

# Methods

## Development and Evaluation of a Yoga Intervention Program for Parkinson's Disease

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### Abstract

Preliminary research indicates that yoga could be a valuable tool for people suffering from Parkinson's disease (PD). However, little has been published about the process by which the yoga interventions were designed and evaluated. This study elaborates on the process of developing and testing a bi-weekly, 12-week yoga program to determine its safety and feasibility for people with PD. The lead yoga teacher used input from a focused literature review to design an initial draft of the intervention program. This draft was reviewed by a group of yoga experts ( $n = 6$ ) to develop the final intervention program. This 12-week intervention was implemented in 19 participants with PD (mean age  $63 \pm 8$ , range 49–75) via twice-weekly yoga classes. Through this comprehensive development process, a series of 24 individual 1-hour yoga sequences was created. These sequences included yoga postures (*asana*), breathing techniques (*pranayama*), and mindfulness meditation principles specifically chosen to address concerns unique to the PD population. The feasibility of the program was supported with excellent attendance: 90% of participants attended  $\geq 75\%$  of the classes, with four participants attending 100%. No adverse events were reported. This development process produced a safe and enjoyable yoga program specific for the needs of people with PD. However, this methodology could serve as a template for future studies on how to develop safe and effective yoga interventions for other populations. Justice, Cheung, & Samson-Burke. *Int J Yoga Therapy* 2018(28). doi: 10.17761/2018-00015R2.

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### Introduction

The objective of this study was to develop and test a biweekly, 12-week yoga program and determine its safety and feasibility for people with Parkinson's disease (PD). PD is a chronic degenerative movement disorder affecting multiple domains including the physical, emotional/affective, and cognitive. It is estimated that PD affects more than one million people in the United States.<sup>1</sup> The primary signs of PD motor dysfunctions include a resting tremor, typically in the arms, hands, legs, feet, jaw, and/or face; bradykinesia, or slowness of movement; rigidity in the limbs and trunk; and postural instability with decreased body awareness, balance, and coordination leading to increased fall risk.<sup>2</sup> In addition to the motor symptoms, PD also can cause affective dysfunctions including depression, difficulty with speech, flat affect, or decreased facial expressions, and cognitive dysfunctions including impaired cognition and decreased sense of smell.<sup>3,4</sup> Because of the multiple domains PD affects, people with PD are in need of holistic, mind-body interventions to address these different ways the disease affects their body, mind, and life.

As currently there is no known cause or cure for PD, people with PD have an extra incentive to find effective and low-cost adjunct treatments to improve quality of life and to foster ongoing management of their physical, mental, and emotional lives. Yoga is uniquely positioned to assist with management of PD because of its potential benefits to these multiple domains, including improved strength, flexibility, and endurance<sup>5</sup>; improved balance, posture, and body awareness<sup>6,7</sup>; increased relaxation and decreased stress response<sup>7,8</sup>; improved respiratory function<sup>9</sup>; and decreased symptoms of depression.<sup>10</sup>

Although there is emerging evidence on the efficacy of using yoga to improve management of PD,<sup>11–20</sup> little has been written about the details of how the yoga programs were developed or the specific yoga practices used. Because

the practice of yoga can be extremely varied from one tradition to another, how the interventions were developed and what specific yoga practices were employed are essential but missing components of the growing body of research. This study aims to fill that gap to make results replicable, guide future research, and guide yoga therapists/teachers themselves on best practices.

This study was part of a wait-list randomized controlled trial. The results of this trial will be reported in a separate paper determining the effect of yoga on stress, motor function, and wellbeing for people with PD. This article examines the design process, intervention protocol, and feasibility and safety of a yoga intervention program for people with PD.

## Methods

### Participant Recruitment

Participants were recruited from clinics via referral and flyers, and through local and national PD networks such as support groups and community events.

