Online Mindfulness-Based Cognitive Therapy for People with Parkinson's Disease and Their Caregivers: a Pilot Study

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Abstract

Anxiety and depression are common non-motor symptoms of Parkinson's disease (PD). Caregivers of people with PD may experience severe caregiver burden. This study explored the feasibility and potential benefits of an online mindfulness-based cognitive therapy (MBCT) intervention for improving anxiety and depressive symptoms in people with PD and their caregivers (ClinicalTrials.gov NCT04469049, 7/8/2020). People with PD or parkinsonism and anxiety and/or depressive symptoms and caregivers of people with PD participated in one of three online MBCT groups. Demographic variables, pre- and post-MBCT behavioral measures (GAD-7, PHQ-9, Five Facet Mindfulness Questionnaire — FFMQ-15, Caregiver Self-Assessment Questionnaire — CSAQ), and satisfaction surveys were collected. Descriptive statistics were used to summarize data. Pre- and post-MBCT behavioral scores were compared using mixed-effect models. Fifty-six potential participants were assessed for eligibility. Twenty-eight entered MBCT groups; all but one completed the intervention. The overall sample analyzed (22 people with PD, 4 caregivers) showed significant GAD-7 and PHQ-9 score reductions and FFMQ-15 total and observing and non-reactivity subscale score increases (all p's < 0.05). Participants with PD and anxiety symptoms ($n = 14$) had a significant GAD-7 score reduction; those with PD and depressive symptoms ($n = 12$) had a significant PHQ-9 score reduction (both p's < 0.05). Participants with PD also had a significant FFMQ-15 observing subscale score increase ($p < 0.05$). The caregiver sample was too small to be analyzed separately. Online MBCT is feasible (as measured by high attendance, completion rate, and participant satisfaction) and may be effective in improving anxiety and depressive symptoms in people with PD.

Keywords Anxiety · Depression · Mindfulness-based cognitive therapy · Online · Parkinson's disease · Caregivers

Introduction

Anxiety and depression are among the most common non-motor symptoms of Parkinson's disease (PD) and may precede the onset of motor manifestations by decades (Broen et al., 2016; Pontone et al., 2009; Reijnders et al., 2008; Seritan et al.,

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2019a). The lifetime prevalence of anxiety disorders in people with PD can reach 50%, while the lifetime prevalence of depressive disorders has been estimated at 66% (Broen et al., 2016; Pontone et al., 2009; Reijnders et al., 2008). Emotional difficulties may exacerbate PD motor symptoms; for example, anxiety, stress, or performance situations may worsen tremor or freezing of gait (Hemmerle et al., 2012; van der Heide et al., 2021a). In turn, motor symptoms can exacerbate anxiety, especially if they occur in public, creating a vicious cycle that PD sufferers are keenly aware of (Vandenberg et al., 2019). The social isolation imposed by the COVID-19 pandemic greatly affected people with PD (Brown et al., 2020; van der Heide et al., 2020). Individuals with PD, particularly those with preexisting neuropsychiatric symptoms and lower cognitive baseline reported increased severity of anxiety, depression, and motor symptoms as a result of pandemic-related stressors (van der Heide et al., 2020).

Evidence-based pharmacological treatments for anxiety and depression exist. However, people with PD may be

sensitive to medication side effects and have a higher risk of drug-drug interactions because they are taking multiple medications concurrently. Non-pharmacological interventions can be powerful tools in the neuropsychiatric armamentarium. A recent review of psychological interventions for people with PD uncovered 56 studies, of which less than half (21) were randomized controlled trials (RCTs) (Zarotti et al., 2021). These included studies of cognitive behavioral therapy (CBT) and mindfulness-based interventions (MBIs), as well as less commonly used approaches, such as acceptance and commitment therapy and psychodrama. The authors concluded that, while there was sufficient evidence to recommend CBT for the treatment of insomnia and depression in people with PD, more research was needed regarding the use of CBT and MBIs for anxiety, impulse control difficulties, and quality of life. MBIs have been shown to alleviate physical and psychological symptoms in many medical conditions including cancer, cardiovascular disease, and chronic pain, as well as psychiatric illnesses (notably, anxiety, and depressive disorders) (Bawa et al., 2015; Evans et al., 2008; Hilton et al., 2017; Lin et al., 2022; Marino et al., 2021; Piet & Hougaard, 2011). MBIs have also been studied in neurological diseases such as multiple sclerosis, demonstrating improvement in anxiety, depression, fatigue, and stress levels (Ghielen et al., 2019; Hoogerwerf et al., 2017; Simpson et al., 2019).

An emerging body of evidence highlights the effectiveness of MBIs for people with PD, showing reduced anxiety and depressive symptoms and improvement in activities of daily living, cognitive functioning, motor symptoms, and general well-being, although studies were small and had mixed results (Advocat et al., 2016; Birtwell et al., 2017; Cash et al., 2016; Dissanayaka et al., 2016; Kwok et al., 2019; Pickut et al., 2015; Vandenberg et al., 2019). A recent meta-analysis found MBIs to have small to moderate effect sizes in reducing psychological distress in people with PD (Ghielen et al., 2019). However, the evidence lags behind public opinion. In a survey of 5000 people with PD, 39% of respondents reported they were practicing mindfulness, with benefit for both their motor and non-motor symptoms (van der Heide et al., 2021b).

Mindfulness-based cognitive therapy (MBCT) is a newer MBI that combines mindfulness practice with cognitive therapy elements and has been shown to prevent depression relapse and improve anxiety symptoms (Eisendrath et al., 2016; Evans et al., 2008; Kuyken et al., 2015; Segal et al., 2013; Tickell et al., 2020). MBCT is conducted in 8-week group sessions, along with independent participant home practice. The mechanisms through which MBIs can improve psychological well-being have not been clearly elucidated. Monitoring and acceptance skills and "decentering" (the ability to observe one's thoughts and feelings as transient, objective events in the mind) have been postulated as main mechanisms of change (Chin et al., 2019; Moore et al., 2022). Additionally, a systematic review of MBCT studies in adults with major depressive disorder (MDD) showed that changes in mindfulness skills, rumination, worry, self-compassion, and decentering were associated with, predicted, or mediated treatment effects (van der Velden et al., 2015). Neuroimaging studies revealed reduced default mode network (DMN) activation and enhanced DMN-central executive network (CEN) connectivity in experienced meditators, suggesting that CEN negatively regulates the DMN (Bauer et al., 2019; Brewer et al., 2011; Garrison et al., 2015).

