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A randomized controlled trial of mindfulness-based intervention on individuals with physical disabilities in China

Lu-yin Liang[1] · Daniel T. L. Shek[2]

Abstract

Individuals with physical disabilities (PD) face many quality of life challenges. In this study, a randomized controlled trial was conducted to investigate the impact of mindfulness-based intervention (MBI) on the psychological morbidity (indexed by depression and anxiety), emotional well-being (indexed by mindfulness and self-compassion), and health-related quality of life (QOL) among individuals with PD in China. A total of 512 participants with PD were randomly allocated to either the MBI group or the control group. Participants in the experimental group received an eight-week MBI in four sequential stages with different mindfulness meditation exercises. Results showed that participants who underwent MBI exhibited significantly fewer symptoms of depression and anxiety, elevated levels of mindfulness and self-compassion, and enhanced health-related QOL compared to those who did not receive the treatment after intervention. The study yielded promising results for using MBI in promoting the well-being of individuals with PD in China. Suggestions for future research are also highlighted.

✉ Lu-yin Liang
   lly312@gdut.edu.cn

1   Law School, Guangdong University of Technology, 161 Yinglong Rd, Guangzhou 510520, China

2   Department of Applied Social Sciences, The Hong Kong Polytechnic University, Kowloon, Hong Kong

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Introduction

Based on official Chinese government official statistics, individuals with disabilities in China surpassed 85 million. There were over 24 million of people with physical disabilities (PD), representing the dominant category within the different types of disability (Second National Sample Survey Office for Persons with Disabilities, 2008). This category includes individuals experiencing muscular dystrophy, amputations, stroke, multiple sclerosis, cerebral palsy, spinal cord injuries, and/or infectious diseases. Notably, these conditions transcend mere physical mobility limitations because they result in psychological distress and broader health risks. The impact of PD on individuals extends beyond the realm of impaired physical functioning to encompass multifaceted impairment in the areas of psychological morbidity, emotional well-being, and health-related quality of life (QOL). Thus, it is necessary to design effective and innovative interventions based on the specific rehabilitation needs of individuals with ID (Huang et al., 2017; Lebrasseur et al., 2021). It is worth noting that COVID-19 pandemic has had a profound effect on the holistic well-being and QOL of the general populations (Shek, 2021; Shek et al., 2023). Against the backdrop of the COVID-19 pandemic, individuals with PD in China, who have endured prolonged city lockdown measures, are likely to encounter increasingly formidable impediments to their health and well-being, owing to constrained avenues for medical intervention and routine caregiving (Wang et al., 2022; Zhang & Chen, 2021). Increased loneliness, heightened stress levels, elevated perception of risk, diminished resilience, and compromised social coping mechanisms are among the observed risks to mental health and QOL within this group (Na & Yang, 2022). Therefore, there is an urgent need to explore methods and strategies for improving the QOL of individuals with PD, both in academia and in practice.

Over the past few years, clinical practitioners have attempted to promote the QOL and well-being of individuals with physical functioning impairment by undertaking a variety of measures, such as implementing different psychological intervention strategies (Anderson & Ozakinci, 2018; Hardison & Roll, 2016; Hickey et al., 2019; McCracken et al., 2007). Among these interventions, Mindfulness-Based Intervention (MBI) is considered as a potentially effective approach for helping individuals with PD.The theoretical basis of mindfulness originates from the philosophy of ancient Buddhist and is deeply influenced by its centuries-old practice of meditation, which emphasizes the regulation of attention and non-reactive awareness. The idea of mindfulness was embraced by Western psychology through the transformative work of Jon Kabat-Zinn. He refined mindfulness methods so that the "secular" mindfulness practices could be used extensively by the public (Kabat-Zinn, 2003; Tirch et al., 2015).

Kabat-Zinn's outstanding contribution lies in his introduction of mindfulness into mainstream practice, laying the foundation for the development of this field (Reibel & McCrown, 2019). In the current context, MBI has developed into a structured psychotherapy system that integrates mindfulness meditation, yoga, and cognitive behavioral techniques (Apolinário-Hagen et al., 2020; Pascoe et al.,

2017; Shelov et al., 2009; Wielgosz et al., 2019). The core goal of MBI is to cultivate individual self-awareness, regulate emotions, and establish adaptive coping mechanisms, thereby stimulating the individual's inner potential for change. The essence of mindfulness lies in non-judgmental awareness of the present moment, which encompasses the observation and acceptance of emotions, experiences, thoughts and body sensations. These skills are developed progressively through formal meditative practices such as mindfulness and breath awareness, as well as informal daily practices such as open monitoring of daily activities (Mace, 2007; Plaza et al., 2013; Wahbeh & Oken, 2016).

Bishop et al. (2004) suggested that the core dimensions of MBI should consist of self-regulated attention and unique experience orientation. Self-regulation requires careful observation and recognition of thoughts, feelings, and perceptions, while an experiential orientation emphasizes curiosity, openness, and a nonjudgmental attitude. The goal of MBI is to reshape one's internal experience, promote his/her objective observation, and, over time, deepen his/her insight into habitual thought patterns. Accroding to Shapiro et al. (2006), mindfulness comprises three main components which are attention, intention and attitude. Based on this, Hölzel et al. (2011) developed a more comprehensive theoretical framework for analyzing the interaction mechanism of MBI. This theoretical framework explains in detail how mindfulness works while identifying the important roles of body awareness, attention regulation, emotion regulation (including exposure, reappraisal, extinction, and reconsolidation), and fundamental changes in the mindful self-perspective. It also seeks to demonstrate the potential benefits of MBI in having a transformative impact on an individual's cognitive and affective processes.

The effectiveness of MBI in improving the health and well-being of a variety of populations (including individuals suffering from stress, anxiety, cancer, and chronic diseases) has been confirmed by several studies (Grossman et al., 2004; Hofmann et al., 2010; Ledesma & Kumano, 2009; Merkes, 2010; Zhang et al., 2016a, 2016b). In the context of people with PD, MBI offers promising ways to help improve mental well-being. These practices encourage accepting physical limitations and building resilience, which can help reduce the negative psychological effects often linked with PD (Battalio et al., 2020). Additionally, through techniques like body scan meditations and mindful movement, individuals with PD can become more aware of their body sensations and feel more in control of their physical experiences (Goodrich et al., 2015). Moreover, fostering mindfulness might contribute to improved pain management, reduced stress reactivity, and enhanced emotional regulation, which are especially relevant for individuals dealing with PD (Liu et al., 2022; Reiner, et al., 2013). Despite that MBI may result in positive outcomes for patients with PD, research in this area remains woefully inadequate. In the process of seeking relevant evidence, we found that some studies have proven the significant effectiveness of MBI in reducing psychological morbidity in patients with physical diseases. For example, existing research has shown that individuals diagnosed with stroke (Beauchamp et al., 2023; Niu et al., 2022) and rheumatoid arthritis (Pradhan et al., 2007) significantly reduced their depressive symptoms after receiving MBI. A single study of patients with traumatic lower limb amputation proposes that mindfulness-related yoga programs can effectively decrease the anxiety levels (Mir et al.,

2023). A systematic review conducted by Hearn and Cross (2020) showed that MBI was a recommended program for reducing the symptoms of both depression and anxiety in patients with spinal cord injury.

