**Background**

This community-based program for individuals with Parkinson Disease (PD) contains group exercise classes for resistance training and yoga as well as a home-based aerobic exercise plan. The program is designed to promote lasting health behavior change using elements of the Health Belief Model (HBM) and Social Cognitive Theory (SCT); and participants’ progress will be assessed using validated outcome measures that will focus on mobility, balance, and health-related quality of life (HRQoL).

Group classes for progressive resistance exercise (PRE) may lead to improvements in physical function and gait.1,2 A two-year Randomized Control Trial (RCT) on PRE for PD found that structured, individualized, high resistance PRE can improve motor signs of PD, as measured by the Unified Parkinson's Disease Rating Scale (UPDRS), as well as HRQOL.1 In another RCT, participants performed two sets of 12-20 repetitions (to fatigue) for six lower extremity exercises twice weekly for 10 weeks.2 Training progressions were based on each individual’s one-rep maximum for each movement and the daily-adjusted progressive resistance exercise (DAPRE) protocol.2 Researchers found that structured PRE improved mean gait velocity by 0.08m/s and mean stride length by 0.05 meters.2 Gait analysis also showed that PRE led to more efficient anticipatory postural adjustments during initial steps of gait; therefore, including PRE in a community program may improve gait dysfunction and reduce risk of falls in the initial steps of gait for those with PD.2 Resistance training group classes in this program are designed based on the detailed, published PRE protocols used in these two studies, and thus, may promote similar positive outcomes in motor functioning.1-2

A yoga intervention can positively impact participants’ motor function, falls risk, and psychological well-being.3-5 A 2018 RCT found that for those with PD, group Hatha yoga classes that included meditation and yoga postures in sitting, standing, and supine led to significant improvements in dynamic balance during walking.3 Furthermore, after eight weeks of twice weekly 60-minute group classes, participants reported a decrease in PD-related gait disturbances with a medium effect size of 0.69 on the Freezing of Gait Questionnaire.3 The experimental group’s mean mini-BESTest scores also increased from 19.47 to 24.87 post-intervention, which demonstrates a reduced fall risk based on the 20/32 cut-off score for detecting fallers.3 Furthermore, yoga practice that involves getting down and up off the ground many times also practices an important skill for falls management.4 After the aforementioned program, participants reported improvements in balance confidence and perceived ability to manage and get up from falls, with effect sizes of 0.81 on the Activities Balance Confidence Scale and of 0.62 on the Falls Management Scale respectively.4 Increased confidence in one’s balance can allow greater participation in other valued activities and improve HRQoL.4 Participants with PD in this study reported a mean change of 8.00 on the Parkinson’s Disease Questionnaire-8 (PDQ-8), which indicates a clinically important difference in HRQoL.4 Another RCT with 138 participants with PD found that in addition to mobility benefits, yoga can also result in increased spiritual well-being and HRQoL and clinically significant improvements in reported anxiety and depression symptoms.5 Therefore, incorporating a yoga intervention into a community-based program for those with PD can address falls risk and provide additional benefits for psychological distress and spiritual well-being.5 This community program’s yoga component is modeled after the available evidence, and thus, may encourage similar comprehensive benefits to physical functioning and psychospiritual health.3-5

The home-based aerobic exercise component of this program will be community walking using Rhythmic Auditory Stimulation (RAS).6,7 A contributing factor to gait abnormalities in PD is loss of automaticity and rhythmicity of movements.6 RAS provides an external cue that may bypass and compensate for this deficit; for example, participants are instructed to synchronize their walking pace with the beat of a song.6 A 2019 RCT showed that treadmill training with RAS promoted additional benefits in dynamic stability and gait quality over typical treadmill training.6 The RAS group demonstrated greater increases on the UPDRS, Functional Gait Assessment, Tinetti Falls Efficacy Scale; and the RAS group had larger improvements in gait parameters, such as step cadence, stride length, and reduction in the stance/swing phase ratio.6 Based on the published parameters, in the community program, group leaders will help each participant find music they enjoy with a pace of 120bpm to use during their walking program to facilitate gait improvements.6 Furthermore, if this also makes walking more enjoyable, RAS may also promote longer participation in ambulation, allowing participants to gain more health benefits from aerobic activity. Based on results from a 2017 pilot study, incorporating a minimally supervised home walking program into this community-based exercise program may be feasible and have high adherence rates.7