MBCT has been studied in PD, albeit not extensively (Dissanayaka et al., 2016; Fitzpatrick et al., 2010; Rodgers et al., 2019; Bogosian et al., 2022). People with PD who participated in an MBCT group noted improved coping skills and appreciated the mutual support (Fitzpatrick et al., 2010). Dissanayaka et al. (2016) and Rodgers et al. (2019) used a 6-week adapted MBCT protocol and demonstrated improvements in depressive and/or anxiety symptoms. A RCT of adapted MBCT delivered via Skype proved its feasibility and found significantly improved quality of life, but there were no differences between the intervention group and waitlist/control group with regard to any of the other study outcomes: anxiety, depression, pain, insomnia, fatigue, or daily activities (Bogosian et al., 2022).

The COVID-19 pandemic imposed the sudden conversion of in-person to telehealth visits in healthcare systems throughout the world (Chen et al., 2020; Torales et al., 2022). Initial reports of online MBIs offered during the pandemic have underscored the feasibility of these interventions, although their effectiveness has not yet been fully established (Accoto et al., 2021; Kang et al., 2021; Nourian et al., 2021). A web-based MBCT application was also studied pre-pandemic for adults with MDD and residual depressive symptoms and found to be superior to usual depression care (Segal et al., 2020). In a previous pilot trial, we had to convert the last two sessions of an 8-week in-person MBCT intervention for people with PD to a virtual format when the pandemic started (Seritan et al., 2021). Therefore, we were interested to explore the feasibility and potential benefits of a fully online MBCT intervention and learn lessons for a post-pandemic future.

Caregivers of people with PD experience mild-to-moderate caregiver burden, emotional difficulties, and disruption of their social lives (Boersma et al., 2017; Martinez-Martin et al., 2015; Mosley et al., 2017; Tolosa et al., 2021). Over half (65%) are women and spend an average of 22 h per week supporting their partners with PD (Tolosa et al., 2021). Caregivers desire access to emotional support and education regarding disease progression and management of PD motor and non-motor symptoms (Boersma et al., 2017). In a sample of 584 pairs of people with PD and their primary caregivers, the patients' neuropsychiatric symptoms (anxiety, mood, apathy, and psychosis) were a

main determinant of caregiver burden (Martinez-Martin et al., 2015). MBCT has been used with family caregivers of patients with dementia, showing reduced stress, anxiety, depression, and distress related to the patients' challenging behaviors (Chacko et al., 2022), but it has not been studied in caregivers of cognitively intact people with PD, to our knowledge.

In this study, we sought to evaluate the feasibility of an online MBCT intervention for people with PD and their caregivers (as measured by the ability to recruit the target number of participants, high attendance and completion rate, and high participant satisfaction). Our second aim was to assess pre- to post-differences in anxiety (for people with PD who also had anxiety symptoms) and depression (for people with PD and depressive symptoms) scores, respectively. An additional, exploratory aim was to evaluate changes in anxiety and/or depressive symptoms and caregiver burden measures for caregivers of people with PD who participated in the MBCT groups. Finally, we were interested to learn if caregiver burden could be reduced in carers who did not pursue MBCT, as an indirect effect of their partners' participation in the intervention.

Materials and Methods

This study was approved by the Institutional Review Board at the University of California, San Francisco (UCSF) and registered on ClinicalTrials.gov (NCT04469049, 7/8/2020).

Participants

People with PD and self-reported anxiety and/or depressive symptoms and caregivers of people with PD were recruited through local neurology clinics, support groups, and websites (https://clinicaltrials.ucsf.edu and ClinicalTrials.gov). Caregivers were also recruited directly after their care partners entered the study. Inclusion criteria were having a diagnosis of PD or parkinsonism established by a neurologist or being a caregiver of a person with PD; being able and willing to attend eight weekly 90-min online group sessions; experiencing minimal-to-moderate anxiety symptoms (Generalized Anxiety Disorder-7 item scale — GAD-7 score ≤ 16) and/or minimal-to-moderate depressive symptoms (Patient Health Questionnaire-9 scale — PHQ-9 score ≤ 18) (Kroenke et al., 2001; Löwe et al., 2008). Exclusion criteria were having severe anxiety symptoms (GAD-7 score > 16) or moderately severe-to-severe depressive symptoms (PHQ-9 score > 18); cognitive impairment (Montreal Cognitive Assessment — MoCA score < 24) (Nasreddine et al., 2005); heavy alcohol or drug use; severe psychosis; active suicidal or homicidal ideation; severe motor fluctuations (less than 2 h "on" time

per day) for people with PD; and pattern of engagement with health care (e.g., repeated no-shows) that indicated a low likelihood of completing the intervention. There were no geographic limitations; the virtual format allowed people from the entire USA to participate, as long as they met eligibility criteria.

Study Design

Prospective participants first completed a telephone pre-screening interview to establish whether they would meet preliminary inclusion criteria and receive information about the study. The prescreening questions covered the following: diagnosis of PD or parkinsonism; frequency of anxiety and/or depressive symptoms (at least once weekly was necessary to advance to the screening step); feeling comfortable in a group of 8–10 people; feeling comfortable with receiving and returning study materials electronically; level of alcohol or drugs use; and daily number of "on" hours (for those with PD). Eligible potential participants were offered to sign study consent at this point. Those who chose to participate and signed consent were scheduled for a 90-min online screening interview with the principal investigator, an experienced geriatric psychiatrist (also the MBCT instructor). Screening was conducted in a rolling manner throughout the study duration.

The screening interview followed a semi-structured format, exploring current psychiatric symptoms (anxiety, depression, suicidality, impulsivity, elevated mood, cognition, psychosis, and substance use); past psychiatric history; medical history; current medications; family psychiatric history; and social support. Neurological diagnosis, year of PD diagnosis, and deep brain stimulation treatment (for people with PD) were noted. Additional screening procedures included the GAD-7, PHQ-9, and MoCA telemedicine version (available at www.mocatest.com). Participants deemed eligible after screening were invited to join an upcoming MBCT group. If they had caregivers interested in participating in MBCT groups as well, caregivers followed the same screening protocol as above. Caregivers who wanted to join the study but were not interested in joining MBCT groups were invited to sign consent and provide data without participating in the intervention.

In essence, there were three participant cohorts: P (people with PD or parkinsonism), C (caregivers who received the intervention/entered MBCT groups), and CN (caregivers who did not receive the intervention/did not enter MBCT groups). Table 1 summarizes the three cohorts, noting partner eligibility and measures collected for each cohort.

