Effects of Tango on Functional Mobility in Parkinson's Disease: A Preliminary Study

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Abstract: Recent research has shown that dance, specifically tango, may be an appropriate and effective strategy for ameliorating functional mobility deficits in people who are frail and elderly. Individuals with Parkinson's disease (PD) experience declines in functional mobility that may be even more pronounced than those experienced by frail elderly individuals without PD. The purpose of this study was to compare the effects of two movement programs: tango classes or exercise classes. Nineteen subjects with PD were randomly assigned to a tango group or a group exercise class representative of the current classes offered in our geographical area for individuals with PD. Subjects completed a total of 20 tango or exercise classes and were evaluated the week before and the week following the intervention. Both groups showed significant improvements in overall Unified Parkinson's Disease Rating Scale (UPDRS) score and nonsignificant improvements in self-reported Freezing of Gait. In addition, the tango group showed significant improvements on the Berg Balance Scale. The exercise group did not improve on this measure. Finally, the tango group showed a trend toward improvement on the Timed Up and Go test that was not observed in the exercise group. Future studies with a larger sample are needed to confirm and extend our observation that tango may be an effective intervention to target functional mobility deficits in individuals with PD.

Key words: *Parkinson's disease, gait, balance, dance*

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INTRODUCTION

Gait changes commonly noted in Parkinson's disease (PD) include a flexed posture, shuffling steps, difficulty with stride length regulation, reduced foot clearance during swing phase, and increased cadence, leading to the potential for falls and the associated sequelae.[1–6] A prospective study found that roughly 60% of people with PD experienced at least one fall in a six-month period.[7] People with PD often have more difficulty turning while walking than they do when walking in a straight line, which may place individuals at greater risk for falls while turning. These falls are eight times more likely to result in hip fracture than are falls during straight walking.[8] Turning can also trigger freezing (ie, a slowing or stoppage of movement) during gait. Freezing, a common problem affecting 53% of patients who have had PD for over five years,[9] also occurs with gait initiation and when walking through doorways or other tight spaces.[10] People with PD often have difficulty walking in dual-task conditions.[11–14] Gait speed, stride length, and gait stability all decrease when individuals with PD are placed in dual-task conditions where they have to walk while they concurrently do another task such as mental arithmetic. Loss of functional mobility can lead to low self esteem, poor mood, withdrawing from activities, and decreased quality of life.[15]

A number of different exercise programs have been suggested to address movement difficulties in an attempt to improve mobility and reduce risk of injury.[16–18] Several exercise programs tailored specifically for individuals with PD (eg, Fit 'N Fun,[16] Motivating Moves,[17] Parkinson's Disease & the Art of Moving[18]) are commercially available, but none have been rigorously investigated to evaluate their effects. Despite this lack of evidence, the only currently offered group exercise programs for people with PD in our area are of this type. As such, one goal of our study was to provide evidence regarding the effects of this type of exercise on functional mobility in people with PD.

Recent evidence suggests that dance can also be used as a therapeutic intervention to effectively target balance and complex gait tasks in healthy elderly individuals.[19] Dance/movement therapy has been recommended for elderly people to increase or maintain their range of motion.[20] Dance/movement therapy has also been used as a successful therapeutic intervention for people with PD. A group of subjects with PD who participated in free-form movement demonstrated improvements in movement initiation.[21]

Jacobson et al[19] reported preliminary results of Argentine tango lessons compared to walking on clinical measures of balance and gait in frail elderly individuals. They reported greater improvements in balance and complex gait tasks in the tango group as compared to the walking group. This suggests that the movements and patterns of tango may be as effective as strength/fitness exercise approaches for addressing balance and gait deficits. In addition to the specific movements, tango may also be beneficial because, like most dance, it involves coordination of movement to music. The music may serve as an external auditory cue. Use of such

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cues to facilitate movement is known to be beneficial for individuals with PD.[22–24] Auditory cues can improve gait initiation, walking speed, and cadence in laboratory settings[22,23] and while performing a functional task within the home.[24] External cues may access cortical circuitry, thereby bypassing the dysfunctional basal ganglia.[25]

From subjective accounts, dance appears to be an appropriate and pleasurable therapeutic activity for people who are elderly and physically challenged in terms of its benefits to physical, mental, and emotional states.[26] Recently, a study of people with chronic heart failure showed that dance improved quality of life and promoted adherence to the program while providing cardiovascular benefit.[27] However, there is little research to date that documents this phenomenon, and it is deserving of attention.[20,28] There is no recent literature evaluating the effects of dance as a movement intervention on functional mobility in individuals with PD.

