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Effects of Popping For Parkinson's dance class on the mood of people with Parkinson's disease

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Abstract

Background/Aims Depression, low mood and apathy can affect people with Parkinson's disease, impacting on their quality of life. The aim of this study was to investigate the effects of one Popping For Parkinson's dance session on the mood of people with Parkinson's disease.

Methods A total of 33 people with Parkinson's disease, with a mean age of 67.5 years (standard deviation 10.3 years), mean Parkinson's level of 1.8 (standard deviation 1.6), took part in one Popping For Parkinson's dance class at four different locations: London (UK), Hatfield (UK), New York City (USA) and Turin (Italy). Participants' mood was measured with the Profile of Mood States questionnaire at four time points: immediately before the dance class, immediately after the dance class, 24 hours after the dance class and 1 week after the dance class.

Results Participants' total mood score and the subscale score of vigour increased, while the subscales of tension, depression, and confusion decreased on the Profile of Mood States, significantly immediately after the dance intervention. However, at 24 hours and 1 week after the dance class, mood scores did not differ significantly compared with baseline measurements. The improvements in mood immediately after the dance class did not differ depending on sex, age, previous dance experience, the location of the dance class, stage of Parkinson's disease, presence of tremor and deep brain stimulation treatment.

Conclusions Participating in a Popping For Parkinson's dance class boosts mood in the short term, and this improvement lasts less than 24 hours. This finding has implications for the provision of dance classes, suggesting that regular attendance may be necessary for sustained improvements. Further studies are needed to determine whether attending a series of Popping for Parkinson's classes may have longer-term effects.

Key words: Dance; Mood; Parkinson's disease; Popping dance; Popping for Parkinson's

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Introduction

Parkinson's disease is a progressive neurodegenerative condition that typically develops in people above the age of 50 years, with no cure found to date. It is the world's second most common neurodegenerative disorder (Lew, 2007) and more than 145 000 people in the UK alone live with the condition (Parkinson's UK, 2018).

The main motor symptoms of Parkinson's include muscle rigidity, bradykinesia and tremors (Kalia and Lang, 2015). Psychological (non-motor) symptoms are also common (Martinez-Martin et al, 2011), including depression, anxiety and apathy (Chaudhuri et al, 2006; Brown et al, 2011; Garlovsky et al, 2016). The non-motor symptoms make an important contribution to the quality of life for people with Parkinson's disease, with low mood and apathy reported to be the best predictors of reduced quality of life (van Wamelen et al, 2021).

Traditional pharmaceutical therapies that boost levels of the neurotransmitter dopamine lessen the impact of motor symptoms, but complications are common, including fluctuating side effects and dyskinesias (Chaudhuri et al, 2018). Dopaminergic drug treatments are not as effective on non-motor symptoms and do not change the course of the disease (Kalia and Lang, 2015). Therefore, it is essential to find supplementary forms of therapeutic intervention to support people living with Parkinson's disease.

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Exercise and physiotherapy-based interventions are increasingly recognised as useful adjuncts in the treatment of Parkinson's disease (Tomlinson et al, 2012; Armstrong and Okun, 2020), and intensive exercise has been reported to delay the progression of symptoms (van der Kolk et al, 2019). Dance offers an engaging way for people with Parkinson's disease to exercise, involving learning routines, musical and emotional experiences, opportunities for creative expression and social interactions (Dhami et al, 2015; Bek et al, 2022). Attendance is generally good, with low drop-out rates (Shanahan et al, 2015a), attracting people who may not be motivated to attend other types of exercise classes (Houston and McGill, 2013).

The majority of studies that have investigated the effects of dance for people with Parkinson's diseasehave focused on motor symptoms, demonstrating improvements on several measures of motor function (Sharp and Hewitt, 2014; Lötzke et al, 2015; Aguiar et al, 2016; dos Santos Delabary et al, 2018; Rocha et al, 2018; Kalyani et al, 2019).

Evidence suggests that people with Parkinson's disease may also benefit psychologically from participating in dance classes, leading to improvements in cognition (Kalyani et al, 2019; Zhang et al, 2019), mood (Heiberger et al, 2011; Koch et al, 2016; Lewis et al, 2016; Fontanesi and DeSouza, 2021) and depression (Blandy et al, 2015; Hashimoto et al, 2015; Lee et al, 2015; Solla et al, 2019).

