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Madeleine E. Hackney
Washington University School of Medicine in St. Louis

Gammon M. Earhart
Washington University School of Medicine in St. Louis

J Rehabil Med 2009; 41: 475–481

ORIGINAL REPORT

EFFECTS OF DANCE ON MOVEMENT CONTROL IN PARKINSON'S DISEASE: A COMPARISON OF ARGENTINE TANGO AND AMERICAN BALLROOM

Madeleine E. Hackney, BFA[1] and Gammon M. Earhart, PhD, PT[1,2,3]

From the [1]Program in Physical Therapy, [2]Department of Anatomy and Neurobiology and [3]Department of Neurology, Washington University School of Medicine, St Louis, MO, USA

Objective: **The basal ganglia may be selectively activated during rhythmic, metered movement such as tango dancing, which may improve motor control in individuals with Parkinson's disease. Other partner dances may be more suitable and preferable for those with Parkinson's disease. The purpose of this study was to compare the effects of tango, waltz/foxtrot and no intervention on functional motor control in individuals with Parkinson's disease.**

Design: **This study employed a randomized, between-subject, prospective, repeated measures design.**

Subjects/patients: **Fifty-eight people with mild-moderate Parkinson's disease participated.**

Methods: **Participants were randomly assigned to tango, waltz/foxtrot or no intervention (control) groups. Those in the dance groups attended 1-h classes twice a week, completing 20 lessons in 13 weeks. Balance, functional mobility, forward and backward walking were evaluated before and after the intervention.**

Results: **Both dance groups improved more than the control group, which did not improve. The tango and waltz/foxtrot groups improved significantly on the Berg Balance Scale, 6-minute walk distance, and backward stride length. The tango group improved as much or more than those in the waltz/foxtrot group on several measures.**

Conclusion: **Tango may target deficits associated with Parkinson's disease more than waltz/foxtrot, but both dances may benefit balance and locomotion.**

Key words: dance, Parkinson's disease, balance, gait, freezing of gait.

J Rehabil Med 2009; 41: 475–481

Correspondence address: Gammon Earhart, Washington University School of Medicine, Program in Physical Therapy 4444 Forest Park Blvd, Campus Box 8502, St Louis, MO 63108, USA. E-mail: earhartg@wusm.wustl.edu

Submitted July 9, 2008; accepted February 4, 2009

INTRODUCTION

Individuals with Parkinson's disease (PD), a progressive neurodegenerative movement disorder affecting more than 1 million people in the USA, often demonstrate postural instability, gait difficulties, and impaired functional mobility that may lead to falls and a decreased quality of life. Seventy percent of patients with PD experienced a fall within one year after diagnosis, and 50% of this group fell again within the following year (1). Falls are particularly problematic for persons with PD because they have a 3.2-fold greater risk of hip fracture than those without PD (2). As pharmacological methods are only partially effective in addressing balance and gait problems, non-pharmacological approaches are needed to address these issues (3).

Programs to address postural instability and gait deficits to reduce fall risk must incorporate practice of dynamic balance and continual adjustment to environmental demands (4, 5). While traditional exercise programs can meet these requirements, they often are not sufficiently interesting or engaging to encourage regular and continued participation. Dance may be an exceptionally effective tool for addressing these problems because it includes key elements of dynamic balance and adjustment to the environment and is, at the same time, enjoyable and engaging. Elderly people consider dance more enjoyable than traditional exercise, and this promotes better adherence and enhances motivation (6–8). Older adults who participated in dance had increased motivation to pursue healthy, exercise-related behaviors and demonstrated improved balance and functional mobility (8, 9). McKinley et al. (6) reported greater balance and gait task improvements in elderly people who participated in Argentine tango compared with a group that walked for exercise. Finally, habitual participation in social dancing over several years is associated with superior balance, postural stability, gait function and leg reaction times compared with age-matched non-dancers (10, 11).