Table 1 Description of participant cohorts and data collected

Cohort	Population	In MBCT groups	Partners in MBCT groups	Pre-MBCT data collected	Post-MBCT data collected
P	People with PD or parkinsonism	Yes	Allowed but not necessary	Demographic survey; GAD-7; PHQ-9; FFMQ-15	GAD-7; PHQ-9; FFMQ-15; Satisfaction survey
C	Caregivers of people with PD	Yes	Allowed but not necessary	Demographic survey; GAD-7; PHQ-9; FFMQ-15; CSAQ	GAD-7; PHQ-9; FFMQ-15; CSAQ; Satisfaction survey
CN	Caregivers of people with PD	No	Necessary	Demographic survey; GAD-7; PHQ-9; CSAQ	GAD-7; PHQ-9; CSAQ

CSAQ Caregiver Self-Assessment Questionnaire, *FFMQ-15* Five-Facet Mindfulness Questionnaire-15, *GAD-7* Generalized Anxiety Disorder-7 item scale, *MBCT* mindfulness-based cognitive therapy, *PD* Parkinson's disease, *PHQ-9* Patient Health Questionnaire-9

Intervention

In a previous pilot study, we adapted the MBCT protocol developed by Eisendrath et al. (Segal et al., 2013; Eisendrath et al., 2016) for use with people with PD (Seritan et al., 2021). Modifications included shortening sessions from 2.5 h to 90 min in order to accommodate motor or non-motor (anxiety, attention, and mood changes) fluctuations; eliminating the mindful eating exercise (which could be perceived as insensitive by people with PD, who often have anosmia); and performing chair yoga instead of full body yoga. Mindful walking was optional since people with PD may have balance problems. Participants were encouraged to take their PD medications prior to starting the sessions (if applicable) and to take breaks as often as needed. This protocol was further modified for online delivery during the COVID-19 pandemic. Group sessions were conducted in Zoom (https://zoom.us/). The participant manual was provided in electronic format prior to starting the groups; hard copies were mailed to those who did not have access to a printer during the quarantine. Home practice was recorded in a practice log returned weekly via email; if participants had difficulty using email attachments, they could also take a photo with their phone or call the principal investigator and leave a message with the information. Emails were sent after each session explaining the home practice and any additional instructions for participants who had missed that session. The Zoom whiteboard was used for teaching, as necessary. Several exercises could not be performed in virtual format (e.g., monsters on a bus). The final week exercise, in which participants pass a ball of yarn from one to the next and thank each other for their contributions to the group, was conducted without props.

Three successive online MBCT groups of 8–10 participants each were conducted between November 2020 and June 2021. Each group lasted 8 weeks except for the first, which extended over 9 weeks due to the winter holidays. Sessions were held in the evening (5–6:30 pm PST),

so participants who worked could join (although they ended quite late for East Coast members). Attendance was recorded. The curriculum was pre-determined, with one change in response to external events: lovingkindness meditation was performed the week of January 6th, 2021, when the attack on the US Capitol took place, in response to the participants' heightened anxiety, and the originally scheduled sitting meditation was done the following week. Audio recordings (body scan, breathing space, and sitting meditations) and links to mindful yoga exercises were provided for independent practice. Participants were encouraged to practice at home for 30–45 min daily between group sessions.

Data Collection and Behavioral Measures

A demographic survey including age, sex, education level, marital status, employment status, distance from the participant's home to UCSF clinic, previous mindfulness experience, and goals for the course was collected for all participants. Participants completed an emergency contact card, so they could be reached in case of emergency. Pre- and post-MBCT behavioral measures, GAD-7, PHQ-9, and Five Facet Mindfulness Questionnaire-15 (FFMQ-15; Baer et al., 2012), were collected for all MBCT participants. Caregivers also completed the Caregiver Self-Assessment Questionnaire (CSAQ) pre- and post-MBCT (American Medical Association 2010).

The GAD-7 and PHQ-9 are standardized self-report instruments that quantify anxiety and depressive symptoms, respectively, over the previous 2 weeks and can be used for screening and tracking treatment response over time. The score range for GAD-7 is 0–21 and that for PHQ-9 is 0–27, with higher scores indicating higher symptom severity. If screening was completed more than 4 weeks prior to starting the MBCT group, GAD-7 and PHQ-9 were repeated to obtain a current measure of participant mood and anxiety. In our overall sample,

Cronbach's α values were 0.81 pre- and 0.86 post-MBCT for PHQ-9, and 0.77 pre- and 0.89 post-MBCT for GAD-7.

The FFMQ is one of the most widely used self-report measures of trait mindfulness (Baer et al., 2006, 2012). The FFMQ-15 has 15 questions and has been shown to have a similar factor structure to the initial FFMQ-39 instrument (Gu et al., 2016). Each question is rated on a Likert-type scale from 1 to 5, with 1 = *never or very rarely true*, 2 = *rarely true*, 3 = *sometimes true*, 4 = *often true*, and 5 = *very often or always true*. A total score is calculated, composed of five subscales: observing, describing, acting with awareness, non-judging of inner experiences, and non-reactivity to inner experiences. The total score range is 5–75, with subscale scores from 1 to 15; higher scores indicate higher mindfulness levels. In our overall analyzed sample, Cronbach's α values were 0.85 pre- and 0.86 post-MBCT for total score, and as follows for each subscale: observing (0.74 pre- and 0.70 post-MBCT), describing (0.77 pre- and 0.80 post-MBCT), acting with awareness (0.87 pre- and 0.77 post-MBCT), non-judging (0.80 pre- and 0.74 post-MBCT), and non-reactivity (0.68 pre- and 0.86 post-MBCT).

The CSAQ is a self-report instrument that measures caregiver burden. It consists of 16 yes/no questions (with one point assigned for each affirmative response) and two additional questions, asking respondents to rate their current stress level and health state on a scale from 1 to 10. The maximum score is 16; scores higher than 10 indicate high caregiver distress levels. The CSAQ has been compared to established screening measures of caregiver burden, stress, depression, and grief, although it has not been fully validated (Epstein-Lubow et al., 2010).

Satisfaction surveys were collected after each MBCT group concluded, inquiring about overall satisfaction with the MBCT course, instructor, and handouts provided; any changes made by participants to their daily routine as a result of this course; barriers (if no changes were made); plans to continue to practice mindfulness; whether they would recommend MBCT to family or friends with PD; medication changes made during the course (for anxiety or depression); and any additional feedback. The satisfaction survey was an original questionnaire developed for our previous trial (Seritan et al., 2021). One question, "Would you recommend MBCT to family or friends with PD?" was adapted, with permission, from a survey used in the Remote Access to Care, Everywhere, for Parkinson's Disease (RACE-PD) study (Dorsey et al., 2010). Data were collected and managed using Research Electronic Data Capture (REDCap), a secure, web-based software platform designed to support data capture for research studies (Harris et al., 2009).

Statistical Analysis

Descriptive statistics including frequencies, means, and standard deviations (SD) were used to summarize the demographic and clinical variables, home practice times, and satisfaction survey responses. Pre- and post-MBCT behavioral measure scores were compared using linear mixed-effects models. The primary analysis included all MBCT participants (people with PD and caregivers). Secondary analyses were conducted by restricting the sample to participants with PD, then to those with PD and more than minimal anxiety symptoms (GAD-7 score ≥ 5) and to people with PD and more than minimal depressive symptoms (PHQ-9 score ≥ 5), respectively. Open-ended comments were analyzed thematically.

