Dancing for Parkinson's: a randomized trial of Irish set dancing compared to usual care

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Running head: Set dancing compared with usual care

Title: Dancing for Parkinson’s: a randomized trial of Irish set dancing compared to usual care

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Conflict of interest declaration

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Abstract

Objective: This pilot trial examined the feasibility of a randomised controlled study design and explored the benefits of the set dancing intervention compared to usual care.

Design: Randomised controlled design, with participants randomised to Irish set dance classes or a usual care control group.

Setting: Community based

Participants: Individuals with idiopathic PD

Interventions: The dance group attended a 1.5 hour dancing class each week for 10 weeks and undertook a home dance programme for 20 minutes three times per week. The usual care control group continued with their usual care and daily activities.

Main outcome measures: The primary outcome was feasibility; determined by recruitment rates, success of randomization and allocation procedures, attrition, adherence, safety, willingness of participants to be randomised, resource availability and cost. Secondary outcomes were motor function (UPDRS-3), quality of life (PDQ-39), functional endurance (six minute walk test) and balance (mini-BESTest).

Results: Ninety participants were randomized (n=45 per group). There were no adverse effects or resource constraints. Although adherence to the dancing programme was 93.5%, there was more than 40% attrition in each group. Post-intervention, the dance group had greater non-significant gains in quality of life compared to the control group. There was a meaningful deterioration in endurance in the control group. There were no meaningful changes in other outcomes. The exit questionnaire showed participants enjoyed the classes and would like to continue participation.

Conclusion: For people with mild to moderately severe PD, set dancing is feasible and enjoyable and may improve quality of life.
Keywords: Parkinson’s disease; Dance; Physical activity; Feasibility; Physiotherapy

Abbreviations

Parkinson’s disease: PD
Randomized controlled trial: RCT
Physical Activity Scale for the Elderly: PASE
Motor section of the unified Parkinson’s disease rating scale: UPDRS-3
Parkinson’s disease questionnaire-39: PDQ-39
Quality of life: QoL

Introduction

People with Parkinson’s disease (PD) often seek information on which forms of exercise provide symptomatic relief. Dancing is emerging as one form of exercise that can enhance movement, balance and quality of life (QoL). There is growing evidence that set dancing, Argentine Tango and contemporary dance may be beneficial for people with PD and improve motor function, freezing of gait and balance. Dance may facilitate motor learning through goal-directed repetitive practice, skill learning to enhance cognitive engagement and motivation and environmental stimulus. Action observation in dance could further facilitate motor learning and lead to neuroplastic changes in areas such as the premotor cortex.

Set dancing is of particular interest for people with PD as it is a rhythmical, energetic, cultural and social dance genre with the potential to cue movements, making them faster and larger. Commensurate with community walking, group movement sequences require
individuals to navigate around other dancers by altering body position, and changing
direction.\textsuperscript{13, 14} Stepping strategies and group movements need to be memorized and
performed in unison.

Currently, there is limited evidence to inform the conduct of a large international randomized
controlled trial (RCT) evaluating the effectiveness of dancing for people with PD.
Conducting large RCTs on exercise for people with PD can be challenging\textsuperscript{15}. Potential
barriers include recruiting sufficiently large samples, implementing valid randomization and
blinding procedures\textsuperscript{16} and minimizing attrition.\textsuperscript{15} The optimum characteristics of set dancing
programmes for people with PD also need examination.

In preparation for international randomized trials, the aims of this pilot trial are to examine:

\begin{itemize}
  \item the feasibility of study design, randomization procedure and resources required
  \item if sufficient recruitment rates and acceptable attrition levels can be achieved
  \item motor impairment, balance, QoL and functional endurance in a set dancing group
  \end{itemize}
compared with a usual care control group

\textbf{Methods}

\textit{Study design}

We conducted a pilot multi-centre RCT with assessors blind to group allocation. Ethics
approval was obtained from University Hospitals Scientific Research Ethics Committees, and
the Faculty Research Ethics Committee. Study development and reporting were complied
with the CONSORT statement\textsuperscript{17} and registration details can be accessed on clinicaltrials.gov (NCT01939717).