Only a few studies have examined the benefits of dance for people with PD. The effects of Argentine tango proved better than traditional exercise for improving balance and functional mobility in those with PD (12). Additionally, a positron emission tomography (PET) study demonstrated increased activity in the basal ganglia when tango movements were performed to a metered and predictable beat (13). Argentine tango movement and patterns may enhance motor abilities by targeting PD-related impairments. For example, tango involves frequent movement initiation and cessation, spontaneous directional changes, and a wide range of movement speeds. These features may target difficulties with movement initiation, turning, and bradykinesia, respectively. Interestingly, tango may also effectively address freezing of gait (FOG), because several step patterns mimic those of rehabilitation exercises designed for those with FOG. No studies have examined waltz

Journal Compilation © 2009 Foundation of Rehabilitation Information. ISSN 1650-1977

or foxtrot in individuals with PD. The purpose of this study was to compare the effects of 2 distinct 20-h partnered dance programs to an untreated age-, sex- and stage of disease-matched cohort (controls). Participants with PD attended progressive Argentine tango dance lessons (tango), or American smooth bronze waltz and foxtrot lessons (waltz/foxtrot). Both dances involve a partner and music, demand postural control, movement initiation and termination, turning, and moving in close proximity to another individual. However, tango involves flexible, improvisational step patterns composed of small step elements, spontaneous multi-directional perturbation (for the follower) and rhythmic variation. In contrast, waltz/foxtrot follows a strict syllabus of step patterns involving more complex step elements, more predictable directions of perturbation (for the follower), and little rhythmic variation or improvisation. We hypothesized that improvements in balance, motor ability, and locomotion would be noted in both dance groups, while no improvements would be noted in the untreated control group. Furthermore, we hypothesized that improvements would be greater in tango than in waltz/foxtrot, as features of tango may more specifically target motor impairments associated with PD, such as stride length deficiency, FOG, bradykinesia (as reflected in gait velocity), and balance.

METHODS

This work was approved by the Human Research Protection Office at Washington University in St Louis. All participants provided written informed consent prior to participation.

Participants

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

Fifty-eight participants with idiopathic PD participated. Participants were at least 40 years of age, could stand for at least 30 min, and walk independently for ≥ 3 m with or without an assistive device. Individuals with Hoehn and Yahr (H&Y) stages I–III participated. Participants were excluded if they had a history of neurological deficit other than PD. All participants had a diagnosis of idiopathic PD using diagnostic criteria for clinically defined "definite PD" based on published standards (14). All subjects demonstrated clear benefit from levodopa and were tested on medications at a standardized time to reduce the effects of medication-related fluctuations in performance. Participants were not formally screened for cognitive dysfunction, but were scrutinized during a health screening questionnaire in an interview process. All participants were able personally to answer the screening questions and easily follow all instructions during testing sessions. There was no evidence of cognitive impairment in any of the participants. During the health screening interview, all participants were asked if they had serious hearing or vision problems that could not be corrected with glasses. All individuals could hear and see adequately to participate in the classes. Fallers were distinguished from non-fallers based on self-report of number of falls within the last 6 months, with fallers classified as those reporting one or more falls. Freezers were distinguished from non-freezers based on self-report of having experienced freezing more than once a week on the Freezing of Gait questionnaire (i.e. a score > 1 on Item 3) (15) (Table I).

Intervention

Participants were randomly assigned to either the waltz/foxtrot, tango classes, or the control group by the first author, who told participants they would participate in one of 2 types of dance classes, or would be assigned to a control group that received no intervention. The first author assigned individuals to waltz/foxtrot, tango, and control by randomly selecting one of the 3 conditions from a hat. While the first author was not blinded to group assignment, the evaluations were videotaped for a rater who was a specially trained physiotherapy student otherwise not involved in the study. Participants were told only that they were participating in the study to further information about the effects of exercise in those with PD. They were not informed of the study hypotheses. Participants were instructed not to change their habitual exercise routines over the course of the study. The dance classes, either progressive tango lessons or waltz/foxtrot lessons, were taught by the same instructor who was an experienced professional ballroom dance instructor and an American Council on Exercise certified personal trainer. Possible risks of bias for the same teacher instructing both classes include instructor preference for one dance over the other or more experience teaching one dance than another. Additionally, the teacher could have formed greater attachments to one group of students than another. However, this instructor was equally versed in both dances, and she attempted to give all students equal attention. Having the same teacher teach both classes may have controlled for distinctions in teaching pedagogy, which is frequently found between dance instructors, due to the general lack of standardization in this field.

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, keeping the forearms parallel to the floor. Healthy young volunteers, recruited from physical therapy, pre-physical therapy and pre-medical programs at Washington University and St Louis University, served as dance partners for those with PD. Volunteers 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.

