Long-term Group Exercise for People With Parkinson's Disease: A Feasibility Study

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Background and Purpose: Aerobic and strengthening exercises have been shown to benefit people with Parkinson's disease (PD) on the basis of highly structured, short-term, clinical protocols. This study extended previous research by investigating feasibility of an ongoing, community-based, group exercise program for people with PD on the basis of short-term (10 weeks) and long-term (14 months) data.
Methods: Twenty people with PD (Hoehn and Yahr stages I to III) participated in at least one of four 10-week sessions. Classes were held twice weekly for 1 hour and included strength, flexibility, and balance and walking exercises. Evaluations were done 1.5 hours after medication intake 1 week before and 1 week after each session. Gait speed, 6-Minute Walk test (6MWT), "Timed Up and Go" test, and grip strength were used to assess physical function. Analysis of short-term results were based on 18 participants (2 dropped out prior to posttest), and long-term results were based on 8 participants who started in the first session continued through the 14-month period.
Results: Attendance rates were moderate to high (73% overall). No injuries were reported. Wilcoxon signed ranks tests based on each participant's first 10-week session demonstrated significant improvements in 6MWT, and grip strength. Long-term participants showed significant improvements in grip strength, and a trend toward improved 6MWT. Gait speed and Timed Up and Go test did not change significantly in the short or long terms.
Discussion/Conclusions: Our community-based group exercise program was safe, feasible, and appears to be effective. While some measures showed no improvement, there was no evidence of decline. This is an important outcome for persons with progressive neurological disorders, and suggests community-based group exercise is a promising option for people with PD.

Key Words: *Parkinson's disease, Exercise, Community-Based Programs, Physical Activity*

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BACKGROUND AND PURPOSE

Parkinson's disease (PD) is a progressive neurologic disorder and is the second most common neurodegenerative disease affecting the elderly.[1] Parkinson's disease causes a wide array of physical symptoms such as tremor, stiffness, and slowed movement as well as other neurologic, cognitive, and emotional symptoms.[2] People with PD often show limited participation in physical activity, which, in turn, may reduce functional status, decrease their sense of well-being, and contribute to secondary health complications.[3,4]

Recent evidence suggests that exercise programs can be beneficial for individuals with PD.[4-7] Exercise programs are shown to reduce the detrimental effects of neuromuscular slowing,[8] improve neuromuscular control,[9] increase strength,[7,9] improve balance and mobility,[5,6] and improve quality of life.[6,7,9,10] Animal studies indicate that high intensity exercise may be neuroprotective, and may slow progression of toxin-induced parkinsonism.[11,12] More generally, exercise programs for people with varied chronic diseases, including PD, reduce the adverse effects of physical inactivity,[13] improve quality of life and wellness, and reduce morbidity and secondary complications.[14-16]

Previous studies investigating the effects of exercise in those with PD have mostly been controlled trials implemented in a clinical research setting with highly structured intervention protocols and either individualized therapy or individualized progression of exercise intensity. These efficacy trials are crucial to understanding the mechanism(s) behind the benefits of exercise, identifying the optimal types of exercise, as well as determining frequency and dosing for people at various stages of PD; however, their generalizability is limited because of the imposed controls. We identified 35 clinical trials that directly investigated exercise for people with PD; many of which have been summarized in recent systematic reviews.[4-7,17] Twenty-four of the 35 studies reported on either a highly structured progressive exercise protocol or an individualized exercise program directed by a physical therapist. In contrast, 8 studies

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investigated group programs in community settings, with 4 focusing on martial arts (karate, Tai Chi, or Qigong),[18-21] and 4 on dancing.[22-25] Only 2 studies examined more general, group exercise programs taught by physical therapists; Bridgewater and Sharpe[26] investigated an aerobic exercise, whereas Rodrigues de Paula and colleagues[27] assessed a group program, including aerobic and resistance training. One study examined a general exercise program administered as "outpatient exercise training" using both a gym and pool, although it did not report whether the exercises were administered individually or in a group.[28]

It is important to know the outcomes of group exercise programs administered in community settings for several reasons. These programs may provide a sustainable and inexpensive approach to exercise that can be easily replicated, and they typically include a wide array of activities that can be readily integrated into a previously inactive lifestyle. They also offer socialization and camaraderie that can be motivating for participants, perhaps, especially over the long term.[29,30] This study sought to examine the effectiveness of a group exercise program delivered in a real-world community setting. It is also noteworthy that all of the 35 clinical trials we identified provided supervised exercise training for a limited time period (generally from 6 to 16 weeks), up to a maximum of 4 months, although one study did extend home exercises for 12 months.[31] Although some studies investigated long-term follow-up effects, the limited time frame of the exercise programs themselves may not be ideal. Recent guidelines for older adults from the American College of Sports Medicine show clear benefits of long-term participation in exercise.[32,33] Those guidelines further indicate that ongoing participation in frequent bouts of moderate exercise has important health benefits for older adults who are unfit.