Recruitment and randomisation

Participants were recruited from voluntary groups and clinicians in Ireland, via flyers and public talks. Inclusion and exclusion criteria were in accordance with Shanahan et al.\textsuperscript{4} All participants received information about the study and provided written informed consent.

Eligible participants were randomly allocated to the dance or control group using sealed brown envelopes. An individual blinded to the hypothesis of the study prepared the envelopes by consequently placing an allocation form for each group into the envelopes. An independent mediator who was otherwise uninvolved and blinded to the hypothesis of the study, was responsible for storing the sealed envelopes in an undisclosed location, generating the random allocation sequence, informing participants of their group allocation and maintaining an undisclosed record of participant’s allocation.

Assessments

Participants were informed of their group allocation after completing baseline assessments. Assessments took place the week before the intervention and within a week following dance completion. Assessors were blinded to group allocation. Baseline demographic information including physical activity levels, determined by the Physical Activity Scale for the Elderly (PASE)\textsuperscript{18} were collected. Participants continued their usual medication treatment, daily
activities and exercise habits during the study. No participants received additional therapies during the study.

Primary outcome: Feasibility

Feasibility was appraised by quantifying:

- the success of randomization and allocation procedures. We aimed to monitor and document issues affecting the correct implementation of the randomization and allocation procedures. The procedures were considered successful if the personnel involved were able to understand and implement the process correctly, without difficulty or time delay.

- resources: availability and cost of buildings, dance studios and personnel (researchers, assessors, independent mediator, dance partners, dance teachers and health practitioners) were documented.

- whether or not 100 participants could be recruited in one year. This would test recruitment rates and the success of recruitment methods.

- willingness of participants to be randomized, determined by recording the number of people that declined participation after being advised of the group they were randomised to.

- attrition rates for the entire study. Attrition less than or equal to 20% per group was regarded as acceptable. This was in line with the criteria established by the Centre for Evidence Based Medicine for appraising the quality of RCTs.

- safety: the intervention was considered safe if no adverse effects or injuries including falls, were recorded.
adherence to the Irish set dancing intervention. The intervention was considered to be successful enough to warrant further large scale international investigations if attendance at classes was $\geq 70\%$.\textsuperscript{6}

Secondary outcomes

Motor impairment, functional endurance, balance and QoL were assessed using the following psychometrically appropriate measures: the motor section of the unified Parkinson’s disease rating scale (UPDRS-3), six-minute walk test, mini-BESTest and Parkinson’s disease questionnaire-39 (PDQ-39) respectively.\textsuperscript{23-28} The PDQ-39 specifically measures health-status, a dimension of QoL.\textsuperscript{29} A sub-sample of participants in the dance group completed an exit questionnaire\textsuperscript{30} at the end of the study. This sought to assess satisfaction with the dance intervention only.

Intervention

Participants allocated to the set dancing group took part in a weekly 1.5 hour class for ten weeks.\textsuperscript{2} Classes were led by set dancing teachers who were also clinicians or experienced teaching clinical populations. Set dancing teachers received safety training from a chartered physiotherapist. During classes participants partnered with family or caregivers, were encouraged to rest as needed or inform the instructor if they felt unwell.

Classes started with a warm-up, targeting movement speed and size,\textsuperscript{31} postural alignment and other physiological systems required for dance.\textsuperscript{32} Exercises were progressed from sitting to standing according to abilities.
Next participants learned the reel and hornpipe step, which have similarities with gait. Attention was given to step rhythm and position. When steps were competently performed during straight line movements with a single turn, participants were introduced to set dances. Set dances combine steps and sequences of group movement patterns. Sets including the Connemara Set, Kilfenora Set and Corofin Plain Set were taught.\textsuperscript{33, 34} To facilitate skill learning, complex patterns of movements were broken down into simpler components before prating as a whole.\textsuperscript{35} The complexity of dance material and the tempo of the music were progressed in line with participants’ abilities. The class ended with dance couples practicing a gait pattern to music. Flexibility exercises were performed to maximise joint movement and cool down.\textsuperscript{36}

In addition to the dance class, participants were given a 20 minute home dance programme to complete three times a week. A standardised video interactive Digital Versatile Disc and Compact Disc developed by the main researcher (JS) were provided to assist warm-up exercises and practice of material taught in class. During rest periods mental rehearsal of material was advised.\textsuperscript{37} Adherence to the home programme was monitored using a home exercise diary.