Testing protocol

Videotaped assessments of participants were conducted the week prior to initiation of training and within the week following com-

Table I. *Baseline participant demographics*

Variable	Waltz/foxtrot (n=17)	Tango (n=14)	Control (n=17)
Age, years, mean ± SE	66.8 ± 2.4	68.2 ± 1.4	66.5 ± 2.8
Gender, male/female, *n*	11/6	11/3	12/5
Time with PD, years, mean ± SE	9.2 ± 1.5	6.9 ± 1.3	5.9 ± 1.0
UPDRS Motor Subscale III, mean ± SE	26.9 ± 2.5	27.6 ± 2.0	27.4 ± 2.4
Hoehn and Yahr, mean ± SE	2.0 ± 0.2	2.1 ± 0.1	2.2 ± 0.2
Fallers/non-fallers, *n*	8/9	9/5	6/11
Freezers/non-freezers, *n*	9/8	8/6	5 /12

SE: standard error; PD: Parkinson's disease; UPDRS: Unified Parkinson's Disease Rating Scale.

pletion of 20 training sessions. Participants were tested at the same time of day for pre- and post-testing. They self-determined a time of optimal performance for pre-testing and were therefore scheduled for the same time at post-testing. Data files were coded for blinded ratings. During assessments, participants were evaluated using the Unified Parkinson's Disease Rating Scale Motor Subscale 3 (UPDRS) (16), Berg Balance Scale (BBS) (17), and the Timed Up and Go test (TUG) (18). These clinical instruments are known to be valid and reliable (19). Also, participants completed a 6-minute walk test (6MWT) along a 30.5 m path in a hallway next to the laboratory and we recorded total distance traveled (20). The FOG questionnaire was administered before and after the intervention to determine freezing status and to detect any changes in this status in the freezers (15). Forward and backward gait were assessed along a 5 m instrumented, computerized GAITRite walkway (CIR Systems, Inc., Havertown, PA, USA). Variables of interest were gait velocity, stride length, and single support time. The results from 3 trials in each direction were averaged. A standardized script with specific instructions for each task was used for all measurement sessions. The post-intervention testing session also included an exit questionnaire that was completed by both dance groups to assess participant experiences and enjoyment of the program. The exit questionnaire asked participants to rank items on a scale of 1–5 (1 = strongly agree, 2 = somewhat agree, 3 = neither agree nor disagree, 4 = somewhat disagree, 5 = strongly disagree.) Item 1 asked if participants enjoyed participating. Items 2 through 7 asked if participants noted improvement in particular aspects of physical well-being. Item 8 asked if participants would continue with the classes if given the opportunity.

Statistical analyses

Data from participants who did not complete the 20 sessions in 13 weeks and those who received alterations in their medical treatment during the course of the study were not included in the analyses.

Data were analyzed using Systat software (Systat, Richmond, VA, USA). Two-way repeated measures analysis of variance (ANOVAs) (3 subject groups (waltz/foxtrot, tango, control) × time (pre, post)), with Holms-Sidak *post-hoc* tests, determined statistical significance of changes from pre to post. Effect sizes were also calculated. The exit questionnaire responses were compared between the tango and waltz/foxtrot groups using Mann-Whitney rank-sum tests. 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 related to family, one reported knee pain after week 2, and 2 had transportation issues and did not complete the required 20 lessons in 13 weeks. Data from one additional tango participant were not included in the analysis due to changes 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 due to frequent out of town travel. Three controls were unable to complete post-testing within 13 weeks due to an ankle injury, a hospitalization, and a death in the family. Thus, 14 tango, 17 waltz/foxtrot, and 17 controls successfully completed the study. Only data from these 48 individuals were analyzed.

At baseline, the 3 groups did not differ significantly in age, UPDRS, H&Y, time with PD, fall history, or freezing status (Table I). Over the course of the intervention, both tango and waltz/foxtrot exceeded the gains of controls, which improved on no measures. Significant improvements were noted in tango and waltz/foxtrot on the BBS, 6MWT and backward stride length when compared with controls. Other non-significant improvements were noted in tango in the TUG, and in both dance groups for other aspects of gait. The control group worsened significantly with respect to disease severity, as measured by