The prominent effects of MBI on improving other aspects of emotional well-being in individuals with physical diseases are also discussed. Pradhan et al. (2007) conducted a study on the effectiveness of a mindfulness-based stress reduction (MBSR) program among 63 patients with rheumatoid arthritis and found that their mindfulness levels improved significantly after the program. Similarly, another qualitative study on the effectiveness of online mindfulness intervention showed that patients with rheumatoid arthritis could develop better understanding and acceptance of mindfulness and learn more mindfulness skills through the practice of MBI (Leov, 2016). A number of systematic reviews suggested that self-compassion of people with chronic poor physical health could be enhanced via a series of mindfulness-related intervention strategies, such as MBSR, mindfulness meditation (MM), -body bridging (MBB)), Yoga and Mindful Self-Compassion Program (MSC). (Friis et al., 2016; Kılıç et al., 2021; Nakamura et al., 2013; Schellekens et al., 2017; Toise et al., 2014). MBSR has been confirmed its effectiveness in increasing levels of self-compassion in people with multiple sclerosis or acquired brain injury as well (Johansson et al., 2015; Simpson et al., 2017). Additionally, the effectiveness of MBI in improving health-related QOL is supported by some existing research evidence (Banth & Ardebil, 2015; Morone et al., 2016; Wong et al., 2011).

A survey of the literature shows that there are limited studies on the effect of mindfulness interventions on individuals with physical functional impairment. When we searched PsycINFO using "physical disability" and "mindfulness" on December 19, 2023, we found 245 citations only. If we add "Chinese" as a search term, the number dropped to 3. Similar observation was found using three Chinese databases (CNKI, Wanfang, and VIP), showing that studies on the effectiveness of MBI in Chinese people are highly inadequate.

With reference to mindfulness interventions in medical and healthcare fields, MBI was predominantly administered in offline settings, with implementation periods ranging from 2 to 8 weeks. Besides, the outcomes primarily revolved around the modulation of negative emotions, demonstrating a alleviation of symptoms related to depression and anxiety (Cui, 2016; Huang et al., 2017; Liu, 2017; Zhao, 2018). Some studies also indicated significant benefits of mindfulness interventions in enhancing mindfulness levels, capabilities of daily living, and health-related QOL (Gan et al., 2019; Zhang et al., 2015). Notably, the subjects targeted in these studies were patients undergoing treatment in hospitals with existing physical impairments, rather than individuals who were discharged into the community.

There are also several limitations of existing studies on the effectiveness of MBI in the Chinese context. These include small sample size involved, lack of information about the basic characteristics of the study subjects, absence of baseline measurements and control groups, excessively short intervention periods, and overly simple descriptions of the conceptualization and operational processes of the intervention activities (Bédard et al., 2014; Simpson et al., 2017; Wang et al., 2019; Xu et al., 2015). This underscores the pressing need to address these research gaps by refining methodologies and enhancing the presentation of intervention processes.

In summary, the preceding literature review highlights that while contemporary Western studies generally support the efficacy of MBI across diverse populations, there exists a significant gap in research dedicated to assessing the effectiveness of MBI tailored for individuals with physical disability (PD). This research gap is particularly significant in the Chinese context due to China's large population (Shek et al., 2022). The scarcity of empirical studies in this area highlights the need for thorough exploration and rigorous investigation. Against this background, the primary purpose of this research is to assess the impact of MBIs on enhancing mental health functioning, emotional well-being, and health-related QOL in this marginalized population. The research seeks to answer the following research questions:

1. Does MBI reduce psychological morbidity (indexed by depression and anxiety) in individuals with PD? With reference to the literature (Beauchamp et al., 2023; Cui, 2016; Hearn & Cross, 2020; Huang et al., 2017; Liu, 2017; Niu et al., 2022; Mir et al., 2023; Pradhan et al., 2007; Zhao, 2018), we expected that there would be reduction in depression and anxiety in people with PD after they join MBI (Hypotheses 1a and 1b).
2. Does MBI promote mindfulness and self-compassion in people with PD after they join MBI? Based on the previous work (Friis et al., 2016; Johansson et al., 2015; Kılıç et al., 2021; Leov, 2016; Nakamura et al., 2013; Pradhan et al., 2007; Schellekens et al., 2017; Simpson et al., 2017; Toise et al., 2014), we predicted that people with PD would have elevated levels of mindfulness and self-compassion after intervention (Hypothesis 2a and Hypothesis 2b, respectively).
3. Does MBI improve the health-related QOL of people with PD? Consistent with the literature (Banth & Ardebil, 2015; Gan et al., 2019; Morone et al., 2016; Wong et al., 2011; Zhang et al., 2015), we expected that there would be an improvement of QOL of people with PD after joining the program (Hypothesis 3).

Materials and methods

Participants

With the assistance of Guangzhou Ren Ren Social Service Centre (a local community rehabilitation service provider), participants were recruited from six communities in Guangzhou, China. The study took place between September 2020 and May 2021 (i.e., under COVID-19 pandemic). Participants were included if they: (1) were willing to participate in the intervention; (2) did not receive any psychological counseling or psycho-social treatment in the past three months; (3) did not experience cognitive impairment, substance abuse, or other mental disorders that may prevent effective understanding of the content of the intervention. The eligibility of participants was screened. Those who met the criteria were assigned to the MBI group or control group randomly. Both groups were invited to complete the pre-test and post-test after the intervention. Upon completion, the participants were given a gift valued RMB 50 (CYN) as a token of appreciation.

Measures

This study used a set of validated and standardized assessment tools to test the effectiveness of MBI interventions on a variety of emotional, psychological, and physical outcomes. These scales include the Self-Rating Depression Scale (SDS), the Self-Rating Anxiety Scale (SAS), the Mindful Attention Awareness Scale (MAAS), the Self-Compassion Scale Short-Form (SCS-SF), and the 12-item Short-Form Health Survey (SF-12).

The Self-Rating Depression Scale (SDS)

This scale was created to access a range of depressive symptoms, including mood, sleep patterns, appetite, and attention (Zung, 1971). It consists of 20 items and a 4-point Likert scale was used for each item. The scale calculates a cumulative score, with higher scores indicating more severe depressive symptoms. According to the results of the Chinese norm, the cutoff score of depression is 52, 53–62 is considered mild depression, 63–72 is considered moderate depression, and a score above 72 suggests severe depression (Zhang et al., 2016a, b). Reliability analyses showed that the SDS was internally consistent at baseline (alpha = 0.81) and post-test (alpha = 0.83).

The Self-Rating Anxiety Scale (SAS)

Developed by Zung et al. (1965), the SAS has been widely adopted to identify the severity of depressive symptoms in both clinical and research areas. Comprising 20 items, the SAS gauges diverse anxiety-related symptoms, including but not limited to nervousness, restlessness, and fear. Employing a 4-point Likert scale, it quantifies the severity of individual anxiety, with higher scores indicating heightened levels of severity. The Chinese normative criteria for the SAS categorize scores into specific bands (Xu et al., 2016): A score of 50–59 is considered mild anxiety, a score of 60–69 is considered moderate anxiety, and a score of 70 or above is considered severe anxiety. It was internally consistent at pretest (alpha = 0.83) and posttest (alpha = 0.84).