Results

Figure 1 depicts the CONSORT flow diagram. Fifty-six individuals were assessed for eligibility; 12 did not sign consent or did not meet prescreening criteria. Of the 44 participants who signed consent, 14 were excluded after screening, for the following reasons: GAD-7 score > 16 ($n = 3$), MoCA score < 24 ($n = 5$), other psychiatric conditions (history of psychosis or suicide attempts, $n = 2$), or other reasons (decided to not join after completing screening, $n = 3$; difficulty keeping study appointments, $n = 1$). Excluded participants were provided local mental health resources, as necessary. MBCT group composition was as follows: Group 1–10 participants (9 P, 1 C), Group 2–9 individuals (7 P, 2 C), and Group 3–9 people (8 P, 1 C). One CN caregiver provided data alongside Group 1, then joined Group 2 as C participant, and 2 CN spouses completed questionnaires along with Group 2. One man with PD (4%) withdrew after two sessions due to competing demands. Three participants initially diagnosed with parkinsonism: one female fragile X premutation carrier, one woman with suspected progressive supranuclear palsy (PSP), and one man believed to have early dementia with Lewy bodies (DLB) also completed the intervention. The woman with suspected PSP was re-diagnosed with PD during the study; her data were analyzed as part of the P cohort. The other two participants were found not to have parkinsonian syndromes on follow-up neurological examinations and were not included in the analyses.

Table 2 presents the demographic and clinical characteristics of the 28 participants who entered MBCT groups. Participants with PD ($n = 22$) had a mean age of 63 years (*SD*, 7; range, 52–76) and mean time since diagnosis of 4.7 years (*SD*, 3.8; range, 1–14) years. Three (14%) had been treated with deep brain stimulation. Eight participants (6 people with PD and 2 caregivers; 28% of total) lived outside California (in Colorado, Missouri, New Jersey, and
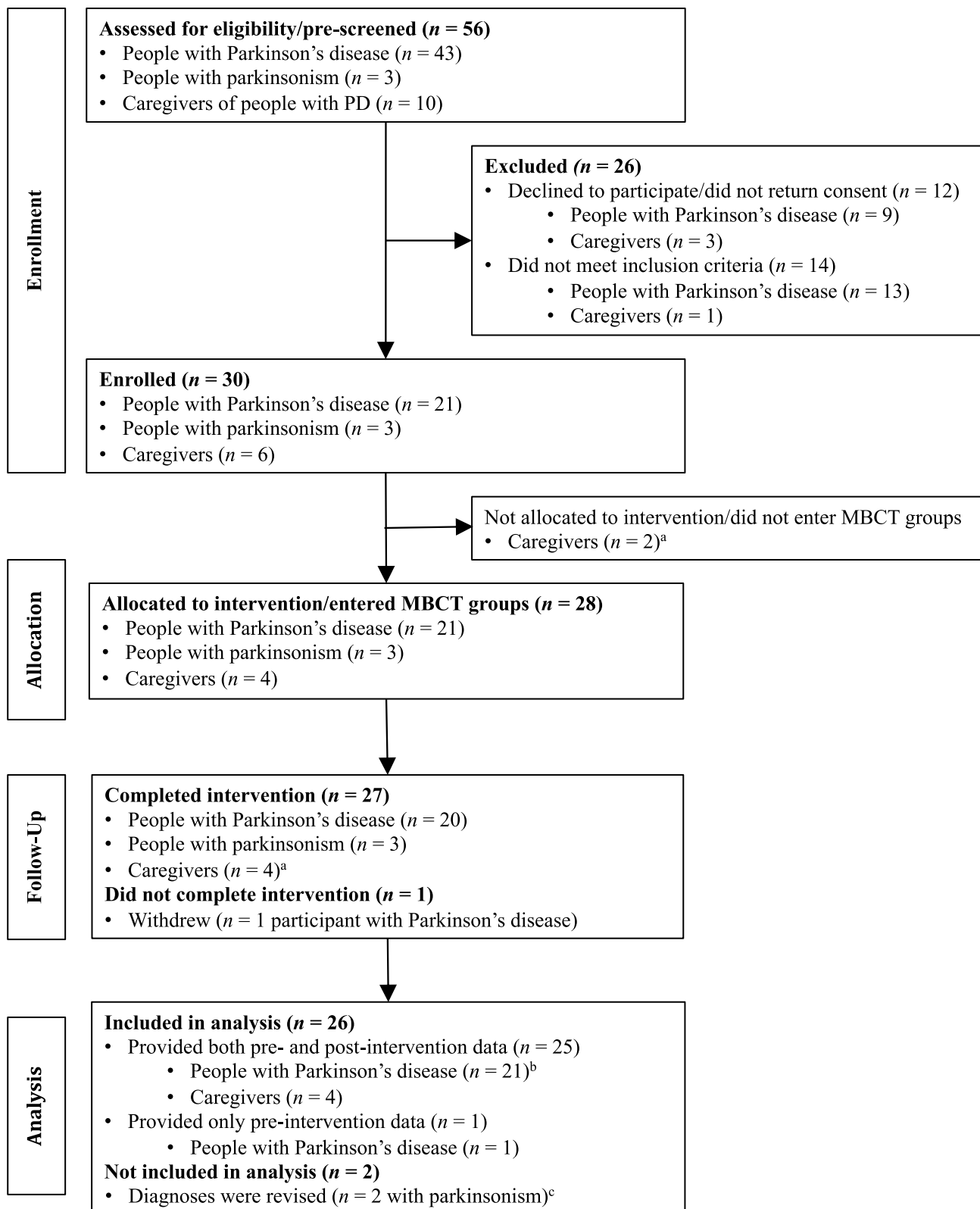
Assessed for eligibility/pre-screened (*n* = 56)
- People with Parkinson's disease (*n* = 43)
- People with parkinsonism (*n* = 3)
- Caregivers of people with PD (*n* = 10)

Excluded *(n* = 26)
- Declined to participate/did not return consent (*n* = 12)
    - People with Parkinson's disease (*n* = 9)
    - Caregivers (*n* = 3)
- Did not meet inclusion criteria (*n* = 14)
    - People with Parkinson's disease (*n* = 13)
    - Caregivers (*n* = 1)

Enrolled (*n* = 30)
- People with Parkinson's disease (*n* = 21)
- People with parkinsonism (*n* = 3)
- Caregivers (*n* = 6)

Not allocated to intervention/did not enter MBCT groups
- Caregivers (*n* = 2)[a]

Allocated to intervention/entered MBCT groups (*n* = 28)
- People with Parkinson's disease (*n* = 21)
- People with parkinsonism (*n* = 3)
- Caregivers (*n* = 4)

