



Components of a successful community-based exercise program for individuals with Parkinson's disease: Results from a participant survey

Anson B. Rosenfeldt^a, Mandy Miller Koop^a, Amanda L. Penko^a, Eric Zimmerman^b, Deborah M. Miller^{c,d}, Jay L. Alberts^{a,b,*}

^a Cleveland Clinic, Lerner Research Institute, Department of Biomedical Engineering, Cleveland, OH, USA

^b Cleveland Clinic, Neurological Institute, Center for Neurological Restoration, Cleveland, OH, USA

^c Cleveland Clinic, Neurological Institute, Mellen Center, Cleveland, OH, USA

^d Cleveland Clinic Lerner College of Medicine of Case Western Reserve School of Medicine, Cleveland, OH, USA

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ABSTRACT

Objectives: The aim of the project was to examine the personal beliefs, motivators, and barriers in people with Parkinson's disease (PwPD) relating to their participation in a year-round community-based cycling program, Pedaling for Parkinson's (PFP).

Design: Cross-sectional survey from a 12-month pragmatic study.

Setting: Five community-based PFP sites.

Main outcome measures: A survey was designed to capture the attitudes and beliefs of those participating in a PFP program. Survey responses were rated on a 5-point Likert scale (1–5; higher number representing a more positive response) assessing the subdomains of Personal Beliefs and Knowledge, Health and Disability, Program, and Fitness Environment following a 12-month exercise observational period.

Results: A total of 40 PwPD completed the survey. Mean subdomain scores were as follows: 4.37 (0.41) for Personal Beliefs and Knowledge, 4.25 (0.65) for Health and Disability, 4.11 (0.53) for Program, and 4.35 (0.44) for Fitness Environment. There were no significant correlations between survey subdomains and demographic variables (age, years of education, years since diagnosis, years attending the PFP program, and disease severity) or subdomains and exercise behavior (cadence, attendance, and heart rate).

Conclusions: Regardless of demographic variables and disease severity, PwPD who attended a PFP program enjoyed the class, felt that their PD symptoms benefited from exercise, and were motivated to exercise by their PD diagnosis. Factors such as location of the gym, cost, and transportation were important. With the growing body of PD literature supporting the role of exercise in potentially altering the disease trajectory, it is critical that communities adopt and implement exercise programs that meet the needs of PwPD and facilitate compliance.

1. Introduction

Over the past decade, exercise has emerged as an important component of disease management in people with Parkinson's disease (PwPD). Initial studies with animal models of PD indicated high intensity aerobic exercise was neuroprotective and promoted neuroplastic changes in the central nervous system (CNS) via the modulation of neurotransmitters such as dopamine,¹ brain derived neurotrophic factor

(BDNF), glial derived neurotrophic factor (GDNF),^{2,3} striatal dopamine transporter⁴, and dopamine D2 receptors.^{4–6} Human mechanistic studies, although preliminary, largely indicate similar CNS changes^{7–10} with short-¹¹ and long-term^{12,13} exercise studies supporting the potential of aerobic exercise as a disease modifying intervention. The mechanistic and behavioral results are encouraging and promote aerobic exercise as a complimentary treatment to medical and surgical disease management.

Abbreviations: BDNF, brain derived neurotrophic factor; CNS, central nervous system; GDNF, glial derived neurotrophic factor; HR, heart rate; PFP, Pedaling for Parkinson's; PwPD, people with Parkinson's disease; REDCap, Research Electronic Data Capture; RPE, rating of perceived exertion; RPM, revolutions per minute; MDS-UPDRS III, Movement Disorder Society–Unified Parkinson's Disease Rating Scale, motor portion.

* Correspondence to: Cleveland Clinic, 9500 Euclid Ave., ND20, Cleveland, OH 44195, USA.

E-mail address: albertj@ccf.org (J.L. Alberts).