However, reviews and meta-analysis have noted that while promising, effects are inconsistent and more evidence is needed to understand the impact of attending dance classes on the non-motor symptoms of Parkinson's (Zhang et al, 2019; Bek et al, 2020; Carapellotti et al, 2020; Ismail et al, 2021). Small sample sizes, variability in the style, frequency and duration of the dance classes, and the baseline characteristics of the participants with Parkinson's disease may all contribute to the inconsistent results (Bek et al, 2020; Carapellotti et al, 2020).

One potential factor that has not been explored is the timing of assessments relative to the final dance class. Many studies have used longitudinal designs, in which assessments were made before and then after a series of dance classes (Hackney and Earhart, 2009; Blandy et al, 2015; Hashimoto et al, 2015; Lee et al, 2015; Romenets et al, 2015; Shanahan et al, 2015b; Lewis et al, 2016; Rocha et al, 2018). The precise timing of the assessments (hours, days, a week or more) after the final class is not always specified.

Since assessments were not measured over a longer period of time, how long any effects last is uncertain. The different timings of assessments relative to the end of the dance intervention might contribute to inconsistent findings. This is particularly the case for mood, given that Steinberg et al (1998) found that increased mood after participation in an exercise class for healthy adults had worn off by the following week before the next class.

Relatively few studies have investigated the effects of a single dance class for people with Parkinson's disease with measures taken immediately after the class (Heiberger et al, 2011; Koch et al, 2016; Lewis et al, 2016; Fontanesi and DeSouza, 2021).

The aim of this study is to explore whether participating in one single Popping For Parkinson's dance class leads to changes in mood of people with Parkinson's disease, and if so for how long these changes last. Popping For Parkinson's is a hip hop-based, style-specific dance that has not previously been investigated as an intervention for Parkinson's disease.

The technique of popping involves voluntary contraction and release of muscles in time with music typically chosen to be high groove with a strong beat. The popping actions are done vigorously to create energetic dance moves. The external rhythmic cues provided by the strong beat may be particularly useful to facilitate movement by people with Parkinson's disease (Leow et al, 2014; Rose et al, 2019), as are strategies that encourage big movements (McDonnell et al, 2018).

It is hypothesised that participants' mood will be positively affected in the short-term by participating in one Popping For Parkinson's class, but any improvements in mood will not last into the week following the dance class.

Methods

Design

This repeated measures design study took place between July and October 2019 at four locations: London (UK), Hatfield (UK), New York City (USA) and Turin (Italy).

Ethical approval

The study was approved by the University of Hertfordshire Ethics Committee (reference: LMS/PGR/UH/03670). Written informed consent was obtained from all participants before the study began.

Participants

Participants were recruited via social media callouts, reaching out to existing dance for Parkinson's groups via email, personal contacts, and through local Parkinson's networks.

To be eligible to take part in the study, individuals were required to have a clinical diagnosis of Parkinson's disease. There were no exclusion criteria regarding stage of Parkinson's disease as the Popping dance class was designed to be accessible to all living with the condition.

Individuals were excluded if they met the following exclusion criteria:

- Were aged 90 years or above
- Had medical conditions indicated on the Physical Activity Readiness Questionnaire, such as stroke or cardiovascular disease, that may be unsafe for the participant to continue with the study (Thomas et al, 1992).

Outcome measures

In order to measure mood, the Profile Of Mood States (POMS) was used (McNair et al, 1981), in line with previous studies in the field (Lewis et al, 2016). The POMS asks participants to report how they are feeling, on a scale of 1–5, in response to 65 questions (eg friendly, tense, angry).

The Hoehn and Yahr scale (Hoehn and Yahr, 1967) was used to classify the stage of Parkinson's disease, in line with other studies (Hackney and Earhart, 2010; Rocha et al, 2018). Participants were provided with the description of symptoms at each stage on the scale and asked to select which description best matched their symptoms.

Participants' demographics information was recorded including sex, age, previous dance experience, presence of tremor, deep brain stimulation treatment, together with the Physical Activity Readiness Questionnaire to check whether participants were medically fit to take part in the class (Thomas et al, 1992).