To address the limited time frames reported in previous studies, their limited generalizability to community-based programs, and the need for continued long-term exercise, this study examined an ongoing, community-based, group exercise program for people with PD. The program was developed in collaboration with a community support group (Brooklyn Parkinson Group), and faculty/researchers from Long Island University. This study sought to describe a community-based program, document its feasibility, and provide data on short-term (10 weeks) and long-term (14 months) changes in physical functioning.

METHODS

Participants

Twenty people with PD were recruited with the assistance of a community support group. Participants met the following inclusion criteria: (1) medical diagnosis of idiopathic PD, (2) Hoehn & Yahr stage I, II, or III, (3) independent community ambulator with or without an assistive device, (4) written medical clearance provided by the participant's personal physician, and (5) capable of giving informed consent. All participants completed an informed consent approved by the Long Island University Institutional Review Board.

Fitness Program

Four 10-week sessions of group exercise (sessions A, B, C, and D) were conducted from September 2008 through November 2009. All sessions were offered without charge to individuals with PD with support of the investigators' university and the community support group. Each of the 4-week sessions consisted of 20 group exercise classes. Classes were conducted for 1 hour, 2 times per week at a university wellness, recreation, and athletic center. Class activities were based on a general exercise program for people with PD and healthy adults that was developed by a certified fitness trainer with diagnosed PD.[34] The exercise program was reviewed and adapted by the investigators, representatives of the community support group, and a certified fitness instructor. Exercises were chosen to address components of fitness (aerobic, strength, balance, and flexibility) deemed essential to healthy aging in individuals with clinically significant chronic conditions or functional limitations.[32]

Classes were divided into a general exercise phase (30 minutes) and a strength-training phase (30 minutes). The general exercise phase consisted of a warm-up, stretching exercises, floor exercises for core muscle strengthening, and walking and balance exercises to challenge ability to maintain the center of gravity over the base of support[35] (see Table, Supplemental Digital Content 1, http://links.lww.com/JNPT/A11, for activities in the general exercises phase). Participants were encouraged to move quickly from one exercise to the next so that a modest aerobic benefit could be achieved. Some participants augmented their general activity with treadmill walking in the final two 10-week sessions (sessions C and D). Owing to the group nature of this program, the content and intensity of the general exercise phase did not change notably across sessions.

The strengthening phase focused on major muscle groups of the upper and lower extremities (see Table, Supplemental Digital Content 2, http://links.lww.com/JNPT/A12, for activities in the strengthening exercises phase). During session A, participants were led through exercises with light free weights and elastic exercise bands. In session B, minimal access to weight training machines became available, so the fitness instructor provided an introduction to the machines. In sessions C and D, the program was moved to a space where 7 dual-action exercise machines, designed to work agonist and antagonist muscles, were available. The format of the class was also changed so that half of the participants began each class with the general exercise phase, and the other half of the participants began each class with strength training on the machines; after 30 minutes, the groups switched phases. To ensure that the participants met the recommendation of performing whole body exercises at moderate intensity,[32] the strength training phase was initiated after each participant was instructed on proper form, and had been tested to determine how much weight he or she could lift comfortably for 10 to 12 repetitions. Thereafter, participants performed the first 7 strengthening exercises (see Table, column 3, Supplemental Digital Content 2) for the first class of each week, whereas the other 7 exercises were done in the second class of each week. Data were recorded for each participant each day, and weight progressions were applied if 12 repetitions of a given weight

were lifted without difficulty for 2 consecutive sets. Weight was increased by 2 kg for upper extremity exercises and 5 kg lower extremity exercises.