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In 2021, the Parkinson's Foundation and the American College of Sports Medicine recommended PwPD complete 90–150 min of aerobic exercise per week.¹⁴ Current evidence indicates that PwPD are not meeting those recommendations, as only 27 % of PwPD engage in 150 min of moderate-vigorous physical activity per week and 16 % achieve 7000 or more steps per day.¹⁵ The low level of physical activity may be in part due to the barriers to exercise in PwPD, which include low outcome expectations, lack of time, fear of falling,¹⁶ and lack of motivation.¹⁷ Community-based exercise classes may overcome barriers and encourage exercise compliance by fostering meaningful social interactions, providing external motivation via an exercise instructor,¹⁸ and being conveniently located close to one's home.¹⁹

Pedaling for Parkinson's (PFP) is a community-based aerobic exercise program for PwPD. Informed by a successful laboratory cycling protocol that resulted in PD motor symptom mitigation,^{11,20} the PFP protocol focuses on high cadence cycling. Classes are held year-round, three times per week, at more than 150 fitness centers throughout the United States. Due to the widespread adaptation and standardized cycling protocol, PFP is an ideal program to observe real-world exercise behaviors in community-dwelling PwPD. Recently, we completed a 12-month pragmatic study examining exercise attendance and intensity in PwPD who attended a PFP program.²¹ As opposed to an explanatory design where conditions are tightly controlled, pragmatic trials are designed to examine interventions under "real-world" conditions in an inclusive group of participants who are representative of those likely to receive the intervention,^{22,23} provide interventional flexibility in a range of environmental settings from administrators who may not be experts in the field, and unobtrusively measure compliance.^{23,24} In an effort to examine "real-world" exercise behaviors, the researchers did not interfere with the class, but rather the study team remotely observed exercise behaviors over a 12-month duration. The results of the 12-month observational period demonstrated that participants attended approximately 1–2 classes/week and exercised at moderate-high intensity based on heart rate and cadence data.²¹ Importantly, the study confirmed that well-designed laboratory protocols can be successfully translated for wide-spread adaptation in communities and facilitate compliance with the aerobic exercise recommendations put forth by the Parkinson's Foundation and the American College of Sports Medicine.¹⁴

To complement our exercise behavioral outcomes, we sought to examine personal beliefs, motivators, and barriers to PwPD participating in a year-round PFP program by conducting an exit survey at the end of the 12-month observational period. We aimed to examine the relationship between demographic variables and survey responses, including general attitudes towards participating in community-based research. Insight into exercise attitudes and beliefs in successful community programs may assist in tailoring future programs for neurologic populations.

2. Methods

Participants were part of a pragmatic observational trial examining exercise behavior in a PFP program over a 12-month period. An exit survey created specifically for the PFP class and research project was administered at the final 12-month assessment to gauge attitudes and beliefs surrounding the PFP program and research participation.

2.1. Participants

Participants were recruited from five community-based facilities (two in northern Washington and three in central Colorado) with established PFP programs. The sites were selected based on geographical diversity (e.g., one site was located in a rural setting, one was urban, and three were suburban), stability of program, and administrative accommodation of each facility. All PwPD who were attending one of the five PFP sites were eligible to enroll in the study if they met the inclusion/exclusion criteria; however, participation did not preclude one's ability

to attend PFP classes. Participants were asked to attend PFP classes at their typical frequency. In accordance with the pragmatic study design, study personnel did not provide instructions or feedback regarding attendance or exercise intensity to either the participants or group fitness instructors.

All participants completed the informed consent process approved by the Cleveland Clinic Institutional Review Board. Individuals with a diagnosis of idiopathic PD who were participating in a PFP program and had the ability to provide informed consent were included. Those who were participating in another pharmaceutical or interventional PD-related study, had a diagnosis of dementia or had undergone deep brain stimulation, or who had a neurological disease other than PD were excluded.