The program will also incorporate multiple strategies at the intrapersonal and interpersonal levels to promote adherence and lasting changes in physical activity.7-10 At the initiation of the program, having participants actively create their own short and long term goals may increase self-regulation skills.8,9 Signing a health contract with the group leader may also promote increased accountability.8 Additionally, group classes provide participants a new network of peers with the same condition, which encourages social support as well as self-efficacy from observing peer models succeed through sustained efforts in exercise.9 Group exercise classes can also promote self-efficacy for performing physical activity as participants accumulate repeated successes.9,10 Classes will also be accompanied by educational sessions, during which program leaders will discuss the evidence for each exercise’s impact on health and PD progression, which can enhance outcome expectations, perceived benefits, and intrinsic motivation.7,10 Group discussions will also focus on problem-solving perceived barriers of physical activity for PD, which can increase program adherence.9 Family members will be encouraged to attend these meetings and participate in the home component of the exercise program for additional social support.9 Having family members accompany those with a fear of falling during community walking and receiving routine check-in calls from program leaders have been shown to minimize attrition during home-based exercise programs.7 In this community program, participants will be paired together and instructed to have a phone call once weekly to increase peer social support and accountability for walking program adherence.9

The interventions in this program aim to address functional impairments in gait and balance, reduce falls risk, and increase overall HRQoL through increased physical activity for those with PD. To assess progress in these areas from participation in the community program, participants will complete the Timed Up and Go (TUG) test and fill out the Activities-Specific Balance Confidence (ABC) Scale and PDQ-8 at initiation and completion of the program. Each of these measures are extensively used in Physical Therapy (PT) and highly recommended for use with PD patients by the PD EDGE group in the Academy of Neurologic PT.11 The TUG assesses functional mobility and balance by having the participant rise from a chair, walk forward 3 meters, turn around, walk back to the chair, and sit down.12 For those with PD, a TUG score greater than 11.5 seconds indicates risk of falling and the Minimal Detectable Change (MDC) is 3.5 seconds.12 Therefore, the program can evaluate its effectiveness at reducing falls risk and at improving dynamic stability and speed during gait by comparing the participants’ changes in scores. The TUG also requires minimal time or equipment, which is feasible for a large group. The ABC Scale is a self-report measure that indicates an individual’s level of confidence that they will not lose their balance or become unsteady while performing various activities.13 It is scored from 0-100%, the cut-off score of 69% predicts recurrent falls, and the MDC has been reported as 11.12-13.0 for the PD population.13 The PDQ-8 is a self-administered questionnaire used to assess participation and HRQoL in those with PD. There is one item for each of the following domains that are relevant to those with PD: mobility, activities of daily living, emotional well-being, stigma, social support, cognitions, communication, and bodily discomfort.14 The Minimally Clinically Important Difference for improvement in HRQoL is +4.91 points, and for worsening is -5.94 points.15 This can be used to evaluate the program’s effectiveness at achieving one of its main goals to improve overall well-being for the PD participants through physical activity.

**Program Goals**

The overall goal for this program is to improve physical health and mental/emotional wellness in the Parkinson Disease (PD) community through physical activity. By the end of 12 weeks, the program aims to achieve the following goals:

1. Participants’ mean TUG score will increase by greater than 3.5 seconds to demonstrate a true change that is beyond random measurement error in functional mobility and dynamic balance.12
2. Participants will increase their mean ABC Scale score by greater than 13.0 to demonstrate a true change in their balance and falls confidence that is beyond random measurement error.13
3. Participants will increase their mean PDQ-8 score by greater than 4.91 to meet the minimal clinically important difference for this outcome measure to demonstrate improved participation and health-related quality of life.15
4. Participants will report compliance with their weekly home program of brisk walking 60 minutes per week for at least 8 out of 12 weeks to demonstrate a sustained increase in their intrinsic motivation to engage in physical activity to progress and maintain their health.

**Methods**

*Physical Education for Parkinson Disease (P.E. for PD)* is a comprehensive, community-based program that introduces various types of physical activity, health and wellness lessons, and group discussions to address overall functioning, fitness, mental health, and social support for those with PD. The 12-week program meets twice a week for a total of 24 sessions. Each session is 90 minutes and consists of 60 minutes of physical activity and a 30-minute group meeting.