Table II. *Balance and mobility measures*

	Waltz/foxtrot	Tango	Controls	*p*-values
UPDRS				
Pre	26.9 ± 2.5	27.6 ± 2.0	27.4 ± 2.4	Within waltz/foxtrot: $p = 0.089$
Post	24.3 ± 3.4	26.0 ± 2.5	32.4 ± 2.6	Within tango: $p = 0.344$
ES	0.22	0.19	–0.48	Within control: $p = 0.002$
BBS				
Pre	48.1 ± 1.2	48.1 ± 1.4	48.2 ± 1.9	Within waltz/foxtrot: $p < 0.001$
Post	52.1 ± 1.2	52.0 ± 0.8	47.0 ± 2.5	Within tango: $p = 0.001$
ES	0.93	0.92	–0.13	Within control: $p = 0.182$
TUG, sec				
Pre	10.9 ± 7.6	12.1 ± 1.5	12.4 ± 1.3	NS
Post	10.8 ± 1.2	10.0 ± 0.8	14.4 ± 2.6	
ES	0.03	0.45	–0.24	
6MWT, m				
Pre	358.1 ± 21.7	364.2 ± 25.3	368.4 ± 27.5	Within waltz/foxtrot: $p < 0.001$
Post	407.2 ± 8.7	423.6 ± 9.6	360.9 ± 33.3	Within tango: $p < 0.001$
ES	0.50	0.63	–0.06	Within control: $p = 0.542$
FOG (out of 24)				
Pre	7.7 ± 1.2	8.4 ± 1.4	4.7 ± 1.4	NS
Post	7.6 ± 1.2	7.5 ± 1.3	5.9 ± 2.5	
ES	0.02	0.18	–0.22	

Values are pre- and post- intervention means ± standard errors (SE) and effect sizes (ES). The *p*-values presented are for the main effect of group and for significant pair-wise comparisons. Two-way repeated measures analysis of variance (ANOVAs) with Holms-Sidak *post-hoc* tests determined statistical significance between groups ($p = 0.05$).

NS: no significant difference; BBS: Berg Balance Scale; TUG: Timed Up and Go test; FOG: freezing of gait; 6MWT: 6-minute walk test; UPDRS: Unified Parkinson's Disease Rating Scale.

Table III. *Forward and backward walking*

	Waltz/foxtrot	Tango	Controls*	*p*-values
Forward velocity, m/sec				
Pre	1.11 ± 0.05	1.11 ± 0.05	1.07 ± 0.08	NS
Post	1.13 ± 0.05	1.19 ± 0.05	1.09 ± 0.10	
ES	0.10	0.35	0.06	
Forward stride length, m				
Pre	1.21 ± 0.05	1.25 ± 0.05	1.17 ± 0.08	NS
Post	1.23 ± 0.05	1.33 ± 0.05	1.15 ± 0.08	
ES	0.12	0.36	–0.07	
Forward single support time, sec				
Pre	0.37 ± 0.01	0.38 ± 0.01	0.38 ± 0.01	Within waltz/foxtrot: $p=0.635$
Post	0.38 ± 0.01	0.39 ± 0.01	0.37 ± 0.01	Within tango: $p=0.359$
ES	0.08	0.21	–0.33	Within control: $p=0.008$
Backward velocity, m/sec				
Pre	0.610 ± 0.05	0.613 ± 0.1	0.783 ± 0.10	Time: $p=0.015$
Post	0.720 ± 0.05	0.723 ± 0.1	0.764 ± 0.08	
ES	0.47	0.33	–0.05	
Backward stride length, m				
Pre	0.656 ± 0.05	0.631 ± 0.1	0.855 ± 0.10	Time: $p=0.008$
Post	0.761 ± 0.05	0.796 ± 0.1	0.799 ± 0.08	Within waltz/foxtrot: $p=0.018$
ES	0.47	0.57	–0.16	Within tango: $p=0.001$
				Within control: $p=0.208$
Backward single support time, sec				
Pre	0.329 ± 0.02	0.320 ± 0.02	0.374 ± 0.02	Within waltz/foxtrot: $p=0.305$
Post	0.344 ± 0.02	0.350 ± 0.02	0.340 ± 0.02	Within tango: $p=0.076$
ES	0.24	0.41	0.57	Within control: $p=0.027$

Values are pre- and post- intervention means ± standard errors (SE) and effect sizes (ES). The *p*-values presented are for the main effect of group and for significant pair-wise comparisons. Two-way repeated measures analysis of variance (ANOVAs) with Holms-Sidak *post-hoc* tests determined statistical significance between groups ($p=0.05$).
*Control values for backward walking represent a sample size of 16, because one control was unable to complete the task.
NS: no significant differences.

the UPDRS, and on time spent in single support during forward and backward walking (Tables II and III).

Freezing of gait

The 3 groups were not different in percentage of freezers within each group (Table I). On the FOG questionnaire, improvement is represented by a decrease in score. The tango group improved, while those within waltz/foxtrot did not change and the control group worsened.

