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ORIGINAL PAPER

Effects and Mechanisms of a Brief Mindfulness-Based Intervention for Caregivers of Frail Older Adults: A Three-Arm Randomized Controlled Trial

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Abstract

Objectives Studies consistently demonstrate that family caregivers often experience poor health, depression, anxiety, and a diminished quality of life. Mindfulness-based interventions have shown positive outcomes, and this study aimed to investigate the effects and mechanisms of a low-intensity mindfulness-based program for caregivers of frail older adults.

Method A multi-site, three-arm randomized controlled trial was conducted to assess the impact of a mindfulness-based intervention for Chinese family caregivers. Intervention effects were compared with those of an evidence-based psychoeducation program and treatment-as-usual. One hundred and fifty-one caregivers initially expressed interest in participating, with 93 eligible caregivers ultimately being randomly assigned to the brief mindfulness-based program, psychoeducation, or treatment-as-usual.

Results Caregivers in the mindfulness group showed greater improvements in depression, experiential avoidance, family functioning, self-efficacy, and problem-solving in coping style at post-intervention, compared with those receiving usual care. When compared to the psychoeducation group, caregivers in the mindfulness group showed greater improvements in experiential avoidance, and problem-solving coping. The improvement in self-efficacy was sustained at the 6-month follow-up.

Conclusions The findings suggest that a brief mindfulness-based intervention can significantly enhance caregiver mental health and overall well-being. This study provides further evidence that a low-intensity mindfulness intervention could be better suited to address the challenges faced by caregivers with limited time due to their demanding schedule.

Preregistration This study was preregistered with the United States Clinical Trials Registration (ClinicalTrial.gov) (NCT04861610).

Keywords Mindfulness-based intervention · Low-intensity mindfulness intervention · Family caregivers · Frail older people · Randomized controlled trial

Frailty is a multi-dimensional syndrome associated with aging, characterized by the accumulation of deficits and a decline in various physical abilities (Rockwood & Mitnitski, 2011). It can also be conceptualized as vulnerability and a diminished capacity to cope with stress (Rockwood, 2005), with studies showing a significant association between frailty in older adults and perceived stress (Lee et al., 2023). The prevalence of frailty is observed to increase rapidly with age, ranging from 22% among individuals aged 65 to 69 years old to 44% among those aged 85 years and above (Rockwood et al., 2011). Frail older individuals face higher risks of physical disabilities and cognitive impairments such as memory deficits and issues with executive function. Research indicates that around 28% of frail older adults with mild cognitive impairment progress to dementia within an average period of 5 years (Roberts et al., 2014). Frailty presents challenges for older individuals in upholding their independence in daily activities. It is linked to a

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perception among older individuals that the environment demands surpass their personal resources, thereby jeopardizing their well-being (Lazarus & Folkman, 1984). This situation often results in an escalated need for healthcare services and caregiving.

In aging societies like Hong Kong, there has been a significant rise in the number of family caregivers. Over a span of 7 years from 2013 to 2020, the number of family caregivers surged by approximately 32%, with 46% of them being adult children or extended family members who take on the role of primary informal caregivers (Census & Statistics Department, 2021). As primary informal caregivers of frail older adults, the responsibilities of caregiving inevitably arise, presenting long-term challenges for adult children to adapt to (Kazemi et al., 2021).

Caregivers often feel burdened and distressed when they witness their beloved frail older family members enduring suffering for extended periods despite their significant caregiving efforts (Bilgin et al., 2022). The stress stemming from the process can trigger mental health conditions among caregivers. Depression often emerges as a result of the ongoing challenges faced during coping, while anxiety manifests as an anticipatory emotion (Horowitz et al., 1980). These mental health conditions, depression and anxiety, are frequently reported symptoms experienced by caregivers throughout the caregiving journey (Stathopoulou & Fragkiadakis, 2023). Throughout this caregiving journey, caregivers may encounter family conflicts and role conflicts, with the caregiving burden potentially impacting their health and quality of life adversely (Gaugler et al., 2018; Sung et al., 2022). These psychological challenges can sometimes lead to abusive behaviors towards care recipients, particularly older individuals with dementia (Cooper et al., 2010), creating a detrimental cycle of increasing caregiving burden.

Caregiver burden encompasses distress arising from various facets of the caregiving process, including their financial, physical, psychological, social, and spiritual sources of distress (Zarit, 1986). This has prompted researchers' attention to focus on the coping strategies employed by caregivers, commonly categorized as problem-focused and emotion-focused coping (Folkman & Lazarus, 1980). Caregivers utilizing problem-focused coping typically seek solutions to address stressors directly, while emotion-focused coping aims to tackle the emotional distress resulting from stressors. Previous studies focusing on caregivers of individuals with dementia found a negative association between problem-focused coping and caregiving burden (Di Mattei et al., 2008). However, emotion-focused coping strategies are varied and diverse among individuals, including acceptance, avoidance, seeking support, and self-blame, and have shown mixed results in terms of mental health outcomes. In contexts involving frail older individuals, some researchers have emphasized that a generic categorization of "emotion-focused" coping strategies may not adequately address the complex family dynamics. Instead, they suggest investigating and emphasizing the effects of specific coping strategies such as denial, accommodation to better promote the mental well-being of caregivers (Cooper et al., 2008). Therefore, interventions targeting the coping strategies of the caregivers of frail older people should be considered for change.