Completed intervention (*n* = 27)
- People with Parkinson's disease (*n* = 20)
- People with parkinsonism (*n* = 3)
- Caregivers (*n* = 4)[a]

Did not complete intervention (*n* = 1)
- Withdrew (*n* = 1 participant with Parkinson's disease)

Included in analysis (*n* = 26)
- Provided both pre- and post-intervention data (*n* = 25)
    - People with Parkinson's disease (*n* = 21)[b]
    - Caregivers (*n* = 4)
- Provided only pre-intervention data (*n* = 1)
    - People with Parkinson's disease (*n* = 1)

Not included in analysis (*n* = 2)
- Diagnoses were revised (*n* = 2 with parkinsonism)[c]

Enrollment / Allocation / Follow-Up / Analysis

Fig. 1 CONSORT flow diagram. [a]One caregiver first provided data without participating in MBCT, then participated in the next MBCT group. [b]One participant with parkinsonism was diagnosed with Par-kinson's disease on follow-up neurological evaluation. [c]These two participants were found to not have parkinsonian syndromes on fol-low-up neurological evaluation

Table 2 MBCT participant demographic and clinical characteristics

Variable	People with Parkinson's disease or parkinsonism (n = 24)	Caregivers (n = 4)
Age (years), *mean* (*SD*) [range]	62.5 (9.1) [36–76]	61.8 (8.5) [53–72]
Male, *n* (%)	15 (63%)	1 (25%)
Race, *n* (%)		
Asian American	5 (21%)	0 (0%)
Black	1 (4%)	0 (0%)
White	18 (75%)	4 (100%)
Education (years), *mean* (*SD*)	17.7 (3.1)	16.5 (3.4)
Marital status, *n* (%)		
Single/Never married	1 (4%)	0 (0%)
Married/Long-term relationship	18 (75%)	4 (100%)
Divorced	4 (17%)	0 (0%)
Widowed	1 (4%)	0 (0%)
Employment status, *n* (%)		
Working full-time	5 (21%)	0 (0%)
Working part-time	5 (21%)	2 (50%)
On disability	3 (12%)	0 (0%)
Retired	11 (46%)	2 (50%)
Distance from clinic (miles), *median* (*Q*1-*Q*3) [range]	26 (15–850) [2–3000]	960 (20–2384) [19–2867]
Previous mindfulness experience, *n* (%)	16 (67%)	2 (50%)
MoCA, *mean* (*SD*)	27.9 (1.7)	27.5 (1.3)
Initial neurological diagnosis, *n* (%)		
Parkinson's disease	21 (88%)	–
Parkinsonism	3 (12%)	–
Pre-MBCT anxiety symptom severity,[a] *n* (%)		
Minimal (GAD-7 score, 1–4)	10 (42%)	2 (50%)
Mild (GAD-7 score, 5–9)	12 (50%)	1 (25%)
Moderate (GAD-7 score, 10–14)	1 (4%)	1 (25%)
Severe (GAD-7 score ≥ 15)	1 (4%)	0 (0%)
Pre-MBCT depressive symptom severity,[b] *n* (%)		
Minimal (PHQ-9 score, 1–4)	10 (42%)	1 (25%)
Mild (PHQ-9 score, 5–9)	10 (42%)	2 (50%)
Moderate (PHQ-9 score, 10–14)	2 (8%)	1 (25%)
Moderately severe (PHQ-9 score, 15–19)	2 (8%)	0 (0%)

Due to rounding, percentages might not add up to 100

Q1 lower quartile, *Q3* upper quartile, *GAD-7* Generalized Anxiety Disorder-7 item scale, *MBCT* mindfulness-based cognitive therapy, *MoCA* Montreal Cognitive Assessment, *PD* Parkinson's disease, *PHQ-9* Patient Health Questionnaire-9, *SD* standard deviation

[a]Participants with GAD-7 scores > 16 were excluded on initial screening; however, scores may have changed by the time participants started MBCT groups

[b]Participants with PHQ-9 scores > 18 were excluded on initial screening; however, scores may have changed by the time participants started MBCT groups

Pennsylvania). Table 3 depicts MBCT session attendance and home practice time. Attendance was high; 95% of people with PD and 75% of caregivers attended at least 7 of the 8 sessions. On average, participants spent approximately 3 h per week in independent home practice, with caregivers dedicating more time than people with PD.

Table 4 summarizes pre- and post-MBCT behavioral measure scores. The overall analyzed sample had significant

Table 3 MBCT group attendance and home practice time

Variable	People with Parkinson's disease (n = 22)[a]	Caregivers (n = 4)
Number of sessions attended, n (%)		
2	1 (5%)	0 (0%)
4	0 (0%)	1 (25%)
7	6 (27%)	1 (25%)
8	15 (68%)	2 (50%)
Home practice time, minutes/week, mean (SD) [range][b]		
Total	169.1 (56.8) [103–322]	206.6 (32.6) [185–244]

MBCT mindfulness-based cognitive therapy, *SD* standard deviation

[a]One participant with Parkinson's disease withdrew after 2 sessions

[b]Data were first averaged within participant for all available weeks. One participant with Parkinson's disease and one caregiver did not provide home practice data

GAD-7 and PHQ-9 score reductions and significant FFMQ-15 total score and observing and non-reactivity subscale score increases (all *p*'s < 0.05). When restricting the analyses to people with PD, score reductions remained significant for anxiety ($p = 0.02$), but not for depression ($p = 0.07$). When restricting analyses further to people with PD and at least mild psychiatric symptoms, both the subsample with anxiety symptoms ($n = 14$, GAD-7 score ≥ 5) and the subgroup with depressive symptoms ($n = 12$, PHQ-9 score ≥ 5) demonstrated significant improvement (both *p's* < 0.05). These subsamples substantially overlapped; all 12 people with depressive symptoms also had concurrent anxiety symptoms. Five people with PD achieved a 5-point reduction in PHQ-9 scores, which is considered clinically meaningful (Löwe et al., 2004). Participants with PD also had a significant FFMQ-15 observing subscale score increase ($p < 0.05$). Additionally, two participants with PD reported being able to use mindfulness techniques to improve their motor symptoms. One man (with previous mindfulness experience) noted less dystonia in his hands or feet during and after sitting meditations, and one novice woman found she could interrupt the vicious cycle of festination-falls by using the breathing space to lower her anxiety in the moment, which in turn reduced falls. These benefits were not consistently present.

The caregiver sample was too small to be analyzed separately. Caregiver GAD-7, PHQ-9, and FFMQ-15 results are included with the overall sample in Table 4. Individual CSAQ scores improved for all four caregivers. Mean pre-MBCT CSAQ score was 7.8 (*SD*, 2.2; range, 5–10), whereas mean post-MBCT CSAQ score was 3.3 (*SD*, 1.9; range, 2–6).

