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REVIEW ARTICLE (META-ANALYSES)

Dance for People With Parkinson Disease: What Is the Evidence Telling Us?

Joanne Shanahan, BSc,[a] Meg E. Morris, PhD,[b] Orfhlaith Ni Bhriain, PhD,[c] Jean Saunders, PhD,[d] Amanda M. Clifford, PhD[a]

From the [a]Faculty of Education and Health Sciences, Department of Clinical Therapies, University of Limerick, Limerick, Ireland; [b]Department of Physiotherapy, School of Allied Health, La Trobe University, Bundoora, Victoria, Australia; [c]Department of Arts, Humanities and Social Sciences, Irish World Academy of Music and Dance, University of Limerick, Limerick, Ireland; and [d]Statistical Consulting Unit, Department of Maths and Statistics, University of Limerick, Limerick, Ireland.

Abstract

Objectives: (1) To appraise and synthesize the literature on dance interventions for individuals with Parkinson disease (PD); (2) to provide information regarding the frequency, intensity, duration, and type of dance used in these programs; and (3) to inform the development of future studies evaluating dance interventions in this population.

Data Sources: Eight databases (MEDLINE, Cumulative Index to Nursing and Allied Health Literature [CINAHL], the Allied and Complementary Medicine Database [AMED], SPORTDiscus, PubMed, PubMed Central, Sage, and ScienceDirect) were electronically searched in April 2014. The references lists from the included articles were also searched.

Study Selection: Studies retrieved during the literature search were reviewed by 2 reviewers independently. Suitable articles were identified by applying inclusion criteria.

Data Extraction: Data regarding participants and the frequency, intensity, duration, and type of dance form used were extracted. The effect that each dance program had on defined outcomes and the feasibility of each program were also reviewed.

Data Synthesis: Thirteen articles were identified. The quality of studies varied, and methodological limitations were evident in some. The evidence evaluated suggests that two 1-hour dance classes per week over 10 to 13 weeks may have beneficial effects on endurance, motor impairment, and balance.

Conclusions: Dance may be helpful for some people with PD. This article provides preliminary information to aid clinicians when implementing dance programs for people with PD. Higher-quality multicenter studies are needed to determine the effect of other dance genres and the optimal therapy volume and intensity.

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Parkinson disease (PD) is a progressive neurodegenerative[1] disease estimated to affect 6 million people worldwide.[2] People with PD can present with movement disorders,[3] postural instability, reduced mobility, and an increased risk of falls.[4] The severity of PD can be classified according to the original or modified Hoeln and Yahr[1] staging scales, with lower stages on these scales representing milder disease states. At stages 1 and 2, physical symptoms are predominantly unilateral; however, as the stage of disease progresses, physical symptoms become bilateral.[1] Dance has been advocated as one form of exercise for people with PD,[5] especially for those who are newly diagnosed or who have mild to moderate disease severity. Dance interventions for people with PD can sometimes have a positive effect on balance and mobility[6,7] and may help improve quality of life by reducing symptoms of depression.[8,9] Research has also found that dance is superior to exercise for improving balance and functional mobility[10] in some people with PD. Dance may improve motor performance[11] and facilitate long-term compliance with physical activity because it incorporates exercise, socialization, and caregiver participation, which helps to motivate people with PD to engage in physical activity.[12]

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Earhart[5] provided a valuable review consolidating evidence on several aspects of dance in people with PD. However, since 2009, a number of studies have been published in this area, and research protocols have differed in terms of the frequency, intensity, duration, and type of dance interventions used. In addition, the methodological quality of studies that investigated dance interventions for people with PD has not been evaluated. The lack of evidence-based dance prescription renders it difficult to translate research into clinical practice. The primary objectives of this article were to (1) critically appraise the peer-reviewed literature that has investigated the benefit of dance for people with idiopathic PD and (2) provide information regarding the frequency, intensity, time/duration, and type (FITT principle) of dance[13] for people with PD.

The FITT principle provides a framework for reviewing the effectiveness of physical activity programs and enables specific guidelines to be established regarding the optimum characteristics of exercise priograms.[13] The secondary objective of this article was to identify limitations in current peer-reviewed research to ensure that the design, methodological quality, and reporting of future unpublished studies adds to the body of existing literature and addresses gaps in the research.

Methods

Inclusion criteria

Only those articles that met all the inclusion criteria listed in appendix 1 were included in this review.

Literature search

An electronic literature search of 8 databases was conducted in April 2014 (Allied and Complementary Medicine Database [AMED], MEDLINE, Cumulative Index to Nursing and Allied Health Literature [CINAHL] Plus, SPORTDiscus, Sage, ScienceDirect, PubMed, and PubMed Central). The search terms used were "Parkinson's disease" AND "dance." The suitability of articles was determined in a staged process by 2 reviewers (J.S. and A.M.C.). First, titles and abstracts were read and articles that were obviously unrelated to this review were excluded. Then, the remaining articles were read in full and those not meeting all inclusion criteria were excluded. Reference lists from suitable articles were also searched. Any disagreements between reviewers were resolved through discussion. A detailed description of the search process is provided in figure 1.

Data extraction

Articles meeting all the inclusion criteria were reviewed to extract relevant details of the intervention (mode of delivery, frequency, intensity, duration, and type of dance implemented) and the outcomes used to assess the effect of the intervention. In addition, data regarding the age and stage of disease of participants involved in the studies, number of dropouts, attendance rates, and the safety of the dance interventions (monitoring and reporting of adverse events) were extracted.