Psychological interventions, including support groups, psychoeducation, cognitive and behavioral interventions, skill-building, and counseling, have been commonly employed to support family caregivers. These interventions focus on educating caregivers about the older adults, imparting knowledge on behaviors and disease information, teaching problem-solving skills, and aiding in distress management (Gaugler et al., 2017). However, the effectiveness of psychological interventions has shown inconsistent evidence in various studies (Collins & Kishita, 2019; Dam et al., 2016). Researchers and practitioners delve into possible change mechanisms within intervention programs, identifying connections between these mechanisms and outcomes to bolster program efficacy (Carey et al., 2019).

Mindfulness-based intervention (MBI) has emerged as a unique approach in mental health and social care (Goldberg et al., 2018; Johnson et al., 2023; Michaelsen et al., 2023). Mindfulness involves maintaining keen awareness and purposeful attention regulation in the present moment with a non-judgmental attitude (Kabat-Zinn, 2013). Various mindfulness exercises including mindful sitting, body scanning, and mindful movements are utilized to cultivate caregivers' moment-to-moment regulation of attention and emotions. The non-judgmental and open attitudes fostered through mindfulness practices can lead to acceptance, enhanced adaptive coping, and reduced experiential avoidance (Zhang et al., 2024). Protocols of 8-week MBIs including Mindfulness-Based Stress Reduction (MBSR) and Mindfulness-Based Cognitive Therapy (MBCT) have been widely studied for their effectiveness in reducing stress and enhancing well-being for individuals with health and mental health issues (Kabat-Zinn, 2013; Zhang et al., 2024). MBI shows promising results in helping caregivers become more aware of maladaptive coping patterns and emotional reactions related to caregiving burden, thereby promoting more positive coping strategies. A comparative study demonstrated that MBI for caregivers has superior outcomes than a behavioral support program with identical intensity (Singh et al., 2020). Nevertheless, caregivers have also faced distinct obstacles, especially when utilizing online interventions, resulting in low adherence rates and significant participation attrition (Abeysinghe Mudiyanselage et al., 2024). This necessitates further exploration for a delivery method and program structure that align with caregivers' requirements.

Although the efficacy of MBIs for caregivers of individuals with chronic diseases has been extensively researched, their impact remains uncertain. Recent research by Erdoğan Yüce et al. (2024) in a systematic review and meta-analysis of 12 studies indicated that MBIs were associated with significant improvements in caregiving burden, depression, and anxiety. However, high heterogeneity in caregiving burden and participant characteristics may influence outcomes. Another meta-analysis by Chacko et al. (2022) suggested that intensive MBI programs could effectively reduce caregiving burden for caregivers of individuals with dementia, although large, high-quality randomized controlled trials were limited. Finally, Han (2022) reiterated that MBIs demonstrated moderate to large effects on reducing depressive symptoms, anxiety, and stress, while enhancing quality of life post-program. These effects varied based on the types of control groups and delivery modes of MBIs spanning from self-guided sessions, therapists-guided sessions, to online programs.

While reviews have underscored that MBIs with durations of 8 weeks or more are inclined to yield superior results, the demanding nature of such programs could present difficulties for caregivers balancing caregiving duties. Consequently, several studies have explored MBIs for caregivers featuring alternative program structures and delivery modes. In a pilot study, a 7-week MBI lasting for 10.5 hr was developed, with 31 caregivers randomized into an MBI, psychoeducation, or respite care program (Oken et al., 2010). Results indicated that both MBI and psychoeducation interventions led to reductions in distress and avoidance coping, along with increased self-efficacy. A feasibility study focused on an app-based MBI for caregivers of individuals with dementia (Goodridge et al., 2021) demonstrated that caregivers experienced decreases in emotional-focused coping and enhancements in emotional well-being, although no significant change was observed in caregiver burden. Another study introduced a weekly four-session online MBI and enlisted 216 caregivers (Juberg et al., 2023). Significant improvements in depression, anxiety, caregiver burden, and positive well-being were noted. However, this study lacked randomization and a control group, raising concerns about the robustness of the findings. Given that the aforementioned studies with alternative delivery modes were either based on small sample sizes or lacked control groups, future investigations should prioritize rigorous designs to advance our understanding in this area.

MBIs have demonstrated benefits in reducing family conflicts and enhancing spiritual well-being, as highlighted in previous studies (Gillions et al., 2019; Park et al., 2020). By fostering emotion regulation, MBIs can potentially alleviate aggression and improve interpersonal dynamics within families. The study by Cooper et al. (2016) focused on developing a support program for caregivers of individuals with dementia and examined its effects on reducing caregiver abusive behaviors. The program was successful in significantly reducing caregiver anxiety and depression levels. However, despite these positive outcomes, the study did not find any improvement in reducing the abusive behaviors exhibited by the caregiver. The impact of the effects of MBIs on family conflicts and overall family functioning requires further exploration. Spiritual well-being, which pertains to an individual's inner sense of peace and meaning, is closely linked to quality of life, especially in the face of chronic, stressful, or life-threatening events (Bai & Lazenby, 2015). Given the importance of family conflicts, family functioning, and spiritual well-being in the context of caregiving for frail older individuals, further investigation into these areas is warranted within the family dynamic. By exploring these dimensions, researchers and practitioners can tailor interventions to address the holistic needs of caregivers and enhance their overall well-being within the caregiving context.