The questionnaires were provided on paper and online using the survey software Qualtrics. Participants choose their preferred method to answer the questionnaires. Hard copies of the questionnaires were given out on the day of the class to participants who chose to give responses on paper and were collected by the researcher on the same day for the baseline (T0) and immediately after the dance class (T1) timepoints. Prepaid envelopes were provided for these participants to return the hard copies of their responses for the 24 hours (T2) and 1 week (T3) time points. For participants who chose to give their responses online, email reminders were sent at appropriate times with links to the relevant online questionnaire. At the New York City class, hard copy questionnaires were used for the T0 and T1 timepoints only as the first author (SS) was not there to collect questionnaires for the later time points. All the New York City participants were provided with a leaflet that gave instructions how to enter their responses online for the T2 and T3 timepoints.

The dance class

The dance class was held at four different geographical locations: London (UK), Hatfield (UK), New York City (USA), Turin (Italy). The class venues were either a dance studio, sports hall, or other appropriate large indoor space.

The Popping For Parkinson's dance class that was offered to participants followed the same structure at all four class locations and for all levels of experience (Table 1). The same instructor led all four classes.

Procedure

After reading the information sheet and signing the consent form, before taking part in the dance class, participants answered the demographics questionnaire, the Physical Activity Readiness Questionnaire and selected the Hoehn and Yahr description of their Parkinson's stage. The POMS questionnaire was answered by participants at four different time points

Table 1. Dance class details	
Class structure	Gentle warm up, body rocking, basic Popping technique, Popping exercises ('drills'), travelling across the floor, short routine (with an augmenting speed), improvisation, cool down/stretching, reverence (thank you). The class is designed to minimise the risk of injuries and provide a safe space for participants to practice
Adaptations	Seated adaptations were offered to those who were unable to stand for a prolonged time
Music	High-groove style-related music, with a balanced mix of pop and funk songs and popping music. For example, 'Kiss' by Prince (110 BPM), 'Right on Time' by The APX (117 BPM), 'Young Love' by Janet Jackson (126 BPM)
Teaching methods	Verbal instructions, imagery, repetition, variations on movement such as speed, levels and directions

BPM: Beats per minute.

over a period of 1 week: time zero (T0) recorded immediately before the Popping For Parkinson's dance class, in order to establish a baseline; time one (T1) recorded immediately after the dance class; time two (T2) recorded 24 hours after the dance class; and time three (T3) recorded 1 week after the dance class.

Participants were asked two open questions to elicit feedback at the end of the dance class: 'How did you find the class?' and 'Anything else you would like to add?' The requested feedback was not compulsory, and it was not formally analysed, rather it was gathered to better inform the evaluation and discussion of the results of the study and offer an insight in understanding any changes on the POMS.

Statistical analysis

Analyses were conducted using the software Statistical Package for the Social Sciences (version 26). A repeated measures analysis of variance with a Greenhouse–Geisser correction was used to determine whether the POMS total score differed significantly across the four timepoints. A one-way repeated measures multivariate analysis of variance, followed by univariate analyses for each sub-scale, was used to determine the contribution of the POMS sub-scales (tension-anxiety, depression-dejection, anger-hostility, vigour-activity, fatigue-inertia, confusion-bewilderment). The significance level for analyses was set at $P<0.05$. Where a significant effect was identified, Bonferroni corrected post hoc *t*-tests were used to determine which time points differed significantly from each other.

To explore whether participant characteristics influenced any effects on mood, for each characteristic, participants were split into groups: sex (male, female); age (≤65 years, >65 years); Parkinson's Hoehn and Yahr stage (1–2, 2.5–5); tremor (tremor present, tremor absent); deep brain stimulation treatment treatment (DBS, no DBS); location of dance class (London, Hatfield, New York City, Turin); previous dance experience (Popping dance experience, other dance experience, both Popping and other dance experience, no dance experience). Separate two-way analysis of variance, with the characteristic as one factor and timepoint as the other factor, were then used to test for any interaction between that characteristic and changes in mood over time.

Results

A total of 47 participants with Parkinson's disease took part in the dance class. No participants were excluded based on answers to the Physical Activity Readiness Questionnaire. Overall, 14 participants did not return their POMS questionnaires for T2 and T3 time points after the dance class, so data from 33 participants, with a mean age of 67.5 years (standard deviation 10.3 years) and mean Hoehn and Yahr stage of 1.8 (standard deviation 1.6), were used in the analyses. Further details of the participant characteristics, including previous dance experience, stage of Parkinson's disease and number attending the class at each of the four locations are given in Table 2.