The purpose of this study was to compare the effects of two movement programs. In one, participants with PD attended progressive Argentine tango dance lessons (tango), performed with a partner. In the other, participants with PD attended a strength/flexibility exercise program (exercise). We chose Argentine tango, a form of partnered dance that is less prescribed and structured than most social dances, because it involves dynamic balance in the presence of random perturbation, postural control, movement initiation and termination, turning, and moving in close proximity to another individual. We expected these movement characteristics to specifically target and ameliorate the movement deficits of our participants. The group exercise program was based upon community classes regularly offered by occupational therapists in our local area for individuals with PD. We considered these classes the current standard of care in our geographical area for community-based group exercise in individuals with PD. We hypothesized that subjects would be capable of participating in the tango classes and that improvements in functional mobility would be noted in both groups.

METHODS

Subjects and Training Sessions

Nineteen subjects diagnosed with idiopathic PD participated (Table 1). Subjects were recruited from the Washington University School of Medicine's Movement Disorders Center and from the surrounding St. Louis community. PD diagnostic criteria included those used for clinically defined "definite PD," as previously outlined by Racette et al[29] based upon established criteria.[30,31] Each subject also demonstrated clear benefit from PD medications. Subjects were randomly assigned to one of two groups: tango or exercise [Unified Parkinson's Disease Rating Scale (UPDRS) motor subscale score tango: 30.6 ± 1.3; exercise: 28.2 ± 1.2] (Table 1). Subjects in both groups were not engaged in any other dancing or group exercise activities during the course of the study. Those in the tango group participated in progressive tango dance lessons. Those in the exercise group participated

TABLE 1. Subject Demographics: Tango (A) and Exercise (B)

A. Tango	Sex (M/F)	Age (years)	Time with PD (years)	Total UPDRS Motor Subscale Score at Baseline	Hoehn & Yahr
T1	M	86	3	29	2
T2	M	65	6	29	2
T3	F	76	1	30	2
T4	M	72	14	32.5	2.5
T5	M	69	11	44.5	3
T6	M	64	3	39.5	2
T7	F	73	4	16	2
T8	M	72	10	28	2
T9	F	76	4	27	3
mean ± SEM	3 F, 6 M	72.6 ± 2.20	6.2 ± 1.5	30.6 ± 1.3	2.3 ± 0.7
B. Exercise	**Sex (M/F)**	**Age (years)**	**Time with PD (years)**	**Total UPDRS Motor Subscale Score at Baseline**	**Hoehn & Yahr**
E1	M	64	3	22	2
E2	F	74	1	16	2
E3	M	80	6	29.5	2.5
E4	F	68	3	35.5	3
E5	M	68	4	41	2.5
E6	M	74	2	19	2
E7	M	65	5	37	2
E8	F	66	1	18	2
E9	M	59	3	35.5	2
E10	F	78	5	28	2
mean ± SEM	4 F, 6 M	69.6 ± 2.1	3.3 ± 0.5	28.2 ± 1.2	2.2 ± 0.6

Abbreviations: PD, Parkinson's Disease; UPDRS, Unified Parkinson's Disease Rating Scale; SEM, standard error.

in structured strength/flexibility exercise classes designed for people with PD and/or elderly individuals (adapted from Fit 'N Fun).[16] Similar group exercise classes are the current standard community offering for individuals with PD in the St. Louis area. Both groups participated in two one-hour sessions per week for a total of 20 sessions completed within 13 weeks. All training sessions, ie, tango and exercise, were led by an instructor who is both a professional ballroom dancer and American Council on Exercise (ACE)-certified personal trainer. Subjects were instructed to continue their ordinary exercise routine, and not to begin any new exercise during the course of the study.