Participants were eligible for inclusion in the study if they were diagnosed with mild to moderate idiopathic PD as indicated by Hoehn and Yahr scale stage one to three, aged between 45 and 75 years, on stable dopaminergic therapy for 4 weeks prior to enrollment, and able to ambulate 6 meters with or without an assistive device. Individuals were excluded if they had any of the following conditions: atypical Parkinsonism or other significant brain conditions such as a stroke, failing score on the Exercise Assessment and Screening for You Questionnaire,<sup>21</sup> significant cognitive impairment as indicated by scoring less than 26 on the Montreal Cognitive Assessment,<sup>22</sup> decline in immune function such as pneumonia or systemic infection, spinal fusion or other orthopedic surgery in the past 6 months, significant mental disease or psychosis, need for greater than minimal assistance for gait and transfers, already practicing yoga regularly, or unable to make regular time commitments to the scheduled yoga sessions. Participants were instructed to continue their medications as usual but to inform the researchers if there were any medication changes during the course of the study; thus, this study focused on subjects who were already managing their PD with medication, and participants practiced yoga during their “on” status. The research protocol was approved by the University of Minnesota Institutional Review Board.

### Literature Review

The process of developing the yoga program began with a literature review performed by the lead yoga teacher. The search terms “yoga AND Parkinson’s disease” were entered into PubMed and the *International Journal of Yoga Therapy*

databases. In this search, eight articles were found<sup>11–18</sup> that described yoga interventions for people with PD. Although most of these articles found preliminary efficacy for the therapeutic benefits of yoga for PD, many did not elaborate on the specific yoga practices,<sup>11,13–16</sup> and none detailed the development process for the intervention. The lead yoga instructor reviewed the details of the specific yoga interventions listed in three of the articles and used some of their practices in the initial draft of the intervention for this study.<sup>12,17,18</sup>

Additional resources used in the creation of the initial draft of the intervention included two yoga therapy texts.<sup>23,24</sup> One of these texts described a yoga program for conditions of decreased reactivity of the nervous system.<sup>23</sup> The other described a yoga program for people with multiple sclerosis.<sup>24</sup> Although neither of these were specific for PD, because both PD and multiple sclerosis are diseases that cause hyporeactive nervous systems, some of the yoga practices in the books were used in the initial draft of the yoga for PD intervention.

Personal communications with Kaitlyn Roland, author of a review article on the use of yoga for people with PD,<sup>20</sup> were also used as a resource in this initial draft. All of the resources used in the initial draft are summarized in Table 1.

One important element of this early draft was the specified use of imagery integrated into the instruction for the yoga practices. In particular, use of PD “think BIG,” techniques where exaggerated imagery is used to increase the body’s ability to initiate and scale movement via stimulating a greater release of dopamine in the brain,<sup>25</sup> were detailed in the draft. Examples of this imagery included the instructors asking the participants to increase axial extension in mountain pose (*tadasana*) via imagining that they had a puppeteer string lifting from the crown of their head and suspending them toward the ceiling, or in seated crescent moon (*parsva sukhasana*) imagining they were lifting their body up and over a giant beach ball.

The lead yoga instructor in this study also drew upon her experience and training as a yoga therapist and as a physical therapist to create the initial draft of the program. This, along with the literature review, informed the creation of a draft of 24 yoga classes designed specifically for people with PD.

### Expert Panel Review

The next step in the development process was an expert panel review. The draft of the yoga for PD program was reviewed by a group of yoga experts ( $n = 6$ ) made up of physical therapists, registered/certified yoga teachers, a yoga therapist, a yoga researcher, and a yoga teacher who is also a PD patient. The 1.5-hour yoga expert panel meeting was held at a community center. At the meeting, certain precautions