Almost all (96%) of the participants who completed satisfaction surveys were satisfied or very satisfied with the course, 96% planned to continue to practice mindfulness, and all stated they would recommend MBCT to family or friends with PD. Twenty (87%) respondents had made changes in their daily routine by starting or adding new practices, dedicating time or quiet space to mindfulness practice, or identifying daily activities they could perform mindfully. Three (13%) participants did not make any changes; barriers cited included time, external stressors, and reluctance to fully embrace mindfulness. Several participants had found MBCT to be extremely helpful in coping with current stressors and learned new strategies to manage their emotional difficulties. Others expressed interest in attending a repeat course or having additional sessions to consolidate gains. Participants shared their gratitude for having access to this intervention during the COVID-19 pandemic. Table 5 summarizes participant satisfaction survey responses, including several illustrative open-ended comments.

Discussion

This study aimed to evaluate the feasibility of an online MBCT intervention for people with PD and their caregivers. Feasibility was demonstrated by the ability to recruit the target number of participants with PD, very low attrition rate (4%), high attendance (95% people with PD and 75% caregivers attended ≥ 7 sessions), consistent home practice (approximately 3 h/week, on average), and high/very high participant satisfaction (96%). Attrition rate in MBCT groups can be as high as 30% (Crane & Williams, 2010; Rodgers et al., 2019). In our previous in-person MBCT study using a similar protocol taught by the same instructor (Seritan et al., 2021), only 11 of 16 (68%) participants attended ≥ 7 sessions, so it is likely that the online format helped ensure adherence. Our PD sample size was small ($n = 22$). This was similar to prior MBI studies in PD, including MBCT (Birtwell et al., 2017; Cash et al., 2016; Dissanayaka et al., 2016; Fitzpatrick et al., 2010; Pickut et al., 2015; Rodgers et al., 2019), except for the previous online MBCT RCT that enrolled 60 people, 30 in the active arm and 30 in the waitlist/control arm (Bogosian et al., 2022).

Table 4 Pre- and post-MBCT behavioral measure scores

Outcome	n	Pre- Mean (SD) [range]	Post- Mean (SD) [range]	Post -vs. pre- Estimated difference (95% CI)[a]
Overall sample (participants with PD and caregivers)[b,c]				
GAD-7 score	26	5.8 (3.3) [1–17]	3.3 (3.5) [0–14]	−2.6 (−4.3 to −0.9)[*]
PHQ-9 score	26	6.3 (4.3) [0–17]	4.2 (4.3) [0–18]	−2.2 (−4.0 to −0.3)[*]
FFMQ-15 scores				
Observing	26	10.0 (2.5) [6–15]	11.2 (2.5) [7–15]	1.0 (0.4 to 1.9)[*]
Describing	26	10.8 (2.3) [7–15]	11.5 (2.4) [7–15]	0.7 (−0.2 to 1.6)
Acting with awareness	26	10.7 (2.7) [6–15]	11.2 (2.3) [7–15]	0.4 (−0.5 to 1.3)
Non-judging	26	12.2 (2.4) [7–15]	12.2 (2.2) [8–15]	−0.02 (−1.0 to 1.0)
Non-reactivity	26	9.7 (1.8) [6–13]	11.0 (2.7) [8–15]	1.3 (0.1 to 2.5)[*]
Total	26	53.5 (7.9) [36–71]	57.0 (8.4) [43–74]	3.6 (0.4 to 6.7)[*]
Participants with PD[c]				
GAD-7 score	22	6.0 (3.4) [1–17]	3.5 (3.8) [0–14]	−2.6 (−4.5 to −0.6)[*]
PHQ-9 score	22	6.4 (4.6) [0–17]	4.5 (4.6) [0–18]	−1.9 (−4.1 to 0.3)
FFMQ-15 scores				
Observing	22	10.1 (2.5) [6–15]	11.0 (2.4) [7–15]	0.8 (0.1 to 1.5)[*]
Describing	22	10.6 (2.2) [7–15]	11.0 (2.3) [7–15]	0.5 (−0.4 to 1.4)
Acting with awareness	22	10.9 (2.6) [6–15]	11.2 (2.2) [7–15]	0.3 (−0.8 to 1.3)
Non-judging	22	12.3 (2.2) [7–15]	11.9 (2.3) [8–15]	−0.3 (−1.3 to 0.7)
Non-reactivity	22	9.6 (1.6) [6–13]	10.6 (2.6) [8–15]	1.0 (−0.2 to 2.2)
Total	22	53.5 (6.8) [42–71]	55.7 (8.3) [43–74]	2.3 (−0.4 to 5.0)
Participants with PD and pre-MBCT anxiety symptoms[d,e]				
GAD-7 score	14	7.6 (3.1) [5–17]	3.9 (3.4) [1–14]	−3.8 (−6.2 to −1.4)[*]
Participants with PD and pre-MBCT depressive symptoms[d,e]				
PHQ-9 score	12	9.8 (3.4) [6–17]	6.0 (5.3) [0–18]	−3.8 (−7.3 to −0.2)[*]

CI confidence interval, *FFMQ-15* Five-Facet Mindfulness Questionnaire-15, *GAD-7* Generalized Anxiety Disorder-7 item scale, *MBCT* mindfulness-based cognitive therapy, *PD* Parkinson's disease, *PHQ-9* Patient Health Questionnaire-9, *SD* standard deviation

[*] $p < 0.05$

[a] From linear mixed-effects regression models with a fixed effect for time (pre-, post-) and a random effect for person-specific intercept

[b] Includes $n = 22$ participants with Parkinson's disease and $n = 4$ caregivers

[c] One participant with Parkinson's disease withdrew; all post-MBCT data are missing

[d] Participants with minimal symptoms (scores 1–4) were excluded from these analyses

[e] These subsamples substantially overlapped (all participants with Parkinson's disease and depressive symptoms had concurrent anxiety symptoms)

We also sought to evaluate pre- to post-MBCT changes in anxiety and/or depressive symptom severity. Both the overall participant sample (people with PD and caregivers) and the subsample of people with PD experienced significant anxiety symptom improvement. The overall sample also showed significant depressive symptom reduction. People with PD and anxiety symptoms had a significant GAD-7 score reduction, whereas those with PD and depressive symptoms had a significant PHQ-9 score improvement. Of note, almost half of the PD subsample entered MBCT groups with minimal anxiety (GAD-7 score < 5) or depressive (PHQ-9 score < 5) symptoms. These participants were excluded from secondary analyses, thus reducing the subsample sizes. It is also important to note the high co-occurrence of anxious and depressive features (all 12 people with PD and depressive symptoms also reported anxiety symptoms). This is much higher

than that found in a prior MBCT trial. Rodgers et al. (2019) reported a 4% comorbidity of MDD and social phobia. However, these authors used the Structured Clinical Interview for DSM-IV (SCID-IV, First et al., 2002) to establish psychiatric diagnoses, whereas we relied on participant self-report. This brings up the question of whether the anxiety improvements observed in our study were driven by alleviating depression, since MBCT was originally designed and has best evidence for MDD relapse prevention (Kuyken et al., 2015; Segal et al., 2013; Tickell et al., 2020). More importantly, although we found statistically significant differences in both anxiety and depression measures, it is not clear if these translated into clinically significant improvements. Only five participants with PD reached the 5-point minimal clinically important difference in PHQ-9 scores (Löwe et al., 2004). Anecdotally, we noted the greatest improvements in participants with the