Heart rate and blood pressure were taken before each exercise class. Participants with systolic pressure over 139 mm Hg were considered prehypertensive and were asked not to exercise that day in accordance with national blood pressure guidelines.[36] The overall ratio of instructors to participants varied. For sessions A and B, there was a primary instructor who was a certified fitness instructor experienced with special populations and 1 to 3 graduate students from the Physical Therapy and Sports Sciences Programs. In sessions C and D, a second instructor (a graduate student who had previously assisted with the program) was added to supervise the strength training phase. A faculty member from the Physical Therapy or Sports Science Divisions also monitored each class and provided intermittent assistance if needed. All instructors and students aimed to ensure safety, and worked with participants to encourage participation.

Data Collection

Participants were evaluated 1 week before and 1 week after each 10-week session by the principal investigators. To help control for effects of medication, participants were instructed to take their PD medication 1.5 hours before each evaluation session. The primary outcome measures were the 6-Minute Walk test (6MWT),[37] gait speed (using the GAITRite system, CIR Systems, Inc.; Havertown, PA; U.S.A),[38,39] the "Timed Up and Go" (TUG) test,[40] and grip strength.[41] These measures were chosen because they sample a range of domains relevant to physical functioning that are likely to be affected by exercise, and they have been shown to be reliable for people with PD[40,42,43] or older adults.[44,45]

Six-Minute Walk Test

The 6MWT is a performance-based test used to measure endurance.[37] Each participant was asked to walk, without running, for 6 minutes to cover as much distance as possible. The test was conducted in a 40-m (125-ft) unobstructed hallway. Total distance walked was recorded. Heart rate and blood pressure were recorded before walking and immediately following the 6-minute walk.

Gait Speed

The GAITRite electronic walkway system was developed to measure spatial and temporal gait parameters.[38,39] Each participant walked 2 trials at their preferred, self-selected, pace over the GAITRite system for a distance of 4.3 m. The 2 trials were averaged.

The "Timed Up and Go" Test

The TUG test is a test developed to measure functional mobility including balance and locomotion.[40] For the TUG test, the participant was seated in a chair with armrests and was instructed to get up from the chair with or without use of the arms, walk to a point 3 m away, turn around, walk back to the chair, and sit down. Each participant performed 2 trials and the results were averaged.

Grip Strength

Grip strength was measured using a hand-held dynamometer.[41] Participants were instructed to stand and hold the dynamometer at their side with the arm straight and the dial face down. Participants performed 3 trials for each hand and the average value was used.

Open Discussion

Along with these quantitative measures, a group discussion was held between sessions B and C; it was attended by 8 of the 13 participants. Two of the principle investigators led a discussion and asked participants about the program's strengths and weaknesses. A written record was made of the participants' comments during the discussion, and was reviewed for accuracy by 2 of the participants.

Data Analysis

Participation rates were determined for each individual, and for each group of participants that began a particular 10-week session. Individual rates were calculated as the ratio of the number of classes attended relative to the 20 classes available in a particular session. Group participation rates reflected the average rate across all participants who began a particular session. In addition, overall participation rates were determined for each individual by averaging his or her individual rates for each session attended. If a participant indicated that he or she would not be attending an entire session due to travel, illness, or official withdrawal from the program, then that session was not included in any calculated rate. Individual, group, and overall participation rates do include zero participation for individuals who did not attend an entire session for undisclosed reasons.

Given the small number of participants and potential for nonnormal distribution of data, the Wilcoxon signed ranks test was used to analyze the quantitative measures. For short-term effects (10 weeks), pretest and posttest evaluation data were compared for whichever session a participant first attended (ie, some participants began in session A, others in sessions B, C, or D). For long-term effects (14 months), data from the initial pretest evaluation for session A were compared to data from the final posttest evaluation after session D for those participants who were present at both ($n = 8$). The significance level was set at $\alpha < .05$ for all comparisons. No adjustments for multiple statistical tests were made due to the preliminary nature of this report. No comparisons between the short-term and long-term groups were conducted because all participants in the long-term group were also members of the short-term group.