**Table 1.** Literature Review Summary: Yoga Interventions for Parkinson's Disease

Author(s)	Resource Design (Sample Size)	Description of Intervention	Description of Practices
Boulgarides, et al. (2014) <sup>17</sup>	Pilot study ( $n = 10$ )	8 weekly 1-hour adaptive yoga sessions	Standing poses (included use of a chair for balance and support with these postures): tadasana (mountain pose variations), hasta chakrasana (standing backbend), modified "vrkasana" (tree pose), modified trikonasana (triangle pose), virabhadrasana III (warrior III), virabhadrasana (warrior II), ardha chadrasana (crescent moon), adho mukha svanasana (down dog), prasrita padottanasana (wide-leg forward fold) Seated poses (done sitting in a chair): "upavasta konasana" (single-leg forward fold), paschimottanasana (forward fold), marichiyasana (spinal twist) Supine poses: supta padangusthasana (hamstring stretch), "apasana" (knee to chest), spinal rolls, "jathara parivartasana" (single-leg abduction), setu bandhasana (bridge), savasana (corpse pose)
Kraftsow (1999) <sup>23</sup>	Yoga therapy text	N/A	Arm movements in chair, tadasana (mountain pose) facing wall with arm movements and heel rises, forward bending in a chair, virabhadrasana I (warrior I) adaptation, utkatasana (chair pose) in a chair, anuloma krama pranayama (staged inhalation), jathara parivritti (supine twist) variation, nyasa technique with sound (chanting om), sitting on a chair (seated mountain)
McCall (2007) <sup>24</sup>	Yoga therapy text	N/A	Chanting om, baddha konasana (cobbler's pose) seated in a chair, virabhadrasana II (warrior II) seated in a chair, supported utthita parsvakonasana (extended side-angle pose) in a chair, supported trikonasana (triangle pose), virabhadrasana I (warrior I) with chair, "parivrtta parsvakonasana" (revolved side-angle pose) with a chair, paschimottanasana (seated forward bend) using two chairs, bharadvajasana (seated twist) in a chair, purvottanasana (supported front-body stretch) on two chairs, supported savasana (corpse pose) with legs on a chair, breath-awareness pranayama
Moriello, et al. (2013) <sup>12</sup>	Case report ( $n = 1$ )	Twice-weekly 1.5-hour hatha yoga program for 12 weeks, followed by 12-week home program	Cat/cow, sun salutation, chaturanga (four-limbed staff pose), modified lunges, chair, warrior III, tabletop, reverse plank, straddle and scissor kicks, savasana (corpse pose), quadruped with arm/leg lifts, prone lat pulls, warrior I, one-leg warrior II, reverse warrior, long sit stretch, tree, pigeon, ankle-to-knee pose, straddle "forward bend," standing single-limb straight-leg raise, pilates one hundreds, one-leg chair, seated straight-leg raise, side-angle lunge
Newell (2005) <sup>18</sup>	Description of an exercise, yoga, breathing, and meditation program	N/A	Sessions began with diaphragmatic breathing/body scan; article included examples of two modified yoga poses: tree pose with hand on chair or seated in chair, warrior II with hand on chair or seated in chair
Rowland (2016)	Personal communication	N/A	Functional movement training, chanting om, dirgha pranayama (deep diaphragmatic breath), tennis-ball massage for soles of feet, postural awareness, upward reach in standing/supine, bridge pose, chair pose, crescent moon sidebending, warrior II, nadi shodhana (alternate-nostril breathing), warrior III with chair, lion's breath, three-part breath, yoga nidra, supported savasana (corpse pose)

were discussed, such as avoiding sequences of poses that would trigger orthostatic hypotension or retropulsion episodes and the importance of teaching careful transitions to and from the poses. The therapeutic value of balancing and standing postures, poses to correct slumped-forward posture, and poses encouraging thoracic and hip mobility was also emphasized by the panel.

### **Final Draft and Intervention Protocol**

The final draft of the yoga for PD program was then completed by the lead yoga instructor, taking into account the recommendations of the panel. A hatha- and vinyasa-inspired approach was the primary yoga tradition used in this study. Hatha yoga classes are generally slow-paced, gentle, and focused on the therapeutic anatomy of the yoga postures,<sup>26</sup> which is an especially useful approach for groups of people new to yoga, as in our study. Vinyasa yoga's use of coordinating breath and movement as well as awareness of the transitions from one pose to the next<sup>27</sup> was thought to be potentially useful for people with PD in assisting with movement initiation and safety. This vinyasa style is similar to an approach used in a randomized controlled trial by Ni et al.,<sup>19</sup> which found comparable therapeutic benefit for yoga and power strength training for people with PD. However, because that study was published after the development process for our project, it was not part of the original literature review. An Iyengar-inspired approach was chosen as an additional yoga tradition because of the usefulness of Iyengar yoga props and posture adaptations to help improve comfort and safety.<sup>28</sup>