At the same time, research interest in MBIs extends to exploring the mechanisms of change associated with these interventions, as evidenced by studies such as those by Alsubaie et al. (2017) and Burzler et al. (2019). While the coping and stress reactivity model is a key theoretical framework in MBIs (Koerbel & Meleo-Meyer, 2019), empirical studies have paid limited attention to its role in MBIs. Coping, as defined by Lazarus and Folkman (1984), involves dynamic cognitive and behavioral efforts to manage perceived demands that exceed an individual's resources. Josefsson et al. (2014) compared a 6-hr MBI with relaxation training and found no significant differences in coping styles changes between the groups, and recommended a higher program intensity for detection of effects. Furthermore, research by Wu and Buchanan (2019) among university students indicated that mindfulness was associated with reduced perceived stress, decreased emotional suppression, and increased direct action. Given that coping strategies can be context-specific, studies focusing on caregivers are essential to understand their specific coping mechanisms (Gilhooly et al., 2016).

Another critical mechanism under investigation to enhance program effectiveness is experiential avoidance, which is linked to various mental health conditions (Akbari et al., 2022). Experiential avoidance involves individuals avoiding distressing situations, sensations, thoughts, and memories potentially exacerbating mental health issues (Hayes & Feldman, 2004; Hayes et al., 2012). This concept aligns with the mindfulness principles of openness and acceptance towards challenges and aversions. Two studies of MBI have highlighted the role of experiential avoidance in mediating improvements in emotional distress and well-being (He et al., 2024; Yela et al., 2022).

Self-efficacy has emerged as a prominent mechanism under study within MBIs, as it could act as a mediator in

the relationship between mindfulness and emotional regulation difficulties (Luberto et al., 2014). Heinen et al. (2024) conducted a systematic review and indicated that MBIs consistently enhance coping strategies and self-efficacy among patients with cancer. Moreover, Moniz-Lewis et al. (2022) observed significant indirect effects of post-treatment self-efficacy in mediating the effect of treatment condition on predicting reduced drug use and heavy drinking following MBIs for individuals in substance use service. In the study, coping strategies, experiential avoidance, and self-efficacy have been selected to investigate their potential mediating effects.

In this clinical trial focusing on Chinese caregivers of frail older adults, we conducted a three-arm non-inferiority, randomized controlled trial (Rothmann et al., 2011). The trial aims to investigate the effects and mechanisms of a brief MBI, in comparation to psychoeducation (PSY) and treatment-as-usual (TAU) groups. The primary goal was to assess whether MBI and PSY exhibit similar effects, and whether both interventions are superior to standard care. In addition, the present study aimed to explore the potential mediating effects of coping strategies, experiential avoidance, and self-efficacy in this context. The research hypotheses were structured as follows: (1) Caregivers in the MBI group, compared to the TAU group, would demonstrate significant improvements in depression, caregiving burden, anxiety, family conflicts, spiritual well-being, and family functioning. (2) Caregivers in the MBI group, compared to the PSY group, would demonstrate similar levels of improvements in depression, caregiving burden, anxiety, spiritual well-being, family functioning, and family conflicts. (3) Caregivers in the MBI group, compared with those in the PSY, would show greater improvements in experiential avoidance. No hypothesis was developed for their differences in coping style and self-efficacy. (4) Changes observed in caregivers in the MBI group would be mediated by their coping strategies, experiential avoidance, and self-efficacy. The research framework is synthesized in Fig. 1.

Method

Participants

This study was conducted from January 2021, and the final intervention programs implemented by December 2023. All follow-up data collection was finalized by June 2024. This study recruited participants in collaboration with several local NGOs and through various channels including social media, emails, and project leaflets. Initially we received 151 caregivers' applications. A research assistant screened them based on inclusion and exclusion criteria. Among them, 53 were excluded from the study due to older individuals not meeting the criteria of frailty ($n=20$), caregivers not meeting the criteria of experiencing caregiving burden ($n=29$), and not cross-generational caregivers ($n=4$). A total of 93 caregivers were included in the final sample, with 32 caregivers in the MBI group (Arm 1), 35 in the PSY group (Arm 2), and 26 in the TAU group (Arm 3). Random assignment to the three groups was conducted by another research assistant using the R package *blockrand*, generating a list of unique IDs for each stratum defined based on characteristics of the caregivers and randomly assigning the eligible participants into the minimum available block size for balanced sample sizes among groups. The IDs within the same block were randomly assigned into one of the three groups and to the participants in the respective stratum. The assistant was blinded to participants' data during the process.