RESULTS

Descriptive statistics of subjects' demographics, medical risk factors, and comorbidities are summarized in Table 1. The majority of participants reported risk factors for heart disease (67%), and many had serious comorbidities (27%) such as stroke, cancer, or HIV-positive. Among the long-term participants, 75% had at least 1 moderate or serious comorbidity (eg, heart disease, diabetes, or cancer). Almost 50% of all participants, including 50% of the long-term participants, reported

Table 1. Demographic and Medical Information[a]

	Short-term (n = 18)	Long-term (n = 8)
Gender	M = 8, F = 10	M = 5, F = 3
Age, y	64.9 (6.6)	64.8 (5.2)
BMI, kg/m^2	25.6 (5.2)	23.9 (3.9)
Hoehn and Yahr stage	2.3 (0.52)	2.3 (0.5)
Years since PD diagnosis	6.8 (4.2)	10.3 (6.3)
Hypertension/hypotension	7 (39%)	3 (38%)
Dizziness/loss of Balance	6 (33%)	4 (50%)
High cholesterol	5 (28%)	3 (38%)
Chest pain	2 (11%)	2 (25%)
Asthma	2 (11%)	1 (13%)
Shortness of breath	3 (17%)	3 (38%)
Periodic falls	2 (11%)	1 (13%)
Major comorbidities		
Stroke	1 (5%)	1 (13%)
Diabetes	0	0
Heart disease	2 (11%)	1 (13%)
Cancer	3 (17%)	3 (38%)
HIV-positive	1 (5%)	1 (13%)
One or more comorbidities	7 (39%)	6 (75%)
Deep brain stimulator	2 (11%)	0
Joint replacement	1 (5%)	1 (13%)
Back/shoulder surgery	2 (11%)	0
Arthritis	8 (44%)	2 (25%)
≥2 h/wk of activity	8 (44%)	4 (50%)
History of smoking	3 (17%)	2 (25%)

[a]Values are provided for participants according to the comparison(s) they were included in: short-term, long-term (a subset of those participants included under short-term), or did not complete an initial session. For the demographic variables, mean values and standard deviations are given. For other variables, frequency counts indicate the number of subjects identified by that condition within the short-term, long-term, or incomplete groupings, and the percentages are calculated relative to that grouping.

Table 2. Flow of Participants and Attendance Rates Across the 4 Sessions[a]

Participant[b]	Session A	Session B[c]	Session C[c]	Session D	Overall Rate
1 (LT)	18 (90%)	11 (55%)	18 (90%)	17 (85%)	80%
2	20 (100%)	11 (55%)	15 (75%)	11 (55%)	71%
3 (LT)	14 (70%)	15 (75%)	18 (90%)	18 (90%)	81%
4 (LT)	15 (75%)	10 (50%)	M	9 (45%)	57%
5 (LT)	18 (90%)	0 (0%)	0 (0%)	11 (55%)	36%
6 (LT)	16 (80%)	14 (70%)	16 (80%)	12 (60%)	73%
7 (LT)	13 (65%)	T	12 (60%)	6 (30%)	52%
8 (LT)	19 (95%)	18 (90%)	20 (100%)	19 (95%)	95%
9	16 (80%)	D			80%
10 (LT)	17 (85%)	15 (75%)	20 (100%)	20 (100%)	90%
11		8 (40%)	11 (55%)	1 (5%)	33%
12		20 (100%)	18 (90%)	20 (100%)	97%
13		16 (80%)	15 (75%)	11 (55%)	70%
14		12 (60%)	13 (65%)	8 (40%)	55%
15			16 (80%)	19 (95%)	88%
16			14 (70%)	14 (70%)	70%
17			19 (95%)	20 (100%)	98%
18			12 (60%)	9 (45%)	53%
Mean	83.0%	62.5%	74.1%	66.2%	73.0%
SD	11.1%	26.2%	24.4%	28.6%	17.8%
N	10	12	16	17	18

[a]The number of classes attended in each session is shown, along with the percentage of those possible (20 classes per 10-week session).
[b]LT indicates participants who were included in the "long-term" analyses.
[c]Letters indicate temporary or permanent withdrawal for the following reasons: D, died; M, medical condition unrelated to PD; T, traveled away from area.

less than 2 hours per week of recreational exercise or routine physical activity before joining our program.

The flow of participants through the four 10-week sessions and their reasons for temporary or permanent withdrawal are illustrated in Table 2. Eighteen participants completed at least one 10-week session while 2 participants dropped out prior to their initial posttests; their data are not included anywhere in this report. Of the 10 participants who completed session A, 8 continued long-term. One of these long-term participants informed us that she would not attend session B because she was traveling; she did complete over 50% of the other classes available to her (sessions A, C and D).