The control group continued with their usual medication treatment. No additional intervention was offered to the control group. Over 60% of participants took part in the set dance classes after completion of post intervention assessments.

\textit{Sample size}
This was a pilot trial and was suitably powered for that purpose. Based on previous recruitment rates, it can be estimated that 100 participants would be recruited for this study in one year. This is approximately 25% of the sample size required to power a much larger trial with the PDQ-39 as the primary outcome (394 participants to detect a four point difference in the PDQ-39). The PDQ-39 was chosen as the primary outcome in future trials due to the apparent link between QoL and exercise adherence. The sample size for a larger RCT (394 participants) was determined by a statistician using statistical analysis of data from earlier research which found a significant 4 point improvement in QoL post intervention.

Statistical analysis

Data were analysed using SPSS version 22. Descriptive statistics (medians and interquartile ranges) were used to describe data as most were non-normally distributed. A per-protocol analysis was performed and included all participants that completed the study. This ensured against a large degree of heterogeneity associated with including data from dropouts or protocol violators in the analysis. The Mann-Whitney U test was used to analyse between-group data from baseline and post intervention assessments. Intragroup comparisons comparing baseline and post intervention data were analysed using the Wilcoxon Signed Ranks test. There was a small amount of missing data for the PDQ-39 for both the dance group (n=2) and control group (n=1) due to incomplete or missing questionnaires. An alpha level of 0.05 was set for all statistical tests.

The attendance rate for dance classes was calculated as a percentage of the total number of participants that started the intervention (n=37). This ensured against falsely elevated adherence levels.
Results

During a 13 month period, ninety nine volunteers were assessed for eligibility to participate in the study and ninety were randomized (n=45 per group). The flow of participants through the study is shown in Figure 1. Attrition over the course of the study was 46.67% in the dance group and 44.44% in the control group. Participants’ demographics are shown in Table 1.

No adverse effects were reported during or after the study. There was no difficulty finding physical resources but there were some issues matching suitable scheduling times between buildings, assessors and participants. These were quickly resolved through schedule changes.

Feasibility of set dancing

Attendance at classes was excellent at 93.5%. Reasons for absences were illnesses or family events that were unrelated to PD. Findings from the exit questionnaire showed that participants enjoyed participating and reported improvements in aspects of health, including (Table 2). Compliance with the home programme was 71.46% for those that handed back exercise diaries (n=10, 50%). Lack of time, forgetfulness, and family events affected compliance with the home programme.

Between-group comparisons

No significant difference was observed between the groups in the PDQ-39 (pre p=0.48, post p=0.43), six minute walk test (pre p=0.57, post p=0.33) and mini-BESTest (pre p=0.24, post
0.28) scores at baseline or post intervention. There was no significant between the groups baseline UPDRS-3 results (p=0.54). After the 10 week intervention a trend toward significance was observed (p=0.07) as the control group deteriorated and the dance group showed minimal signs of improvement.

*Intragroup comparisons*

Figure 2a, 2b, 2c and 2d display the results of the intragroup comparisons for the UPDRS-3, PDQ-39, six minute walk test and the mini-BESTest for the dance and control group. QoL improved non-significantly in both groups yet the dance group improved to a greater extent. Endurance declined in both groups during the intervention but to a much larger degree in the control group.

**Discussion**

The set dancing intervention was feasible and no safety issues or adverse effects were reported. Participants reported set dancing was a motivating and enjoyable form of exercise and showed interest in continuing participation. In accordance with this only seven participants discontinued the classes. Attendance at classes (93.5%) was higher than reported in previous studies of comparable duration. High adherence (91%) was also reported in a six month set dancing programme in a sample of Venetians with PD and longer-duration studies are warranted in an Irish population.