The intervention program was implemented to two randomized cohorts of 9–10 participants with PD ( $N = 19$ ) via twice-weekly yoga classes for 12 weeks. This protocol matched that of a randomized controlled trial by Colgrove et al.,<sup>16</sup> which found therapeutic benefit from a yoga program for people with PD. The two cohorts were taken through the program sequentially, with the first from April–June and the second from June–September 2016. The first cohort (immediate treatment group) received the 12-week intervention right away, while the waitlist group served as the control during the first 12 weeks. The waitlist group participated in the same intervention program 13 weeks after randomization. The yoga studio chosen for the study was conveniently located in South Minneapolis and had ample street parking. The yoga props available to the class included mats, chairs, bolsters, blocks, blankets, straps, sandbags, and wall space. A basic emergency protocol, including the line of communication and who to contact if an emergency situation occurred, was created.

The two instructors for the classes alternated, with one teacher teaching Tuesday and the other teaching Thursday classes. Both instructors were also physical therapists, and each had  $\geq 10$  years of yoga teaching experience. The lead instructor (C. Justice) has a teaching background primarily in therapeutic hatha/vinyasa yoga. The second instructor's (A. Samson-Burke) primary background is in Iyengar yoga. The use of two instructors assisted with the validity of the study by minimizing the treatment effects of the personality of the teachers and their interactions with the students. This reduced the potential for bias in the results of this study, particularly in the feasibility measures. However, to ensure consistency and fidelity of the program delivery, a teaching notebook was used as a means of communication between the two teachers. The notebook was highly detailed, with 119 pages listing the individual sequences, weekly themes, and suggested modifications for the yoga practices. Additionally, the yoga researcher (C. Cheung) was present on randomly selected dates to observe the adherence to the original design of the intervention program and the consistency between the two teachers during program implementation. The teachers used the teaching notebook to record any reflections that the participants reported each week, the observations of teachers, and as a means of communication for any relevant information that one instructor needed to impart to the other.

### **Postintervention Reflection and Evaluation**

At the end of each of these 12-week intervention periods, both yoga instructors met with the head researcher for 1.5–2 hours to discuss and reflect on what worked well, challenges/areas for improvement, and to create a list of key yoga postures and breathing/relaxation practices.

The feasibility of the program was assessed through the lens of safety, attendance, and participant satisfaction. Safety was assessed through adverse-event reporting, including falls with or without any injuries, strains, and moderate to severe or prolonged muscle soreness. Participants were monitored by the yoga instructors during each of the group sessions and were asked at the beginning of each class whether they had experienced any unusual signs and symptoms at home during the 12-week intervention period.

Patient satisfaction was measured using three survey questions on a 4-point Likert scale, where 1 represents the most negative and 4 represents the most positive. The survey questions addressed the overall enjoyment of the intervention program and whether the frequency and duration of the program were satisfactory. Descriptive statistics were used to calculate means and standard deviations for all feasibility outcomes.

## Results

### Participants

Recruitment took 4 months. A total of 51 potential participants, who either signed up at a recruitment event or contacted the study line, were screened by a trained research assistant. Forty met the inclusion criteria and were invited to participate in the second-step screening that included the Exercise Assessment and Screening for You Questionnaire<sup>21</sup> and a cognitive function test using the Montreal Cognitive Assessment.<sup>22</sup> Twenty individuals (50%) who passed the second screening and were able to commit to the dates and duration of the yoga intervention program were enrolled. Potential participants were excluded for a variety of reasons, the major ones being not passing the cognitive assessment and being unable to commit to the intervention dates and location. The participants had a mean age of  $63 \pm 8$  years (range 49–75) and a mean disease duration of  $4.8 \pm 2.9$  years (range 1–13). Fifty percent of the participants were male. All participants had mild to moderate disease severity as determined by Hoehn and Yahr stage one to three. Eighteen (90%) participants were on dopaminergic medications.

### Yoga for PD Program

Through this rigorous testing and development process, a final yoga sequence of 24 classes (1 hour each) specific for the needs of people with PD was created.