Table 5 Participant satisfaction survey responses (*n* = 23)[a]

Survey question	*n* (%)
Overall, how satisfied were you with this MBCT course?	
Very satisfied	17 (74%)
Satisfied	5 (22%)
Neutral	1 (4%)
How satisfied were you with the group facilitator(s)?	
Very satisfied	21 (91%)
Satisfied	2 (9%)
How satisfied were you with the handouts provided?	
Very satisfied	16 (70%)
Satisfied	6 (26%)
Neutral	1 (4%)
Do you plan to continue to practice mindfulness after completion of the MBCT course?	
Yes[b]	22 (96%)
No	1 (4%)
Would you recommend MBCT to a friend or family member with Parkinson's disease?	
Yes	23 (100%)
No	0 (0%)
If you were taking medications for anxiety or depression, were there any medication changes made during this MBCT course?	
Yes[c]	2 (9%)
No	11 (48%)
Not taking medications	10 (43%)
Do you have any other feedback about this MBCT course?	

"I am going through a very stressful period and trying to find a medication regimen that manages my leg tremors at night. The MBCT course helped to greatly reduce my anxiety during this time." (Participant with PD)

"I have enrolled in various mindfulness programs before but didn't maintain my daily practice. This course came at a much needed time for me personally […] The MBCT course really played a big role in helping me cope [with multiple stressors] with a level head […] Rediscovering mindfulness has been a savior for me." (Participant with PD)

"It was quite helpful for me, in that the social connections were a tonic during the involuntary COVID isolation." (Participant with PD)

"This course was a wonderful opportunity and awakening to the power of mindfulness […] I would highly recommend the course to others with PD. I will be using the tools I learned for years to come and I truly believe the course helped change my mindset about being a victim of PD to owning my experience." (Participant with PD)

"I am profoundly grateful for this training in mindfulness, which is now among my most useful skills for coping with life with a partner with Parkinson's. As I look toward the future for my loved one, I am confident that our mindfulness practice will support our resiliency, nurture our mutual and self-compassion, and help us navigate the rocky emotional terrain of disease progression […] I hope this study will validate the need for expanded mindfulness supports for individuals with Parkinson's and their caregivers." (Caregiver)

The first 3 questions were rated on a 1–5 Likert-type scale, with 1 = *very satisfied*, 2 = *satisfied*, 3 = *neutral*, 4 = *dissatisfied*, and 5 = *very dissatisfied*. Categories were not listed if no participant selected that option

MBCT mindfulness-based cognitive therapy, *PD* Parkinson's disease

[a] *n* = 20 people with Parkinson's disease and *n* = 3 caregivers completed surveys

[b] Participants may have listed more than one mindfulness practice. Practices included body scan (*n* = 4), breathing exercises (*n* = 9), coping (*n* = 1), mindful walking (*n* = 4), sitting meditation (*n* = 14), and yoga (*n* = 4)

[c] One participant started sertraline; one participant's escitalopram dose was increased by 5 mg

highest pre-MBCT scores. Future studies could focus on more symptomatic patients, by setting GAD-7 and PHQ-9 scores of 5 as inclusion threshold and recruiting people with more severe anxiety and/or depressive symptoms. However, this will have to be carefully considered, because MBCT was not designed for use with patients experiencing active illness episodes. Safety aspects will also be important, given the online intervention format.

When compared to previous MBCT studies in PD, Dissanayaka et al. (2016) found reductions in both anxiety and depressive symptoms, whereas Rodgers et al. (2019) showed improvement in depression, but not anxiety measures. In our previous pilot trial, we also found significant pre- to post-PHQ-9 score reductions only; that study was completed just as the COVID-19 pandemic was starting in the USA and our participants (many of

them aging adults) were understandably very anxious (Seritan et al., 2021). The only other online MBCT trial published to date did not yield any significant differences in mood or anxiety measures (Bogosian et al., 2022). Of note, all previous studies, as well as our own, used adapted MBCT protocols. We did not collect data on the instructor's adherence to the model. Adherence to protocol integrity is important in designing standardized interventions that can be broadly replicated (Crane & Hecht, 2018).

The symptomatic improvement cannot be attributed exclusively to our intervention, as there can be many contributing factors. Of note, 70% of patients and 50% of caregivers had prior mindfulness experience. Our intervention likely built on previous gains, and this may have led to more robust outcomes. Nevertheless, there were several complete novices who benefited greatly. Additionally, only two (15%) of the 13 participants who were taking medications for anxiety and/or depression reported starting or titrating such medications during the course, suggesting a positive effect of our intervention. We did not inquire about PD medication changes, which may impact study outcomes through improvement in motor symptoms or wearing-off related anxiety. Future studies should note all medication changes.

We also explored changes in trait mindfulness. We found a significant increase in FFMQ-15 total score, as well as observing and non-reactivity subscale scores in the overall sample. These differences were attenuated when the analysis was restricted to participants with PD; only the observing subscale score increase remained significant. This was expected since MBIs, as well as some non-MBIs, can enhance mindfulness skills (Xia et al., 2019). This finding was consistent with prior MBI studies in PD which revealed significant improvement in FFMQ-15 or FFMQ-39 total score (Cash et al., 2016; Pickut et al., 2015) and/or observing subscale score (Dissanayaka et al., 2016; Pickut et al., 2015). Gu et al. (2016) found that the FFMQ-15 factor structure varies before and after MBCT as well as across samples of experienced meditators and nonmeditators. They suggested excluding the observing subscale and removing its items from the total score calculation. We chose to retain the observing subscale and include its items in the total score, as originally designed by Baer et al. (2006), because we believe changes in the awareness of inner states (reflected by this subscale) may translate into clinically meaningful improvements for people with PD, as detailed in the next paragraph. Future studies with larger samples may help elucidate the value of including the observing subscale items in the analysis. Pre- to post-MBCT non-reactivity subscale differences were also significant in the overall sample analyzed. The non-reactivity facet best correlates with self-compassion (Baer et al., 2006). Anecdotally, novice participants had lower pre-MBCT non-reactivity scores and improved the most in this regard. It is

difficult to comment on non-significant FFMQ-15 subscale changes, given the small sample size and heterogeneous group composition (novices and experienced meditators). Larger samples would also allow correlations between GAD-7, PHQ-9, and FFMQ-15 results.