Compliance with the home programme was not strong. Many participants reported “they forgot” to complete the programme. This indicates it may not be a consistently feasible
option for increasing weekly dance activity. SMS text messaging alerts have been found to increase daily physical activity in older adults\textsuperscript{43} and maybe a strategy to encourage participation with home dance programmes. Qualitative research methods may identify appropriate options for home programme scheduling or alternative approaches for increasing the weekly dosage of dance.

Recruitment rates were in line with feasibility criteria, although the recruitment period took one month longer than anticipated. This due to summer breaks in some of the chosen recruitment bodies. Resource availability was also sufficient for the current trial and for future trials. Randomization and allocation procedures were successfully implemented; however, the high dropout rate raises feasibility concerns for larger trials. In this study the attrition rate exceeded 40\% in both groups which was higher than reported in dance classes in the USA\textsuperscript{30, 44} and exercise studies included in Australia.\textsuperscript{45} Health issues unrelated to PD and family reasons accounted for a large proportion of dropouts in this study, however, some participants did not give a reason for ceasing participation. Future studies may consider alternative study designs such as non-randomized comparison studies\textsuperscript{46} or use strategies to promote retention. McGinley and colleagues\textsuperscript{15} advocate that group based patient education maybe a suitable intervention to increase adherence in control groups.

After 10 weeks of dancing, the dance group had a reduction of 4.9 point on the PDQ-39 SI. This magnitude of improvement in QoL maybe substantial as Volpe et al\textsuperscript{5} reported an 8.44 point reduction in PDQ-39 scores following six months of set dancing. While the increase in QoL in this study did not reach statistical significance, it may be clinically meaningful given the improvements participants reported in various aspects of health (Table 2). The social cultural context of set dancing may improve QoL by enhancing mood and creating a sense of
social connectivity, satisfaction and reward.\textsuperscript{47-52} Musical accompaniment may modulate dopamine and serotonin,\textsuperscript{53} alleviating symptoms of fatigue or depression as well as improving quality of life.\textsuperscript{54-56} Future studies should consider the effect of set dancing on emotional and social wellbeing.

The results showed a small non-significant decline in motor function (UPDRS-3) in the control group. Endurance deteriorated in both groups, suggesting external factors outside the study may have influenced performance of the six minute walk test. Although the deterioration in both groups was not clinically meaningfully for this population (minimal clinically important difference = 82 metres), the reduction in endurance in the control group was above the 50 meter cut-off for substantial change in older adults\textsuperscript{57} and thus, may have clinical relevance. The dance group experienced less than half the reduction of the control group, indicating a possible protective benefit of set dancing. Notably, the intervention intensity may have been insufficient to improve endurance. Skill learning is central in set dancing as steps and movements have be learned, automatized and retained between classes. Research has found people with PD show slower rates of learning compared to age-match controls\textsuperscript{58}. In this study participants spent a great deal of time learning and perfecting movement patterns. A slower musical tempo and simple unidirectional movements allowed participants to practice, refine and consolidate precise motor sequences. Although exercise intensity progressed (music beats per minute (bpm) increased from 64 to 100 bpm)\textsuperscript{2} during the intervention, musical tempo remained approximately 20\% lower than used in set dancing classes for healthy adults. Longer interventions maybe more beneficial, allow more time to automatize motor skills\textsuperscript{59} and increase the intensity.\textsuperscript{60} The short duration of this study may also explain the lack of improvement in balance as participants did not get an opportunity to learn a variety of turning and multidirectional movements. These movements maybe vital for
improving balance and therefore should be implemented at a sufficient level to challenge balance without increasing the risk of falls.\textsuperscript{61} Additionally, low compliance with the home programme reduced the weekly dosage of dance activity and may have impacted results.