The Mindful Attention Awareness Scale (MAAS)

It is a self-report questionnaire comprising 15 items (Brown & Ryan, 2003). It aims to assess an individual's mindfulness level, gauging the extent to which they sustain attention to present-moment experiences. Respondents express their agreement with each statement on a 6-point Likert scale, typically spanning from 1 (almost always) to 6 (almost never). The total score is then computed, with elevated scores indicative of a heightened level of mindful attention awareness.

In the context of this study, the MAAS exhibited very good reliability at baseline and posttest (alpha = 0.93 in both cases).

The Self-Compassion Scale-Short Form (SCS-SF)

This scale assesses an individual's self-compassion (Neff, 2003) and covers six dimensions with a total of 12 items: common humanity, self-isolation, self-kindness, self-criticism, present moment mindfulness, and excessive self-indulgence. Responses are provided on a 5-point Likert scale, ranging from "never" to "always." Elevated scores on the scale signify heightened levels of self-compassion. The scale was shown to be reliable at pretest (alpha = 0.91) and posttest (alpha = 0.94).

The 12-Item Short Form Health Survey (SF-12)

This scale assesses an individuals' health-related QOL (Jenkinson et al., 1997) in two domains: physical health and mental health, with higher scores indicating better health conditions. Studies have supported the validity of SF-12 in Chinese populations. In this study, reliability showed that the scale was reliable at pretest (alpha = 0.82) and posttest (alpha = 0.84).

Design and Procedure

The experimental design employed in this study employed both matching and random assignment techniques. Specifically, participants were initially matched based on demographic factors such as age, gender, and severity levels of disability. Subsequently, each matched pair was randomly allocated to either the MBI group or the control group. A two-armed randomized controlled design was adopted in this study with the involvement of two groups: a MBI group and a control group. The signed informed consent forms of participants were collected prior to the study. Ethical approval was obtained from the Guangdong University of Technology Review Board. Research data were collected through questionnaires administered during two periods: pre-test (prior to the intervention) and post-test (after the intervention). Baseline measurements were taken during the pre-test for levels of depression, anxiety, mindfulness, self-compassion, and overall health, and differences between the two groups were examined. If no significant differences were found between the groups, the MBI program was carried out within two weeks after the pre-test, and the post-test was conducted within a month after the intervention ended. The control group did not undergo MBI. Instead, they received routine home visit services. In contrast, the MBI group received weekly face-to-face mindfulness treatment sessions conducted by therapists during routine home visits over an eight-week period. It is important to note that participants in MBI group did not avail themselves of any other psychotherapy services during the study. Finally, in the post-test stage, the above indicators (i.e. levels of depression, anxiety, mindfulness, self-compassion,

and overall health) were tested again to compare the differences between and within the groups.

Intervention

The mindfulness-based interventions were conducted at a community service center to individuals with PD in Guangzhou, China. A cohort of 257 participants in the MBI group underwent mindfulness-based therapy administered by trained therapists with 168 h of training. Each participant attended face to face intervention at their home once a week for a total of eight sessions weekly, amounting to eight sessions, each spanning 80 min. The therapist-to-participant ratio was maintained at 1:7–8, ensuring effective facilitation.

The framework guiding the mindfulness therapy program was anchored in the mindfulness meditation model proposed by Hölzel et al., (2011) delineated across four sequential stages: attention regulation (stage 1), body awareness (stage 2), emotional regulation (stage 3), and change in perspective on the self (stage 4). Throughout the intervention, the executive attention system (stage 1) enabled participants to discern conflicts hindering the maintenance of a mindful state during emotional triggers. Heightened body awareness (stage 2) facilitated the recognition of immediate physiological responses. Emotion regulation mechanisms,, encompassing reappraisal and exposure, extinction, and re-consolidation (Stage 3), aided in clearing reactive emotions, fostering the generation of new emotions, and consolidating emotional experiences. The dynamic interplay with perceptions, emotions, or cognition during the intervention engendered a transience that reshaped the participants' self-perception, culminating in self-transformation and heightened self-regulation ability (Stage 4). The design of the mindfulness intervention adhered to fundamental operational principles, with specific activities such as mindful breathing, body scanning, mindful eating, sitting meditation, and the incorporation of aromatherapy essential oils and relaxation music to enhance the experiential aspect (Fig. 1).

Given the potential for physical and emotional reactions like distraction, fatigue, or negative thoughts among participants, therapists were directed to integrate professional coaching skills, including active listening, motivational enhancement, empathy, goal clarification, and focus, to augment the effectiveness of the intervention. A detailed account of the intervention activities is presented in 1 (Table 1).

Data Analysis

The acquired data were analyzed using SPSS 27. Initially, descriptive statistics for the variables under investigation were examined. Subsequently, independent samples t-tests and chi-square tests were executed to compare demographic and baseline outcome variables among groups. Following this initial assessment, a series of 2 (group) * 2 (time) mixed-model ANOVAs were employed to explore whether the MBI group engaged in mindfulness practices demonstrated significant reductions in
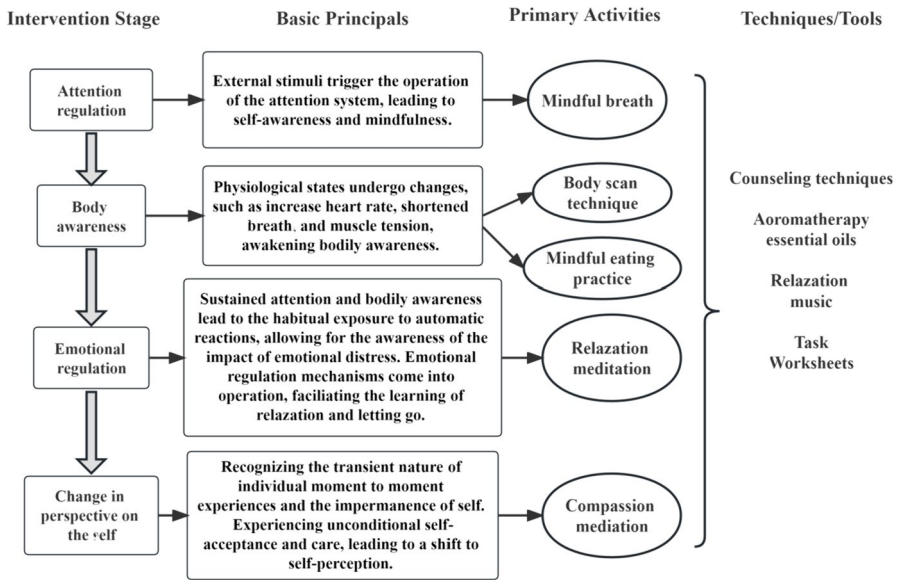
Fig. 1 The framework of the mindfulness-based intervention program

depression and anxiety, alongside increased levels of mindfulness, self-compassion, and health-related QOL in comparison to the control group.

Prior to conducting the mixed-model ANOVAs, adjustments were made to ensure the data adhered to normal distributions. This involved conducting homogeneity tests and the Box M test, which collectively affirmed the appropriateness of the data for subsequent analysis. In the ANOVAs, examination included the main effect of time, the main effect of group, and the interaction of group and time. In cases where the interaction between group and time was present, pairwise comparisons were conducted through post hoc tests to further identify within-subjects differences among outcome observations. The effect sizes were estimated and reported as partial eta squared (η^2).