Table IV. *Exit questionnaire*

Aspects of well-being	Waltz/foxtrot	Tango
Enjoyment	1.0 (1.0, 1.25)	1.0 (1.0, 1.0)
Balance	2.0 (1.0, 3.0)	2.0 (2.0, 2.0)
Walking	2.0 (1.0, 3.0)	2.0 (2.0, 3.0)
Mood	2.0 (1.0, 4.0)	2.0 (2.0, 2.0)
Coordination	2.0 (1.0, 3.0)	2.0 (2.0, 3.0)
Strength	3.0 (2.0, 3.0)	2.0 (1.0, 3.0)
Endurance	3.0 (2.0, 3.0)	2.0 (1.0, 2.0)
Continuing	2.0 (1.0, 3.0)	1.5 (1.0, 2.0)

Values are medians and interquartiles for Likert 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 particular aspect of physical well-being. Item 8 asked if they would continue to participate if additional dance classes were offered.

Participant assessments of dance interventions

Participants in all groups reported enjoying the classes and noted improvements, particularly in walking, balance, coordination, mood and endurance. Many indicated that they would continue participating if possible. There were no differences between the tango and waltz/foxtrot groups. Table IV summarizes results of the exit questionnaire.

DISCUSSION

Both waltz/foxtrot and tango conveyed significant benefits with respect to balance, motor ability and locomotion of participants with idiopathic PD who took part in 20 h of partnered dance instruction. An age- and sex-matched control group did not improve, and grew worse in terms of disease severity. Many changes noted in both dance groups were not statistically significant, but may have been clinically meaningful. Also, as the first study to examine the effects of waltz/foxtrot in those with PD, our results demonstrate its feasibility and positive effects.

Clinical relevance of dance effects

Changes noted on the UPDRS, BBS, 6MWT, and gait speed may have functional significance. A conservative 5-point, or 20%, change on the UPDRS was the clinically relevant cut-off for those in stages I–III who had received 6 months of pharmacological treatment (21). Therefore, changes we observed approach clinical meaningfulness, as control worsened 24% (5.0 points), reaching the aforementioned clinical cut-off, whereas waltz/foxtrot improved 16% on the UPDRS. On the BBS, a 5-point change is the minimal detectable change (MDC) for clinical significance in those with parkinsonism (22), which is nearly matched by our interventions' statistically significant 4-point increase on the BBS. An 82 m change is the MDC of the 6MWT for those with PD, an estimate that may be high given an extremely large standard deviation (22). Also, effect sizes of 0.5–0.6 can be considered clinically substantial change, which correspond to an increase of only 50 m for the 6MWT in elderly subjects with moderate motor impairment (23). Tango and waltz/foxtrot achieved this much improvement in the 6MWT. Finally, for gait speed, Steffen & Seney (22) propose 0.18 m/sec as the MDC for comfortable gait speed for those with PD, but suggest qualifying these results according to stage of PD. Others consider a change of 0.1 m/sec to be clinically substantial, which was achieved in backward walking by both dance groups and nearly reached in forward walking by tango. More research into what qualifies as a meaningful change is necessary (23).

Mechanisms of dance benefit

Several mechanisms may account for the improvements noted with dance including external cues, which may derive from the music or the partner, as well as the specific movements incorporated in the particular form of dance.

External cues. Individuals with PD often move slowly, but can achieve movements of nearly normal speed and amplitude through focused attention to critical aspects of movement (18, 24), especially with the aid of external cues. External cues may access cortical circuitry, thereby bypassing the dysfunctional basal ganglia (25) in those with PD. Two integral aspects of tango and waltz/foxtrot may provide important external cues: the music and the partner. The music may provide auditory cues that access the supplementary motor area via the thalamus (26), or the pre-motor cortex via the cerebellum (27). Using auditory cues has improved gait speed, initiation and cadence in laboratory settings (28) and while performing a functional task at home (29). Coordinated steps with the musical beat and one's partner may facilitate less slowly paced movement. The partner also may enhance balance by virtue of the physical contact at the hands, as even a light touch contact is known to facilitate postural stability (30). Cues such as the partner's weight shifting and indicated direction of movement can help initiate movement, and increase or maintain stride length and cadence. Walking towards a target aids in increasing and maintaining stride length (31); therefore, dancers may benefit by walking towards their partner.