List of abbreviations:

FITT	**frequency, intensity, time/duration and type**
MDS- UPDRS-3	**Movement Disorder Society-Unified Parkinson's Disease Rating Scale-Subsection 3**
PD	**Parkinson disease**
RCT	**randomized controlled trial**
UPDRS-3	**Unified Parkinson's Disease Rating Scale-Subsection 3**

Outcomes of interest

The outcomes reviewed in this study were chosen so that the benefit of dance for people with PD was assessed at the 3 levels of the International Classification of Functioning, Disability and Health. These levels are body structure and function, activity, and participation.[14] The primary outcomes of interest were balance function measured on the Berg Balance Scale,[15,16] motor impairment measured using the Unified Parkinson's Disease Rating Scale-Subsection 3 (UPDRS-3),[16,17] and functional mobility measured using the Timed Up and Go Test.[16] Secondary outcomes of interest were endurance assessed using the 6-minute walk test,[18,19] quality of life assessed on the Parkinson's Disease Questionnaire-39,[20,21] and activity and participation as measured on the Physical Activity Scale for the Elderly.[14,22] If studies used more than 1 measurement tool to assess the same outcome (primary or secondary), information regarding only the measurement tool listed was reviewed.[23] If studies reported an outcome (primary or secondary) using different measurement tools than those listed,[23] the first measurement tool listed in the article was included in the review. Feasibility was measured using the dropout and attendance rates. Safety was assessed by reviewing adverse effects reported.[24]

Quality assessment

The *Cochrane Handbook for Systematic Reviews of Interventions*[25] was used to define the study design. Level of evidence was graded according to the Agency for Health Care Policy Research recommendations previously described by Ritchlin et al.[26] Two separate quality assessment tools were used to appraise the included articles because of the diversity of study designs.[27] This was done to ensure that key methodology issues associated with each type of design were considered during the appraisal process.[28] The PEDro Scale was used to measure the quality of randomized controlled trials (RCTs) and quasi-RCTs. This scale is valid and reliable and evaluates a clinical trial's statistical methods and internal and external validity.[29-31] The quality of cohort studies was assessed using the Newcastle-Ottawa Quality Assessment Scale for Cohort Studies. This is a reliable scale and recommended by the Cochrane Non-Randomised Studies Methods Group.[32]

Data analysis

Where possible, forest plots were used to illustrate data from RCTs/quasi-RCT for the primary outcomes of interest (balance, motor impairment, and functional mobility). Forest plots were produced by comparing between-group differences for dance and control/other intervention groups using Comprehensive Meta-analysis Software.[a] For accurate and appropriate cross-study comparability, only the data collected using 1 measurement tool was included in each forest plot analysis. The most frequently used measurement tool for each primary outcome of interest was chosen because this would give the largest representation on the effects of dance. Only an exploratory meta-analysis could be performed for each forest plot because of the variability in intervention protocols and participant characteristics. For this reason,

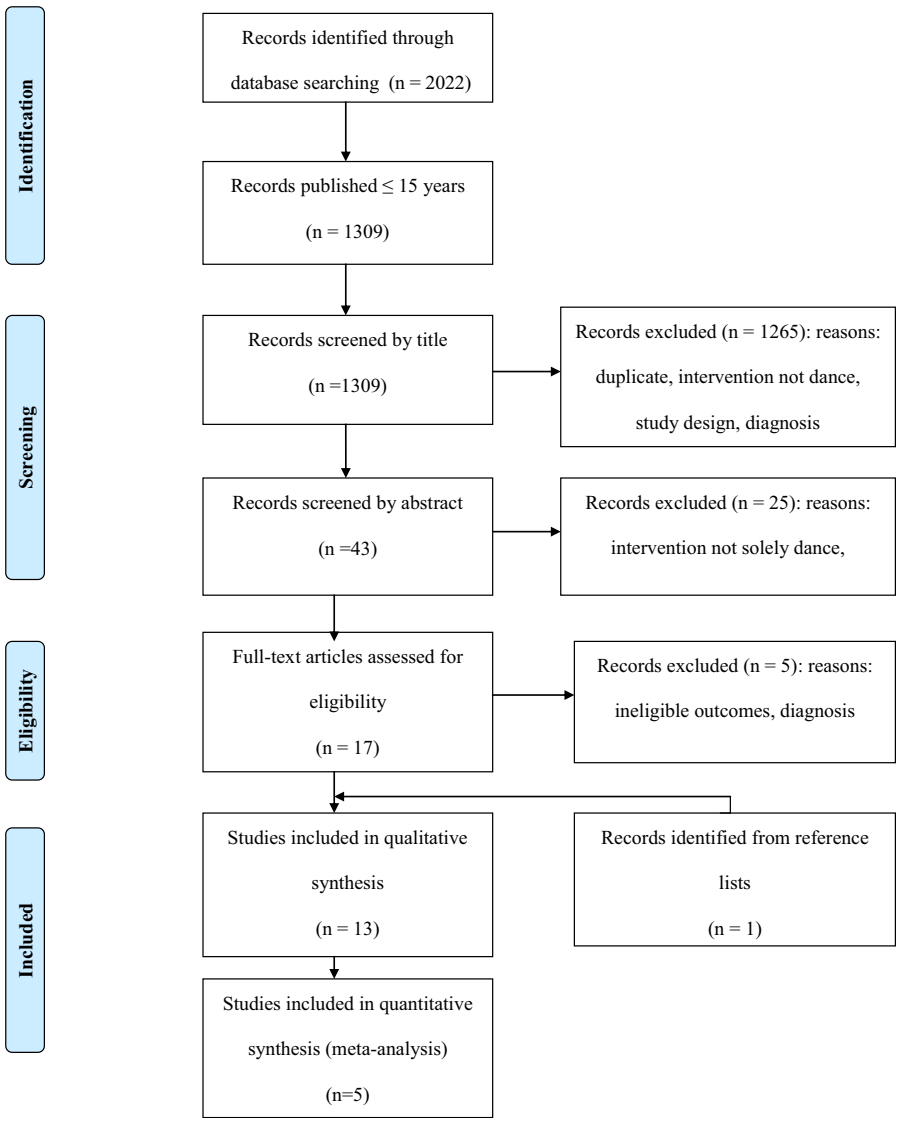

Fig 1 Search strategy based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram.

the meta-analysis results may be used only to provide an indication of the effects of dance on the primary outcomes of interest.