2.2. Pedaling for Parkinson's (PFP) program

Each of the five sites had an established PFP program (length of establishment ranged from 8 months to 4.5 years). To establish a PFP program, fitness centers complete a no-cost licensing agreement (<https://www.pedalingforparkinsons.org>). All PFP sites are provided with the PFP exercise guidelines, safety considerations, guidelines for selecting appropriate participants based on physical and cognitive abilities, and tips for delivering effective group exercise to individuals with PD. Classes are held 3x/week and are conducted year-round. The exercise protocol specifies 45–60 min of cycling (including a 5–10 min warm-up and cool-down), a target pedaling cadence between 80 and 90 revolutions per minute (rpm), and an aerobic intensity between 60 % and 80 % of their age-estimated heart rate (HR) maximum or a rating of perceived exertion (RPE) between 4 and 7 on a 10-point RPE scale. The PFP protocol details safety measures such as how to mount and dismount a cycle based on physical ability and provides a pre-exercise participation medical screen and physician clearance form. General instructor training and an overview of PD pathology is outlined, as classes are typically taught by a group fitness instructor who does not have PD-specific training.

2.3. Study design

Study personnel were scheduled to make a total of three visits to each site at enrollment, 6-months, and 12-months. During the initial visit, the informed consent process was completed, a battery of motor and non-motor assessments were conducted, and the exercise monitoring systems were set up. Assessments were completed in both the on-antiparkinsonian and off-antiparkinsonian (withholding PD medication 12 hours prior to testing) medication state. The assessment included a Movement Disorder Society – Unified Parkinson's Disease Rating Scale, motor portion (MDS-UPDRS III),²⁵ a scale of global motor function in PD, which served as a measure of overall disease severity. Over the 12-month observational period, exercise behaviors were remotely monitored. Participants donned HR and cadence monitors at each class; exercise data (attendance, cadence, and HR response) were transferred to the study team through various group or individual monitoring systems. Participants were able to view exercise performance data through the exercise monitoring systems, and study personnel did not provide specific attendance or performance feedback. Details of the remote exercise monitoring have been described previously.²¹

2.4. Survey design

The exit survey was designed by the investigators based on experience and an extensive literature review of the barriers and motivators of exercise in neurologic populations.^{16–19,26–28} The primary author of the survey was a physical therapist board certified in neurology. Following the initial draft, the survey was reviewed and edited by an exercise physiologist and a Ph.D. researcher with over two decades of experience in PD exercise-related interventions. Appropriate edits were made, and

the survey was transcribed into REDCap (Research Electronic Data Capture),^{29,30} a secure electronic database hosted in the Cleveland Clinic.

Based on the literature review and expert opinion, a total of 47 survey questions were created and grouped into 4 categories: Personal Beliefs and Knowledge (9 questions), Health and Disability (7 questions), Program (14 questions), and Fitness Environment (8 questions). Additionally, a section on attitudes and beliefs specifically related to the research (9 questions) was included in the survey.¹⁹ Participants were asked to rank each question on a 5-point Likert scale; strongly disagree (1), disagree (2), neutral (3), agree (4), and strongly agree (5). To avoid confusion, negatively and positively worded questions were clearly delineated in the survey.³¹

The survey was designed to be self-administered on an iPad. Participants from the Washington sites completed the survey in-person during the 12-month assessment. The final site visit for the three sites in Colorado was scheduled to be conducted during the spring of 2020; however, due to the COVID-19 pandemic, traveling and in-person evaluations were not feasible. The study team pivoted to telehealth assessments,³² and the exit survey was emailed to participants via the REDCap portal.

2.5. Statistical analysis

Summary statistics were computed for participant demographics (Table 1). For survey data, mean scores were calculated for each question and for each domain. When calculating mean of each subdomain, negatively worded questions were reversed in score so that higher values indicate more positive responses for all questions. Pearson correlations were computed to determine the relationship between subdomain scores and select demographic (age, years of education, years since diagnosis, years attending the PFP program, and disease severity) and mean exercise performance variables (attendance, percentage of age-estimated HR max, and cadence). Symptom severity was measured by the Movement Disorder Society – Unified Parkinson's Disease Rating Scale, motor portion (MDS-UPDRS III) in the off medication state.²⁵ The significance of correlations was controlled for using the Bonferroni method of

Table 1
Participant demographics and baseline characteristics.