Specific therapeutic foci of the program included increasing range of motion, improving balance and safety with transitions, reducing stress, improving posture, and fostering mindful self-acceptance. Increasing range of motion and flexibility—particularly in the spine, hips, ankles, and shoulder girdles—was a major focus of the program, as stiffness in these areas is one of the primary motor symptoms of PD<sup>29</sup>; yoga postures that target these areas were included in every class. Improving balance and safety with transitions was also taken into consideration via the inclusion of yoga postures emphasizing balance as well as building time and awareness into transitioning to and from the chair or the floor. All mats were positioned around the edges of the room next to the walls of the studio, and every participant had a yoga mat and a chair for added stability with transitions and standing poses. Standing extension postures were omitted from the sequence to avoid episodes of retropulsion. Yoga props (including mats, chairs, blankets, bolsters, blocks, and straps) were used to help increase physical support and comfort in the different postures. Sandbags were offered for use during corpse pose (*savasana*) to help reduce resting tremors in the hands. To accommodate a wide variety of physical abilities within the partici-

pant pool, modifications to the traditional yoga postures, such as seated versions of standing poses, were also offered. Guided relaxation practices were detailed at the beginning and end of every class to help increase parasympathetic nervous system activation and reduce stress. Yoga poses that assist with upright posture were included in every class, as rounded-forward posture is a common postural pattern in people with PD.<sup>30</sup> The core yoga principles of truthfulness (*satya*) and nonharming (*ahimsa*)<sup>31</sup> were built into the program via instructions for the teachers to encourage participants to be aware of their limitations as well as specific instruction on how to keep themselves safe throughout the practice. Lastly, a focus on fostering mindfulness, self-acceptance, and self-love was written into the program via weekly themes and meditation/guided relaxation topics. Such themes included “learning to listen to your body,” “connecting breath to movement,” “opening the heart,” etc. These themes were intended to link the two classes each week together and to guide a progression of mindfulness practices throughout the trial.

Each class followed a similar format, beginning with a question-and-answer and check-in time with the participants. A short seated guided meditation and breathing practice followed. Next the instructors led the participants through a seated yoga posture sequence designed to open and relax the major joints of the spine, thorax, and extremities. This was followed by a standing sequence emphasizing posture awareness, weight transfer and balance, and coordination of breath with movement. Then came quadruped, supine, and prone sequences designed to further increase flexibility in the spine and hips, coordinate movement and breath, and increase core strength. Each class ended with restorative postures designed to induce relaxation and calm the nervous system.

The classes were designed with a progression of increasing challenge throughout the 12 weeks. The initial 3 weeks of classes focused on foundational yoga postures, basic breathing techniques, mindfulness, body awareness, and cultivating self-compassion. Each class built upon the previous class, adding one to four new poses each session with increasing challenges for balance, coordination, respiratory capacity, strength, and mobility. As the weeks went on, the program also included more transitions to and from the floor, advanced breathing techniques, and yoga sequences encouraging thoracic extension and rotation, deep relaxation, and fluidity of movement. The final classes included a modified sun salutation sequence in which many students were able to transition between standing and the floor for several repetitions. Representative sections of the intervention program are detailed in Table 2.