1. *WHO*
2. *P.E. for PD* is designed for those with a diagnosis of idiopathic PD. The evidence that backs this program has shown that the included exercise interventions are safe and effective for those with Hoehn and Yahr Scale ratings of 1 to 3.1-8 This would encompass those with mild-to-moderate bilateral disease that are physically independent but present with some postural instability.16 Individuals at Hoehn and Yahr stage 4 (severe disability, but still able to walk or stand unassisted) may be assessed to determine their appropriateness for participation in the program.16 Because the *P.E for PD* consists of group classes, participants must be able to exercise without guarding or standby assist. Hoehn and Yahr stage 5 is excluded from this program because those individuals require aid to rise from a wheelchair and to ambulate.16
3. Group leaders will be local Physical Therapists (PTs) that have the expertise required to modify exercise based on an individual’s motor symptoms of PD. PTs also have knowledge and experience assisting those with PD achieve their maximal function and participation, and are therefore appropriate to lead health/wellness lessons and group discussions. Ideally, the same few PTs will volunteer their time throughout the 12 weeks to develop a closer rapport and personal relationships with participants, which will assist with the psychosocial aspects of the program. Volunteers that are interested in the PT profession will also be recruited from local high schools and colleges to assist during exercise sessions as well.
4. During the initial installment of *P.E. for PD*, a total of 20 participants will be the maximum capacity for the program, and 2 PTs will be present for each in-person session. This maintains a 10:1 ratio of participants to PT to ensure safe supervision. During program evaluation, these numbers may be altered for future enrollment periods based on participant and personnel feedback.
5. *WHERE*

*P.E. for PD* will meet at the Chapel Hill-Carrboro YMCA located at 980 M.L.K. Jr Blvd, Chapel Hill, NC 27514.17 This facility is already equipped with all of the supplies that the program requires (ie: large group fitness room, multiple yoga mats and sets of dumbbells).17 Additionally, this YMCA has shown dedication to the community’s health and wellness through existing programs, such as: Diabetes Prevention Program, Moving for Better Balance, Blood Pressure Self-Monitoring, etc.17 Participants can enroll in the *P.E. for PD* program with a YMCA medical membership with referral from their physician.18 Medical memberships are given to those with a health diagnosis (ie: pre-diabetes, hypertension, risk of falls due to age or illness) and allows access to evidence-based programs.18 The membership lasts the duration of the prescribed program and also includes general access to the YMCA.18 Thus, those with PD will be able to access the *P.E for PD* program and gym for 3 months. The YMCA’s policy is that individuals must attend the majority of the program meetings to keep their Medical Membership active, which may provide additional motivation for adherence.18 The P.E. for PD program will be advertised via flyers in local YMCAs, medical offices, PT clinics, and community centers. Interested parties will be directed to call the YMCA’s Medical Membership staff at 919-582-9396 to enroll or to answer any questions.18

1. *WHEN*

The program will initiate when it has been deemed safe for higher risk older adults to congregate in large groups indoors (re: COVID-19). Throughout the 12 weeks, the *P.E. for PD* program will meet every Tuesday and Thursday evening from 7-8:30pm. Tuesday sessions will contain a yoga class and Thursday sessions are for resistance training. Assessments (TUG, ABC scale, PDQ-8) will be measured on the first and last days of the program. Participants will fill out the provided ABC scale and PDQ-8 questionnaires as they wait for their turn to perform the TUG. The TUG is administered by a PT and requires a steady chair, a marking indicating distance of 3 meters, and a stopwatch.12 Specific topics for certain 30-minute group meetings are as follows:

|  |  |  |
| --- | --- | --- |
|  | Tuesday | Thursday |
| Week 1 | Introductions, TUG testing, ABC and PDQ-8 questionnaires. | Lesson about PAG and goals for home walking program.  Setting personalized goals and signing health contracts.  Disbursal of physical activity tracking diaries. |
| Week 2 | Introduce Rhythmic Auditory Stimulation. |  |
| Week 6 |  | Satisfaction Survey. |
| Week 12 | Personal goal evaluation | TUG testing; ABC, PDQ-8, and satisfaction questionnaires. Wrap-up. |

