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Health-related Quality of Life and Alternative Forms of Exercise in Parkinson Disease

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Abstract

Parkinson disease (PD) reduces health-related quality of life (HRQoL), but exercise may improve HRQoL. This pilot study compared the effects of Tango, Waltz/Foxtrot, Tai Chi and No Intervention on HRQoL in individuals with PD. Seventy-five persons with PD (Hoehn and Yahr I-III) were assigned to twenty lessons of Tango, Waltz/Foxtrot, Tai Chi, or an untreated No Intervention group. Participants completed the PDQ-39 before and after participation in 20 classes or within thirteen weeks in the case of the No Intervention group. Two-way repeated measures ANOVAs determined differences between interventions. Tango significantly improved on Mobility ($p = 0.03$), Social Support ($p = 0.05$) and the PDQ-39 SI ($p < 0.01$) at post-testing. No significant changes in HRQoL were noted in the Waltz/Foxtrot, Tai Chi or No Intervention. Tango may be helpful for improving HRQoL in PD because it addresses balance and gait deficits in the context of a social interaction that requires working closely with a partner.

Keywords

Parkinson disease; quality of life; PDQ-39; exercise; dance

INTRODUCTION

Parkinson Disease (PD) is a neurodegenerative movement disorder that detrimentally impacts motor ability but also affects psychological and cognitive aspects of wellbeing [1]. Health Related Quality of Life (HRQoL), or “the perception and evaluation by patients themselves of the impact that the illness and its consequences have caused in their life” [2], is most affected by depression [3], co-morbid with PD in nearly half of patients [4]. Psychological adjustment to the effects of Parkinson disease had a greater effect than disease severity on several aspects of HRQoL [5]. Also, life goal disturbance as a result of neurological disease may impact HRQoL, mood and independence [6]. As such, motor symptom treatment of a disease cannot be the sole concern in patient care.

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Relationship-related goals with partner and family appear to be of utmost importance to those with PD and activities that foster achievable life goals and prevention of life goal derailment are imperative for their mood function and HRQoL [6]. However, currently most rehabilitation programs for those with PD do not place enough importance on goals related to personal relationships [6]. To encourage wellbeing of those with PD, activities that improve social network size and quality and encourage social interaction should be developed [7]. Axial impairment also contributes to decreased HRQoL [8]. Exercise programs can effectively rehabilitate axial impairments and a meta-analysis demonstrated they are likely to improve HRQoL in those with PD [9]. Therefore, it would be ideal to foster the creation of a rehabilitation program that targets and alleviates axial impairments while concurrently placing importance on personal and social relationships.

Tai Chi as group exercise for the elderly and those with motor impairments has positive effects on axial impairment [10] and HRQoL [11]. We hypothesized that an even more suitable rehabilitation program for those with PD might be social partnered dance because while fostering community involvement and social support it necessitates practice of dynamic balance and adjustment to environment [12]. Dance is enjoyable and engaging, promoting adherence and enhancing motivation [13,14,15,16]. Argentine Tango has been effective in improving functional mobility and balance in those with PD while being enjoyable [16]. Modern dance has also been shown to positively influence HRQoL in those with PD [17]. However, this study lacked a control group and administered an HRQoL survey post-intervention, requiring participants to retrospectively report perceived changes in HRQoL as a result of participating in the dance program.

The purpose of this study was to prospectively compare the effects of three distinct, socially-interactive, physical activities and no intervention on HRQoL in those with PD. Seventy-five persons with PD were assigned to twenty group lessons of Tango, Waltz/Foxtrot, Tai Chi or to an untreated No Intervention group. Each intervention mixed social interaction with loved ones and other participants in the context of a physical activity that included elements designed to improve axial impairment and mobility. We also examined differential effects of the interventions on those with PD of longer and shorter duration as measured by a standard HRQoL instrument. Measures of HRQoL were obtained using the PDQ-39, which has adequate clinimetric characteristics, has been employed in many studies and demonstrates satisfactory internal consistency and reliability [18]. We hypothesized that those involved in both dance interventions would experience more improvements in HRQoL as measured by the PDQ-39 than would those participating in Tai Chi or the No Intervention group and also hypothesized that those with longer disease duration may reveal greater improvements in HRQoL.

METHODS

The Human Research Protection Office at Washington University in St. Louis approved this work. All participants provided written informed consent before participation in the study.

Participants

Participants were recruited from the St. Louis community through advertisement at local support groups and community events. While some participants self-identified, most were directly recruited via telephone from the Washington University Movement Disorders Center database.