Several participants were able to use techniques learned in the course to improve dystonia or festination leading to falls. This was an anecdotal finding, yet worth noting. People with PD may have difficulty recognizing when motor symptoms occur and intervening in the moment to reduce associated anxiety. Our MBCT protocol emphasizes awareness of inner states and their bodily manifestations. Three previous MBI studies (Dissanayaka et al., 2016; Kwok et al., 2019; Pickut et al., 2015) also reported motor benefits, although only two (Kwok et al., 2019; Pickut et al., 2015) had significant results. Other teams sought to improve awareness of motor symptoms by using mindfulness or a novel body awareness training (BEWARE) that combined physical therapy with acceptance and commitment therapy elements (Buchwitz et al., 2021; Ghielen et al., 2017). None of these trials found significant differences with regard to their primary outcomes, although they uncovered benefits in secondary outcomes such as emotional well-being, anxiety, and cognitive functioning. Future studies should include standardized motor scales validated for online use to explore potential benefits of MBCT on motor symptoms (Dorsey et al., 2015).

This study was conducted during the COVID-19 pandemic, which greatly affected people with PD and their caregivers, increasing stress and exacerbating anxiety and mood difficulties (Brown et al., 2020; van der Heide et al., 2020; Edwards & Carroll, 2020). The heightened stress may have obscured our findings, either by mitigating the benefit of our intervention or by enhancing a sense of solidarity among participants and, as such, increasing attendance and adherence with the practice. We were impressed with the participants' dedication to home practice (on average, 3 h/week), although this may have reflected the lack of social activities during the pandemic. A larger sample might allow correlations between home practice time and study outcomes.

To our knowledge, the present study is the first completed trial of an online nationwide 8-week MBCT intervention conducted during the pandemic. A double-blind RCT of a 4-week web-based MBCT intervention to prevent chronic pain after cardiac surgery is in progress (Martorella et al., 2021). Our team's prior experience providing telehealth services to patients with movement disorders (Seritan et al., 2019b) allowed us to quickly pivot and design and conduct this study in a virtual format. Removing the geographic barriers facilitated access for people residing as far as 3000 miles away and helped reduce isolation during this challenging time. Additionally, it is much more convenient for people with PD to not travel to the clinic, even if they reside

locally (Seritan et al., 2019b). The environmental impact of not driving is also noteworthy, by reducing greenhouse gas emissions. On the other hand, one out-of-state group participant commented it was difficult to remember the schedule, due to the time zone difference. One important concern with studies of remote psychiatric interventions is that participants should be able to be reached in emergency situations. For this reason, we could not include patients with history of psychosis, suicide attempts, or other severe psychiatric illness. We asked our study participants to complete emergency contact cards prior to starting MBCT and discussed safety aspects in detail during the consent process. Fortunately, no emergencies occurred. One advantage of the virtual format was that the MBCT instructor was able to see more readily when a participant wished to speak in the Zoom gallery view, in contrast to in-person sessions. There are few comparisons of virtual and in-person MBIs; one RCT found online and in-person MBCT to be equally effective in reducing psychological distress in patients with cancer (Compen et al., 2018). Future studies should explore pros and cons of online MBIs in more detail.

Caregivers dedicate a lot of time and energy to caring for their partners with PD but are often overlooked. Only one prior MBI study (not MBCT) included caregivers of people with PD (Cash et al., 2016). Our caregiver sample was too small to be analyzed separately, although individual CSAQ scores improved. We did not specifically advertise through caregiver support groups or websites. A larger sample would have allowed us to offer a separate MBCT group for caregivers. This could have facilitated connection, ensuring a group dynamic that focused on the caregivers' emotional needs. On the other hand, caregivers expressed better understanding of their partners' experiences by participating alongside patients with PD. An additional benefit was that couples participating together could practice together at home, enhancing adherence.

We also included several caregivers who did not participate in MBCT groups but had a partner complete the training. We intended to explore the potential impact of an intervention targeting the care partners' anxiety and/or depression on caregiver well-being. However, the CN cohort was too small and insufficient data were collected to allow meaningful inferences (e.g., no information was gathered regarding their medical or psychiatric history or current medications). A larger, better characterized caregiver sample might have allowed exploration of associations between care partner behavioral measures and caregiver outcomes. Future studies should develop specific recruitment strategies aimed at caregivers and use more established caregiver burden scales such as the Zarit Burden Interview (Zarit et al., 1980). For this study, we selected non-proprietary instruments, given budget constraints.

Three people initially diagnosed with parkinsonism also participated in the study. These were individuals whose neurologists had not yet established clear diagnoses but suspected atypical parkinsonian syndromes. We decided to include patients with parkinsonism because of the high prevalence of anxiety and mood manifestations in atypical parkinsonian syndromes such as PSP and DLB (Bono et al., 2021; Coughlin & Litvan, 2020; Tampi et al., 2019). There can be early diagnostic uncertainty before idiopathic PD is confirmed, especially for patients presenting with gait abnormality or atypical features (Breen et al., 2013). Moreover, virtual visits during the COVID-19 pandemic only allowed limited neurological examinations, which may have reduced initial diagnostic accuracy.

Strengths of the present study included using a previously validated MBCT protocol adapted for people with PD, pioneered in a prior trial and improved with participant feedback; including caregivers; having an instructor experienced in group facilitation and providing telemedicine services for patients with PD; using validated scales for primary outcome quantification; and conducting the study entirely virtually, which allowed nationwide participant recruitment and helped improve retention.

Limitations include the lack of a control group, which did not allow to evaluate the effectiveness of the intervention; small caregiver sample size; limited racial/ethnic diversity among participants; not using a validated interview such as the SCID to characterize psychiatric disorders; lack of data collection on the instructor's adherence to the MBCT protocol integrity; and lack of longitudinal follow-up to observe whether gains were maintained. A measure of group cohesion would have also been helpful to explore as an outcome modifier.

Conclusions

Online MBCT is feasible and may be effective in improving anxiety and depressive symptoms in people with PD. These results should be replicated in studies with larger, more diverse samples, and using control groups. Benefits of mindfulness are multi-faceted. We hope this study will serve as a catalyst for other centers to develop online MBIs, particularly given the ongoing challenges posed by the COVID-19 pandemic to people with PD and their caregivers.

analysis. Drs. Seritan and Iosif drafted the manuscript. All co-authors critically reviewed and edited the manuscript draft.

Declarations

Ethics Approval The University of California, San Francisco Institutional Review Board reviewed and approved the study.

Consent to Participate Informed consent was obtained from all individual participants included in the study.

Competing Interests The authors declare no competing interests.

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