Results

Thirteen articles consisting of 8 RCTs,[6,7,10,12,33-36] 1 quasi-RCT,[37] and 4 cohort studies[38-41] met the inclusion criteria. All reported the demographic characteristics of participants and provided clear descriptions of the interventions used. Some also referenced material for where a description of the intervention could be obtained.[6] Only 2 studies carried out a follow-up assessment after postintervention testing.[35,37] Tables 1 and 2 provide a summary of the included studies and FITT principles used.

Participants

The sample size of studies ranged from a minimum of 11 studies[38,40,41] to a maximum of 75 studies.[7] All studies except 1 study[33] recorded the mean age of participants, which ranged from 61.6 years[36] to 74.4[37] (see tables 1 and 2). Ten studies used the Hoeln and Yahr scale to describe participants' stage of disease,[6,7,10,12,34,35,37,39-41] and 2 studies used the modified Hoeln and Yahr scale[36,38] (see tables 1 and 2). One study[33] did not state participants' stage of disease.

Frequency

Frequency was defined as the number of classes delivered per week. Seven studies provided 2 classes per week,[6,7,10,12,33-35] 3 studies provided 2 classes per week,[36,37,40] and 1 study provided 3 classes per week.[38] Two studies[39,41] just stated the total number of classes provided during the intervention (10 classes in 2wk) and did not specify the exact number of classes per week.

Intensity

The intensity of the intervention was not measured in any study. Two studies[6,38] stated that the intervention was low intensity but did not specify how this was identified. The remaining 10 studies stated that the intervention was progressive[7,10,12,33-35,37,39-41] but did not provide a description of how the intervention was progressed.

Table 1 Summary of study characteristics for RCTs and the quasi-RCT

Study (Level of Evidence for the Study Design)	Participants	Dropouts (N)	Stage of Disease (H&Y)	Frequency	Intensity	Length of a Dance Class	Duration of Intervention	Type of Dance/Activity
McKee and Hackney[37] (quasi-RCT)	Total N=33 Tango group: n=24; mean age, 68.4y Education group: n=9; mean age, 74.4y	Tango group=1 Education group=1	Tango group=2.3 Education group=2	1 class per week until 20 classes were completed in 10–12 wk	Progressive	1.5h	12wk	Adapted tango education
Volpe et al[36]	Total N=24 Irish set dance group: n=12; mean age, 61.6y Physiotherapy group: n=12; mean age, 65y	None	Irish set dance group=2.2 (mean) Physiotherapy group=2.2 (mean)	1 class per week	Not stated	1.5h	6mo	Irish set dancing Physiotherapy in line with KNGF guidelines
Foster et al[12] (1b)	Total N=62 Tango group: n=32; mean age, 69.3y Control group: n=30; mean age, 69y	Tango group=16 Control group=11	Only the number of participants at each stage stated	2 classes per week	Progressive	1h	12mo	Tango
Duncan and Earhart[6] (1b)	Total N=62 Tango group: n=32; mean age, 69.3y Control group: n=30; mean age, 69y	Tango group=16 Control group=11	Tango group= 2.5 (mean) Control group=2.5 (mean)	2 classes per week	Low	1h	12mo	Tango
Hackney and Earhart[35] (1b)	Total N=39 Partnered tango group: n=19; mean age, 69.6y Nonpartnered tango group: n=20; mean age, 69.6y	Partnered tango group=7 Nonpartnered tango group=5	Partnered tango group=2.5 (median) Nonpartnered tango group=2 (median)	2 classes per week	Progressive	1h	10wk	Partnered Nonpartnered tango
Hackney and Earhart[34] (1b)	Total N=58 Tango group: n=19; mean age, 68.2y Waltz/foxtrot group: n=19; mean age, 66.8y Control group: n=20; mean age, 66.5y	Tango group= 5 Waltz/foxtrot group=2 Control group=3	Tango group=2.1 (mean) Waltz/foxtrot group=2 (mean) Control group=2.2 (mean)	2 sessions weekly until 20 sessions were completed in 13wk	Progressive	1h	13wk	Tango Waltz/foxtrot

(*continued on next page*)

Table 1 (*continued*)

Study (Level of Evidence for the Study Design)	Participants	Dropouts (N)	Stage of Disease (H&Y)	Frequency	Intensity	Length of a Dance Class	Duration of Intervention	Type of Dance/Activity
Hackney and Earhart[7] (1b)	Total N=75 Tango group: n=19; mean age, 68.2y Waltz/foxtrot group: n=19; mean age, 66.8y Tai chi group: n=17; mean age, 64.9y Control group: n=20; mean age, 66.5y	Tango group= 5 Waltz/foxtrot group=2 Tai chi group=4 Control group=3	Tango group=2.1 (mean) Waltz/foxtrot group=2 (mean) Tai chi group=2 (mean) Control group=2.2 (mean)	2 sessions weekly until 20 sessions were completed in 13wk	Progressive	1h	13wk	Tango, waltz/foxtrot, tai chi
Hackney et al[10] (1b)	Total N=19 Tango group: n=9; mean age, 72.6y Exercise group: n=10; mean age, 69.6y	None	Tango group=2.3 (mean) Exercise group=2.2 (mean)	2 sessions weekly until 20 sessions were completed in 13wk	Progressive	1h	13wk	Tango Exercise (breathing, flexibility, resistance, dexterity, and core exercises)
Hackney et al[33] (1b)	Total N=38 Parkinson tango group: n=9 Control tango group: n=9 Parkinson exercise group: n=10 Control exercise group: n=10 Mean age not stated	None	Not stated	2 sessions weekly until 20 sessions were completed in 13wk	Progressive	1h	13wk	Tango Exercise (strength, flexibility, chair exercises)

NOTE. Level of evidence 1b indicates 1 or more RCT.
Abbreviations: H&Y, Hoeln and Yahr; KNGF, Koninklijk Nederlands Genootschap voor Fysiotherapie [Royal Dutch Society for Physical Therapy].