The average attendance rate was moderately high (73%; as shown in Table 2) but varied across sessions. There was considerable variation in attendance rates for individuals in any given 10-week session, and over the entire set of sessions for which each individual was enrolled.

No injuries or other adverse events were reported by participants. During 800 person-hours of participation in the program, 1 participant sustained 2 partial falls (1 from a quadruped position to the floor, and 1 from standing where an assistant guided her to rest on the floor). A second participant sustained a fall when rising from a seated position, but was guided to rest on the floor. In each instance, no injuries occurred. There was 1 death and 1 withdrawal after session A, both of which were reported to be due to preexisting medical conditions. Some participants reported fatigue or mild muscle soreness as a result of a previous class, but none chose to discontinue participation or reduce their level of effort in subsequent classes as a result. Occasionally, participants elected to forgo particular exercises due to muscle soreness, limitations from some preexisting medical condition, or fatigue. Over the course of the 4 sessions, there was one instance where an individual was asked to forgo the exercise class due to a high blood pressure reading, and there were several instances wherein participants rested until their blood pressure or heart rate dropped to acceptable levels.

For the quantitative measures, short-term data (n = 18) demonstrated increased 6MWT distance ($P < 0.02$), and higher grip strength ($P < 0.04$). No significant short-term changes were seen for gait speed, or TUG test, as noted in Table 3. Long-term data (n = 8) suggested a trend toward improved 6MWT distance ($P < 0.06$), and a significant improvement in grip strength ($P < 0.01$). Gait speed and TUG test were not significantly changed as a result of long-term participation.

Qualitative information from the discussion group indicated that participants enjoyed the exercise program, and valued the camaraderie, social support, and sense of community provided by the group. Participants reported functional benefits such as improvements in balance, strength, bed mobility, the ability to walk longer distances and navigate complex urban areas, and more readiness to engage in challenging community activities. Barriers to participation included feeling tired after class, and difficulty managing day-to-day medical issues, and scheduling problems. One participant also noted that the class

Table 3. Short-term and Long-term Comparisons (Median and Range)

	Short-term Effects (n = 18)		Long-term Effects (n = 8)	
	Pretest	Posttest	Pretest	Posttest
Six-Minute Walk test, m	364 (207-554)	392[a] (227-569)	382 (328-497)	408[b] (336-563)
Gait speed, m/s	1.2 (0.7-1.5)	1.1 (0.7-1.5)	1.2 (1.0-1.5)	1.2 (0.9-1.5)
Timed Up and Go test, s	10.9 (7.0-20.3)	11.2 (8.5-15.1)	10.6 (8.3-16.5)	10.9 (6.2-14.6)
Grip strength, kg	21.0 (9.0-37.6)	24.4[a] (10.8-42.0)	25.1 (16.0-37.6)	35.1[a] (20.0-47.0)

[a] $P \leq 0.05$, exact values given in the text.
[b] $P = 0.054$.

did not address her difficulties with fine motor skills such as handwriting and eating.

DISCUSSION

This study was conducted to investigate the feasibility of an ongoing, community-based, group exercise program for people with PD on the basis of short-term and long-term data. The program offered traditional fitness components of strength, flexibility, balance, and walking exercises, in a community-based group setting for people with PD over a 14-month period. Results of this study suggest that participants obtained modest short-term benefits from participating in a single 10-week exercise program. These results concur with other clinical trials that demonstrate positive changes in physical function in response to varied exercise programs over a range of 4 to 12 weeks, including progressive resistance training,[46] aerobic exercise,[26] treadmill walking,[47] dance,[22-25] and Qigong.[19] Our results are also consistent with the 2 previous studies that directly examined community-based group exercise programs.[26,27] However, our outcome measures cannot be directly compared with the results from those 2 studies, because Rodrigues de Paula and colleagues[27] reported only on quality of life, whereas Bridgewater and Sharpe[26] focused on changes in aerobic capacity using a multidimensional scale of physical function.