	N = 40
Age (years)	69.2 ± 6.6
Male	24 (60 %)
Race	
White	38 (95 %)
2 or more	2 (5 %)
Ethnicity	
Hispanic or Latino	1 (3 %)
Not Hispanic or Latino	39 (98 %)
Years of education	16.7 ± 2.7
Employment status	
Employed full-time	2 (5 %)
Employed part-time	2 (5 %)
Retired due to PD	9 (23 %)
Retired by choice	27 (68 %)
MDS-UPDRS III Score (off medication)	37.7 ± 12.4
Hoehn and Yahr stage (off medication)	
I	2 (5 %)
II	28 (70 %)
III	10 (25 %)
Disease duration (years)	5.3 ± 4.6
Self-reported Exercise Frequency (days/week)	5.3 ± 1.4
Levodopa Equivalent Daily Dose, mg	633 ± 385
Years attending PFP class	1.5 ± 1.5
Taking a beta blocker	7 (18 %)

MDS-UPDRS III = Movement Disorders Society-Unified Parkinson's disease Rating Scale, motor portion

Summary statistics presented as mean ± standard deviation or N (%) for categorical data.

controlling family-wise error rate with a significance level of 0.05. All statistical analysis was computed using RStudio 2021.9.1.372, R version 4.1.2.

3. Results

A total of 40 participants completed the survey either during the in-person assessment or via email. Demographics are displayed in Table 1.

3.1. Survey results

Results from individual survey questions are presented in Table 2. Mean subdomain scores were as follows: 4.37 (0.41) for Personal Beliefs and Knowledge, 4.25 (0.65) for Health and Disability, 4.11 (0.53) for Program, and 4.35 (0.44) for Fitness Environment (Fig. 1).

The final survey question read "How did you first find out about the PFP class at your gym?" Subjects were able to select more than one response. Participants indicated that they initially heard about the PFP class by word-of mouth (n = 18, 45 %), PD-specific support group (n = 12, 30 %), through another PD-specific exercise group (n = 9, 22.5 %), health care provider (n = 6, 15 %), advertisement directly from the exercise facility (n = 5, 12.5 %), advertisement from a source other than the exercise facility (n = 3, 7.5 %), and other (n = 3, 7.5 %).

3.2. Results from research-specific questions

The mean score from the research subdomain was 4.14 (0.45) points. Responses to individual questions are presented in Table 3.

3.3. Correlations between survey subdomains and demographic variables

Mean attendance from the observed cohort was 75.6 (26.4) sessions over the 12 month period; mean cadence was 75.0 (8.6) rpms and mean percent of age-estimated HR maximum was 70.0 (12.3) %. There were no significant correlations between survey subdomains and measures of exercise behavior including attendance, cadence, and HR (p > 0.05).

There were no significant correlations between survey subdomains and demographic variables including age, years of education, years since diagnosis, years attending the PFP program, and disease severity (p > 0.05).

4. Discussion

Aspects of personal beliefs, disability, environment, and the program itself appear to be key to facilitating successful community-based exercise programs for PwPD. The successful translation of an effective laboratory-based exercise protocol into a PFP program currently implemented in over 150 community-based sites is encouraging and can be used to inform future disease-specific community-based exercise programs. With the growing body of literature that supports exercise in mitigating disease symptoms and potentially altering the disease trajectory, it is critical to identify exercise attitudes, motivators, and barriers to exercise in this disease population. Likewise, it is critical that communities adopt and implement exercise programs that meet the needs of PwPD and facilitate exercise compliance.

The Personal Beliefs and Knowledge subdomain affirmed that PwPD are motivated to exercise due to their PD diagnosis and possess a general belief that exercise is beneficial to their physical and mental well-being. The cohort reported being very motivated by their PD diagnosis to attend the PFP class. In a 2013 publication, Ellis and colleagues reported that low outcome expectation (i.e., the participants did not expect to derive benefit from exercise) was the most prominent barrier to exercise participation in PwPD.¹⁶ In the decade since, aerobic exercise has become a mainstream complimentary PD intervention and is generally encouraged by health care providers for its overall health benefits and the positive impact on PD symptomology.³³⁻³⁵ Our survey results

Table 2
Exit survey results (N = 40).