Table 2 Summary of study characteristics for cohort studies

Study (Level of Evidence for the Study Design)	Participants	Dropouts (N)	Stage of Disease (H&Y)	Frequency	Intensity	Length of a Dance Class	Duration of Intervention	Type of Dance/Activity
Heiberger et al[40] (2b)	N = 11; mean age, 71.3y	None	Only the number of participants at each stage stated	1 class per week	Progressive	1.15h	8mo	Modified version of Mark Morris Dance Group for PD: Combined elements of ballet, jazz steps, contemporary dance, dance theater, and choreographic
Batson[38] (2b)	N = 11; mean age, 72.7y	None	Stages 1–2.5 (modified)	3 classes per week	Low	85min	3wk	Modern dance
Marchant et al[41] (2b)	N = 11; mean age, 71.2y	None	2.4 (average)	10 classes completed in 2wk	Progressive	1.5h	2wk	Contact Improvisation
Hackney and Earhart[39] (2b)	N = 14; mean age, 62.2y	N = 2	2.4 (median)	10 sessions completed	Progressive	1.5h	2wk	Tango

NOTE. Level of evidence 2b indicates other well-designed trial (quasi-experimental).
Abbreviation: H&Y, Hoeln and Yahr.

Duration

In all studies, duration was described as both the length of each dance class and the duration of the intervention.[6,7,10,12,33-41] With respect to the length of a dance class, 7 studies provided 1-hour classes,[6,7,10,12,33-35] 4 studies provided 1.5-hours classes,[36,37,39,41] 1 study implemented 1.25-hour classes,[40] and another study provided 85-minute classes.[38]

The duration of the interventions varied between short periods of 2 and 3 weeks,[38,39,41] medium lengths of 10 to 13 weeks,[7,10,33-35,37] and longer durations of 6 to 12 months.[6,12,36,40]

Type

Type was defined as the genre of dance used in each study. Tango dancing was used in 9 studies,[6,7,10,12,33-35,37,39] and 1 study[37] out of these 9 studies stated that the tango material thought was adapted. Waltz/Foxtrot dancing was used in 2 studies.[7,34] Contact Improvisation,[41] Irish set dancing,[36] and a modified version of Mark Morris Dance for PD[40] were all investigated in single studies.

Feasibility and safety

The number of dropouts in each study is given in tables 1 and 2. Attendance rates at classes ranged from 78%[6] to100%.[10,33] A number of studies reported that participants were satisfied with the dance intervention and wished to continue classes post-intervention.[6,10,34,35,39,41] Two studies illustrated that participants preferred to attend a dance class compared with an exercise class because almost 50% of the participants in dance groups attended additional classes after postintervention testing whereas no one from the exercise groups attended additional classes.[10,33]

The safety of the dance interventions was poorly monitored and reported. Only 3 studies reported that they monitored for adverse effects.[36-38] Three studies reported that participants dropped out because of injuries described as knee pain[7,34] and the aggravation of long-standing sciatica.[39]

Measurement tools

Tables 3 and 4 list the measurement tools used in each study and the absolute changes for each measure.

With respect to the primary outcomes of interest, balance measures were reported in 11 studies.[6,10,33-41] All 11 studies except 1 study[40] reported improvements after the dance intervention. Balance was measured using the Berg Balance Scale,[10,34,35,36,39,41] the Fullerton Advanced Balance Scale,[37,38] the Mini-BESTest,[6] the Semi-tandem Test, and the Functional Reach Test.[33] Motor impairment was reported in 8 studies.[6,10,34,36,37,39-41] All 8 studies reported improvements in motor impairment. The Movement Disorder Society-Unified Parkinson's Disease Rating Scale-Subsection 3 (MDS-UPDRS-3)[6] or the UPDRS-3[10,34,36,37,39-41] were used to assess motor impairment. The timed Up and Go test was used to assess functional mobility in 9 studies,[10,34-41] and 6 of these reported improvements.[10,34,36,38-40]

With regard to the secondary outcomes of interest, endurance was assessed in 5 studies[6,34,35,39,41] using the 6-minute walk test. Three studies reported improvements. Significant improvements in quality of life were reported in 2 studies[7,36] of the 5 studies[7,36,37,40,41] that assessed this outcome. Quality of life was assessed using the PDQ-39[7,36,37,41] and a modified version of the Quality of Life Scale.[40] The effect of dance on activity levels and