Studies of community-based group exercise programs for people with PD outside of a traditional clinical paradigm are rare.[18,26,27] This study demonstrated that a community-based group exercise program for individuals with PD is safe and feasible. It was implemented as designed, no classes were cancelled, attendance rates varied considerably but were moderate overall, and 80% of those who completed in the first 10-week session participated, at least sporadically, throughout the 3 following sessions. During more than 800 person-hours of exercise, no injuries or major adverse events were sustained. The safety data are noteworthy, given that our participants were typical of older adults with a chronic and progressive disease in that many had serious comorbidities, risk factors for heart disease, or both. The safety data are also consistent with previous studies of group physical activity for people with PD, which have shown very few serious adverse events.[18-27]

To our knowledge, this is the first study to document long-term participation in a community-based group exercise program, although one case series examined 4 months of supervised endurance training in conjunction with 12 months of home exercises for 3 individuals with PD.[31] Our long-term results showed a modest within-group benefit for grip strength, and a trend toward improved 6MWT. Those effects did not meet the thresholds for minimum detectable change or smallest real difference for 6MWT,[42] nor for grip strength, where statistics were only available for people with stroke and disabled older adults.[48,49] The group nature of the exercise was a unique feature of this exercise program, and may have contributed to the large proportion of individuals who participated over the entire 14-month period of classes. This viewpoint was corroborated by the participants' anecdotal comments, and is consistent with reports from other studies on group physical activity for people with PD.[18-27]

Although significant improvements were observed only for short-term changes in walking endurance and for short- and long-term changes in grip strength, there did not appear to be decline in any of the outcome measures. Given that PD is a progressive neurological disorder, evidence that measures of function and mobility remained stable in individuals who participated in an exercise program may represent an important finding. This program was intended to promote physical function and wellness rather than to be used as a medical intervention. Such programs can be used as adjunct to rehabilitation approaches to augment the rehabilitation of individuals with disabilities and reduce the cost of health care.[13,14] By advocating, developing, and implementing such programs that benefit people with disability, physical therapists may influence the community to promote health and wellness.

LIMITATIONS

Given the preliminary examination of the effectiveness of a community exercise program performed in this study, by design, various elements of internal validity were lacking. There was no control group; neither the participants nor evaluators were blinded to the exercise or the testing; and multiple statistical tests were performed without adjusting the α level. Conversely, the small number of participants may have limited our statistical power to detect changes, and the moderately high, but imperfect, attendance rates may have reduced the potential to show statistically significant changes. Other limitations that are common to some long-term studies of people with PD include natural variations in symptoms, changes in lifestyle factors such as physical activity, changes in medication over the 14-month period, and the inability to fully control the "on" and "off" periods characteristic of PD during evaluation sessions. With regards to the exercise program itself, this study did not attempt to determine which specific aspects of the exercise program were most beneficial, but rather allowed for flexible programming of a varied set of exercises that might be typical of other community-based programs. Finally, this program may be difficult to replicate in other community settings because the classes were free, and high levels of supervision were available. Additional research that addresses each of these limitations is needed, including long-term randomized, controlled trials comparing community-based group exercise to a plausible control condition, and research that explores the role of social variables in promoting exercise

participation among individuals with a common, chronic, degenerative disease.

CONCLUSIONS

A community-based group exercise program for people with PD, designed to promote physical fitness in a community setting, is feasible and safe to implement. Although some measures of function and mobility did not improve, it appears that none of the measures declined, which may be an important finding for individuals with a progressive neurological disorder. Such a program is potentially beneficial as an adjunct to traditional rehabilitation programs.