Results

In this study, 512 participants who met rigorous inclusion criteria were randomly assigned, with 257 individuals allocated to the Mindfulness-Based Intervention (MBI) group and 255 to the control group. Within the MBI group, there were 149 males and 108 females, with age ranging from 19 to 87 years (mean age = 64.13, SD = 11.95). Among them, 76.65% experienced moderate to lower levels of psychological distress (PD), and 91.44% had attained a junior high school level of education or lower. Furthermore, 80.54% were married, while the remainder were single (5.45%), widowed (10.12%), or divorced (3.89%). Additionally, over 60% were either unemployed or retired.

Table 1 Contents of the mindfulness-based intervention program

| Time	Stage	Intervention Procedure and Activities
Week 1	Stage one Attention Regulation	1. Relationship Building, including introduction of mindfulness activity objectives, therapist's Self-Introduction, Clarifications, and addressing queries, consent form signing (15 min)
		2. Providing an overview of the concept, basic principles, and common practices of mindfulness to participants (25 min)
		3. Instructing the specific steps of mindful breathing and playing the audio for "Mindful Breathing" for participants to practice. Facilitating firsthand experiences and discussing the differences between mindful diaphragmatic breathing and typical chest breathing (30 min)
		4. Assigning homework and previewing the next session's activities (10 min)
Week 2		1. Conduct warm-up activities (5 min)
		2. Review the completion of homework sheets, discussing difficulties and uncertainties encountered during home practice, as well as changes and gains before and after practice (15 min)
		3. Utilize aromatherapy tools for mindful breathing exercises, breaking down the regulation of breath and inhalation frequency in a step-by-step manner, practicing extending the duration of breath (20 min)
		4. Play the audio material "Deuter," allowing participants to practice breathing along with the music and freely adjust the rhythm, assisting participants in recording and observing the duration of their breathing exercises (15 min)
		5. After the practice, engage in a group discussion on the participants' physical and mental experiences and feelings during the breathing exercises. Address any potential adverse reactions promptly, such as negative emotions, drowsiness, physical discomfort, etc. (10 min)
		6. Review the content of this session, assign homework, and preview the next session's activities (5 min)

Table 1 (continued)

Time	Stage	Intervention Procedure and Activities
Week 3	Stage two Body awareness	1. Conduct warm-up activities, review, and discuss the completion of homework sheets (20 min) 2. Introduce the fundamental principles, benefits, and techniques of body scanning. Invite participants to practice "Warm Light Meditation" during the body scan in a comfortable sitting or lying position. Use aromatherapy essential oils as an activity introduction. During the practice, focus on the sensations in each part of the body where the breath reaches, and cultivate awareness of the connection between the body and thoughts (40 min) 3. Discuss the experiences brought about by the body scan, compare the differences in various breathing exercises, and provide timely intervention for any potential adverse reactions (15 min) 4. Review the content learned in this session, assign homework, and preview the next session's activities (5 min)
Week 4		1. onduct warm-up activities, check and discuss the completion of homework assignments (20 min) 2. Introduce the relationship between mindfulness and daily life to participants, explaining the fundamental principles of mindful eating (10 min) 3. Focus on the theme of the "Raisin Exercise," introducing training objectives and methods. Use aromatherapy and play the audio material "Mindful Eating." Invite participants to practice mindful eating with raisins in a comfortable sitting position. During the exercise, participants are instructed to mindfully experience "holding," "seeing," "touching," "smelling," "placing," "chewing," "swallowing," and "feeling." Afterward, participants share and discuss their eating experiences with the facilitator (30 min) 4. The therapist guides participants in reflecting on how the mindfulness approach, emphasizing present-moment experiences, can be applied to the handling of daily emotional challenges. Help participants recognize the benefits of focusing on the present and living in the moment for overall well-being (15 min) 5. Review the content learned in this session, assign homework, and preview the next session's activities (5 min)

Table 1 (continued)

Time	Stage	Intervention Procedure and Activities
Week 5	Stage three Emotional Regulation	1. Conduct warm-up activities, check and discuss the completion of homework assignments (20 min) 2. Invite participants to share their recent week's mood, discussing the impact of different emotions on their lives and their perspectives on these emotional reactions (20 min) 3. Use aromatherapy and play the audio material "Mindful Observation of Emotions." Invite participants to practice relaxation meditation in a comfortable sitting position. During the exercise, participants are instructed to carefully observe their current emotions, feel the connection between emotions and different parts of the body, and experience the expression and release of emotions through breath (15 min) 4. After the practice, engage in a discussion with participants about their experiences and insights, and encourage them to write a "Mood Diary" (20 min) Review the content learned in this session, assign homework, and preview the next session's activities (5 min)
Week 6		1. Conduct warm-up activities, check and discuss the completion of homework assignments (20 min) 2. Introduce the principles, benefits, and practice methods of relaxation meditation, explaining the similarities and differences between this method and other mindfulness practices (20 min) 3. Use aromatherapy and play the audio material "Releasing Suppressed Emotions." Invite participants to engage in an emotional relaxation exercise in a comfortable sitting position. During the exercise, instruct participants to follow the guided voice to relax the entire body, allowing the release of pent-up emotions without suppression or control. Encourage experiencing unpleasant memories and negative emotions without judgment. Participants are guided to imagine placing these emotions into a box and then emptying the box (20 min) 4. After the practice, engage in a discussion with participants about their experiences. Explain the relationship between breath and emotional regulation, the connection between the body and emotions, and the impact on personal health. Appreciate and affirm their engagement and effort in the activity, encouraging them to continue using relaxation meditation for emotional regulation in their daily lives. Provide timely intervention for any emotional reactions that may arise during the practice (20 min) 5. Review the content learned in this session, assign homework, and preview the next session's activities (5 min)

Table 1 (continued)