Table 3 Outcome measures and results for RCTs and the quasi-RCT

Study (Level of Evidence for the Study Design)	Outcome Measure	Absolute Change*
McKee and Hackney[37] (quasi-RCT)	-Motor impairment (UPDRS-3)	-Motor impairment improved† in the tango group and worsened in the education group (Tango = 3.9pts, Education = 2.1pts).
	-Balance (Fullerton Advance Balance Scale)	-Dynamic balance improved† in the tango group only (Tango = 2.6pts, Education = 1.2pts).
	- Functional mobility (TUG)	-Functional mobility did not change in either group (Tango = 0.2s, Education = 1s).
	-QOL (PDQ-39)	-Unchanged QOL in both groups (Tango = 0.2pts)
Volpe et al[36]	-Motor impairment (UPDRS-3)	-Motor impairment improved more in the set dance group (Set dance = 7.16pts, Physiotherapy = 2.92).
	-Balance (BBS)	-Dynamic balance improved in both groups (Set dance = 10pts, Physiotherapy = 4.84pts).
	-Functional mobility (TUG)	-Functional mobility improved more in the set dance group (DNA).
	-HRQOL (PDQ-39)	-HRQOL improved in both groups (Set dance = 8.44pts, Physiotherapy = 4.97pts).
Foster et al[12] (1b)	-Activity and participation (Activity Card Sort)	-New social activities gained in the tango group only (DNA). -Current participant and activity retention increased only in the tango group (DNA).
Duncan and Earhart[6] (1b)	-Motor impairment (MDS-UPDRS-3)	-Improved motor impairment† (12.8pts) in the tango group only.
	-Balance (Mini-BESTest)	-Improved dynamic balance† (DNA) in the tango group only.
	-Endurance (6-MWT)	-Endurance worsened in the control group. No change in the tango group (DNA).
Hackney and Earhart[35] (1b)	-Balance (BBS)	-Improved dynamic balance† in both groups (partnered = 3.2pts, nonpartnered = 2.6pts).
	-Endurance (6-MWT)	-Improved endurance in both groups (DNA).
	-Functional mobility (TUG)	-No change in functional mobility in both groups.
Hackney and Earhart[34] (1b)	-Balance (BBS)	-Improved dynamic balance† in dance groups only (Tango = 3.9pts, Waltz/Foxtrot = 4pts).
	-Endurance (6-MWT)	-Improved endurance† in dance groups only (Tango = 59.4m, Waltz/Foxtrot = 49.1m).
	-Motor impairment (UPDRS-3)	-Improved motor impairment in the waltz/foxtrot group only (4pts). Worsened motor impairment† in the control group only (5pts).
	-Functional mobility (TUG)	-Improved functional mobility in the tango group only (2.1s).
Hackney and Earhart[7] (1b)	-HRQOL (PDQ-39)	-Improvement in HRQOL† in the tango group only (DNA).
Hackney et al[10] (1b)	-Motor impairment (UPDRS-3)	-Improved motor impairment† in both groups (Tango = 8pts, Exercise = 7.6pts).
	-Balance (BBS)	-Improved dynamic balance† in the tango group only (3.8pts).
	-Functional mobility (TUG)	-Improved functional mobility in the tango group only (0.9s).
Hackney et al[33] (1b)	-Balance (Functional Reach Test)	-Improved balance in the Parkinson tango group (1.32cm) and the Parkinson exercise group (1.01cm). -No change in balance in the control tango group. -Worsened balance in the control exercise group (1.27cm).

NOTE. Level of evidence 1b indicates 1 or more RCT.
Abbreviations: BBS, Berg Balance Scale; DNA, data not provided in original article; HRQOL, health-related quality of life; Mini-BESTest, Mini Balance Evaluation Systems Test; PDQ-39, Parkinson's Disease Questionnaire-39; pts, points; QOL, quality of life; 6-MWT, 6-minute walk test; TUG, timed Up and Go test.
* Absolute change is the difference between preintervention and postintervention results. Absolute changes provided only where change occurred.
† Significant changes.

participation was assessed in 1 study using the Activity Card Sort.[12] Improvements were found in these outcomes after the intervention.

Methodology quality

A summary of the methodological quality assessment of the RCTs (n = 8) and the quasi-RCT (n = 1) is presented in table 5. No study was double blinded, and 1 concealed group allocation.[36] Five of the studies scored 7 out of 10, indicating good methodological quality, and 1 study[7] scored 4, indicating poor quality. The methodology quality of the cohort studies (n = 4) is presented in table 6. No study fulfilled the comparability section or item number 2 of the selection category because they were all single-group studies. None of the cohort studies had a follow-up assessment after the postintervention testing. Two studies did not complete full-blinded assessments.[40,41]

Effect of dance on primary outcomes of interest

Forest plots were developed to evaluate the effect of dance on the primary outcomes of interest (balance, motor impairment, and

Table 4 Outcome measures and results for cohort studies

Study (Level of Evidence for the Study Design)	Outcome Measure	Absolute Change*
Heiberger et al[40] (2b)	-Motor impairment (UPDRS-3)	-Improved motor impairment† (8.2pts).
	-Functional mobility (TUG)	-Improved functional mobility (0.7s).
	-Balance (Semi-tandem test)	-No improvement in balance.
	-QOL (Modified Quality of Life Scale)	-Improved QOL (DNA).
Batson[38] (2b)	-Balance (Fullerton Advance Balance Scale)	-Improved dynamic balance† (3.1pts).
	-Functional mobility (TUG)	-No meaningful change in functional mobility.
Marchant et al[41] (2b)	-Motor impairment (UPDRS-3)	-Improved motor impairment† (5.4pts).
	-Balance (BBS)	-Improved dynamic balance† (3pts).
	-Functional mobility (TUG)	-No change in functional mobility.
	-Endurance (6-MWT)	-No change in endurance.
	-QOL (PDQ-39)	-No improvement in QOL.
Hackney and Earhart[39] (2b)	-Motor impairment (UPDRS-3)	-Improved motor impairment† (4.6pts).
	-Balance (BBS)	-Improved dynamic balance† (2.8pts).
	-Functional mobility (TUG)	-Improved functional mobility (2s).
	-Endurance (6-MWT)	-Improved endurance (35m).