The neural correlates of the preserved performance in the dance group are not completely clear. It is proposed that dance may stimulate neural processes involved in protective and maintaining brain health.\textsuperscript{62} The combination of music, aerobic exercise, skill learning and rhythmic dance steps may alleviate motor symptoms by encouraging synaptogenesis and protecting brain structures from oxidative stress.\textsuperscript{62, 63} Music with dancing may modulate emotional processes helping to improve mood and enhance neuroplasticity.\textsuperscript{53, 62} The regular rhythmic beat of Irish dance music may help individuals cope with timing deficits in the basal ganglia-supplementary motor circuits and normalize movement execution.\textsuperscript{64}

\textbf{Study Limitations}

The modest sample size is a limitation of this study in terms of generalizability, however, this sample was sufficient to achieve the aims of the study and pilot the methods for a planned larger trial. Of note, this study identified issues affecting participant retention which are paramount to inform further trials. Adherence to usual care was not monitored in this study and should be considered in future research.

\textbf{Conclusion}

Set dancing is enjoyable for many people with PD. The results suggest set dancing may influence QoL. Tailoring the dance intervention and support mechanisms to minimize
attrition and optimise physical gains is recommended in future RCTs. It is necessary to compare set dancing to other dance forms to help individualize interventions and identify clients who may benefit most.

References


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http://dx.doi.org/10.1155/2012/795294.


http://dx.doi.org/10.3389/fnins.2015.00444.


Figure 1 CONSORT flow diagram of participants through study

Figure 2a
Values are median±interquartile range, p=alpha level, back lines are for Wilcoxon Signed Ranks test, blue lines are baseline Mann-Whitney-U test, green lines are post intervention Mann-Whitney U test

Figure 2b
Values are median±interquartile range, p=alpha level, back lines are for Wilcoxon Signed Ranks test, blue lines are baseline Mann-Whitney-U test, green lines are post intervention Mann-Whitney U test

Figure 2c
Values are median±interquartile range, p=alpha level, back lines are for Wilcoxon Signed Ranks test, blue lines are baseline Mann-Whitney-U test, green lines are post intervention Mann-Whitney U test, 6 minute walk test=six-minute walk test

Figure 2d
Values are median±interquartile range, p=alpha level, back lines are for Wilcoxon Signed Ranks test, blue lines are baseline Mann-Whitney-U test, green lines are post intervention Mann-Whitney U test
Table 1
Values for age, duration, Hoeln and Yahr, PASE are median± interquartile range (minimum, maximum values), *Mann-Whitney U Test, *= Significant finding, PASE=physical activity scale for the elderly

Table 2
1=strongly agree, 2=somewhat agree, 3=neither agree nor disagree, 4=somewhat disagree, 5=strongly disagree
Table 1 Demographic profile of participants

<table>
<thead>
<tr>
<th></th>
<th>Dance group (n=20)</th>
<th>Control group (n=21)</th>
<th>Between group (aP value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>69±10 (36,77)</td>
<td>69±8 (46, 79)</td>
<td>0.70</td>
</tr>
<tr>
<td>Hoeln and Yahr</td>
<td>1.25±1 (1, 2.5)</td>
<td>2 ±1 (1, 2.5)</td>
<td>0.27</td>
</tr>
<tr>
<td>PASE</td>
<td>154.45 ±106.02 (40, 301.57)</td>
<td>108.79±114.54 (33.60, 342.31)</td>
<td>0.38</td>
</tr>
<tr>
<td>Disease duration (years)</td>
<td>5.5±6 (0.50, 18)</td>
<td>6 ±8 (1, 20)</td>
<td>0.96</td>
</tr>
<tr>
<td>Gender (male:female)</td>
<td>13:7</td>
<td>13:8</td>
<td></td>
</tr>
<tr>
<td>Previous Irish set dance experience</td>
<td>40% (n=8)</td>
<td>14.3% (n=3)</td>
<td></td>
</tr>
</tbody>
</table>

Values for age, duration, Hoeln and Yahr, PASE are median± interquartile range (minimum, maximum values), aMann-Whitney U Test, *= Significant finding, PASE=physical activity scale for the elderly
Table 2 Results of exit questionnaire