Time	Stage	Intervention Procedure and Activities
Week 7	Stage one Change in perspective on the self	1. Conduct warm-up activities, check and discuss the completion of homework assignments (20 min) 2. Invite participants to share recent life concerns or interpersonal challenges from the past month. Discuss their feelings in these situations, the coping methods they have tried, and their effectiveness (15 min) 3. Use aromatherapy and play the audio material "Living in Harmony with Worries." Invite participants to engage in a compassionate meditation in a comfortable sitting position. During the practice, instruct them to carefully adjust the rhythm of their breath and feel the flow of breath in different parts of the body. Following the guided voice, visualize important people, significant individuals, and the surrounding community one by one. Silently express gratitude and complete acceptance to each person. Conclude by generating warmth and energy of love through gratitude towards loved ones, subsequently reconciling with personal worries and accepting oneself with imperfections (20 min) 4. After the practice, engage in a discussion with participants about their experiences. Explain the importance of self-care and self-identity in improving mental and physical health. Appreciate and affirm their engagement and effort in the activity, encouraging them to continue using compassionate meditation for self-awareness and self-regulation in their daily lives. Provide timely intervention for any emotional reactions that may arise during the practice (20 min) 5. Review the content learned in this session, assign homework, and preview the next session's activities (5 min)
Week 8		1. Conduct warm-up activities, check and discuss the completion status of homework (20 min) 2. Use aromatherapy and play audio material "Self-Love Meditation." Invite participants to engage in a comfortable sitting position for a nurturing meditation. During the practice, encourage following the verbal guidance, focusing attention on every part of the body, experiencing sensations including calmness and discomfort. Express love and gratitude to these body parts by silently reciting "I'm sorry, please forgive me. Thank you! I love you!" This fosters wholehearted self-acceptance and self-love (20 min) 3. Review exercises conducted in the 8 intervention sessions, discuss changes and gains obtained during these exercises (including changes in physical condition, emotions, sleep, concentration, etc.). Acknowledge and appreciate participants' efforts and contributions, encourage them to continue mindfulness practices after the session ends (30 min) 4. Conclude the mindfulness intervention session, arrange follow-up visits and effectiveness assessments with participants (10 min)
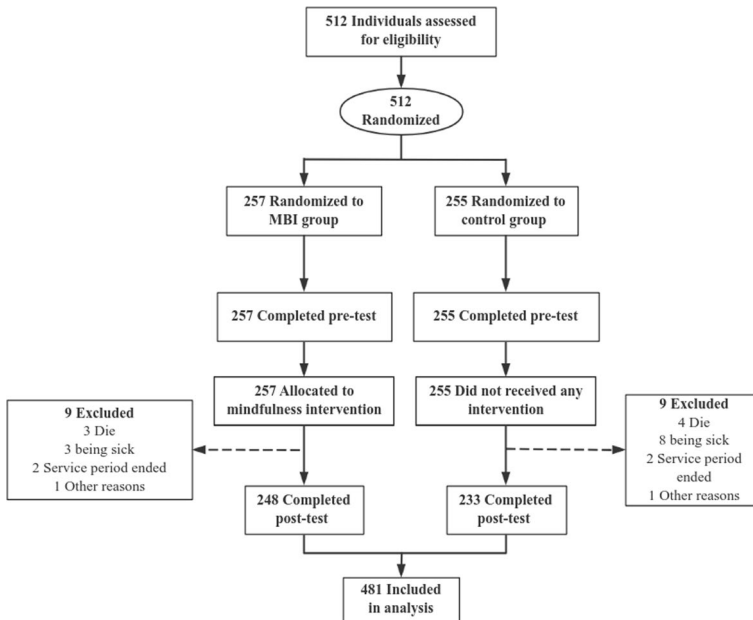
Fig. 2 Flow chart of participants

The control group consisted of 152 males and 103 females, aged between 20 and 91 years (mean age = 64.31, SD = 12.47). Within this group, 77.26% experienced moderate to lower levels of PD, and 90.98% had attained a junior high school level of education or lower. Similarly, 80% were married, with the remaining participants being single (5.49%), widowed (11.37%), or divorced (3.14%). Additionally, 63.92% were either unemployed or retired.

At post-intervention, 18 participants (3.51%) did not complete outcome measures, leaving 481 participants (MBI group: 248, control group: 233) for the post-test analysis, yielding an overall response rate of 93.94.0%, with rates of 96.50% in the MBI group and 91.37% in the control group. Figure 2 illustrates the flow of participant in the study.

Regarding the demographic characteristics, analysis of the baseline data indicated no statistically significant differences between both groups concerning age (t = -0.16, p > 0.5), gender (χ^2 = 0.23, p > 0.5), severity levels of disability (χ^2 = 0.72, p > 0.5), education level (χ^2 = 4.28, p > 0.5), marital status (χ^2 = -0.40, p > 0.5), and employment status (χ^2 = 1.55, p > 0.5) (Table 2). The findings suggest that there was no pre-existing differences between the two groups in terms of these demographic characteristics.

Regarding depressive symptoms, the ANOVA test revealed significant main effects for both Time (F = 7.40, p < 0.05, η^2 = 0.02) and Group (F = 7.73, p < 0.05, η^2 = 0.02). Furthermore, a notable interaction emerged between Time and Group (F = 3.26, p < 0.05, η^2 = 0.01). Post hoc testing, corroborated by visual inspection of plots, indicated no significant differences in depressive symptoms between

Table 2 Demographic information by group and group comparison at baseline ($N = 512$)

		MBI group ($n = 257$)		Control Group ($n = 255$)		Group Difference	
		Mean	*SD*	*Mean*	*SD*	t/χ^2	*p*
	Age	64.13	11.95	64.31	12.47	-0.16	0.87
		N	*%*	*N*	*%*		
Gender	Male	149	57.98%	152	59.61%	0.23	0.63
	Female	108	42.02%	103	40.39%		
Severity Levels of Disability	Mild	56	21.79%	60	23.53%	0.72	0.47
	Moderate	141	54.86%	137	53.73%		
	Severe	41	15.95%	34	13.33%		
	Profound	19	7.39%	24	9.41%		
Education Level	≦Elementary school	189	73.54%	190	74.51%	4.28	0.37
	Junior high school	46	17.90%	42	16.47%		
	High/secondary school	16	6.23%	17	6.67%		
	≧Undergraduate	6	2.33%	6	2.35%		
Marital Status	Single	14	5.45%	14	5.49%	-0.40	0.69
	Married	207	80.54%	204	80.00%		
	Widowed	26	10.12%	29	11.37%		
	Divorced	10	3.89%	8	3.14%		
Employment Status	Unemployed	29	11.28%	31	12.16%	1.55	0.12
	Employed	2	0.78%	3	1.18%		
	Retired	130	50.58%	132	51.76%		
	Others	96	37.35%	89	34.90%		

N/n = number of cases; *SD* = standard deviation; t/χ^2 = value of T-test or Chi-Square test

both groups at baseline (F = 0.68, p > 0.05, η^2 = 0.002). However, a discernible reduction in depressive symptoms was observed within the MBI group from baseline to post-test (F = 10.51, p < 0.01, η^2 = 0.03). Conversely, no significant changes were noted in the control group over time (F = 0.41, p > 0.05, η^2 = 0.001) (Table 3, Fig. 3). The findings supported Hypothesis 1a.

Regarding anxiety symptoms, the ANOVA results revealed a significant main effect for Group (F = 6.97, p < 0.05, η^2 = 0.02), while the main effect for Time did not reach significance (F = 0.80, p > 0.05, η^2 = 0.002). Additionally, a there was a significant Time X Group interaction (F = 9.90, p < 0.01, η^2 = 0.03). Post hoc testing, confirmed with inspection of plots, disclosed no significant disparities in anxiety symptoms between both groups at baseline (F = 0.002, p > 0.05, η^2 = 0.0001). Notably, within the MBI group, a significant reduction in anxiety symptoms was observed from baseline to post-test (F = 8.21, p < 0.01, η^2 = 0.02). Conversely, no significant changes were observed in the control group throughout the study duration (F = 2.52, p > 0.05, η^2 = 0.01) (Table 3, Fig. 4). The findings supported Hypothesis 1b.