Data Collection and Analysis

Subjects were assessed the week prior to initiation of training and the week following the 20th training session. Subjects were tested on medications and at the same time of day for premeasures and postmeasures. All assessments were videotaped and all data files coded to allow for blinded ratings by a rater trained in the Program in Physical Therapy at Washington University. During each assessment, subjects were evaluated using the UPDRS, Motor Subscale 3.[32,33] The UPDRS was administered by a physical therapist who has been trained extensively in the use of the UPDRS and whose scores have been demonstrated to be reliable and in agreement with those of expert neurologists at the Washington University School of Medicine's Movement Disorders Center. Balance was evaluated using the Berg Balance Scale.[34] Gait velocity was assessed while walking straight along a 5-m path with and without a concurrent dual task (performing mental calculations). In the dual-task conditions, subjects were required to walk while counting backwards in specified increments from a starting number, ie, "count backwards from 100 by 7." Mobility was assessed with the Timed Up and Go (TUG).[35,36] For the gait tasks and the TUG, subjects performed five trials of each task and results from the five trials were averaged. Subjects also completed a Freezing of Gait questionnaire,[37] a six-item self-report questionnaire where each item is answered on a 0 to 4 scale for a maximum possible score of 24. Higher scores indicate the perception of more freezing. The UPDRS, Berg, TUG, and Freezing of Gait questionnaire have all been shown to be reliable, valid, and sensitive when used with individuals with PD.[36–38] Measurement sessions were conducted using a standardized script with specific instructions for each task. Measurement sessions were videotaped and a trained, blinded rater scored the Berg Balance Scale by watching the videos. Gait speed during the walking tasks was assessed using a motion capture system (Motion Analysis Corporation, Santa Rosa, California) to track a marker placed on the trunk at the T12 vertebral level. Because all data were normally distributed, two-way repeated measures ANOVAs [group (tango vs exercise) and time (preintervention vs postintervention) as factors] with Student-Neuman-Keuls post-hoc tests were used to compare values ($P > 0.05$). Effect size was calculated for each group for variables of interest. All values presented are means ± standard error (SEM).

Tango Classes

Twenty one-hour progressive tango sessions were completed within 13 weeks. These lessons included postural stretches, balance exercises, tango-style walking, footwork patterns, and experimentation with timing of steps to music, both with and without a partner. The sessions were structured such that each dancer could learn from his/her partner and from the rest of the group. During the partnering, participants danced both the leading and following roles, regardless of gender. Dancing to Argentine tango commercial recordings, they rotated partners approximately every 10 to 15 minutes. Although several participants were quite physically challenged, everyone participated in most of each class period. Students were encouraged to take breaks as necessary and to ask questions or offer comments about their dance experience at the end of the class.

Exercise Classes

Twenty one-hour exercise classes were completed within 13 weeks. During the first 40 minutes of the class, participants exercised in chairs. They began with breathing and stretching exercises, and progressed to resistance and dexterity exercises, sometimes using water bottles or yard sticks to provide resistance or leverage. Approximately 40 minutes into the class, participants would exercise while standing and using the chair for support. Students were encouraged to challenge themselves maximally, in terms of range of motion and strength limits. During the last 10 minutes of class, students performed core strengthening and stretching exercises using floor mats. Those that could not recline on the floor completed modified exercises in a chair.

RESULTS

There were no significant differences between the tango and exercise groups at baseline on all measures, including age, time with PD ($P = 0.07$), UPDRS motor subscale 3 scores, and Hoehn & Yahr stage (Table 1). Results for each of the measures used are presented in the following paragraphs.

Unified Parkinson's Disease Rating Scale

Both the tango and exercise groups improved on motor subscale 3 of the UPDRS. There was a significant main effect of time (pre vs post, $F = 38.3$, $P > 0.001$). Within groups, there was significant improvement in the UPDRS for the tango participants (pre: 30.6 ± 1.3, post: 22.6 ± 1.3; $P > 0.001$) and for the exercise participants (pre: 28.2 ± 1.2, post: 20.6 ± 1.2; $P > 0.001$). There was no significant main effect of group (tango vs exercise) and no significant interaction of group with time (pre vs post).