	Mean (SD)
Personal Beliefs and Knowledge	
Cycling improves my PD motor symptoms (i.e. tremor, slowness of movement, walking, balance)	4.4 (0.7)
Cycling improves my cognition (i.e., how I think, process information, and my memory)	4.0 (0.8)
Participating in cycling gives me a sense of well-being	4.7 (0.5)
I enjoy participating in the PFP classes	4.7 (0.6)
My PD diagnosis motivates me to participate in PFP classes	4.7 (0.7)
I perform other types of exercise (i.e. exercising at home, outside, or in the gym) in addition to the PFP classes	4.6 (0.8)
There is scientific evidence that cycling improves PD symptoms	4.3 (0.7)
I feel self-conscious in the gym because of my PD ^a	2.0 (0.8)
My mood (i.e. depression, anxiety) prevents me from exercising ^a	2.0 (1.0)
Health and Disability	
My neurologist encourages physical activity	4.6 (0.5)
Attending PFP classes increases my overall physical activity level	4.7 (0.5)
Since being diagnosed with PD, I exercise more	4.3 (1.0)
My PD symptoms limit my ability to cycle in the PFP class (i.e. rigidity, tremor, gait and balance, medication wearing off) ^a	2.0 (1.2)
Dyskinesias (extra movements) as a result of my PD medication limit my ability to cycle ^a	1.7 (1.0)
Dystonia (muscle spasms) as a result of PD limit my ability to cycle ^a	1.7 (1.0)
Other health issues (non PD related) limit my ability to cycle ^a	2.5 (1.4)
Program	
The PFP protocol is attainable (i.e. 80 +rpm for 30–45 min exercise set)	4.4 (0.8)
The bike is comfortable	3.4 (1.2)
It is easy to get on/off the bike	4.1 (0.8)
I feel safe when exercising on the bike	4.5 (0.6)
I prefer to exercise in a group, rather than on my own	4.2 (0.7)
The group setting motivates me to cycle more frequently than I would on my own	4.4 (0.8)
The group setting motivates me to cycle harder than I would cycle on my own	4.2 (0.9)
I like having a cycling instructor motivate and guide me through the class	4.6 (0.6)
I like the music that the instructor selects	3.8 (0.8)
My instructor is knowledgeable about PD	4.3 (0.7)
I enjoy the comradery of the PFP group	4.7 (0.5)
I get bored with the repetitiveness of cycling ^a	2.4 (1.2)
I have difficulty completing daily tasks after the PFP class because I feel too tired ^a	2.1 (1.1)
I have difficulty completing my daily tasks/chores after the PFP class because my muscles and/or joints are sore ^a	1.8 (1.0)
Fitness Environment	
The location of the PFP class is convenient to my home	4.2 (1.0)
The cost of the PFP class and associated gym membership is reasonable	4.7 (0.5)
The cycling room is easy to navigate (i.e. I can easily maneuver my body between bikes.)	4.2 (0.9)
My gym where the PFP class is held is accessible to individuals with mobility problems and disabilities	4.2 (0.5)
I have a reliable mode of transportation to get to PFP class	4.6 (0.6)
Parking at my gym where the PFP class is held is convenient	4.0 (1.1)
People who are close to me (i.e. spouse, family, friends) support me attending the PFP class	4.9 (0.4)
Being around other people with PD makes me fearful about my future ^a	2.3 (1.0)

^a Question is negatively worded, where a lower score indicates a more positive response.

indicate that patient attitudes regarding the role of aerobic exercise in mitigating disease symptoms is evolving, and the value of aerobic exercise is being realized by PwPD.

The Health and Disability subdomain revealed that PwPD generally disagree that their PD symptoms limit their ability to participate in the cycling class. This is consistent with previous reports that the ability to cycle persists even as gait and posture deteriorate and freezing of gait increases.^{36,37} While other forms of aerobic exercise, such as over ground and treadmill walking, also appear to provide symptomatic benefit,^{12,38} cycling limits postural demands and may provide a safer approach to achieve and sustain high intensity aerobic exercise at various stages of the disease process.