Abbreviations: BBS, Berg Balance Scale; DNA, data not provided in original article; PDQ-39, Parkinson's Disease Questionnaire-39; pts, points; QOL, quality of scale; 6-MWT, 6-minute walk test; TUG, timed Up and Go test.

* Absolute change is the difference between preintervention and postintervention results. Absolute changes provided only where change occurred.

† Level of evidence 2b indicates other well-designed trial (quasi-experimental).

functional mobility). Findings are presented in figures 2, 3, and 4, respectively. Only RCTs and the quasi-RCT that used the Berg Balance Scale, the UPDRS-3, and the Timed Up and Go Test were included in the forest plots. These measurement tools were chosen because they were frequently used to assess the primary outcomes of interest.

Discussion

There is emerging level 1b (1 or more RCTs) and 2b (other well-designed trials [quasi-experimental]) evidence to suggest that multidimensional benefits are sometimes achieved through dance in people with mild to moderately severe PD. The findings of this review have found that improvements in balance,[6,10,34,35-39,41] motor impairment,[6,10,34,36,37,39-41] and endurance[6,34,35,39,41] were reported after participation in dance. The effect of dance programs for those with severe stages of disease has not been investigated. Thus, the conclusions of this review may not be appropriate to implement in a population of individuals with severe PD.

Most of the measurement tools used in the included studies were valid, reliable, and sensitive to change.[14-22,42-45] The only exceptions were the Semi-tandem Test, the MDS-UPDRS-3, the Activity Card Sort, and the modified version of the Quality of Life Scale. To our knowledge, the Semi-tandem Test is usually performed as part of a battery of tests rather than as a single balance test.[46] The MDS-UPRDS-3[44] and the Activity Card Sort[47] are valid and reliable, but the sensitivity of these measures has not yet been established. Reliability and validity of the original version of the Quality of Life Scale have been established,[48] but no literature was found examining the psychometric properties of the modified version of the Quality of Life Scale.

Frequency

Most of the level 1b evidence reviewed supports the implementation of 2 dance classes per week.[6,7,10,12,33-35] Significant improvements were found in balance,[6,10,34] motor impairment,[6,10] endurance,[34] quality of life,[7] and participation in social activities[12] after attendance at 2 weekly classes. Only 1 RCT did not report a reduction in motor impairment for a dance group after this frequency of classes.[34] The reason for this conflicting result is difficult to ascertain because characteristics of participants and elements of the FITT principle were similar to a study that reported significant improvements.[10] However, failure to carry out an intention-to-treat analysis may have caused either overestimation or underestimation of results.

There was a limited amount of level 1b and 2b evidence reviewed that investigated the benefit of lower and higher frequencies of dance classes per week. With respect to lower frequencies, only 3 studies (1 RCT, 1 quasi-RCT, and 1 cohort study)[36,37,40] implemented 1 class per week. For the majority, findings were positive, with the greatest effect achieved in motor impairment and quality of life when the course of treatment was longer.[36,40] Results were conflicting for balance because 1 study reported no improvement.[40] Notably, the sole use of the Semi-tandem Test as a balance measure and the dance type used may have affected results.

The benefit and feasibility of a high-frequency dance intervention cannot be fully established on the basis of the existing literature. The findings from 2 of the 3 included short-duration studies (level 2b evidence) suggest that a high frequency of dance classes per week may lead to greater improvements in functional mobility[39] and motor impairment.[39,41] It is currently not known whether a longer duration, high-frequency dance class would lead to a greater magnitude of improvement; thus, further research is necessary.

Intensity

The lack of detail reported may be problematic for clinicians who seek clarity regarding an optimum and safe intensity to use when implementing dance programs. Methods of measuring intensity such as scales of exertion have been recommended for monitoring and reporting the intensity of endurance and strength training in older adults.[49] When these scales are used,

Table 5 Summary of methodological quality of included RCTs and the quasi-RCT

	Quasi-RCT	RCTs							
Item	Mckee and Hackney[37]	Volpe et al[36]	Foster et al[12]	Duncan and Earhart[6]	Hackney and Earhart[35]	Hackney and Earhart[34]	Hackney and Earhart[7]	Hackney et al[10]	Hackney et al[33]
Eligibility criteria	√	√	√	√	√	√	√	√	√
Random allocation	×	×	√	√	√	√	√	√	√
Allocation concealment	×	√	×	×	×	×	×	×	×
Baseline comparability	√	√	√	√	√	√	×	√	×
Blind subjects	×	×	×	×	×	×	×	×	×
Blind therapists	×	×	×	×	×	×	×	×	×
Blind assessors	√	√	√	√	√	√	×	√	√
Adequate follow-up	√	√	√	√	√	√	√	√	√
Intention-to-treat	√	√	√	√	√	×	×	√	√
Between- group comparisons	√	√	√	√	√	√	√	√	√
Point measures and measures of variability	√	√	√	√	√	√	√	√	√
Total PEDro Scale score*	6	7	7	7	7	6	4	7	6

NOTE. √, Yes; ×, No.
* Total PEDro Scale score can range from 0 to 10, with higher scores indicating better quality.

the desired exercise level is achieved by instructing patients to exercise at a level of exertion that is equivalent to a particular number on a scale of 0 to 10.[49] Although this method of measurement may be suitable for individual forms of exercise, it is difficult to implement in dance because each individual's performance intensity is synchronized to the tempo of the music. For safety, the tempo of the music is usually set to ensure that individuals with the highest level of impairment are able to participate without increasing the risk of falls, and thus intensity may be progressed in line with participants' abilities. The progressive nature of the dance interventions was described in most of the studies[7,10,12,33-35,37-41] and is necessary to ensure that gains are obtained.[13] This suggests that tempo and intensity can be increased once the dance movements (motor skill) have been acquired and can be performed safely.