Berg Balance Scale

The tango group, but not the exercise group, improved on the Berg Balance Scale. There was a significant main effect of time (pre vs post, $F = 8.6$, $P = 0.01$). Within groups, the tango group significantly improved on the Berg Balance Scale (pre: 46.8 ± 1.0, post: 50.6 ± 1.0; $P = 0.01$; effect size (ES) = 0.90). The exercise group demonstrated no improvement on the Berg (pre: 45.4 ± 0.9, post: 47.1 ± 0.9; $P =$

0.20; ES = 0.27) (Figure 1). There was no significant main effect of group (tango vs exercise) and no significant interaction of group with time (pre vs post).

Freezing of Gait

There was a significant main effect of time (pre vs post, $F = 4.7$, $P > 0.044$) for the Freezing of Gait questionnaire for the sample as a whole. Within groups, there was no significant change in perception of freezing for either the tango or the exercise group. However, both groups showed trends toward a reduction in reported freezing (tango: pre: 8.4 ± 0.6, post: 7.4 ± 0.6, ES = 0.24; exercise: pre: 7.9 ± 0.5, post: 6.5 ± 0.5, ES = 0.30).

Timed Up and Go

There were no significant main effects of group (tango vs exercise) or time (pre vs post) and no significant interaction of group with time for the TUG. However, those in the tango group showed a trend toward improvement in the TUG test (pre: 10.7 ± 0.4 sec, post: 9.8 ± 0.4 sec; ES = 0.37). Those in the exercise group showed no trend toward improvement in the TUG test (pre: 11.7 ± 0.4 sec; post: 11.8 ± 0.4 sec; ES = 0.02) (Figure 2).

Velocity of Walking and Dual-Task Walking

Both groups showed slight, nonsignificant changes in gait velocity (tango pre: 0.86 ± 0.04 m/s, post: 0.88 ± 0.04 m/s; exercise pre: 0.89 ± 0.05 m/s, post: 0.91 ± 0.01 m/s). Both groups also showed virtually no change in dual-task walking velocity (tango pre: 0.53 ± 0.10 m/s, post: 0. 56 ± 0.10 m/s; exercise pre: 0.69 ± 0.05 m/s, post: 0.64 ± 0.08 m/s) (Figure 3).

Attendance

In order to accommodate vacations and illnesses, we needed to offer more than 20 sessions. Individuals who completed their 20 classes were invited to attend the extra sessions after they had completed their postintervention testing. Subjects were not permitted to attend extra sessions if they had not completed their postintervention assessment. Four of the nine subjects in the tango group attended additional sessions. None of the 10 subjects in the exercise group attended additional sessions.

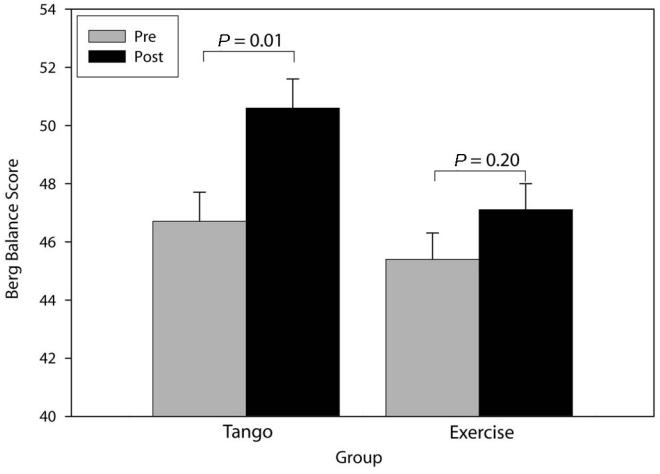

FIGURE 1. Berg Balance Scores for the tango and exercise groups before (gray) and after (black) intervention. Values plotted are means +/− SEM. The tango group demonstrated significant improvement while the exercise group did not.