The Program subdomain revealed that PwPD generally felt that the PFP protocol is attainable and were motivated by cycling with their peers and the instructors. Two modifiable areas of improvement include the comfort of the upright cycle and the instructor's music selection. The PFP classes are conducted in cycling rooms and almost exclusively using upright spinning bikes, which generally have small, hard seats. Padded cycling shorts and/or a padded seat are simple ways to increase comfort. Music selection reveals an opportunity for the instructor to interact with the participants in selecting desirable, motivating music for the group. One of the sites planned to implement a "Cyclist of the Month" who

would select up to 5–10 songs that would be included in the monthly playlist. Similar engagement strategies can be implemented with minimal effort to facilitate enjoyment and compliance.

Lastly, the Fitness Environment subdomain revealed that cost of the program, parking and transportation, proximity to residence, and ease of gym navigation are important to participants. A PFP implementation study revealed that the most common reason that PwPD elected not to participate in a PFP program was inconvenient class time or location,³⁹ highlighting the importance of "meeting people in their communities". In terms of cost, the majority of sites included the PFP class as part of the standard monthly membership fee; one site allowed PwPD to attend the class at no cost. We did not measure the cost of the program to the fitness site, as this is a known barrier to site implementation.³⁹ However, the majority of gyms use an existing cycling or spin room with existing upright bikes; the major cost to the fitness facility is supplying a group cycling instructor. From a gym navigation standpoint, instructors at several of the sites strategically arranged the bikes several feet apart to increase the navigational ease between bikes. Additionally, two of the sites preferred setting up the room with bikes in a circular arrangement to facilitate personal connection.

There was no significant relationship between survey subdomains and key demographic variables, including disease severity, and survey

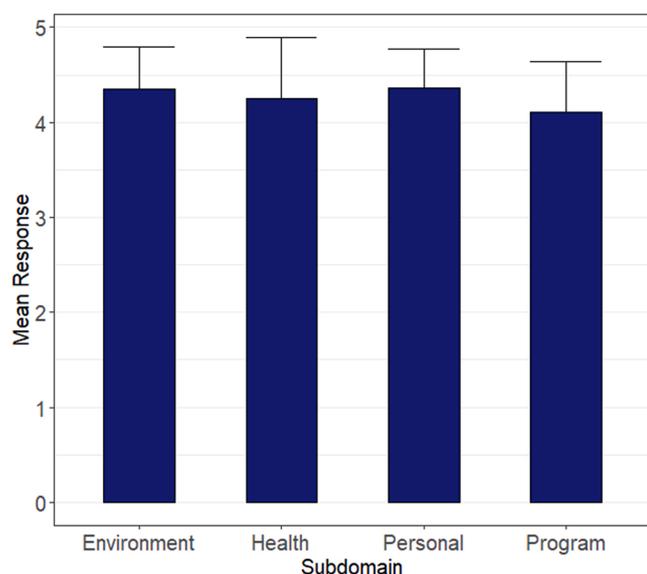


Fig. 1. Mean, SD of the Health and Disability, Fitness Environment, Personal Beliefs and Knowledge, and Program Subdomains. When calculating mean of each subdomain, negatively worded questions were reversed in score so that higher values indicate more positive responses for all questions.

Table 3

Research subdomain results (N = 40).

	Mean (SD)
Being part of the study improved my motivation to attend PFP classes	4.4 (0.6)
Being part of the study encouraged me to cycle faster	4.3 (0.8)
I feel that I am contributing to the PD community by being part of this research study	4.5 (0.6)
I feel connected to the other PFP sites (Colorado and Washington) who are part of this research study	3.2 (0.9)
I will continue to cycle in the PFP program once the research study is over	4.5 (0.6)
I will continue to cycle the same amount and intensity once the research study is over	4.4 (0.7)
Getting the heart rate monitor on my body was easy	3.7 (1.2)
Receiving feedback on my cycling frequency, cadence, and heart rate as part of the research study motivated me to work harder	3.9 (0.8)
I would be willing to participate in another research study relating to PD in the future	4.5 (0.6)