Inclusion criteria of this study included (1) caregivers of frail older adults with a Clinical Frailty Scale score of 6 or

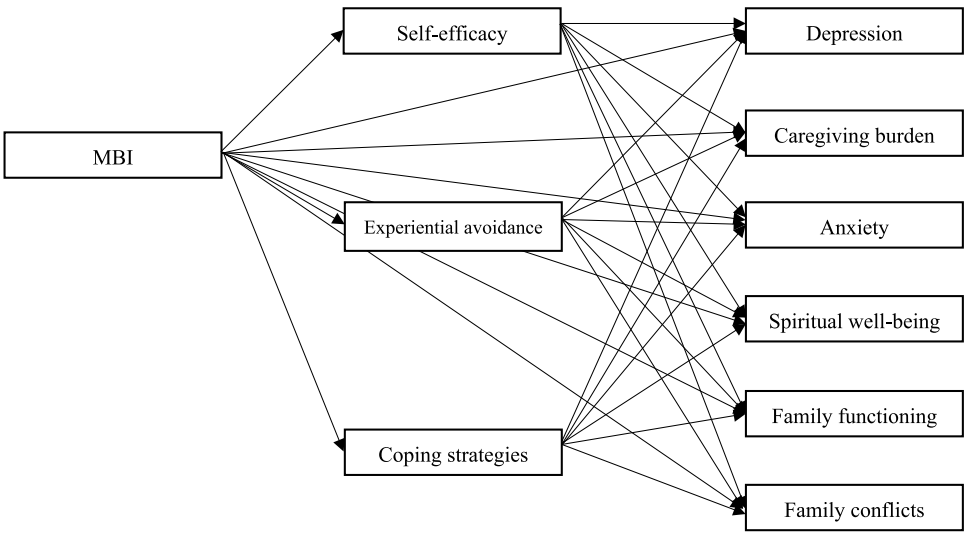

Fig. 1 The research framework of the study

above indicating moderate or high frailty (Rockwood et al., 2005). (2) Caregivers should be adult children of frail older people, or extended family members, such as their children-in-law. (3) Caregivers should rate their caregiving stress as 8 or above using the Zarit Burden Interview Screening Version (ZBI-4; Bédard et al., 2001). Exclusion criteria included (1) caregivers diagnosed with developmental disabilities and psychosis, and other cognitive impairments were excluded due to their difficulties in understanding the contents of the program. (2) Caregivers with moderate to severe dementia were excluded through a screening by the Clinical Dementia Rating Scale (Hughes et al., 1982) administered by the research assistant. (3) Caregivers who had previously participated in any MBI or equivalent programs. The participant flowchart based on the Consolidated Standards of Reporting Trials (CONSORT) flow diagram is depicted in Fig. 2.

Participants in arms 1 and 2 were informed about participating in the "Family Psychoeducation Program," with participants in Arm 1 not explicitly informed about "mindfulness" to prevent potential placebo effect. All participants were recruited on a voluntary basis, and written informed consents were obtained from all eligible participants before the program commenced. Participants who completed the program at post-intervention and 6-month follow-up received cash remuneration coupons as incentive.

Procedure

This was a multi-site, three-arm randomized controlled trial focusing on the effects of MBI for caregivers of frail older people. The outcomes of the caregivers were assessed at three time points including pre-intervention (T0), post-intervention (T1), and 6-month follow-up (T2). The MBI content was refined based on pilot study showing improvements in depressive symptoms, self-efficacy, and reduced experiential avoidance (Lo et al., 2022a, 2022b). Feedback from participants, social workers, and a mindfulness instructor involved in pilot study was incorporated to refine the MBI content.

Arm 1 was based on the authors' previous clinical trials on low-intensity mindfulness intervention (Lo et al., 2016,