Table 2. Profile of mood states total score by participant characteristics

Characteristic		*n*	T0 (SD)	T1 (SD)	T2 (SD)	T3 (SD)	F (df)	*P*	Effect size
Sex	Male	14	17.9 (21.6)	3.21 (19.1)	11.4 (13.9)	16.4 (25.5)	0.581 (3,93)	0.579	0.018
	Female	19	17.6 (22.1)	0.21 (13.9)	18.5 (26.7)	20.3 (36.6)			
Age (years)	≤65	13	18.3 (23.0)	–2.85 (12.4)	17.3 (20.7)	18.1 (29.4)	0.541 (3,93)	0.600	0.017
	>65	20	17.0 (21.2)	4.3 (17.8)	14.2 (26.7)	19.0 (34.3)			
Hoehn and Yahr stage	1–2	24	14.1 (23.5)	–1.2 (13.8)	11.9 (25.1)	18.4 (35.1)	0.705 (3,93)	0.511	0.022
	2.5–5	9	26.6 (12.9)	8.7 (20.1)	24.9 (20.1)	19.3 (23.3)			
Tremor	Present	19	23.8 (23.6)	5.1 (18.1)	21.2 (29.6)	22.1 (36.8)	0.331 (3,93)	0.739	0.011
	Absent	14	8.9 (15.5)	–3.4 (11.7)	7.6 (10.9)	13.9 (24.5)			
Deep brain stimulation treatment	Yes	7	17.1 (26.8)	–6.4 (10.6)	11.1 (8.2)	12.3 (20.5)	0.326 (3,93)	0.742	0.010
	No	26	17.6 (20.6)	3.6 (16.8)	16.6 (27.0)	20.4 (34.5)			
Dance experience	Dance	12	22.7 (24.3)	12.7 (20.9)	22.1 (26.2)	21.2 (28.0)	1.685 (9,87)	0.125	0.148
	P for P	7	12.1 (18.2)	–5.7 (5.6)	7.6 (9.5)	3.6 (11.1)			
	Dance and P For P	3	24.0 (18.7)	0.7 (5.1)	39.7 (52.3)	59.0 (76.3)			
	None	11	13.5 (22.2)	–5.4 (9.8)	6.3 (12.4)	14.5 (22.1)			
Location	Hatfield	6	22.0 (19.2)	14.3 (22.4)	20.8 (30.9)	17.3 (34.1)	0.942 (9,87)	0.478	0.089
	New York City	3	21.0 (25.4)	–9.7 (11.7)	12.3 (34.5)	17.7 (22.5)			
	Turin	17	15.0 (22.7)	2.0 (13.9)	11.1 (14.9)	15.2 (22.3)			
	London	7	18.1 (23.3)	–6.0 (10.2)	22.9 (34.6)	28.4 (53.3)			

df: degrees of freedom; F: the two-way interaction between the participant characteristic and the four time points; P For P: Popping for Parkinson's; POMS: Profile of mood states; SD: standard deviation; T0: baseline before the class; T1: immediately after the class; T2: 24 hours after the class; T3: 1 week after the class.

Mood

Total mood scores on the POMS differed significantly across the four time points ($F(3,31) = 7.32$, $P<0.001$, $\eta^2=0.186$; Figure 1). Post hoc tests revealed that mood differed immediately before (T0) and immediately after (T1) the dance class ($P<0.001$), with scores lower at T1 than T0, indicating improved mood immediately after the class. Scores differed between T1 and T2 ($P=0.005$), and there were no significant differences in scores between T0 compared with T2, T0 compared with T3, and T2 compared with T3 (Figure 1). Overall, these comparisons reveal that mood improved immediately after the dance class, and then went back to baseline levels within 24 hours.

A multivaraiate analysis of variance considering the POMS sub-scales simultaneously revealed a significant effect ($F(18)=2.685$, $P<0.001$); therefore separate univariate analyses of variance were conducted for each sub-scale. Significant decreases were found for the tension, depression and confusion sub-scales, while there was increase in the vigour subscale, but no significant decrease was found in the the anger and fatigue sub-scales (Table 3). Post hoc tests revealed that the changes in the tension, depression, vigour and confusion sub-scales occurred between T0 and T1, and between T1 and T2, but not between T0 compared with T2, between T0 compared with T3, and between T2 compared with T3 (Table 3).