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REFERENCES

1. de Lau LM, Breteler MM. Epidemiology of Parkinson's disease. *Lancet Neurol.* 2006;5(6):525-535.
2. Boelen MP. *Health Professionals' Guide to Physical Management of Parkinson's Disease*. Champaign, IL: Human Kinetics; 2009.
3. Morris M. Movement disorders in people with Parkinson's disease: a model for physical therapy. *Phys Ther.* 2000;80:578-597.
4. Crizzle AM, Newhouse IJ. Is physical exercise beneficial for persons with Parkinson's disease? *Clin J Sport Med.* 2006;16:422-425.
5. Dibble LE, Addison O, Papa E. The effects of exercise on balance in persons with Parkinson's disease: a systematic review across the disability spectrum. *J Neurol Phys Ther.* 2009;33(1):14-26.
6. Goodwin VA, Richards SH, Taylor RS, Taylor AH, Campbell JL. The effectiveness of exercise interventions for people with Parkinson's disease: a systematic review and meta-analysis. *Mov Disord.* 2008;23(5):631-640.
7. Falvo MJ, Schilling BK, Earhart GM. Parkinson's disease and resistive exercise: rationale, review and recommendations. *Mov Disord.* 2008;23(1):1-11.
8. Bergen JL, Toole T, Elliott RG, Wallace B, Robinson K, Maitland CG. Aerobic exercise intervention improves aerobic capacity and movement initiation in Parkinson's disease patients. *NeuroRehabilitation.* 2002;17:161-168.
9. Dibble LE, Hale TF, Marcus RL, Gerber JP, LaStayo PC. High intensity eccentric resistance training decreases bradykinesia and improves quality of life in persons with Parkinson's disease: a preliminary study. *Parkinsonism Relat Disord.* 2009;15(10):752-757.
10. Baatile J, Langbein WE, Weaver F, Maloney C, Jost MB. Effect of exercise on perceived quality of life of individuals with Parkinson's disease. *J Rehabil Res Dev.* 2000;37(5):529-534.
11. Faherty CJ, Raviie Shepherd K, Herasimtschuk A, Smeyne RJ. Environmental enrichment in adulthood eliminates neuronal death in experimental Parkinsonsim. *Brain Res Mol Brain Res.* 2005;134(1):170-179.
12. Mabandla M, Kellaway L, St Clair Gibson A, Russell VA. Voluntary running provides neuroprotection in rats after 6-hydroxydopamine injection into the medial forebrain bundle. *Metab Brain Dis.* 2004;19(1-2):43-50.
13. Rimmer JH. Health promotion for people with disabilities: the emerging paradigm shift from disability prevention to prevention of secondary conditions. *Phys Ther.* 1999;79:495-502.
14. Rimmer JH, Braddock D. Health promotion for people with physical, cognitive, and sensory disabilities: an emerging national priority. *Am J Health Promot.* 2002;16:220-224.
15. Rimmer JH. Exercise and physical activity in persons aging with a physical disability. *Phys Med Rehabil Clin N Am.* 2005;16:41-56.
16. Gillison FB, Skevington SM, Sato A, Standage M, Evangelidou S. The effects of exercise interventions on quality of life in clinical and healthy populations; a meta-analysis. *Soc Sci Med.* 2009;68:1700-1710.
17. Keus SHJ, Bloem BR, Hendricks EJM, Bredero-Cohen AB, Munneke M. Evidence-based analysis of physical therapy in Parkinson's disease with recommendations for practice and research. *Mov Disord.* 2007;22:451-460.
18. Palmer SS, Mortimer JA, Webster DD, Bistevins R, Dickinson GL. Exercise therapy for Parkinson's disease. *Arch Phys Med Rehabil.* 1986;67(10):741-745.
19. Schmitz-Hübsch T, Pyfer D, Kielwein K, Fimmers R, Klockgether T, Wüllner U. Qigong exercise for the symptoms of Parkinson's disease: a randomized, controlled pilot study. *Mov Disord.* 2006;21(4):543-548.
20. Hackney ME, Earhart GM. Tai Chi improves balance and mobility in people with Parkinson disease. *Gait Posture.* 2008;28:456-460.
21. Burini D, Farabollini B, Iacucci S, et al. A randomised controlled crossover trial of aerobic training versus Qigong in advanced Parkinson's disease. *Eura Medicophys.* 2006;42(3):231-238.
22. Westheimer O. Why dance for PD? *Top Geriatr Rehabil.* 2008;24(2):127-140.
23. Hackney ME, Earhart GM. Effects of dance on movement control in Parkinson's disease: a comparison of Argentine tango and American ballroom. *J Rehabil Med.* 2009;41:475-481.
24. Hackney ME, Earhart GM. Effects of dance on gait and balance in Parkinson's disease: a comparison of partnered and nonpartnered dance movement. *Neurorehabil Neural Repair.* 2010;24(4):384-392.
25. Hackney ME, Kantorovich S, Levin R, Earhart GM. Effects of tango on functional mobility in Parkinson's disease: a preliminary study. *J Neurol Phys Ther.* 2007;31:173-179.
26. Bridgewater KJ, Sharpe MH. Aerobic exercise and early Parkinson's disease. *J Neurol Rehabil.* 1996;10:233-241.
27. Rodrigues de Paula R, Teixeira-Salmela LF, de Moarais Faria DC, De Brio PR, Cardoso F. Impact of an exercise program on physical, emotional, and social aspects of quality of life of individuals with Parkinson's disease. *Mov Disord.* 2006;21(8):1073-1077.
28. Reuter I, Engelhardt M, Stecker K, Baas H. Therapeutic value of exercise training in Parkinson's disease. *Med Sci Sports Exerc.* 1999;31(11):1544-1549.
29. Grove NC, Spier BE. Motivating the well elderly to exercise. *J Community Health Nurs.* 1999;16(3):179-189.
30. Zimpfer DG. Groups for the aging: do they work? *J Special Group Work.* 1987;12(2):85-92.
31. Schenkman M, Hall D, Kumar R, Kohrt WM. Endurance exercise training to improve economy of movement of people with parkinson disease: three case reports. *Phys Ther.* 2008;88(1):63-76.
32. Nelson ME, Rejeski WJ, Blair SN, et al. Physical activity and public health in older adults: recommendation for the American college of sports medicine and the American heart association. *Circulation.* 2007;116:1094-1105.
33. Chodzko-Zajko WJ, Proctor DN, Fiatarone Singh MA, et al. Exercise and physical activity for older adults. *Med Sci Sports Exerc.* 2009;41:1510-1530.
34. Neesemann C, Neesemann H. *Brooklyn Parkinson Group Fitness Program*. Brooklyn, NY: Brooklyn Parkinson Group; 2007:1-38.
35. American Geriatrics Society, British Geriatrics Society, American Academy of Orthopeadic Surgeons Panel on Fall Prevention. Guideline for the prevention of falls in older persons. *J Am Geriatr Soc.* 2001;49:664-672.
36. National High Blood Pressure Education Program. *The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7).* Washington, DC: National High Blood Pressure Education Program; 2003.
37. Butland RJA, Pand J, Gross ER, Woodcock AA, Geddes DM. Two-, six, twelve-minute waling tests in respiratory disease. *Br Med J.* 1982;284:1607-1608.
38. Bilney B, Morris M, Webster K. Concurrent related validity of the GAITRite walkway system for quantification of the spatial and temporal parameters of gait. *Gait Posture.* 2003;17(1):68-74.