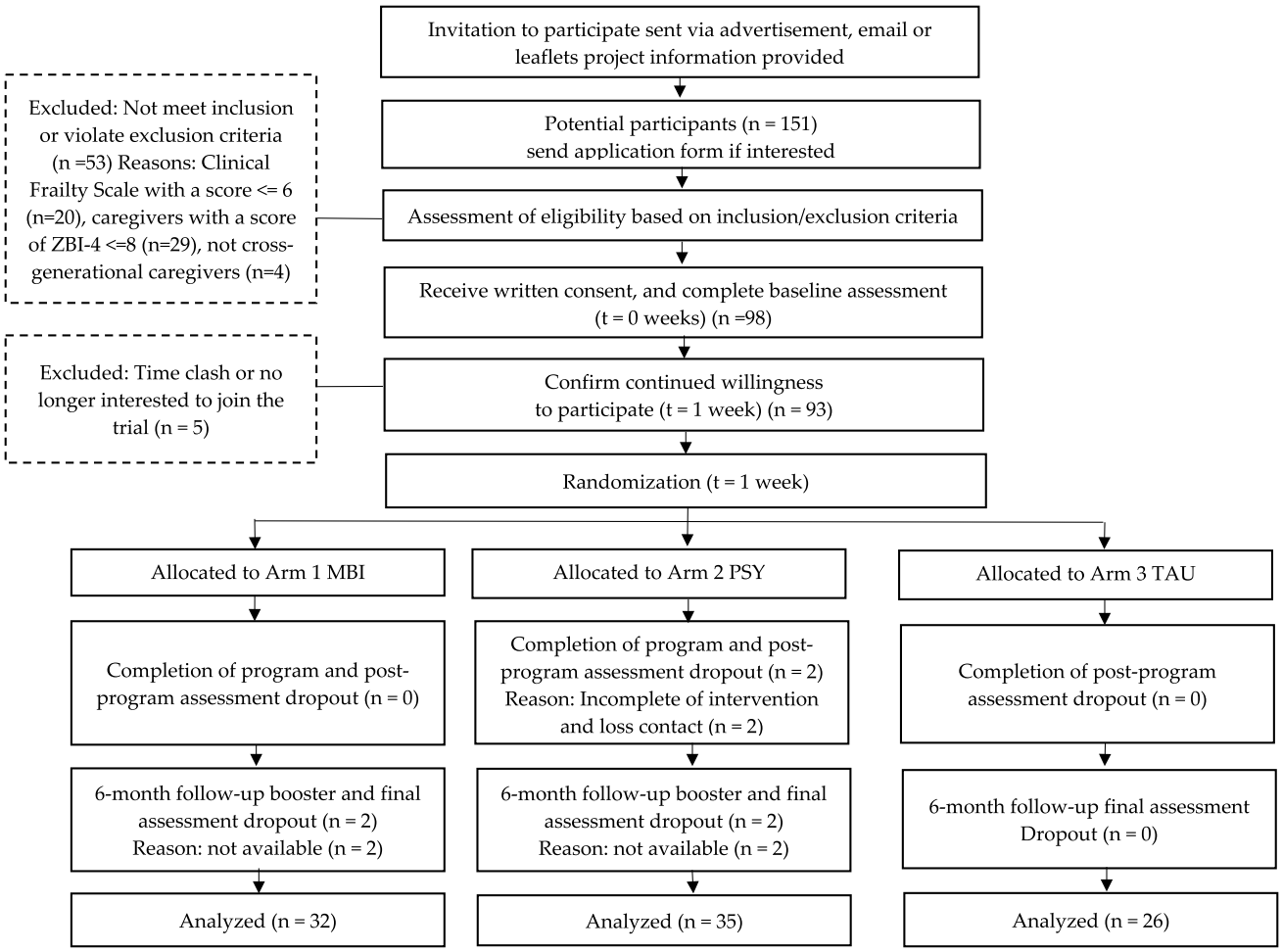

Fig. 2 The CONSORT flow diagram of the study

2019, 2020, 2022). Within a fast-paced and high-pressure living conditions in Hong Kong, a low-intensity intervention design would address the challenges in relation to caregivers' household tasks and work-family balance. Many caregivers expressed their preferences to a brief support program, as they are reluctant to commit an intensive MBI with a similar structure to MBSR or MBCT. Brief mindfulness practices and homework audio guidance were integrated with psychoeducation for caregivers. The intervention comprised four weekly sessions lasting 10 hr aimed at leading mindfulness practices, addressing caregivers' inquiries in mindfulness exercises, and offering support. In addition to mindfulness exercises, the reactivity patterns of caregivers, including avoidance and aggression (Session 2), pleasant and unpleasant events, and communication in caregiving (Session 3), were addressed in inquiry and psychoeducation. Caregivers in Arm 1 were tasked with engaging in 15-min daily mindfulness exercises to be practiced at home. Arm 2 was an adapted version of the START (STrAtegies for RelaTives) program (Livingston et al., 2014) which was modified into a 10-hr program tailored to frailty-related caregiving needs, followed by 15-min daily home practice assignments of stress management techniques. It was first developed by the corresponding author and was later endorsed by the third author who is an expert in caregiver intervention. In Arm 3, support was given as usual for the caregivers when their frail older adults were in regular consultation with general practitioners and specialists or received community care service.

Participants in Arms 1 and 2 were engaged in group interventions (less than 10 caregivers per group). The programs were conducted face-to-face way at four NGO collaborators and the corresponding author's university. Instructors in Arm 1 had at least 2 years of experience of delivering MBI and underwent professional MBI organized by the Oxford Mindfulness Foundation in the UK. Instructors in Arm 2 had over 2 years of experience working with caregivers of frail older adults. See detailed intervention structure and contents of both arms in Table 1.

Measures

The primary outcome in this study is the depressive symptoms of the caregivers. Secondary outcome variables included caregiving burden, anxiety, spiritual well-being, family functioning, and family conflicts. This study also assessed the mediators of outcomes including self-efficacy, experiential avoidance, and coping style. Demographic information collected includes details about the caregivers (age, gender, education level, marital status, work status, religion, living status, caregiving duration, and number of family members) and frail older adults (age, gender, relationship with their caregiver, marital status, and diagnosis). McDonald's omega (ω; Hayes & Coutts, 2020) was used to report the internal consistency reliability for the multi-item measures in this study, with an omega value of 0.70 or above indicating sufficient psychometric properties. The omega values were calculated using the pre-intervention data.