subdomain response. Our results are encouraging, as PwPD, regardless of age, sex, and disease duration or severity, exhibit positive feelings towards the PFP program. As mentioned above, this may be due to the safety and feasibility of cycling throughout the disease process, even as gait and postural deficits worsen.^{36,37} There was also no significant relationship between subdomain scores and performance variables (i.e. attendance, cadence, and HR), indicating that general enjoyment of the class does not drive performance. We acknowledge the potential bias in our sample, as those who were dissatisfied with the program may have discontinued the workouts; however, our previous publication noted that only one of the study PFP participants was lost to follow-up,²¹ substantiating that the PFP model is successful in retaining participants over a 12-month period of time. Individuals in the study were already exercising and self-reported a high level of physical activity, and thus the results may not be generalizable to an exercise naïve or sedentary cohort of PwPD. Additionally, the majority of the population was white, non-Hispanic, and were highly educated; it is unknown if this was due to site selection bias or if the racial and educational profile is representative of those who attend community-based exercise classes. Further work is necessary to identify strategies scale the PFP program to ensure it reaches PwPD broadly and is accessible to all communities.

This project is unique in that it was designed to be truly pragmatic. Study assessments and interventions were performed entirely at the community exercise site and group exercise classes were taught by a group exercise instructor employed by the gym. The participants were asked to don a HR and cadence monitor during each class they attended, but they were not provided instructions regarding exercise frequency or intensity by the study team. While participants generally agreed that being part of the study provided motivation to exercise, an overwhelming majority agreed or strongly agreed that they would continue to exercise at the same frequency and intensity once the study was completed. Overall, the cohort of PwPD in this project were enthusiastic about participating in the research study, considered the burden of participation to be minimal, and felt that they were contributing to the PD community. Notably, the community bond was strong within the PFP classes, and almost half of the participants discovered the class based on word-of-mouth.

The role of exercise in PD management has changed considerably over the past several decades.³⁴ As recently as the 1980's, exercise recommendations for PwPD were predominately driven by clinical opinion and prescribed at relatively low intensity.^{40,41} Impactful animal and preliminary human studies from the past two decades support a recommendation of high intensity exercise for PwPD,^{2,3,9} which has resulted in utilizing aerobic exercise in managing the disease progression. However, in order to be considered a mainstream intervention, it must be endorsed and emphasized by health care providers and to facilitate initiation and compliance by PwPD. Despite the clear evidence that exercise is beneficial in PwPD,^{42,43} adherence to physical activity and exercise is relatively low with only 27 % of PwPD engaging in 150 min of moderate-vigorous physical activity per week.¹⁵ Participation in a regular exercise program requires consistent effort and barriers for PwPD have been well described.¹⁶ Until barriers and low participation levels are addressed, exercise remains a complementary therapy to PD treatment. This study provides a feasible model of a community exercise program for PwPD that provides a supportive environment for the execution of high intensity exercise that is consistent with contemporary exercise recommendations.

In conclusion, disease-specific community-based exercise programs are a feasible and enjoyable way for PwPD to achieve the Parkinson's Foundation and American College of Sports Medicine recommendations for aerobic exercise. The survey provides insight into aspects of a laboratory protocol that was successfully translated into a nation-wide exercise program for PwPD. True community translation in rehabilitation protocols is rare,⁴⁴ and pragmatic study designs allow for unobtrusive examination of "real-world" exercise behaviors. Future studies should consider the use of both pragmatic and explanatory study designs to establish feasibility and efficacy of community-based exercise interventions.

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CRedit authorship contribution statement

Anson B. Rosenfeldt: Conceptualization, data curation, formal analysis, funding acquisition, methodology, project administration; writing – original draft, **Mandy Miller Koop:** Data curation, formal analysis; writing – review and editing, **Amanda L. Penko:** Data curation, project administration, writing – review and editing, **Eric Zimmerman:** Formal analysis; writing - review and editing, **Deborah M. Miller:** Investigation, writing – review and editing, **Jay L. Alberts:** Data curation, formal analysis, methodology, project administration, resources, writing – review and editing.

Declaration of Competing Interest

ABR serves as an unpaid member of the Davis Phinney Foundation Scientific Advisory Board. JLA has authored intellectual property associated with the tablet applications that were used in the larger pragmatic study. DMM is an inventor of the technology underlying the Multiple Sclerosis Performance Test which has been licensed to Qr8 and is entitled to any compensation that results in royalties it accrues. The remaining authors have no conflicts of interest to declare related to this project.

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