Table 3 Results of intra- and inter-group differences in study variables (pre-test and post-test)

			Depression (SDS)	Anxiety (SAS)	Mindfulness (MAAS)	Self-compassion (SCS-SF)	Health-related QOL (SF-12)	
							Physical aspect	Mental aspect
MBI group	Baseline	Mean (SD)	48.62 (8.64)	44.96 (9.17)	4.19 (1.01)	2.30 (0.48)	36.40 (10.32)	44.52 (11.86)
	After intervention	Mean (SD)	44.98 (12.72)	41.96 (12.25)	4.43 (1.03)	2.61 (0.73)	39.40 (9.77)	49.74 (9.53)
	Within group difference	F(p)	10.51(0.001)**	8.21(0.004)**	7.31(0.007)**	32.41(0.0001)***	10.88(0.001)**	35.18(0.0001)***
		η^2	0.03	0.02	0.02	0.06	0.02	0.07
Control group	Baseline	Mean (SD)	49.53 (12.58)	44.96 (11.97)	4.16 (1.05)	2.33 (0.71)	37.05 (10.35)	44.51 (9.23)
	After intervention	Mean (SD)	48.80 (11.16)	46.63 (10.92)	4.11 (1.04)	2.32 (0.51)	36.73 (9.57)	44.60 (8.62)
	Within group difference	F(p)	0.41(0.52)	2.52(0.11)	0.34(0.56)	0.06(0.81)	0.11(0.75)	0.01(0.92)
		η^2	0.001	0.01	0.001	0.0001	0.0003	0.0001
Between group difference	Baseline	F(p)	0.68(0.41)	0.002(0.99)	0.14(0.71)	0.30(0.59)	0.44(0.51)	0.0004(0.99)
		η^2	0.002	0.0001	0.0005	0.001	0.001	0.0001
	After intervention	F(p)	9.58(0.002)**	15.08(0.0001)***	11.41(0.001)**	26.47(0.0001)****	9.05(0.003)**	35.27(0.0001)
		η^2	0.03	0.04	0.02	0.05	0.02	0.07
Main effect	Time	F(p)	7.40(0.01)*	0.80(0.37)	2.15(0.44)	14.40(0.0001)***	4.23(0.04)*	17.54(0.0003)***
		η^2	0.02	0.002	0.004	0.03	0.01	0.04
	Group	F(p)	7.73(0.01)*	6.97(0.01)*	6.21(0.01)*	10.94(0.001)**	2.51(0.01)*	13.60(0.0001)***
		η^2	0.02	0.02	0.01	0.02	0.01	0.03
Time * Group effect		F(p)	3.26(0.04)*	9.90(0.002)**	5.29(0.02)*	17.18(0.0004)***	6.36(0.01)*	16.38(0.0001)***
		η^2	0.01	0.03	0.01	0.04	0.02	0.04

F = value of ANOVA test; SD = standard deviation; *$p < 0.05$ **, $p < 0.01$, ***$p \leq 0.001$; η^2 = effect size for analysis of ANOVA
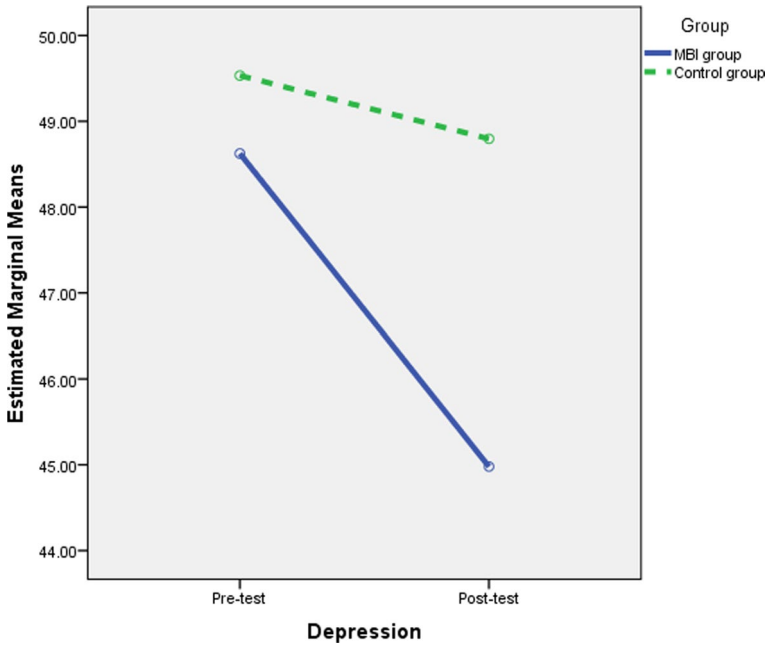
Fig. 3 Changes in depression for both groups after the intervention
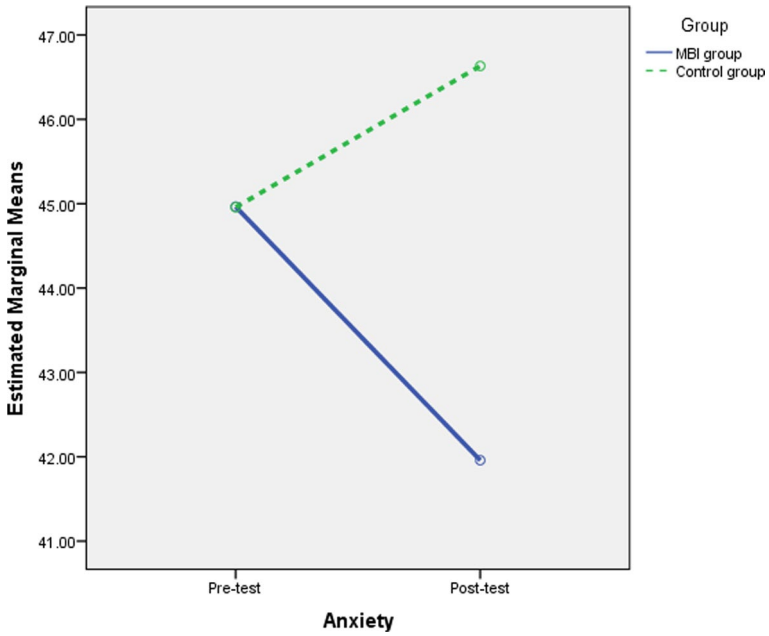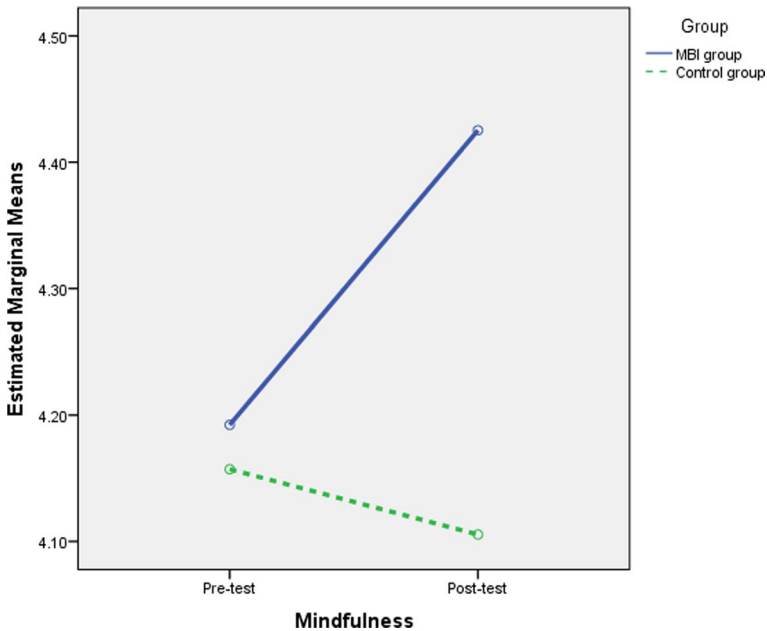