Table 1 Content and home assignments of the MBI (Arm 1) and PSY (Arm 2)

Mindfulness-based intervention (Arm 1)	Psychoeducation (Arm 2)
Session 1: **Stepping out from automatic pilot** • Course orientation and mutual understanding • Mindfulness exercise: mindful eating and body scan Home assignment: body scan	Session 1: **Stress of caregivers** • Orientation and mutual understanding • Overview of frailty • Listing out problem • Understanding trigger-behavior-reaction chain • Signal breath Home assignments behavior record form; signal breath
Session 2: **Reaction vs. responding in care** • Awareness of avoidance and aggression in caregiving • Mindfulness exercise: 3-min breathing and mindful stretching Home assignments: 3-min breathing and mindful stretching	Session 2: **Making a behavior plan** • Setting behavior goals • Changing behaviors by changing reactions • Changing unhelpful thoughts • Guided imagery Home assignment: mood record form; guided imagery
Session 3: **Being mindful in relationships** • Awareness of pleasant and unpleasant events in caregiving • Mindful communication • Mindfulness exercise: mindful sitting and ice cube exercise Home assignment: mindful sitting	Session 3: **Communicating with older adults** • Communication styles (passive vs. aggressive vs. assertive) • Assertiveness in communication • Care options and pain management • Relaxation exercise: stretching Home assignments: health management plan; stretching
Session 4: **Self-care and care of others** • Reviewing course learning • Developing self-care plan • Mindfulness exercise: befriending exercise	Session 4: **Self-care and care of others** • Identifying pleasant events • Course review

Depressive Symptoms

The Center for Epidemiologic Studies Depression Scale (CES-D) was used to measure the depressive symptoms of the participating caregivers based on their experiences in the previous week (Radloff, 1977). The self-reported scale contained ten items (e.g., "I felt lonely"), and each item was rated from 0 (*rarely or none of the time*, *less than 1 day*) to 3 (*all of the time*, *5–7 days*). A higher score of the sum indicated a higher level of depression. This scale has been validated in the Chinese sample, showing a good internal consistency (Boey, 1999). McDonald's omega for this study was 0.81.

Caregiving Burden

This study used the Zarit Burden Interview (ZBI) to assess the caregiving burden among the participating caregivers (Zarit et al., 1980). The scale had 22 items to measure the caregivers' perceived stress from aspects of finances, social life, health status, psychological well-being, and relationship with the older adults (e.g., "Do you feel that because of the time you spend with your relative, you don't have time for yourself?"). The 5-point Likert scale was rated from 0 (*not at all*) to 4 (*extremely*), and a higher total score demonstrated a higher level of caregiving burden. The Chinese version was validated for its high internal consistency (Tang et al., 2017), and McDonald's omega was 0.95 in this study.

Anxiety

The Anxiety subscale of the Hospital Anxiety and Depression Scale (HADS-A) was used to measure the anxiety of the participating caregivers (Zigmond & Snaith, 1983). It assessed anxiety symptoms from 0 (*low*) to 4 (*severe*). HADS-A has been well-established and commonly used in a worldwide range. Its Chinese version has also been assessed to have good internal consistency (Leung et al., 1999) and McDonald's omega in this study was 0.94.

Spiritual Well-Being

This study used the Functional Assessment of Chronic Illness Therapy–Spiritual Well-Being Scale (FACIT-Sp-12) to examine the spiritual well-being of the caregiver (Peterman et al., 2002). This scale contained 12 items on a 5-point Likert scale to focus on the meaning/peace and faith of the participating caregivers. A Chinese version has also been assessed to have good internal consistency (Wu et al., 2017). The scale showed its good internal consistency and McDonald's omega was 0.92 in this study.

Family Functioning

The Family Adaptation, Partnership, Growth, Affection, Resolve (APGAR) Scale was used in this study to assess the perceived family functioning of the caregivers (Smilkstein et al., 1982). This scale was a 5-item self-reported measurement with each item scoring from 0 (*hardly ever*) to 2 (*almost always*). The perceived family functioning was measured from five domains, including growth, affection, adaptation, partnership, and resolve (e.g., "I am satisfied with the way my family and I share time together and issues about money"). The Family APGAR has been widely adopted in Chinese studies with high internal consistency (e.g., Nan et al., 2013). McDonald's omega was reported to be 0.93 in this study.

Family Conflict

The Modified Conflict Tactics Scale (CTS) was used as a measure to examine behavioral assault or psychological aggression within the family context in this study (Beach et al., 2005). This self-reported scale contained 10 items, focusing on physical conflict, and verbal conflict. The Chinese version has been translated and widely used in related studies (e.g., Yan et al., 2022), and McDonald's omega was 0.93 in this study.

Self-Efficacy

The Caregiver Inventory (CGI-18) was a measure adopted in this study for assessing the self-efficacy of caregivers (Leung et al., 2017; Merluzzi et al., 2011). The scale focused on three domains, including managing emotional interactions with the care recipient, care of the care recipient, and managing information and self-care (e.g., "providing emotional support for the person I'm caring for"). There were 18 items scoring from 1 (*not at all*) to 9 (*totally confident*). The Chinese version has been assessed and validated based on a Chinese sample (Leung et al., 2017), and the good internal consistency was showed in this study ($\omega = 0.95$).