Separate two-way analyses of variance were run to investigate whether the participants' characteristics, previous dance experience, location of the dance class, presence of tremor, stage of Parkinson's disease and deep brain stimulation treatment surgery influenced POMS

Table 3. Profile of mood states subscales

	T0 Mean (SD)	T1 Mean (SD)	T2 Mean (SD)	T3 Mean (SD)	F	*P*	Effect size
Tension-anxiety	7.36 (4.61)	4.45 (2.49)†	7.21 (5.30)	7.06 (5.54)	5.89	0.001	0.155
Depression-dejection	6.79 (7.66)	2.58 (3.81)*	6.36 (8.01)	7.67	5.17	0.003	0.139
Anger-hostility	4.76 (5.14)	2.88 (3.25)	4.18 (4.09)	5.24 (6.30)	2.36	0.09	0.069
Vigour-activity	14.61 (5.50)	18.03 (6.93)†	14.42 (5.91)	13.97 (6.17)	8.44	0.001	0.209
Fatigue-inertia	6.94 (4.54)	5.64 (4.58)	6.97 (5.11)	6.79 (4.97)	1.52	0.22	0.045
Confusion-bewilderment	6.24 (3.39)	3.97 (2.83)†	5.15 (3.22)	5.85 (4.04)	5.73	0.003	0.152
Total score	17.48 (21.59)	1.48 (16.07)†	15.45 (24.24)	18.64 (31.97)	7.32	<0.001	0.186

*T0: baseline before the class; T1: immediately after the class; T2: 24 hours after the class; T3: 1 week after the class. SD: standard deviation; Post-hoc tests compared with T0, *P<0.05; †P<0.001.*

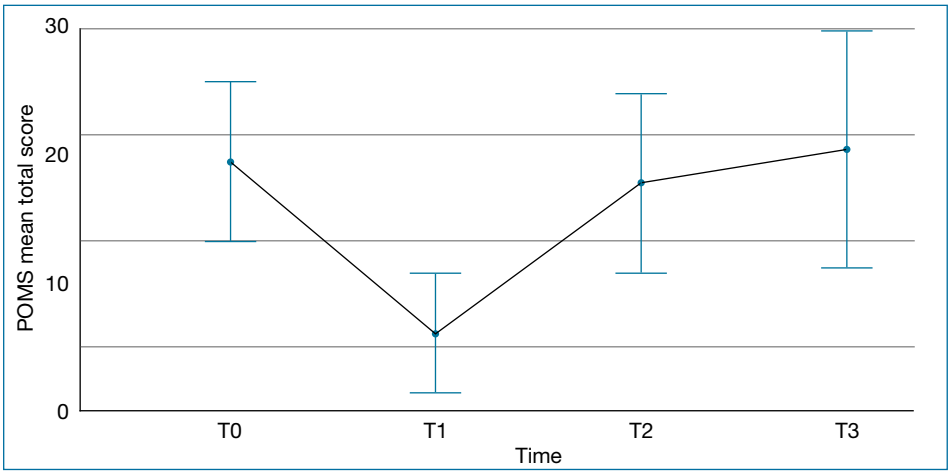

Figure 1. Profile of mood states (POMS) mean total score at each time point. T0: baseline before the class; T1: immediately after the class; T2: 24 hours after the class; T3: 1 week after the class. Error bars represent ± 2 standard error.

total scores across the four timepoints. None of the characteristics significantly influenced mood scores, nor did any characteristic interact significantly with the effects of time on mood scores (Table 2), suggesting that changes in total mood scores between before and immediately after the dance class occurred regardless of participants' sex, age, stage of Parkinson's disease, presence of tremor, deep brain stimulation treatment, previous dance experience or the location of the dance class.

Participant feedback

Of the 33 participants, 11 gave written responses to the open questions asking for feedback on how they found the class. Of the 11 participants, nine reported that they enjoyed the class, with three specifically mentioning that they enjoyed the music. Three participants reported that they found the class fast paced and challenging, and three found the class tiring. Words such as energised, satisfying, invigorating, optimistic, positive, superb were used to describe the dance class, regarding the material, the atmosphere, and/or the teacher.

One participant who had no previous dance experience reported:

> **'The class was great fun and I liked the music. I enjoyed the class but sometimes the movements were difficult. Towards the end of the week I was feeling better than before the class, both physically and mentally, I also felt a little calmer.'**

One participant that had previous dance experience but no specific Popping For Parkinson's experience reported:

'Most enjoyable class. I have always enjoyed dance. It makes me feel able and at times as if I don't have the condition.'