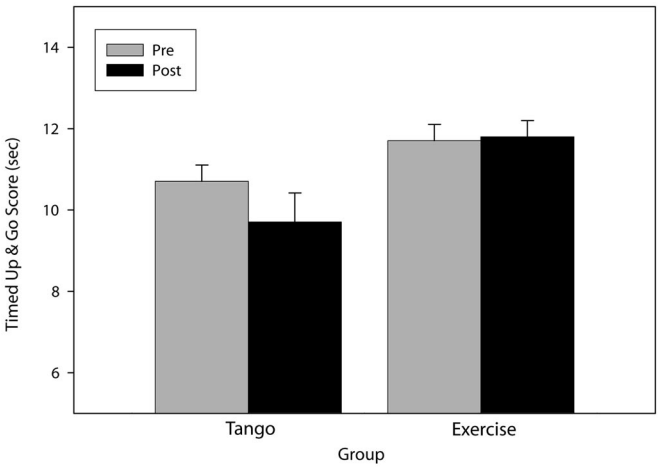

FIGURE 2. TUG scores for the tango and exercise groups before (gray) and after (black) intervention. Values plotted are means +/− SEM. Note that the tango group improved while the exercise group showed no change.

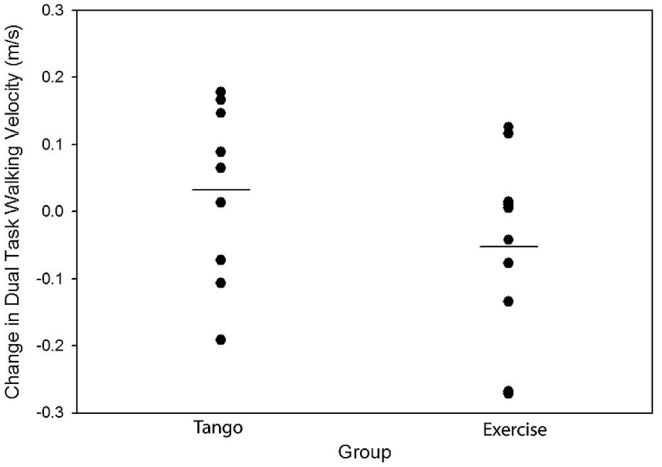

FIGURE 3. Plot of change in Dual-Task Walking Velocity from pretraining to posttraining sessions. Each point represents the change in dual-task walking velocity (post-pre) for an individual subject. Horizontal lines represent the average change in dual-task walking velocity for each group. The two groups showed little change in dual-task walking velocity following training.

DISCUSSION

Those who participated in the Argentine tango dance group improved on measures of balance and mobility. Those who participated in the exercise class experienced fewer gains which may reflect the fact that, for much of the class, exercises were performed while the individuals were seated.

Given these preliminary results, we think that tango is feasible for individuals with PD and may be an appropriate and effective form of group exercise for individuals with PD. Exercise may also provide benefits, though functional mobility changes were less pronounced in the exercise group than in the tango group.

Possible Mechanisms for Improvements with Tango

Tango incorporates several aspects of movement that may be especially relevant for individuals with PD. While dancing tango, participants are engaged in a multitasking activity that requires dynamic balance and involves turning, initiation of movement, and moving at a variety of speeds and often backward in close proximity to a partner.

Dance in general may be particularly beneficial for individuals with PD. Emerging evidence suggests that the basal ganglia, the structures particularly affected by PD, are specifically involved in the control of dance movements. Brown et al[39] used positron emission tomography to study the regions of the brain involved in the control of tango movements of a single lower extremity in healthy subjects lying supine. They noted increased activity in the basal ganglia, specifically in the putamen, when tango movements were performed to a metered beat in a predictable rhythm. The relevance of this information for those with PD remains unclear at present. While tango movements themselves promote increased activity in the basal ganglia, the benefits of tango may also stem from the fact that tango, like most dance, involves the synchronization of movements to a beat. The individuals who participated in the tango group were instructed to move their torsos and legs while guided by the metric beat of the tango music. The timing of the steps was synchronized with their partners' steps and the beat. Use of auditory cues to facilitate movement is known to be beneficial for individuals with PD. Auditory cues can increase gait initiation, walking speed, and cadence in laboratory settings[22,23] and while performing a functional task within the home.[24] Training with auditory cues can also reduce severity of freezing.[40] Auditory cues may be able to bypass the defective loop from basal ganglia to the supplementary motor area via the thalamus, a loop that is normally used for internally cued movements.[41] Evidence suggests that auditory cues may access the premotor cortex via the cerebellum.[42] The use of rhythmic cues from music may thus be an important feature of dance as an intervention for individuals with PD. In fact, music therapy has been shown to improve motor function, activities of daily living (ADL), mood, and quality of life in individuals with PD.[43]