Coping Strategies

This study used the Brief COPE to measure the coping strategies of the participating caregivers (Carver, 1997). This was a self-reported scale, containing 28 4-point Likert items. The scores ranged from 0 (*I have not been doing this at all*) to 3 (*I've been doing this a lot*) for examining the frequency of the caregivers' engagement in different coping behaviors or thoughts (e.g., "refusal to believe the stressor exists").

The scale was validated based on a Chinese sample with 11 subscales (Tang et al., 2016). Based on such finding, accommodation, problem-solving, and denial were selected for this study. McDonald's omega of three subscales in this study were 0.79, 0.76, and 0.53, respectively.

Experiential Avoidance

The 15-item Chinese version of the Brief Experiential Avoidance Questionnaire (BEAQ) was adopted in this study to examine the caregivers' experiential avoidance (Gámez et al., 2011). Each item in this self-reported questionnaire ranged from 1 (*strongly disagree*) to 6 (*strongly agree*), and a sample item was "when unpleasant memories come to me, I try to put them out of my mind." The Chinese version has been validated and good internal consistency was reported among the Chinese sample (Lo et al., 2023) and the reliability in this study is good ($\omega = 0.78$).

Fidelity of the MBP

All sessions in this study were audio-recorded and a rater who was an experienced teacher of mindfulness-based program with expertise in MBCT and 10 years of experience in teaching MBI randomly chose 20% of the clips and conducted independent assessments. Apart from the quality of the completion of the interventions, the contents of Arm 1 were further rated by using the Mindfulness-Based Interventions: Teaching Assessment Criteria (MBI: TAC; Griffith et al., 2021). It contained six domains of competence in instructing a mindfulness-based program, including (1) coverage, pacing, and organization of session curriculum; (2) relational skills; (3) embodying mindfulness; (4) guiding mindfulness practices; (5) conveying course themes through interactive inquiry and didactic teaching; and (6) holding the group learning environment. Each domain was rated with a score ranging from 1 (*incompetent*) to 6 (*advanced*).

Data Analyses

The intention-to-treat (ITT) principle was adopted in this study. Specifically, full analysis set (FAS), a type of ITT introduced by the statistical principles for clinical trials (ICH E9) guideline was used to ensure that all participants initially assigned to a specific intervention arm were included in the analysis, regardless of their adherence (Lewis, 1999). Multiple imputation was conducted according to the types of variables for addressing the missing data under the assumption of missing completely at random (MCAR; Bell et al., 2014), which was proved by Little's test (χ^2 distance = 230.27, $p = 0.212$; Li, 2013) in this study.

Descriptive analysis was utilized to present basic demographic and clinical information about both the frail older individuals and their caregivers, and a balance check across three groups was conducted by using chi-square tests and one-way ANOVA to examine demographic differences. According to our first, second, and third research hypotheses, the group × time interaction effects were examined by comparing the outcomes of the MBI (Arm 1) with both the PSY (Arm 2) and the TAU (Arm 3). This study conducted the repeated measure ANCOVAs separately to examine differences in outcomes between groups of Arms 1 and 2 and between groups of Arms 1 and 3 across time points, controlling the caregivers' age as a covariate. The effect sizes were reported using the partial eta squared (η^2) metric, with thresholds of 0.01, 0.06, and 0.14 indicating small, medium, and large effects, respectively, following the criteria by Cohen (1988).

Mediation analyses were performed for the outcomes that showed statistically significant treatment effects comparing the MBI (Arm 1) with the TAU (Arm 3) based on the analyses of treatment effects. Controlling for caregiver age, structural equation modeling was used to conduct a multiple-mediation model with the selected mediators as separate mediation pathways. The model was estimated using the full information maximum-likelihood estimation procedure. As for an acceptable model fit, the *p*-value of the chi-square (χ^2) test should be non-significant ($p > 0.05$); the comparative fit index (CFI) should be 0.95 or above; the root mean square error of approximation (RMSEA) should be 0.06 or below; the Tucker-Lewis index (TLI) should be 0.90 or above; and standardized root mean square residual (SRMR) should be 0.08 or below (Hu & Bentler, 1999). All the analyses were carried out using IBM SPSS 23.0 and Stata 15.

Results

Table 2 provides detailed demographic and clinical information about frail older adults and their caregivers and includes a balance check across the MBI, PSY, and TAU groups. Among the caregivers, 55% ($n = 51$) were aged 59 or younger and 33% ($n = 31$) were aged between 60 and 69 years, with female caregivers comprising the majority ($n = 80$). Approximately 41% ($n = 38$) of frail older adults lived with their caregivers. The caregivers reported spending an average of 7.29 ± 8.78 hr on weekdays and 8.10 ± 7.35 hr on weekends in caregiving activities. The average age of the frail older adults was 84.76 ± 10.03, with 74% ($n = 69$) of them being female. Among the care recipients, 60% were widowed, and 52% had been diagnosed with a mild level of dementia or dementia with comorbidities. No statistically significant difference was found among the three groups. However, the age of the caregivers showed a marginal difference between those in the MBI and the TAU ($\chi^2 = 5.70$, $p = 0.058$) when compared pairwise, and the subsequent