1. *WHAT (Intervention Specifics)*

Each session will start with a 30-minute group meeting, which will consist of health/wellness lessons and group discussions. The group will discuss general and PD-specific health benefits of physical activity to increase participants’ perceived benefits and intrinsic motivation to create a lasting change in their exercise behavior.10 When appropriate, groups leaders will also distribute handouts or worksheets because educational materials have been shown to effectively communicate both health benefits and outcome expectations of increasing physical activity levels.8 Some topics will include introducing participants to gym equipment machines and problem-solving any difficulties they have accessing them so participants become more familiar and less intimidated by the gym setting. This can help minimize a perceived barrier that is common to adults who are not gym members.10 Other sessions will focus on functional aspects of living with PD, such as useful home equipment or strategies for motor symptoms (ie: freezing gait). The group will also discuss psychosocial topics, such as accepting and adjusting to the PD diagnosis or changing family roles, to provide a space where participants can learn from and support each other. Family members will also be encouraged to join the lessons and group discussions so they can encourage positive behaviors at home. Enlisting this social support can promote behavior change at the interpersonal level to help participants reach their desired goals.9

In the first week of the program, participants will actively create their own short- and long-term goals and sign a health contract with the program’s PTs to encourage self-regulation and accountability.8 Then, a physical activity diary will be distributed to all members so they can record their activity throughout the 12 weeks. The diary will collect data, such as type of activity, level of intensity, and duration in minutes. One of the first lessons will be about the Physical Activity Guidelines for Americans, which informs the home walking aspect of the community program. During group meetings, participants will achieve the guidelines of performing muscle-strengthening activities 2 days per week, and they will have performed 120 minutes of moderate-intensity exercise throughout.19 They will be tasked with walking briskly in their community for 60 minutes each week to help achieve/surpass the benchmark of 150 minutes per week that promotes substantial health benefits for adults and older adults.19 Participants who are more deconditioned will be educated about ways that they can split up the minutes throughout the week (ie: 2 30-minute walks, or 6 10-minute walks, etc). Those who are more conditioned can create higher aerobic activity goals with the PT during goal setting. During the first week, participants will also be paired off with another member based on their age, and the pair will become “buddies” throughout the program. Buddies will be instructed to have a check-in phone call at least 1x/week to provide accountability and support for the walking program.

On Tuesday of the second week, the PT leaders will introduce Rhythmic Auditory Stimulation (RAS). The group will practice synchronizing their walking pace to a metronome set to 120bpm.6 If any participant struggles to maintain this pace, the PTs will help find a slower pace that facilitates improved gait parameters for that individual. Then PTs will distribute a list of songs from various genres that have a pace of 120bpm (or adjusted pace) that participants can use for their walking training. Group leaders will also discuss various options that participants can use to walk accompanied to music. Participants will use their own devices if possible (ie: cell phone, iPod, CD/cassette player) and will be instructed on how to make a playlist of their favorite songs. The leaders can also provide assistance and the program can provide inexpensive options to lend or sell to participants to minimize any barriers to the intervention. The group will be encouraged to use RAS during their home walking program.

Yoga sessions will be 60 minutes in duration and contain Hatha yoga postures in sitting, standing, and supine.3-5 PTs will lead the sessions and can provide individualized modifications as needed. Group leaders will also be given a manual describing the core poses, postures, breathing exercises, and meditation techniques that will be used.5 Yoga classes in this program are modeled after the Mindfulness Yoga for PD (MY-PD) program from Kwok et al’s 2019 RCT that showed improvements in mobility, psychological distress, spiritual well-being, and HRQoL.5 The MY-PD protocol was designed to address the impairments of PD. For example, to combat the rounded shoulders and stooped posture in PD, the mountain pose promotes awareness of the head and shoulders in standing and the cobra pose opens the chest and practices maintaining an upright spine.5 The structure of yoga classes is as follows5:

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| --- | --- |
| Breathing exercises (10 min) | * Diaphragmatic (belly) Breathing * Bee Breath * Lion Breath |
| Warm-up exercises (5 min) | * Child pose * Cat and cow * Bridge * Lying hamstring stretch |
| Sun Salutations (30 min) | * Mountain pose * Upward salute pose * Standing forward bend * Lunge * Plank pose * Knees, chest and chin pose * Cobra pose * Downward-facing dog pose * Lunge * Standing forward bend * Upward salute pose * Mountain pose |
| Cool-down exercises (5 min) | * Child pose * Knee to chest * Corpse pose (Shavasana) |
| Mindfulness Meditation (10 min)  One method performed per session | * Breath awareness * Body scan * Mindful walking * Gatha meditation |