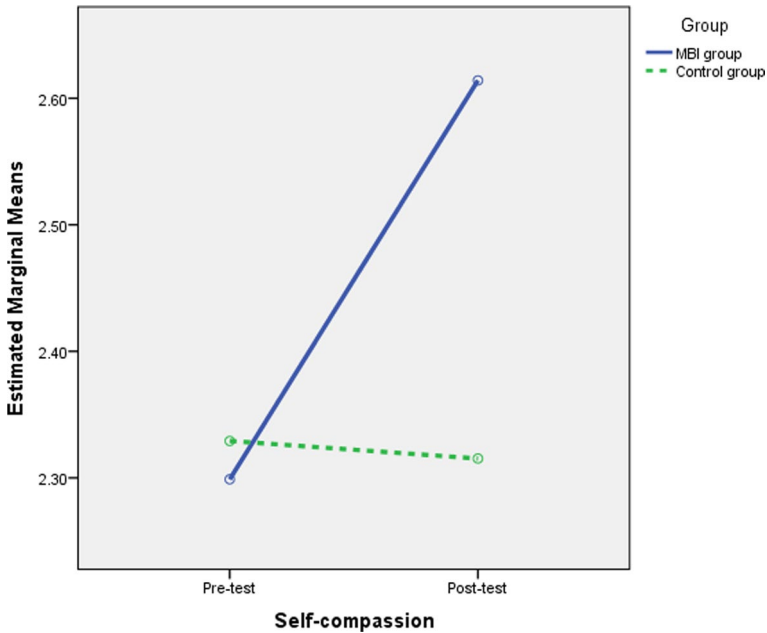**Fig. 4** Changes in anxiety for both groups after the intervention

Fig. 5 Changes in mindfulness for both groups after the intervention

Concerning mindfulness, the ANOVA results indicate a significant main effect for Group ($F=6.21$, $p<0.05$, $\eta^2=0.02$) but not for Time ($F=2.15$, $p>0.05$, $\eta^2=0.004$). Besides, a statistically significant interaction between Group and Time was identified ($F=5.29$, $p<0.05$, $\eta^2=0.01$). Post hoc analyses, validated through plot inspection, revealed no substantial differences in mindfulness levels between both groups at baseline ($F=0.14$, $p>0.05$, $\eta^2=0.0005$). As predicted, a notable improvement in mindfulness emerged from baseline to post-test in the experimental group ($F=7.31$, $p<0.01$, $\eta^2=0.02$), whereas no statistically significant changes were observed in the control group across time ($F=0.34$, $p>0.05$, $\eta^2=0.001$) (Table 3, Fig. 5). The findings support Hypothesis 2a.

For self-compassion, the ANOVA results indicated that both main effects for Group ($F=10.94$, $p<0.01$, $\eta^2=0.02$) and Time ($F=14.40$, $p<0.001$, $\eta^2=0.03$) were statistically significant. The interaction between Group and Time was also significant ($F=17.18$, $p<0.001$, $\eta^2=0.04$). Post hoc testing, validated through careful examination of plots, revealed no substantial differences in self-compassion between both groups at baseline ($F=0.30$, $p>0.05$, $\eta^2=0.001$). Nevertheless, within the MBI group, a significant improvement in self-compassion was observed from baseline to post-test ($F=34.41$, $p<0.001$, $\eta^2=0.06$), while no significant changes were detected in the control group throughout the entirety of the study ($F=0.06$, $p>0.05$, $\eta^2=0.0001$) (Table 3, Fig. 6). This observation provided support for Hypothesis 2b.

Two domains of health-related QOL were assessed: the physical domain and mental health domain. For the physical domain, the ANOVA results demonstrated that

Fig. 6 Changes in self-compassion for both groups after the intervention

both the main effects for Group ($F = 2.51$, $p < 0.05$, $\eta^2 = 0.01$) and Time ($F = 4.23$, $p < 0.05$, $\eta^2 = 0.01$) were statistically significant. The interaction between Group and Time was also found to be significant ($F = 6.36$, $p < 0.05$, $\eta^2 = 0.02$). Post hoc testing, confirmed with the plot inspections, revealed no significant differences in physical domain between both groups at baseline ($F = 0.44$, $p > 0.05$, $\eta^2 = 0.001$). However, within the MBI group, a noteworthy improvement in PCS was observed from baseline to post-test ($F = 10.88$, $p < 0.05$, $\eta^2 = 0.02$), while no significant changes were detected in the control group throughout the entire study duration ($F = 0.11$, $p > 0.05$, $\eta^2 = 0.0003$) (Table 3, Fig. 7). This provides support for Hypothesis 3.

Similarly, for the results of mental health domain, the ANOVA outcomes indicated that both the main effects for Group ($F = 13.60$, $p < 0.001$, $\eta^2 = 0.03$) and Time ($F = 17.54$, $p < 0.001$, $\eta^2 = 0.04$) were statistically significant. The interaction between Group and Time was also found to be significant ($F = 16.38$, $p < 0.001$, $\eta^2 = 0.04$). Post hoc testing, supported by a thorough examination of plots, revealed no substantial differences in mental health domain between both groups at baseline ($F = 0.0004$, $p > 0.05$, $\eta^2 = 0.0001$). Nevertheless, within the MBI group, a significant enhancement in mental health domain was observed from baseline to post-test ($F = 35.18$, $p > 0.05$, $\eta^2 = 0.07$), while no significant changes were detected in the control group throughout the entirety of the study ($F = 0.01$, $p > 0.05$, $\eta^2 = 0.0001$) (Table 3, Fig. 8). This finding also provided support for Hypothesis 3.
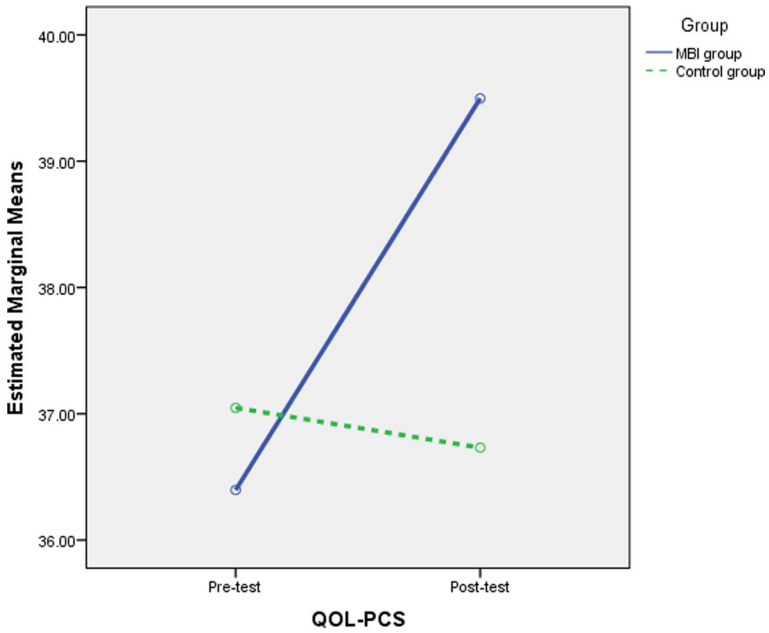
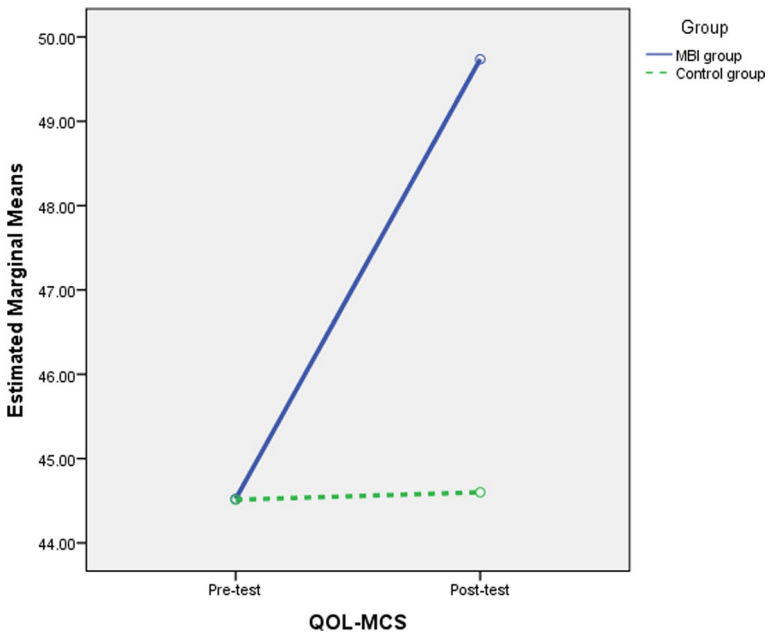**Fig. 7** Changes in QOL-physical domain for both groups after the intervention