One participant that had previous Popping For Parkinson's experience reported:

'Excellent! I always feel optimistic and hopeful after class. It is the highlight of my week. The collective spirit led by the teacher is superb. Every time [the teacher] is supportive and encouraging.'

One participant reported:

'I found it fun and challenging. The popping moves seem to help me release some of the stiffness. Not to mention the "wows" I get from my grandchildren!'

Discussion

The key novel finding of the present study is that participants' mood improved immediately after attending the Popping dance class, regardless of their demographics, factors related to Parkinson's disease (stage, tremor, deep brain stimulation treatment), previous dance experience or the class location, but the effect was short lived and no longer evident even 24 hours after the class. That participation in a dance class can boost mood is in line with previous studies of dance interventions for people with Parkinson's disease. Importantly, studies that have reported improved mood have tended to be those in which mood was measured immediately after compared with before a dance class (Heiberger et al, 2011; Koch et al, 2016; Lewis et al, 2016; Fontanesi and DeSouza, 2021).

In contrast, studies in which depression was measured as one of a battery of assessments after a series of dance classes have tended not to find improvements (Westbrook and McKibben, 1989; Romenets et al, 2015; Westheimer et al, 2015). A complication in this literature is that mood and depression have sometimes been conflated (Zhang et al, 2019) when these are different constructs assessed by different measures. The POMS or the Positive and Negative Affect Schedule are commonly used to measure mood, and the Beck Depression Inventory is used to measure depression. Most people experience feelings that change over time, known as moods, whereas not everyone who experiences decreased mood in the short term is depressed. While depression is common in people with Parkinson's disease, not everyone with a diagnosis of Parkinson's disease is depressed (Brown et al, 2011). Whether or not participation in dance classes is found to reduce depression may depend on the extent to which the participants in the study were depressed before the start of the dance programme (McNeely et al, 2015). The findings of the present study highlight the need for clarity in reporting the time at which assessments are made relative to dance classes, and careful use of terms when considering the psychological impact of participation in the classes.

That mood improved in the short term immediately following the class, but did not last, is in line with findings from studies that measured mood changes in adults who do not have Parkinson's disease following exercise classes (Maroulakis and Zervas, 1993; Steinberg et al, 1998). Since the mood-enhancing effects last less than 24 hours, attending a dance class daily may be considered similar to a pharmacological pill to be taken once a day to see lasting improvements. This has implications for the design of dance programmes for people with Parkinson's disease. While attending daily group classes daily may not be feasible, alternatives such as home dance routines, perhaps with online support, might be useful to supplement weekly group classes. Whether or not such hybrid dance programmes, or indeed more frequent group classes, would in the longer term lead to more lasting improvements in mood, remains to be explored.

Potentially, the Popping dance intervention might have brought functional benefits to participants in ways the study was not designed to capture, for example, the participant who reported how his grandchildren were impressed with his dance moves. This participant's experience with his grandchildren might have had an impact on his life in a way that was not predicted at the beginning of this study and would not be detected by the outcome measures

used in this study. As McGill et al (2014) have argued, the emphasis on measuring effects on clinical symptoms of Parkinson's disease neglects wider influences of dance on other aspects of participants' lives.

Limitations

The number of participants in the present study (n=33) compares favourably with many studies that have examined the effects of those with Parkinson's disease attending dance classes, including those judged sufficiently sound to be included in meta-analyses (Lötzke et al, 2015; dos Santos Delabary et al, 2018; Zhang et al, 2019; Carapellotti et al, 2020). Nevertheless, in the present study there was variability in participant characteristics related to symptoms of Parkinson's disease and factors such as previous dance experience. Mood scores were similar between sub-groups created to explore the impact of each of these characteristics (**Table 2**), but participant numbers in some sub-groups were small, limiting the conclusions that may be drawn. The majority of participants had mild Parkinson's disease (Hoehn and Yahr stages 1–2), so whether mood improvements following dance are similar in mild and more severe Parkinson's cases cannot be determined for certain from the present study results. Further studies designed specifically to compare sub-groups of participants depending on symptoms, stage of Parkinson's disease, treatments such as deep brain stimulation treatment and previous dance experience are needed to answer the question whether dance effects on mood might differ depending on these factors.

The focus of the present study was the duration of mood changes following a Popping dance class. There was no control group to determine whether the mood changes were specific to the Popping dance or would also have been seen following a different style of dance, or indeed other types of group activities such as singing, exercise classes, or social gatherings with no specific activity. Whether the vigorous movements of the Popping dance, the style of accompanying music or social interactions contributed to the improved mood cannot be determined from the present study.