Seventy-five participants with idiopathic PD were randomly assigned to participate in 20 twice weekly one-hour sessions of either Argentine Tango (Tango), or combined Waltz and Foxtrot lessons (Waltz/Foxtrot) (30 minutes waltz, 30 minutes foxtrot), or Tai Chi or to be part of a No Intervention group. The first author completed group assignment by randomly selecting

one of the four conditions from a hat. Participants were at least 40 years of age, could stand for at least 30 minutes, and walk independently 3 or more meters with or without an assistive device. Individuals with Hoehn and Yahr stages of I-III participated. Participants were excluded if they had history of neurological deficit other than PD. All participants had a diagnosis of idiopathic PD using diagnostic criteria for clinically defined “definite PD” based upon published standards [19]. Individuals had been previously screened for dementia by their neurologists and none were diagnosed with dementia. As another measure of cognitive function and a separate part of the study not reported here, all participants were required to perform a subtraction task while simultaneously walking. All participants understood the directions and were able to complete the task with at least 85 percent accuracy, and as such we considered them to be cognitively intact for the purposes of this study. Participants demonstrated clear benefit from levodopa and were tested in the “ON” state at a standardized time to reduce the effects of medication-related fluctuations in performance. Participants also came to intervention classes at the same time each day. Individuals who reported one or more falls in the six months before testing were considered “fallers”. Participants were also categorized into those who had had PD for more than six years (Longer Duration) and those who had had PD for six years or less (Shorter Duration).

All participants were on stable medication regimens prior to enrolling in the study and if participants received alterations in their medication schedules or doses, their data were excluded from the study, thereby controlling for effects of drug therapy. Participants were instructed not to change their habitual exercise routines over the course of the study.

Intervention

An experienced instructor, both a professional ballroom dancer and an American Council on Exercise certified personal trainer, taught the progressive Tango lessons and Waltz/Foxtrot lessons, possibly controlling for distinctions in teaching pedagogy frequently found between dance instructors due to a general lack of standardization in social dance instruction. This instructor was equally versed in both dances and attempted to give all students equal attention. Both genders spent equal time in leading and following dance roles. All steps were done in a “closed practice” position, an adaptation of the traditional ballroom frame in which participants maintain contact through the upper extremities and face one another. This position involved holding hands with bent elbows, and maintaining the forearms parallel to the floor. Tai Chi participants received progressive lessons on Tai Chi’s first and second circles, including 37 postures of the Yang Short Style of Cheng Manching from an experienced instructor. Participants completed 20 one-hour lessons within 13 weeks.

To maximize safety of the participants, a physical therapist was present at all sessions. Spouses, family members, friends and healthy young volunteers participated, partnered and assisted those with PD in all interventions. Young volunteers were recruited from physical therapy, pre-physical therapy and pre-medical programs at Washington University and St. Louis University, and were educated about posture and gait problems associated with PD, methods for monitoring balance and anticipating falls, and proper spotting and assistance techniques to use for a loss of balance. Their participation was imperative to the success and safety of the program.

Testing Protocol

Pre-testing took place in the week before commencing classes. Participants were evaluated for disease severity using the Unified Parkinson’s Disease Rating Scale Motor Subscale 3 (UPDRS-III) [20] and they completed a subtraction task while walking forward, counting backward from 100 by threes, from 50 by fours and from 75 by sixes. Participants completed the Parkinson Disease Questionnaire-39 items (PDQ 39), a disease-specific measure of

subjective health status [21]. The PDQ-39 produces a profile indicating PD impact in eight areas of health status: Mobility, Activities of Daily Living (ADL), Emotional Well Being, Stigma, Social Support, Cognitive Impairment, Communication, and Bodily Discomfort [21]. This questionnaire is deemed the most appropriate to test HRQoL hypotheses given its extensive usage, and adequate clinimetric properties [18]. Furthermore, the PDQ-39 has effectively revealed improvements in HRQoL as the result of physical activity interventions [22]. We also examined the PDQ-39 Summary Index (PDQ-39 SI), which indicates the global impact of PD on health status, and has been found to be internally reliable and valid [23]. Within one week of completing 20 classes, participants again completed the PDQ-39.