**Table 2.** Yoga for Parkinson's Disease Intervention Program,\* *continued on next page*

Week	Theme	Yoga Intervention
1, classes 1 and 2	Learning to listen to your body	<p>Seated poses (sitting on bolster or in a chair)</p> <ol style="list-style-type: none"> <li>1. Easy pose</li> <li>2. Diaphragmatic breathing training</li> <li>3. Wrist/shoulder/ribcage circles</li> <li>4. Seated crescent moon (side-body stretch)</li> <li>5. Seated twist</li> </ol> <p>Standing poses (standing with wall and chair nearby for balance)</p> <ol style="list-style-type: none"> <li>1. Mountain pose</li> </ol> <p>Floor poses (seated chair variations offered, blanket roll under neck in supine poses)</p> <ol style="list-style-type: none"> <li>1. Cat/cow (moving with breath back and forth between the poses)</li> <li>2. Child's pose</li> <li>3. Table pose (moving with breath, shifting weight forward onto hands and back onto knees, maintaining neutral spine)</li> <li>4. Table pose with knee lift (class 2 only; shifting weight back onto legs and lifting knees a few inches off the ground)</li> <li>5. Low lunge with knee on floor (blanket under knee for comfort)</li> <li>6. Low lunge with back knee lifted (class 2 only)</li> <li>7. Pelvic tilts (class 2 only)</li> <li>8. Supine knee-to-chest</li> <li>9. Supine hamstring stretch</li> <li>10. Supine twist</li> <li>11. Supported corpse pose/guided relaxation (bolster under knees, optional sandbags on hands)</li> </ol>
6, classes 11 and 12	Balancing	<p>Seated poses (sitting on bolster or in chair)</p> <ol style="list-style-type: none"> <li>1. Easy pose</li> <li>2. Alternate-nostril breathing</li> <li>3. Wrist/shoulder/ribcage circles</li> <li>4. Seated crescent moon (side-body stretch)</li> <li>5. Seated twist</li> <li>6. Seated goddess arms</li> </ol> <p>Standing poses (standing with wall and chair nearby for balance)</p> <ol style="list-style-type: none"> <li>1. Mountain pose with arm circles</li> <li>2. Chair (class 12 only)</li> <li>3. Warrior I</li> <li>4. Warrior II/reverse warrior (flowing back and forth from one pose to the other, coordinated with breath)</li> <li>5. Tree (one hand on chair; lifted foot placed on heel, inner calf, or inner thigh)</li> </ol> <p>Floor poses (seated chair variations offered, blanket roll under neck in supine poses)</p> <ol style="list-style-type: none"> <li>1. Cat/cow (moving with breath back and forth between the poses)</li> <li>2. Child's pose</li> <li>3. Twisting table (thread the needle)</li> <li>4. Heart chakra pose (puppy pose)</li> <li>5. Table pose with knee lift (shifting weight back onto legs and lifting knees a few inches off the ground)</li> <li>6. Down dog</li> <li>7. Table pose with contralateral arm/leg reaching</li> <li>8. Bridge</li> <li>9. Single-leg bridge</li> <li>10. Supine knee-to-chest</li> <li>11. Supine hamstring stretch</li> <li>12. Supine twist</li> <li>13. Supported corpse pose/guided relaxation (bolster under knees, optional sandbags on hands) or legs on chair/guided relaxation (optional sandbags on hands)</li> </ol>

**Table 2.** Yoga for Parkinson's Disease Intervention Program, *continued*

Week	Theme	Yoga Intervention
12, classes 23 and 24	Gratitude	<p>Seated poses (sitting on bolster or in a chair)</p> <ol style="list-style-type: none"> <li>1. Easy pose</li> <li>2. Heart-centered breathing</li> <li>3. Wrist/shoulder/ribcage circles</li> <li>4. Seated crescent moon (side-body stretch)</li> <li>5. Seated twist</li> <li>6. Seated goddess arms</li> <li>7. Seated eagle (arms only)</li> <li>8. Seated backbend</li> </ol> <p>Standing poses (standing with wall and chair nearby for balance)</p> <ol style="list-style-type: none"> <li>1. Modified sun salutation (optional to do seated chair version from previous week; standing mountain and circle arms, exhale to chair pose, inhale mountain, exhale forward fold and sit in chair, inhale seated cow, exhale seated cat, inhale seated cow, exhale seated down dog [hold five breaths], inhale seated cobra [hold five breaths], exhale seated child's pose, inhale chair pose, exhale circle arms to mountain)</li> <li>2. Modified sun salutation (optional standing version, class 24 only; standing mountain circle arms, exhale chair pose, inhale mountain, exhale forward fold, inhale cow pose, exhale cat, inhale cow, exhale down dog [hold five breaths], inhale cobra [hold five breaths], exhale child's pose [hold five breaths], inhale return to mountain)</li> <li>3. Chair/warrior I (flowing back and forth from one pose to the other, coordinated with breath)</li> <li>4. Warrior II/reverse warrior (flowing back and forth from one pose to the other, coordinated with breath)</li> <li>5. Standing single-leg balance</li> </ol> <p>Floor poses (seated chair variations offered, blanket roll under neck in supine poses)</p> <ol style="list-style-type: none"> <li>1. Bridge</li> <li>2. Supine knee-to-chest</li> <li>3. Supine hamstring stretch</li> <li>4. Supine pigeon (figure four)</li> <li>5. Supine twist</li> <li>6. Supported corpse pose/guided relaxation with gratitude theme (bolster under knees, optional sandbags on hands) or restorative heart opener/guided relaxation with gratitude theme (optional sandbags on hands)</li> </ol>

\*The complete intervention program is available from the corresponding author.

