance. With regard to other motor symptoms, there is not enough evidence to support any beneficial effect of AT. Motor severity was only improved by the two studies where patients were off their PD medication. TUG, gait velocity and FOG, which were assessed at least in four of the seven studies, showed minimum or no improvements. For instance, FOG was not affected by AT in any of the five studies that assessed it. FOG is a prevalent motor disturbance of PD that is most commonly associated in the advanced stages of the disease [21]. Dancing should improve FOG episodes due to the auditory cues from the music and visual cues from the dance [22]. Patients enrolled in the studies of this review had mild to moderate PD symptoms (Hoehn and Yahr stage mostly not higher than 3). That can explain the lack of improvements in FOG. Regarding non-motor outcomes, no conclusions can be made because of the limited number of studies that assessed them. However, it is important to notice that Quality of Life is mainly affected in patients within the stage 3 of the Hoehn and Yahr scale [23]. Thus, the present studies were not optimally designed to assess Quality of Life.

Important limitations were noticed in this review such as small samples, restriction to patients in the early stages of PD, use of non-recommended tests and evaluation of only AT as ballroom dancing except in one study and evaluation of almost only motor symptoms. We want to highlight the importance of including patients in all stages of PD because, as previously stated, some symptoms of PD such as FOG and deterioration of quality of life can be only evaluated in the advanced stages of the disease. Other important limitation that was detected was the use of non-recommended tests to assess the motor outcomes gait velocity and FOG. While European guidelines recommend to use the 10 meter walk test to analyze gait velocity and the new questionnaire of freezing of gait [17], the present studies used 4.87 - 5 meters to assess gait velocity and an older version of the questionnaire of freezing of gait from Giladi., *et al.* [24] Besides those limitations, the studies were quite heterogeneous in the length of the intervention, the use of medication during the evaluation, type of control group (no intervention or physical exercise) and the instruments that were used to measure the effects of the intervention. All those aspects limited the comparison of the studies.

Conclusion

In conclusion, ballroom dancing can improve some motor symptoms of PD, specially balance. Besides, ballroom dancing can offer a more social and enjoyable form of physical exercise than routine exercise that can improve the Quality of Life of patients with PD. In view of these results, more studies are needed to assess the short and long-term effects of ballroom dancing on motor symptoms and Quality of Life of patients with PD.

Clinical Messages

- There is emerging evidence about the beneficial effects of AT on balance.
- Further studies are needed using larger sample sizes, patients with all stages of PD, long-term outcomes, and recommended tests to measure both motor and non-motor symptoms of PD.

Author's Contributions

AR was responsible for the organization and execution of the review: literature search, selection of the inclusion and exclusion criteria, quality assessment of the articles, data extraction and synthesis of the results. JCC was responsible for the review, critique and final production of the manuscript.

Declaration of Conflicting Interests

The authors declare that there is no conflict of interest.

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