Duration

There was little variation in the length of classes (1−1.5h; see tables 1 and 2). Currently, most of the literature supports the use of 1-hour classes. There is limited evidence to suggest that 1.5-hour classes may be more beneficial, but more RCT research is needed to confirm this because of inconsistencies and confounders present in studies.[36,37,40] In addition, the frequency of weekly classes may be an important consideration. More than 1 class per week may be needed to accompany shorter class durations to enhance gains.[49]

Duration of the dance interventions ranged from 2 weeks[39,41] to 12 months.[6,12] Most of the programs were 10 to 13 weeks long.[7,10,33,34,37] Longer duration interventions may be more beneficial, with greater improvements evident in balance[6,10,34,36] and motor impairment.[6,10,36,40] Results are inconsistent for

Table 6 Summary of methodological quality of included cohort studies

	Study			
Item	Batson[38]	Hackney and Earhart[39]	Heiberger et al[40]	Marchant et al[41]
Selection				
Representativeness of the exposed cohort?	√	√	√	√
Selection of the nonexposed cohort?	×	×	×	×
Ascertainment of exposure?	√	√	√	√
Demonstration that outcome of interest was not present at start of study?	√	√	√	√
Comparability				
Comparability of cohorts on the basis of design or analysis?	×	×	×	×
Outcome				
Assessment of outcome?	√	√	×	×
Was follow-up long enough for outcomes to occur?	×	×	×	×
Adequate follow-up of cohorts?	√	√	√	√
Total score	5/8	5/8	4/8	4/8

NOTE. √, Yes; ×, No.

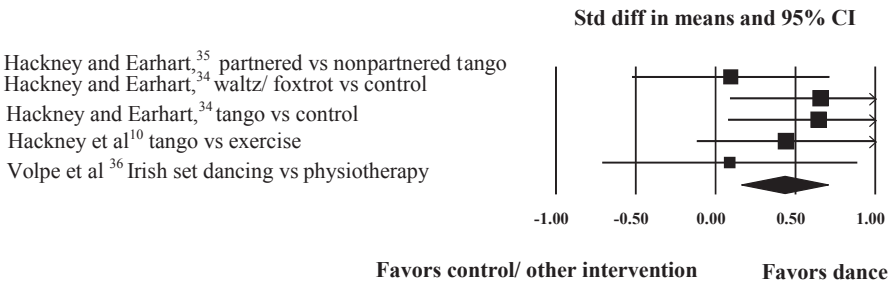

Fig 2 Results for balance. Balanced assessed using the Berg Balance Scale. Abbreviations: CI, confidence interval; Std diff, standard difference.

endurance because the longest duration study failed to report improvement.[6] This conflicting result may be partly explained by participants' higher stage of disease (mean, 2.6) and suggests that improvements may be harder to achieve in individuals with more advanced disease. Nonetheless, an FITT principle of two 1-hour classes per week for 12 months was sufficient to maintain baseline endurance, as demonstrated by the significant deterioration in the control group.[6]

It is difficult to determine the effect of duration on outcomes for functional mobility because of the variability in results and the potential influence of frequency on results.

From the literature reviewed, inadequate evidence exists to support the use of dance for improving health-related quality of life because of conflicting results[7,36,37,40,41] Overall, it appears that a higher dosage of dance activity may enhance quality of life through increased participation[7,36,40] but a greater body of research is required before more substantiated recommendations can be established.

Type

The evidence from this small number of articles showed tango to be a beneficial dance genre for people with PD. Both long- and short-duration tango interventions reduced the severity of motor impairment and improved balance, functional mobility, endurance, activity and participation, and quality of life. Tango is proposed to target movement disorders associated with PD because it incorporates dynamic balance, continuous movement initiation and termination in multiple directions, and rhythmic and speed variations.[10,34] Limited evidence suggests that other forms of dance may be beneficial for people with PD (see tables 1 and 2). Greater improvements in motor impairment were reported after participation in waltz/foxtrot than in tango,[34] and Contact Improvisation may be as effective as tango for improving balance and motor impairment.[41] It is difficult to compare the effectiveness of tango to that of other dance genres because only sparse, lower-quality evidence exists to support their use. In addition, there was variability in the FITT principles used, making comparison difficult. More research is warranted to establish the benefit of other dance interventions including cultural and regional dance forms that may have additional meaning for some people. Different forms of dance may target different clinical features of PD because of the variation between dance genres' cognitive demands, stepping strategies, and musical input.[34,40,41]

Effect of dance on primary outcomes of interest

The forest plot representation of data indicates that dance can improve balance and motor impairment in people with PD. Dance was found to be more effective than a control intervention for improving balance and motor impairment[34] (see figs 2 and 3). This may help reduce the risk of falls in people with PD and have positive implications on physical functioning.[12,34] There is also evidence to suggest that dance is more effective than traditional exercise[10] and physiotherapy,[36] with greater benefit evident for motor impairment (see fig 3). With respect to functional mobility, there is currently no evidence to suggest that dance is more effective than a control/other intervention (see fig 4). As previously stated, this may be due to insufficient weekly dosage or the relatively short duration of included studies.

The heterogeneous study protocols and participant characteristics make it impossible to accurately interoperate the meta-analysis results. However, they do indicate the potential benefits of dance and suggest that future research is necessary to enable a comprehensive meta-analysis to be conducted.