Statistical Analyses

One-way ANOVAs tested for baseline differences in duration with PD, age, distribution of sexes, etc., between the three intervention groups and No Intervention and between Longer and Shorter Duration groups. To analyze the PDQ-39 domains and PDQ-39 SI, and test for differences between intervention and No Intervention groups and time, we used two-way repeated measure ANOVAs with Holm-Sidak post-hoc tests to correct for multiple comparisons, as it was unclear which way groups would differ beforehand, given the nature of this pilot study. However, further analyses were performed on results from only intervention participants examining differences between those with longer and shorter duration PD, defined as greater than 6 years and 6 years or less, respectively. As we had reason to believe that the PDQ-39 is more biased toward those with longer and more severe illness [24], planned comparisons were used to examine the interacting effects of disease duration and participation in a group intervention. Two-way repeated measure ANOVAs with planned comparisons and Tukey-Kramer Multiple Comparison post-hoc tests tested for differences between groups and time. Level of significance was set at $p = 0.05$.

RESULTS

Four participants in Tango did not complete the study: one withdrew after week 5 citing personal problems, one reported knee pain after week 2, and two lacked transportation. Data from one additional Tango participant were not included in the analysis due to changes received in medical treatment during the intervention. Two participants in Waltz/Foxtrot did not complete the study: one due to an injury that occurred at his home, and another because of infrequent attendance for unknown reasons. Four participants in Tai Chi did not complete the study: one withdrew upon being hospitalized for unrelated issues, one withdrew after week 5 citing insufficiently intense exercise, and two had transportation issues. Three individuals in the No Intervention group were unable to complete post-testing during the required time interval due to an ankle injury, a hospitalization, and a death in the family. Thus, 14 Tango, 17 Waltz/Foxtrot, 13 Tai Chi, and 17 No Intervention participants successfully completed the study. Only data from these 61 individuals were analyzed.

At baseline, the four groups did not differ significantly in age, UPDRS-III, Hoehn & Yahr scale, time with PD, or fall history. Those in Tai Chi may have had slightly more dyskinesia than those in Waltz/Foxtrot, Tango or No Intervention ($p = 0.05$) (Table 1). This was due primarily to one participant in Tai Chi who had more dyskinesia than any other participant. (Note: Examination of other data from this individual showed him to be similar to other Tai Chi participants in terms of degree of change with intervention.) Forty-five percent of those with PD had a history of falls, though no falls occurred at any time of observation in the presence of close monitoring from safety personnel. There were no differences in UPDRS-III scores between fallers and non-fallers within groups. Those in the Shorter and Longer Duration groups did not differ significantly in age, UPDRS-III, or fall history, but the longer duration group

had more males, had PD longer, a higher stage of the Hoehn & Yahr scale and more dyskinesia (Table 2).

Effects of Tango, Waltz/Foxtrot, Tai Chi and No Intervention on HRQoL

A higher score on each dimension of wellbeing on the PDQ-39 indicates worsening impact of PD in that domain, while the PDQ-39 SI provides a global figure for disease impact on HRQoL. We compared measures of the PDQ-39 from those in Tango, Waltz/Foxtrot, Tai Chi and No Intervention. There was a main effect of time for Stigma ($F(1, 57) = 2.796, p = 0.05$), and ADL ($F(1, 57) = 3.977, p = 0.05$) but no differences between groups. There were significant two-way interactions between group and time in Mobility, (interaction: $F(3, 57) = 2.865, p = 0.04$), Social Support (interaction: $F(3, 57) = 2.957, p = 0.04$), and PDQ-39 SI (interaction: $F(3, 57) = 3.326, p = 0.03$). The Tango group showed significant decreases in scores in Mobility ($p = 0.03$), Social Support ($p = 0.05$) and PDQ-39 SI ($p < 0.01$) indicating improved HRQoL. There were no significant differences between pre and post in Waltz/Foxtrot, Tai Chi or No Intervention. Table 3 summarizes these results.

Effects of Interventions on HRQoL in Individuals with Different Duration of PD

We compared measures of the PDQ-39 from those classified in the Longer and Shorter duration groups, with all participants collapsed across the three intervention groups. There were main effects of group for Mobility ($F(1,42) = 4.10, p = 0.05$), Communication ($F(1,42) = 4.11, p = 0.05$), and PDQ-39 SI ($F(1,42) = 4.44, p = 0.04$), with the Shorter Duration group having lesser (better) scores than did the Longer Duration group for these domains. There were no significant main effects of time and no group x time interactions. Table 4 summarizes these results.

DISCUSSION

In this pilot study, individuals with PD who participated in twenty lessons of Argentine Tango dance reported significant improvements in overall HRQoL and in HRQoL related to Mobility and Social Support. Likely, this paper is the first to prospectively demonstrate improved HRQoL in individuals with PD after participation in a dance program and the first to include a control group of individuals with PD who received no intervention. These interventions could have favorably impacted cognition or depression, neither of which were directly measured currently, but it is largely unclear what mechanisms underlie improvements in HRQoL in the participants in Tango.