39. McDonough AL, Batavia M, Chen FC, Kwon S, Ziai J. The validity and reliability of the GAITRite system's measurements: a preliminary evaluation. *Arch Phys Med Rehabil.* 2001;82:419-425.
40. Podsiadlo D, Richardson S. The timed "up & go": a test of basic functional mobility for frail elderly persons. *J Am Geriatr Soc.* 1991;39:142-148.
41. Agre JC, Magness JL, Hull SZ, et al. Strength testing with a portable dynamometer: reliability for upper and lower extremities. *Arch Phys Med Rehabil.* 1987;68(454-58).
42. Steffen T, Seney M. Test-retest reliability and minimal detectable change on balance and ambulation tests, the 36-item short-form health survey, and the unified Parkinson disease rating scale in people with parkinsonism. *Phys Ther.* 2008;88(6):733-746.
43. Campbell C, Rowse J, Ciol M, Shumway-Cook A. The effect of cognitive demand on timed up and go performance in older adults with and without Parkinson disease. *Neurol Rep.* 2003;27:2-6.
44. Bohannon RW. Intertester reliability of hand-held dynamometry: a concise summary of published research. *Percept Mot Skills.* 1999;88:899-902.
45. Bohannon RW, Schaubert KL. Test-retest reliability of grip-strength measures obtained over a 12-week interval from community-dwelling elders. *J Hand Ther.* 2005;18(4):426-428.
46. Comella CL, Stebbins GT, Brown-Toms N, Goetz CG. Physical therapy and Parkinson's disease: a controlled clinical trial. *Neurol.* 1994;44(3 Pt 1): 376-378.
47. Miyai I, Fujimoto Y, Yamamoto H, et al. Long-term effect of body weight–supported treadmill training in Parkinson's disease: a randomized controlled trial. *Arch Phys Med Rehabil.* 2002;83:1370-1373.
48. Nitschke JE, McMeedken JM, Burry HC, Matyas TA. When is a change a genuine change? A clinically meaningful interpretation of grip strength measurement in healthy and disabled women. *J Hand Ther.* 1999;12(1): 25-30.
49. Chen HM, Chen CC, Hsueh IP, Hsueh SL, Hsieh CL. Test-retest reproducibility and smallest real difference of 5 hand function tests in patients with stroke. *Neurorehabil Neural Repair.* 2009;23(5): 435-440.