Specific patterns of movement. It is important to design therapeutic exercise programs that target PD-related impairments while considering neurological and musculoskeletal relationships (32). While improvements were clearly noted in both dance groups, the effects of waltz/foxtrot were not exactly the same as those of tango. We think that waltz/foxtrot may better suit the preferences of some individuals with PD, given socio-cultural differences in musical and dance traditions. Dance variety could increase the effectiveness of a dance intervention by sustaining interest and appealing to diverse populations. Evidence supports waltzing in other patient populations, as patients with congestive heart failure enjoyed a waltzing program more than a cycling/walking program and experienced as much cardiovascular benefit with dance as with cycling (7). Additionally, participants with Alzheimer's disease participated in a short-term waltzing program and significantly improved in procedural learning (33). However, if limited to a single form of dance, tango may be preferable for those with PD, as it equaled waltz/foxtrot on many measures and had larger effects than waltz/foxtrot for TUG as well as forward and backward gait features.

The larger effects of tango on TUG and gait may be due in part to the specific nature of the movements performed in tango. For example, tango incorporates movements that are similar to strategies commonly taught to people with FOG by physical therapists (34). Visual cues, such as a foot to step over, can relieve FOG (35). Tango steps can involve stepping over a partner's foot, tapping a partner's foot, or crossing one foot over another. Similar visual cue techniques are used in conventional rehabilitation to address FOG (36). Moreover, tango also involves rhythmic rocking, or alternating shift of center of mass from foot to foot, another strategy commonly used to address freezing. Nearly 55% of participants in the dance groups identified themselves as freezers in the present study. While effects of both dance interventions on freezing were relatively small, tango appeared to have a larger effect on freezing than waltz/foxtrot.

Tango may help to improve walking velocity and stride length because it involves practised control of movement speed and size. Tango incorporates slow and quick steps of varying lengths and requires continual adjustment of these features. Tango may be particularly effective for addressing backward walking, a critical area given the tendency for falls in the backward direction in PD (37). While both waltz/foxtrot and tango use backward steps and dancers are instructed to reach the toe back as far as possible before shifting their weight, in tango dancers spend more time going simply backward, while waltz/foxtrot spends equal time going sideways or forward.

Compliance and attrition

Although approximately 20% of participants dropped out, we considered this to be good in terms of compliance, given that 80% came to 20 lessons within a 13-week time period. Also, drop-out rates were similar between controls and those in experimental groups. All participants provided their own transportation and many drove long distances. Those with PD are typically impacted by day-to-day health issues more than healthy individuals. They often need to rely on family members and friends to transport them to outings away from their home, which means that they must consider others' schedules. Exercise compliance in impaired individuals is often difficult to effect. In one study, only 30–45% of cancer survivors were meeting physical activity recommendations (38); furthermore, adherence to a physical activity of 60–85% in the impaired elderly has been considered high (39).

In conclusion, participants with PD who received 20 h of instruction within 13 weeks in progressive Argentine tango or American smooth waltz and foxtrot lessons improved on standard clinical measures of locomotion, balance and motor control. Limitations of this study include the small sample size and the fact that these data do not include information about the transfer of the dance class effects to activities of daily living. However, this work provides pilot data to support a larger randomized controlled trial. One major limitation of most investigations on rehabilitation efficacy in those with PD is the lack of demonstration of a carry-over effect. While our participants experienced gains, we do not know the duration of the effect; therefore, there is a great need for studies examining the duration and maintenance of benefits derived from social dance practise. Future studies should include measures to determine retention of gains and an appropriate maintenance schedule for this retention. Dance may be particularly effective over the long term as it is an enjoyable exercise that interests and engages older individuals. This is critical, as 60% of Americans older than 65 years do not achieve the recommended daily amount of physical activity (40), and activity levels in individuals with PD are 15% lower than those of age-matched controls (41). Dance may help to promote adherence while also incorporating the key elements of successful balance rehabilitation programs, such as practice of dynamic balance and continual adjustment to environmental demands (4, 5).

ACKNOWLEDGEMENTS

We would like to acknowledge Josh Funk, Callie Mosiman, Minna Hong, Ruth Porter, Mike Falvo, Nick Asakawa, Lauren Mehner, Svetlana and Adele Kantorovich, Tiffany Chung, Ba Huynh, Jeff Becket, Kyleen Albert, Laura Cohen, Patricia Engel, Callie Chen, and Ryan Choi, for their assistance with this project. This work was supported by a grant from the American Parkinson's Disease Association and NIH grant K01-048437. The study sponsors played no role in the study design, in the collection, analysis and interpretation of data; in the writing of the manuscript; or in the decision to submit the manuscript for publication.

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