With random assignment, individuals with Longer or Shorter Duration PD were evenly distributed in Waltz/Foxtrot and Tai Chi, but slightly more individuals of Short Duration PD were in Tango. However, comparison of Short to Long Duration PD groups showed no significant differences from pre- to post-testing between the groups. This suggests that those with long and short durations of PD responded similarly to the interventions with respect to HRQoL.

Because relationships with loved ones are extremely important to those with PD [6], adequate social support is crucial to wellbeing. Higher depression, anxiety and stress levels are significantly associated with greater problems in self-reported social support [7], which improved only in Tango. Decreased availability of dopamine transporter in the anterior putamen correlates with depressive symptoms and anxiety [25] but rhythmic Tango steps have been shown to selectively activate the putamen [26]. The lack of improvement in Social Support in other groups is unexplained as all interventions involved loved ones and supportive volunteers. While Tai chi does not involve partnering, this characteristic of both Waltz/Foxtrot and Tango should promote teamwork and organization.

Overall HRQoL, as measured by the PDQ-39 Summary Index, improved in Tango. Dancing Tango may improve walking backward and allow more problem solving and movement improvisation, possibly targeting mobility issues in individuals with PD (Hackney & Earhart, submitted). Tango may improve axial impairment [17] that greatly affects HRQoL in those with PD [27]. Additionally, music therapy involving rhythmic body movement demonstrably improved scores on the PD Quality of Life questionnaire [28]. In contrast, results from a cohort with PD and their caregivers who received educational information designed to increase social support, and relieve stress and caregiver burden, revealed neither significant changes in the PDQ-39, nor in the EuroQol 5D, a questionnaire for caregivers [29]. The most beneficial ingredients of dance for improved HRQoL still require elucidation, but dance programs may have multidimensional effects on self-assessment and the attractive break in everyday lives of patients with PD may alone provide a short-lasting effect that appears in improved PDQ-39 scores.

Comparison to Prior Work on Exercise and HRQoL

Changes noted in our study are comparable to those presented previously with other exercise interventions. Individuals with PD demonstrated improvements in social interactions, emotional reactions and physical ability on the Nottingham Health profile after 36 sessions of aerobic and strength conditioning [29]. Follow-up measures are lacking from both this study and ours, so lasting efficacy of these results remains equivocal. Previously, benefits garnered from cardiovascular and resistance exercise programs have not appeared to remain beyond the intervention, suggesting that a maintenance program in exercise is critical to maintain gains in HRQoL. Six weeks of treadmill training improved the PDQ-39 SI score 10 points, but these effects did not persist after five weeks [22].

While improved HRQoL demonstrated in this pilot study from participation in Tango is encouraging, one must carefully interpret these results. The PDQ-39 may be biased toward more severe disease and may not perfectly target all participants [24] particularly those with less severe problems. Further examination of the responsiveness of the PDQ-39 to smaller clinical changes as a result of interventions is warranted [18]. Future research should evaluate both depression and cognitive impairment as they relate to interventional success as primary outcomes of interest. Furthermore, new research should include retention measures and delineate ideal frequency and duration of exercise sessions to obtain and retain exercise-related gains in HRQoL. It is imperative to investigate the frequently overlooked issue of HRQoL for those with PD, and dance interventions like Tango may be ideal for the following reasons: 1) dance targets axial impairment and gait deficits that are major contributors to reduced HRQoL [16], 2) dance is a social activity that will likely enhance strong supportive relationships between those with PD and their caregivers [14,17], and 3) dance is enjoyable and motivating, thereby promoting long-term involvement and adherence to a schedule of regular participation [13].

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Table 1

Baseline Participant Demographics

Variable	Waltz/Foxtrot (n = 17)	Tango (n= 14)	Tai Chi (n= 13)	No Intervention (n= 17)	P value
Age (years)	66.8 ± 2.4	68.2 ± 1.4	64.9 ± 2.3	66.5 ± 2.8	0.83
Sex (male/female)	11/6	11/3	11/2	12/5	0.64
Time with PD (years)	9.2 ± 1.4	6.9 ± 1.3	8.7 ± 1.3	5.9 ± 1.0	0.22
UPDRS Motor Subscale III	26.9 ± 2.5	27.6 ± 2.0	26.3 ± 2.5	27.4 ± 2.4	0.98
Hoehn & Yahr scale	2.0 ± 0.2	2.1 ± 0.1	2.0 ± 0.1	2.2 ± 0.2	0.63
Dyskinesia score	0.82 ± 6.2	0.32 ± 0.2	2.27 ± 0.8	0.38 ± 0.2	0.05
Fallers/Non-fallers	8/9	9/5	3/10	6/11	0.16
Fallers UPDRS/Non-Fallers UPDRS (*)	28.1 ± 3.8/25.9 ± 3.4 (0.69)	29.8 ± 2.9/23.6 ± 1.0 (0.11)	25.0 ± 0.6/26.7 ± 3.3 (0.79)	28.3 ± 4.7/26.9 ± 2.9 (0.80)	N/A