<table>
<thead>
<tr>
<th>Questionnaire item</th>
<th>Median (min, max) (n=13)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I enjoyed participating</td>
<td>1, (1,2)</td>
</tr>
<tr>
<td>My balance improved</td>
<td>2,(2,5)</td>
</tr>
<tr>
<td>My walking has improved</td>
<td>2 (1,5)</td>
</tr>
<tr>
<td>My mood improved</td>
<td>2, (1,4)</td>
</tr>
<tr>
<td>My coordination improved</td>
<td>2 (1,3)</td>
</tr>
<tr>
<td>My strength improved</td>
<td>2, (1,4)</td>
</tr>
<tr>
<td>My endurance improved</td>
<td>2 (1,3)</td>
</tr>
<tr>
<td>I would continue classes if offered</td>
<td>1 (1,3)</td>
</tr>
<tr>
<td>I use ideas/skill learned in ADL’S</td>
<td>2,(1,4)</td>
</tr>
</tbody>
</table>

1=strongly agree, 2=somewhat agree, 3=neither agree nor disagree, 4=somewhat disagree, 5=strongly disagree.
Figure 1 CONSORT flow diagram of participants through study

Enrolment

Assessed for eligibility (n=99)

Excluded (total n=9)
- Not meeting inclusion criteria (n=9)

Randomized (n=90)

Allocated to dance (n=45)
- Received allocated intervention (n=37)
- Did not attend initial assessment (total n=8)
  - Family reasons (n=1)
  - Unwell unrelated to PD (n=1)
  - Travel problems (n=1)
  - No reason (n=5)

Allocated to control (n=45)
- Received allocated intervention (n=40)
- Did not attend initial assessment (total n=5)
  - Unwell unrelated to PD (n=1)
  - No reason (n=4)

Follow-Up

Lost to follow-up (did not attend post-intervention assessment (total n=6)
- On holidays (n=2)
- Unwell unrelated to PD (n=4)

Discontinued intervention (total n=7)
- Too intense (n=1)
- No reason (n=1)
- Did not like (n=2)
- Family reasons (n=1)
- Change in work schedule (n=2)

Analysis

Analysed (n=20)
- Excluded from analysis (total n=4)
  - Medication changes (n=4)

Analysed (n=21)
- Excluded from analysis (total n=4)
  - Medication changes (N=3)
  - Diagnosis of idiopathic PD under review (n=1)
Figure 2a Pre and Post Assessments Results for the UPDRS-3 for the Dance and Control Group

Values are median±interquartile range, p=alpha level, back lines are for Wilcoxon Signed Ranks test, blue lines are baseline Mann-Whitney-U test, green lines are post intervention Mann-Whitney U test.
Figure 2b Pre and Post Assessments results for the PDQ-39 for the Dance and Control Group

Values are median±interquartile range, p=alpha level, back lines are for Wilcoxon Signed Ranks test, blue lines are baseline Mann-Whitney-U test, green lines are post intervention Mann-Whitney U test
Figure 2c Pre and Post Assessments Results for the Six-minute Walk Test for the Dance and Control Group

Values are median ± interquartile range, p = alpha level, back lines are for Wilcoxon Signed Ranks test, blue lines are baseline Mann-Whitney-U test, green lines are post intervention Mann-Whitney U test, 6 minute walk test = six-minute walk test
Figure 2d Pre and Post Assessments Results for the Mini-BESTest for the Dance and Control Group

Values are median±interquartile range, p=alpha level, back lines are for Wilcoxon Signed Ranks test, blue lines are baseline Mann-Whitney-U test, green lines are post intervention Mann-Whitney U test
Highlights

• This was a pilot RCT comparing Irish set dancing to usual care for people with PD
• Primary outcome was feasibility of study design for implementation in future trials
• Results showed Irish set dancing is enjoyable and can improve quality of life
• Feasibility issues to be considered in future trials were identified
• Results will be used to inform larger international trials