### Program Fidelity

Although there were no objective measurements of fidelity, steps were taken to ensure that the yoga intervention was delivered in a consistent manner between the two instructors. Both teachers followed the yoga sequences laid out in the detailed 119-page teaching notebook. The lead researcher's presence on randomly selected dates also allowed her to observe and communicate with both the instructors to ensure that they were teaching the intervention in a consistent manner.

### Subjective Observations

After each cohort was taken through the program, the teachers and the lead researcher met to discuss the successes and challenges of the program. In these discussions, certain key yoga postures were identified that appeared to have potential therapeutic benefit. Although the measured effectiveness of the program will be reported in a separate paper, the authors of this study noted that postures that emphasized thorax and spinal mobility, balancing/weight shifting,

core strength, and use of repetitive flowing sequences of poses linked with breath appeared particularly beneficial.

In conversations with the instructors, the participants themselves noted subjective and functional improvements in managing the symptoms of PD, including improved ability to breathe deeply, ability to transfer to/from the floor with greater ease, improved posture, decreased leg cramping and pain, improved neck range of motion, increased strength, decreased tremors, increased sweating during physical activity, improved sense of smell, decreased back pain, improved sexual function, decreased stiffness, increased relaxation, and improved posture. Two participants noted the ability to delay the timing of their medication in the morning because of a decrease in overall PD-related symptom severity. At the end of the program many of the participants stated an interest in continuing yoga. A list of appropriate classes in the area was distributed to the participants at the end of the study for those who wanted to continue practicing yoga in a class environment.

The teachers also observed a growing sense of community with the participants throughout the course of the study. On several occasions the participants expressed an increased sense of safety and belonging when practicing yoga in a community where they did not feel rushed or pushed and where they did not have to be embarrassed about using the wall for balance or taking more time with transitions. There were also several discussions at the start of class where the students were able to discuss PD-related concerns that went beyond the scope of the yoga program. This included sharing stories about their response to medication, a sense of isolation/loneliness and how hard it was to talk to friends and family about their experience with PD, the emotional strain they felt in their relationships with loved ones, etc.

### Feasibility and Safety

Safety was measured via adverse-event reporting. As there were no adverse events or injuries reported or observed during the intervention, the program was determined to be safe.

The attendance statistics of the participants also further validated the feasibility of the program, as 21% of participants attended 100% of classes and 90% attended 75% or more. Only two participants missed more than 75% of the classes, both because of PD-related health issues unrelated to the intervention. One participant had to drop out before the study began, also because of PD-related illness.

Participant satisfaction scores were also favorable: 89% of participants answered with the highest possible ranking of 4 points on the question “how much did you enjoy the program,” with a mean score of  $3.8 \pm 0.5$  (range 2–4). Many participants were satisfied with the frequency (64%) and duration (74%) of the program. None of the participants thought the program was offered too frequently or for too long. Participants who were somewhat dissatisfied recommended that the program to be offered three days a week for 24–39 weeks. One participant wished that the program would be ongoing.

### Discussion

Through this testing process, the yoga program for PD was determined to be safe, feasible, and enjoyable for the participants. However, it is worth noting that this study did not control for a group effect; it is unclear whether the high scores in participant satisfaction were due to the enjoyment of being part of the community of participants versus the yoga intervention itself. This unknown group effect notwithstanding, we postulate that the safety, feasibility, and enjoyable nature of the intervention were primarily due to three factors: (1) the rigorous development process and

planning that went into creating the yoga program, which took into account the specific challenges of the PD population; (2) the use of yoga props and modifications, particularly with standing and balancing postures and with transitions to and from the floor, helped to keep the participants safe from falls or other injury; and (3) the level of expertise and experience of the instructors was also a factor in keeping the participants engaged, challenged, and safe throughout each class.