Values are means ± SE. P values are for One-way ANOVAs. N/A= non-applicable

* P value between fallers and non fallers within groups

Table 2

Baseline Participant Demographics for Longer and Shorter Duration of PD for Individuals from interventions only (n = 44)

Variable	Long Term PD (n = 21)	Shorter Term PD (n = 23)	P values
Age (years)	65.5 ± 1.8	67.78 ± 1.6	0.35
Sex (male/female)	19/2	14/9	0.02
Time with PD (years)	12.7 ± 1.0	4.4 ± 0.3	< 0.01
UPDRS Motor Subscale III	28.12 ± 1.4	25.87 ± 2.2	0.41
Hoehn & Yahr scale	2.2 ± 0.1	1.9 ± 0.1	0.04
Dyskinesia scores	1.95 ± 0.7	0.30 ± 0.2	0.02
Fallers/Non-fallers	13/8	8/15	0.10

Values are means ± SE. P values are for One-way ANOVAs.

Table 3

Exit Questionnaire

Aspects of Well-Being	Waltz/Foxtrot	Tango	Tai Chi	P value
Enjoyment	1.0 (1.0, 1.25)	1.0 (1.0, 1.0)	1.0 (1.0, 2.0)	0.311
Balance	2.0 (1.0, 3.0)	2.0 (2.0, 2.0)	2.0 (1.8, 3.0)	0.863
Walking	2.0 (1.0, 3.0)	2.0 (2.0, 3.0)	2.0 (1.0, 3.0)	0.595
Mood	2.0 (1.0, 4.0)	2.0 (2.0, 2.0)	2.0 (2.0, 3.0)	0.520
Coordination	2.0 (1.0, 3.0)	2.0 (2.0, 3.0)	2.0 (2.0, 3.0)	0.860
Strength	3.0 (2.0, 3.0)	2.0 (1.0, 3.0)	3.0 (2.8, 3.0)	0.589
Endurance	3.0 (2.0, 3.0)	2.0 (1.0, 2.0)	2.0 (1.8, 3.0)	0.299
Continuing	2.0 (1.0, 3.0)	1.5 (1.0, 2.0)	2.0 (2.0, 3.0)	0.401

Values are medians and interquartiles for Leikert scale ranging from 1 (strongly agree) to 5 (strongly disagree). Item 1 asked if participants enjoyed participating, items 2 through 7 asked if participant noted improvement in that aspect of physical well-being. P values are for Kruskal Wallis One Way ANOVAs on Ranks.

Table 4

PDQ 39 for Interventions: Longer Duration and Shorter Duration of PD (n = 44)

Dimension of PDQ- 39	Longer Duration (n = 21)		Shorter Duration (n = 23)	
	Pre	Post	Pre	Post
Mobility*	32.14±1.99	29.05±1.99	22.50±1.90	17.83±1.90
ADL	32.34±1.94	29.76±1.94	26.99±1.85	23.19±1.85
Emotional Well-Being	22.02±2.00	22.20±2.00	20.83±1.91	19.57 ±1.91
Stigma	15.48±2.47	14.58±2.47	16.85±2.36	12.50±2.36
Social Support	15.48±2.20	14.29±2.20	13.41±2.10	11.23±2.10
Cognitive Impairment	38.10±2.09	34.82±2.09	27.99±2.00	28.80±2.00
Communication*	30.16±1.96	34.92±1.96	21.38±1.87	20.29±1.87
Bodily Discomfort	28.17±2.94	33.73±2.94	29.36±2.81	27.17±2.81
PDQ 39 SI*	25.56±1.11	25.54±1.11	20.64±1.06	18.80±1.06

Values are means ± SE for pre and post values. PDQ 39 subscales are scored from 0-100. Lower scores indicate less impact of disease on health. Two-way repeated measures ANOVAs (two groups × two measurement time points) with Tukey-Kramer post-hoc tests determined statistical significance of differences.

* Main effect of group, $p < 0.05$.