It is possible that the improved mood observed in the present study was a placebo effect: participants' belief that the dance intervention would bring beneficial effects rather than a direct effect of the dance per se. This is particularly relevant given the neurotransmitter dopamine is involved in placebo effects (de la Fuente-Fernández, 2009) and the evidence of placebo effects in drug trials for people with Parkinson's disease (Shetty et al, 1999). Designing studies so that the participant is blind to the intervention to avoid placebo effects, as is done in pharmacological trials, is particularly difficult for studies involving dance or other activities. Comparing the dance intervention with another activity that the participant would find useful and enjoyable is an approach that could be used to distinguish placebo from direct effects of the intervention. Quantitative measures based on questionnaires may not fully reflect the impact of the dance intervention (Houston and McGill, 2019). While feedback was gathered informally from participants, formal qualitative analysis of comments may have provided deeper insights into participants' perceptions of the dance class.

Future studies

Future studies could include appropriate control groups to test specific hypotheses, for example to determine which features of the Popping dance class might be particularly important to enhance mood (eg the vigorous dance moves, the music, the social interaction), and to control for potential placebo effects. Studies can be designed with appropriate recruitment strategies and sufficient power to test whether participant characteristics such as stage of Parkinson's disease and symptoms differentially affect the outcomes of attending a Popping dance class.

The focus of the present study was mood changes over time following a single Popping dance class. It would be interesting in future studies to investigate the physical benefits that attending Popping dance classes might bring to participants, considering outcomes relevant to Parkinson's symptoms, including balance, gait, tremor and freezing. A longer-term study in which participants attend Popping dance classes once or twice a week over a series of weeks would be appropriate to allow time for any physical improvements to develop and be comparable to many other studies that have investigated effects of various dance styles on physical aspects of Parkinson's disease (Lötzke et al, 2015; Aguiar et al, 2016; dos Santos Delabary et al, 2018; Kalyani et al, 2019).

Key points

- This study investigated the effects of one Popping For Parkinson's dance session on the mood of people with Parkinson's disease.
- The dance class was held at four different geographical locations: London (UK), Hatfield (UK), New York City (USA), Turin (Italy).
- Participants' mood improved immediately after attending the Popping dance class, regardless of their demographics, factors related to Parkinson's disease (stage, tremor, deep brain stimulation treatment), previous dance experience or the class location, but the effect was short lived and no longer evident even 24 hours after the class.
- Alternatives such as home dance routines, perhaps with online support, might be useful to supplement weekly group classes.
- Further research using appropriate controls and a wider range of measures is needed to fully characterise the physical and psychological benefits that Popping For Parkinson's dance classes may offer to participants with Parkinson's disease.

A longer-term study with Popping dance classes held over several weeks would also be useful to explore the relationship between mood and depression over time. Evidence from the present study comparing mood changes in participants who had danced before and those who had not, and from studies of exercise effects on mood (Steinberg et al, 1998), suggests that mood improvements (albeit time-limited) are reinstated at repeated dance sessions. Would repeated mood enhancement after each dance class in a series of classes help relieve depression in participants with Parkinson's disease who were depressed before the start of the dance programme?

As dance is a multifaceted activity (Houston, 2015), future studies could measure broader psychological aspects of living with Parkinson's disease. For example, how participation in Popping dance classes might impact on confidence, self-esteem, feelings of control and stigma, and other factors that may contribute to the quality of life for people living with Parkinson's disease (Ma et al, 2016). A mixed-methods approach examining both quantitative and qualitative data would be useful in future studies for a deeper understanding of the variety of ways in which participating in Popping dance classes might benefit people with Parkinson's disease.

Conclusions

Participating in one Popping For Parkinson's dance class boosted the mood of people with Parkinson's disease. The effect on mood was immediate but lasted less than 24 hours. The finding reveals that dance effects on mood may be shorter than previously assumed from longitudinal dance studies and this may be a factor in some inconsistencies in the literature. Further research using appropriate controls and a wider range of measures is needed to fully characterise the physical and psychological benefits that Popping For Parkinson's dance classes may offer to participants with Parkinson's disease.

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Conflicts of interest
SS is the founder of Popping for Parkinson's.

Data sharing
Data are available from the authors upon reasonable request.

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