Although the yoga sequences and practices were specifically designed for the needs of the PD population, we acknowledge that the observed physical, psychological, and social benefits of the study go beyond the particulars of the yoga sequences used in the practice and summarized in Table 2. Perhaps more important than the physical postures and breathing practices themselves could be the use of yoga as a means of reframing the body-mind connection, particularly in realms where the disease process of PD has created disruption. Helping participants to slow down their breathing, engage the parasympathetic nervous system, coordinate movement and breath, and cultivate patience, acceptance, and loving-kindness toward themselves and their physical abilities rather than limitations were all fundamental goals of the practice. The ability to focus on the accomplishments rather than the dysfunctions of the body could create a paradigm shift in the way someone with PD frames their physical body and their disease process. This new mindset could potentially assist with alleviating the symptoms of depression, which is particularly prevalent in the PD population.<sup>32</sup>

For future studies or programs incorporating yoga for a PD population, the instructors from this study offer the following recommendations. Any teacher working with students with PD should have a basic understanding of the disease and how it affects the mind and the body. To create a culture of safety, mats should be positioned next to the walls of the room, with a chair nearby with at least two of its legs on the mat, even if the students do not feel they need it. Extensive use of yoga props is recommended to offer full stability and comfort in the yoga postures. These include sitting on bolsters/blankets/chairs, a blanket rolled under the neck and/or supporting the head for supine postures if patient has rigid thoracic kyphosis, use of a chair and/or a wall for transitions and balancing poses, and use of sandbags on hands to reduce tremors in corpse pose. The use of imagery and breath-body coordination are helpful in potentially re-establishing conscious and subconscious movement patterns that are disrupted in people with PD. Finally, to manage the emotional side of PD, it is helpful to encourage participants to cultivate gratitude for all their bodies can do and to focus on their accomplishments rather than their dysfunctions.

The methods used to create this program can be used and validated by future studies beyond the scope of PD. Key elements of this process involved a focused literature review; a team approach in developing the yoga interventions, with input from yoga experts, medical experts, as well as members of the population themselves; teachers with experience adapting yoga to the needs of the community being studied; and a practice space with the necessary yoga props and physical support.

## Limitations

As this was a relatively small study with only 19 participants, this program needs to be validated with a larger group of participants to sufficiently power feasibility measures. The primary barrier to full participation in the study and class attendance was PD-related illness. As yoga was the only intervention in the study, it is unclear how yoga would compare to usual care or other mind-body modalities such as tai chi or qi gong. The study is also limited in the lack of follow-up data, as it is unclear whether any of the participants found the yoga practice helpful enough to continue with it. The participants in this study were also quite high functioning, and this program would need to be modified for a more severely affected population; as it stands now, it is only appropriate for those with stage one to three PD. Because the program involved multiple transitions from sitting to standing and because of the teacher-to-participant ratio of 1 to 9 or 10, this program may not be safe for someone with more severe PD. If a participant required assistance with these transitions, the teacher-to-participant ratio would have to be much lower. It is also unclear how the experience with these specific yoga sequences compares to people with PD attending general yoga classes in the community or practicing on their own at home. Are the positive effects we have observed here due to the specific sequences, the class environment, the calming of the nervous system, and/or the general fostering of a deeper mind-body connection? Future studies that isolate these variables would be helpful to advance the research on therapeutic benefits of yoga with the PD population.

## Conclusions

The yoga for PD program developed in this study appears to be safe, feasible, and enjoyable for the participants. This study can be used as a template for future studies on the therapeutic use of yoga for PD with larger cohorts. Because of the progressive and currently incurable nature of PD, there is an eminent need for mind-body interventions to address the full spectrum of the disease's symptoms. The specific yoga practices detailed in this study could also be a

useful resource not only for researchers, but also for yoga therapists and teachers working with clients with PD.

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## Conflict-of-Interest Statement

There are no conflicts of interest associated with this work.

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