Feasibility

Dance can be a feasible and acceptable form of exercise for some people with PD. Studies investigating different dance genres reported similar dropout rates in both dance and control groups.[7,34] Furthermore, there were no dropouts in 5 studies.[10,33,38,40,41] The high attendance rates and participants' requests to continue classes indicate that dance may be feasible long-term. However, the safety of dance programs has not been fully examined. Studies that report and monitor adverse events on a larger sample of people

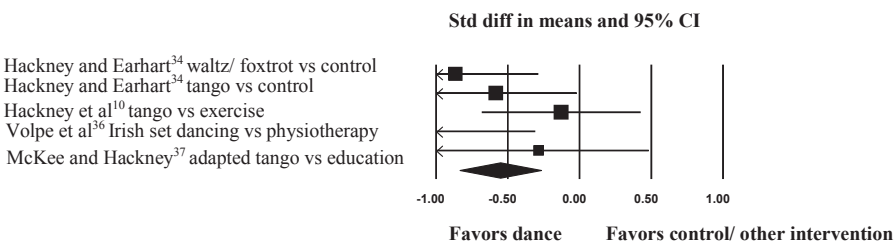

Fig 3 Results for motor impairment. Motor impairment assessed using the UPDRS-3. Abbreviations: CI, confidence interval; Std diff, standard difference.

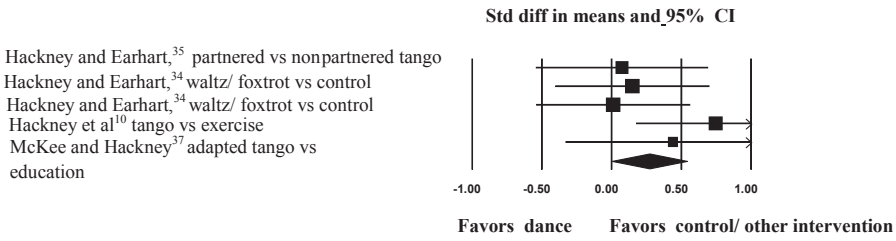

Fig 4 Results for functional mobility. Functional mobility assessed using the Timed Up and Go Test. Abbreviations: CI, confidence interval; Std diff, standard difference.

with PD are needed. This will help clinicians determine the suitability of an individual for a particular intervention.

The results of this review suggest that a lower frequency of classes per week might enhance compliance. No participants dropped out of an 8-month intervention that had 1 weekly class,[40] whereas 50% of the participants dropped out of a 12-month intervention that provided 2 classes per week.[6,12] A possible explanation for this may be travel difficulties.[34] Prescribing a dance home exercise program in addition to attending a dance class may be one initiative to help promote adherence while also increasing physical activity levels in line with the recommendations for weekly physical activity.[49] Research has shown that home exercise programs are feasible and beneficial,[50,51] with compliance rates of 79%.[50] They can be performed safely in the home when clear instructions are given and a practice session with clinicians is attended before commencing.[51]

Study limitations

There are limitations associated with this review. Consequently, the recommendations outlined may offer preliminary guidance and should be implemented with caution. Seven of the included studies were carried out in a homogenous study location. This may potentially reduce the clinical transferability of findings until more multicenter RCTs are conducted. The low number of included studies along with the small sample size in some articles means that the population of those with PD may not be fully represented by results.

In terms of methodological quality, all studies had an increased risk of bias; even RCTs with high PEDro Scale scores (see table 5). The main methodological limitations present in the RCTs were lack of allocation concealment and therapist and participant blinding. This may lead to an increased risk of selection[52] and performance bias.[53] However, it should be noted that performance bias may be present in all intervention studies because it is impossible to blind therapists and participants to group allocation. In addition, 1 study had a risk of detection bias[7] because it did not state whether assessors were blinded. Two studies did not carry out an intention-to-treat analysis,[7,34] and participants were not comparable for all baseline characteristics in a further 2 studies.[7,33]

With respect to the included cohort studies, the nonrandomized, uncontrolled study design increases the risk of selection bias. This means that confounders may go unrecognized[53] and makes it difficult to determine the true benefit of treatment.[54] Detection bias may be present in 2 studies because of inadequate blinding of assessors.[40,41] On the contrary, cohort studies allow preliminary data to be collected on the effect of a treatment. Future studies need to consider methodology limitations present in the current literature and ensure that research gaps are investigated analytically.

Conclusions

Participation in dance classes may be beneficial for some individuals with mild-to-moderate PD. This review provides preliminary guidance regarding an optimum FITT principle. It has highlighted methodological limitations and gaps in the current literature to help inform future research development.

The results of this review found level 1b and 2b evidence to suggest that two 1-hour dance classes per week, for at least 10 weeks, can have positive effects. Greater benefit might also be seen with longer duration interventions. Various dance types appear helpful including tango, Contact Improvisation, and waltz/foxtrot. However, not all forms of dance have been investigated. To date, much of the research has focused on tango. More high-level, multicenter RCTs with robust methodology are needed to determine the effect of different types of dance and their long-term benefit for people with PD. In addition, the safety of dance programs needs to be adequately reported to ensure the safe and appropriate implementation of dance interventions.

Suppliers

a. Biostat, 14 North Dean St, Englewood, NJ 07631.

Keywords

Dance therapy; Exercise; Parkinson disease; Rehabilitation

Corresponding author

Joanne Shanahan, BSc, Faculty of Education and Health Sciences, Department of Clinical Therapies, University of Limerick, Limerick, Ireland. *E-mail address:* joanne.s@outlook.com.

Appendix 1 Inclusion Criteria

Peer-reviewed and published in the last 15y.
Study participants must have been diagnosed with idiopathic PD. All stages of the disease were included. For comparability purposes, the stage of disease must have been measured using the original or modified Hoeln and Yahr staging scales.
Included more than 1 participant.
Evaluated the outcome of a dance intervention for people with PD.
Described the dance intervention and FITT principle used and reported the effect that the dance intervention had on 1 or more of the primary or secondary outcomes of interest.

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