Adherence and Compliance with Exercise Programs

While not directly measured, we speculate that tango may be more likely to promote adherence than strength/flexibility exercise. A recent study of individuals at risk for heart failure demonstrated that the waltz was as beneficial as aerobic exercise for cardiovascular health and that people were happier dancing than exercising, as evidenced by increases in measures of quality of life and greater likeliness to comply with the exercise regimen.[27] Argentine tango may convey similar benefits. While both groups were equally compliant in completing the required 20 sessions, our results indicate that subjects desired to continue tango classes, as evidenced by the fact that nearly half the tango group attended extra sessions following their postintervention assessments. Moreover, several subjects expressed an interest in continuing tango beyond the study, and as a result, we have instituted a weekly free tango class for individuals with PD and their partners. Several members of the original tango group continue to participate, as well as some from the exercise group. The qualities of the tango experience that appeared to appeal to participants and make them want to continue are not to be overlooked because a movement intervention is only useful if it is actually implemented.

Social dance in a group setting can enhance motivation in elderly individuals.[44] Older individuals who have demonstrated long-term participation in social dancing have better balance and gait function than age-matched nondancers.[45] Activities that engage older individuals and keep their interest are needed, as approximately 60% of Americans older than 65 do not achieve the recommended daily amount of physical activity.[46] Activity levels in individuals with PD are reduced even further, being roughly 15% lower than that of age-matched controls.[47]

Complementary Therapies for PD

Tango may be considered a complementary therapy to address movement problems associated with PD. Other interventions in this category include Qi Gong, Tai Chi, and dance/movement therapy. Qi Gong has been shown to enhance scores on the UPDRS motor subscale 3 in the short term and reduce worsening of symptoms across a one-year period in a large randomized clinical trial.[48] Tai Chi has only been studied in individuals or small groups with PD, but evidence suggests that it may improve balance, mobility, and perception of physical health.[49–51] Dance/movement therapy has also been used as a successful therapeutic intervention for individuals with PD. People with PD who were encouraged to explore alternative movement strategies through dance demonstrated gains in neurological status and movement initiation.[21] Like these other therapies, tango requires balance and attention to movement control. However, tango differs from other complementary movement approaches because: (1) it is performed with a partner in a setting that fosters community involvement, (2) it is progressive in nature (ie, the participant is always learning), and (3) it is performed to music which may engage the participant in addition to serving as an external cue.

CONCLUSION

This is the first study to systematically investigate and compare the effects of dance and strength/flexibility exercise on functional mobility in people with PD. We have demonstrated the feasibility of tango movement sessions for individuals with PD. While some significant changes in measures were noted, these changes were small and may not be clinically meaningful. Future studies with a larger sample size are needed to confirm and extend the present results. This work

may ultimately lead to improved therapeutic movement approaches employing dance as an enjoyable and effective strategy for addressing functional mobility deficits in individuals with PD. These preliminary data suggest that dance may be a beneficial group activity to address balance and gait problems specific to PD.

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Call for Nominations

The following positions will be elected in 2008

Neurology Section Executive Committee:
1) Secretary
2) Nominating committee

Special Interest Groups:

1) Degenerative Disease:
a. Chair
b. Nominating Committee

2) Spinal Cord Injury:
a. Chair
b. Nominating Committee (2 positions)

3) Stroke:
a. Chair
b. Nominating Committee

4) Traumatic Brain Injury:
a. Chair
b. Nominating Committee

5) Vestibular:
a. Chair
b. Nominating Committee

Anyone interested in running for an office or nominating another Neurology Section Member to run for an office should contact Kathleen Ganley at kathleen.ganley@nau.edu