Resistance training sessions will be 60 minutes in duration and utilize dumbbells, ankle weights, and Therabands. Throughout the program, PTs will demonstrate safe ways to use weights during exercise; and they will help participants find the appropriate resistance for each movement. Based on Haas et al’s success with improving gait dysfunction and strength, group leaders will measure participants’ one repetition maximum resistance (1RM) for each movement and begin training sessions at 70% 1RM.2 Throughout the program, the following exercises to address most major muscle groups and promote gains in mobility for the PD population will be introduced: 1) chest press, 2) biceps curl, 3) shoulder press, 4) triceps extension, 5) abdominal curl, 6) back extension, 7) single arm row, 8) hip extension, 9) hip abduction, 10) knee flexion, 11) knee extension, 12) calf raises, and 13-16) ankle dorsi/plantarflexion and inversion/eversion.1,2 Movements that require complex gym equipment (ie: seated leg press) were excluded to ensure availability of equipment for a group class. The group will be taught and instructed to perform 2 sets of 12-20 repetitions to fatigue for each of the movements.2 Group leaders will modify the positioning and type of equipment used for individual participants as needed.

**Program Evaluation**

The interventions in *P.E. for PD* aim to address functional impairments in gait and balance, to reduce falls risk, and to increase overall HRQoL through increased physical activity for those with PD. To determine the effectiveness of this program to achieve its goals and objectives, evidence will be collected on the first and last days of the 12-week program.20 Physical Therapists will administer the TUG and collect the participants’ questionnaires on these days. The average pre- and post-intervention scores will be compared to determine if a significant change in function occurred. The outcome measures used to indicate effectiveness are credible and validated for the PD population.12-15, 20 By the end of the program, participants should increase their mean TUG time by greater than 3.5 seconds, increase their mean ABC Scale score by greater than 13.0 points, and increase their mean PDQ-8 score by greater than 4.91 points.12-15 Additionally, participants should report compliance with their home program of walking for at least 60 minutes weekly.

A satisfaction survey will be administered to both participants and group leaders at the mid-point and final day of the program to gather information about implementation, efficiency, and perceived value of *P.E for PD*.20,21 PT group leaders will be asked if the program’s activities were put into place as originally planned and asked if they have any suggestions for better utilization of resources.20 Participants will be asked if they feel they are benefitting from the program (and how); how the program fits their needs; if there are any challenges/barriers to participating in the program; and what they do differently as a result of the program.21 Both groups will be asked to identify strengths and weaknesses of the program and provide any suggestions for improvement.21 Results at the mid-point can be used to make adjustments during the second half of the program; and all gathered information can be used to inform changes to the program in the future.21

The ultimate purpose of program evaluation is to use the gained information to improve the program.20 By analyzing these results, developers of *P.E for PD* can make recommendations for future installments of the program.20 If outcomes do not show significant improvement and/or those involved are not satisfied with aspects of the program, changes should be made based on feedback from participants and personnel.20,21 All results and analyses will be made available to all parties involved in the program in order to build and maintain trust with *P.E. for PD*’s stakeholders.20

**Conclusion**

Physical inactivity is a risk factor for the development of obesity, metabolic syndrome, and its associated chronic conditions. Adults with PD may be less likely to engage in exercise if their PD symptoms make physical activity more difficult.Without intervention, these patients are at an increased risk for multiple chronic illnesses that can diminish their functioning and quality of life. *Physical Education for Parkinson Disease (P.E. for PD)* introduces safe ways to participate in yoga and resistance training, and it encourages adoption of regular home exercise. By incorporating constructs from the Health Belief Model and Social Cognitive Theory, *P.E. for PD* promotes lasting behavior change in physical activity. Guidance through group fitness classes facilitates gains in self-efficacy that may increase participants’ intrinsic motivation to continue exercising. Educational sessions and group discussions can foster social support and increase participants’ perceived benefits of physical activity. The program design also encourages self-regulation and accountability through goal setting and use of an activity diary. *P.E. for PD* provides a safe, motivating environment with exercise interventions that are feasible and can be modified to accommodate PD symptoms. Through this community-based exercise program, participants will be equipped and empowered to modify the progressive course of PD and improve their PD symptoms, motor functioning, and quality of life.

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