Fig. 8 Changes in QOL-mental health domain for both groups after the intervention

Discussion

The current study explored the effects of MBI on psychological morbidity (indexed by depression and anxiety) as well as emotional well-being (mindfulness and self-compassion), along with the health-related QOL of individuals with PD in China. The findings demonstrated a significant impact of mindfulness-based intervention in this population. Participants who received MBI exhibited significant alleviation of psychological symptoms (depression and anxiety) compared to individuals with PD who did not undergo such interventions, giving support to Hypotheses 1a and 1b. These outcomes align with conclusions drawn from previous research on individuals with impaired physical functions in both Western and Chinese contexts (Beauchamp et al., 2023; Cui, 2016; Hearn & Cross, 2020; Huang et al., 2017; Liu, 2017; Mir et al., 2023; Niu et al., 2022; Pradhan et al., 2007; Zhao, 2018).

This study also showed that the mindfulness level of individuals with PD was significantly enhanced through MBI, and Hypothesis 2a was supported. This conclusion is in line with the findings of earlier Western studies (Leov, 2016; Pradhan et al., 2007). By practicing MBI, participants can focus more on the present moment and be more open to self-awareness and acceptance. This not only helps improve their QOL, but also encourages them to play a more active role in the psychological recovery process, thereby further gaining better adaptation to physical symptoms. The present findings offer practical guidance for introducing mindfulness to this population. Consequently, it provides insightful implications for both the academic community and clinical practitioners, advancing the application and development of mindfulness research among Chinese individuals with disabilities.

Besides promotion of mindfulness, self-compassion improved in the participants giving support to Hypothesis 2b. Although the effectiveness of MBI in promoting self-compassion levels among individuals with physical functional impairments has received attention in Western studies, scholarly discourse on this topic is scarce in China. This study confirms that MBI effectively enhances the self-compassion of individuals with PD. Participants who underwent MBI exhibited improvements in self-kindness, a reduction in self-criticism, self-isolation, and excessive self-indulgence, enhancement of common humanity, and improvement in present-moment mindfulness, aligning with conclusions from Western studies (Johansson et al., 2015; Kılıç et al., 2021; Simpson et al., 2017). Results of this study also support Hypothesis 3 that QOL for individuals with PD improved across time. Participation in MBI led to effective improvements in the health functioning of these individuals on both physical and psychological levels. This aligns with previous Western and Chinese research indicating consistent positive effects of MBI across different cultural backgrounds (Banth & Ardebil, 2015; Gan et al., 2019; Morone et al., 2016; Wong et al., 2011; Zhao et al., 2015). Firstly, the study results resonate with the positive influence of mindfulness on physical health. Individuals with PD, following a period of MBI training, demonstrated not only physiological improvements but also significant progress in disease management and rehabilitation. Mindfulness practice improves physical function by helping individuals perceive body signals more effectively and increase their tolerance for pain and discomfort. For individuals with

PD, this physical and mental transformation process will bring them a more positive recovery experience, such as improving their QOL. Second, this research identified the positive influences of MBI on mental health. For individuals with PD, long-term physical illness may result in significant negative emotional burden, such as anxiety, depression, etc. Mindfulness methods can play an important role in improving the mental health of them and helping them establish a more positive attitude towards life. This intervention can educate individuals on how to release psychological stress, deal with negative emotions, and promote emotional stability in daily life. These research findings provide a reasonable theoretical basis for introducing MBI to a broader spectrum of individuals with PD, transcending cultural differences. In short, the present study provides valuable insights for future rehabilitation interventions and psychological health treatments. In practice, a deeper understanding of the mechanisms of MBI could enhance their potential in the rehabilitation and psychological well-being maintenance of individuals with physical disabilities.

As previous MBI practices were predominantly conducted in Western societies and targeted Western populations, this study's practical application and effectiveness evaluation demonstrate the efficacy of MBI in implementing interventions for individuals with PD in Chinese society. Similar to some earlier Chinese research, this study confirms that an intervention period of eight weeks is optimal for achieving effectiveness. Furthermore, in contrast to some projects utilizing group-based MBI, this study implements one-on-one, home-based sessions. Despite the higher personnel and time investment required for this intervention method, it better suits the practical needs of local communities with individuals with PD. As a majority of this population encounters significant challenges in traveling, and local support for transportation aids is limited, conducting activities outside the home would add to the barriers and burdens. Home-based, one-on-one services not only address transportation obstacles but also provide participants with more individualized attention during mindfulness activities, ensuring greater privacy in the service.

Overall, the findings from this research hold the potential to facilitate and encourage the incorporation of mindfulness-based methodologies into the comprehensive landscape of disability care and rehabilitation within the healthcare system in China. These results could serve as a catalyst, promoting the adoption and utilization of mindfulness-based practices as an integral component within the framework of providing care and support for individuals with PD. The present findings have the potential to inspire and guide clinical practices, offering actionable recommendations to healthcare professionals in China. Ultimately, this may facilitate the integration of mindfulness-based approaches into the broader framework of disability care and rehabilitation within the Chinese healthcare system. The study is also important in the context of COVID-19 because mental health and QOL were much impaired under COVID-19 (Shek, 2021; Shek et al., 2023).

Acknowledging the limitations of this study is crucial. The aftermath of the COVID-19 pandemic, marked by prolonged lockdowns and administrative disruptions in the study area following the implementation of MBI, hindered the opportunity for conducting subsequent tracking of intervention effectiveness. As a result, the study was unable to observe the enduring impacts of MBI on the physical and mental well-being of individuals with PD. Furthermore, the study's sample predominantly

focused on older individuals with PD, with insufficient consideration for the circumstances of younger and middle-aged groups. Future research endeavors should focus on continuous tracking of intervention efficacy, ensuring a balanced age distribution within the research sample, exploring the impact of MBI on pain management and social interactions, and evaluating the varying effectiveness of this treatment across various categories of disabled individuals.

Data availability For original data, please contact the corresponding author. Ethical approval does not cover making data openly accessible.

Declarations

Competing interests The authors report no competing interests.

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