Table 2 Demographic and clinical information of the caregivers and their care recipients of frail older adults ($n = 93$)

Variables	Mean (*SD*)	*n* (%)	X^2/F	*p*
Age range (years)			7.37	0.12
59 or below		51 (55)		
60–69		31 (33)		
70 or above		11 (12)		
Gender			0.20	0.90
Female		80 (86)		
Male		13 (14)		
Education			7.21	0.51
Below primary school		3 (3)		
Primary school		6 (6)		
Secondary school		50 (54)		
Post-secondary or above		34 (37)		
Marital status			7.02	0.72
Single		29 (31)		
Married		45 (48)		
Divorced		12 (13)		
Widow		7 (8)		
Religion			3.90	0.69
No religion		47 (51)		
Buddhist		4 (4)		
Catholic		6 (6)		
Christian		21 (23)		
Others		15 (16)		
Work status			7.77	0.65
Unemployed		12 (13)		
Retired		37 (40)		
Part-time		15 (16)		
Full-time		29 (31)		
Living status of care recipient			9.39	0.50
Living with caregiver		38 (41)		
Living with other family members		37 (40)		
Singleton		13 (14)		
Living in residential home		5 (5)		
Caregiving duration				
Hours per weekdays	7.29 (8.78)		0.47	0.62
Hours per weekend	8.10 (7.35)		0.15	0.86
Number of family member living together	2.09 (1.60)		1.00	0.37
Age of frail elders (years)	84.76 (10.03)		0.94	0.393
Gender of frail elders			3.70	0.72
Female		69 (74)		
Male		24 (26)		
Marital status of frail elders			6.70	0.75
Single		2 (2)		
Married		31 (33)		
Divorced		4 (4)		
Widow		56 (60)		
Diagnosis of frail elders			1.29	0.53
Dementia or with comorbidities		48 (52)		
Others (Parkinson's disease, stroke, diabetes, cardiovascular diseases, and depression)		45 (48)		
Depression level of caregivers at baseline	9.49 (4.47)		0.10	0.91

analyses identified the age of the caregivers as a covariate. Details can be seen in Table 2.

Outcomes and Effect Size of the Interventions

In the group × time interaction analysis, caregivers in the MBI showed a significant reduction in depression ($\eta^2 = 0.07$, $p = 0.043$) and experiential avoidance ($\eta^2 = 0.10$, $p = 0.016$) at T1 compared to the TAU group, with medium effect sizes. They also exhibited significant improvements in family functioning ($\eta^2 = 0.13$, $p = 0.006$), self-efficacy ($\eta^2 = 0.11$, $p = 0.011$), and problem-solving coping style ($\eta^2 = 0.13$, $p = 0.007$) at T1 compared to the TAU group, all with medium effect sizes. Self-efficacy in the MBI group also demonstrated a medium effect size at T2 ($\eta^2 = 0.07$, $p = 0.046$) and a small effect size across three time points ($\eta^2 = 0.06$, $p = 0.043$) compared to the TAU group, indicating sustained self-efficacy improvements due to the MBI. A significant small maintenance effect was also reported on problem-solving coping style across three time points ($\eta^2 = 0.05$, $p = 0.048$).

Compared to the PSY group, the MBI group reported a significant reduction in experiential avoidance ($\eta^2 = 0.09$, $p = 0.018$) at T1, with a medium effect size. A larger improvement in problem-solving coping style was observed at T1 in the MBI group compared to the PSY group, with a medium effect size ($\eta^2 = 0.08$, $p = 0.022$). The outcomes of caregiving burden were significantly reduced at T1 in both groups ($\eta^2 = 0.08$, $p = 0.025$), but returned to their pre-intervention levels at T2 ($\eta^2 = 0.07$, $p = 0.028$). The marginally significant difference across three time points indicated a similar immediate effect on caregiving burden ($\eta^2 = 0.05$, $p = 0.054$) between the MBI and the PSY. Moreover, significant improvements of self-efficacy at T1 ($\eta^2 = 0.15$, $p = 0.001$), T2 ($\eta^2 = 0.09$, $p = 0.013$), and across three time points ($\eta^2 = 0.09$, $p = 0.005$) also showed similar immediate and maintenance effects of both the MBI and the PSY. Additionally, a delayed improvement with a medium effect size was reported for the MBI group in terms of denial as a coping style at T2 ($\eta^2 = 0.06$, $p = 0.042$) and a small effect size was reported across three time points ($\eta^2 = 0.05$, $p = 0.046$). Detailed outcomes and effect sizes are summarized in Table 3.

A sensitivity analysis was conducted by adjusting for covariates. After adjusting for gender, education, and marital status of the caregivers, similar results of treatment effects were consistent with the primary findings in Table 3.

Mediation Outcomes

According to the fourth research hypothesis, this study incorporated significant coping strategies and other potential mediating variables within a group × time interaction analysis to explore their mediating roles in influencing the effects of the MBI. The mediation analysis controlled for the caregiver's age as a covariate, with changes in the outcomes assessed at T1. Upon consolidation, changes in self-efficacy, experiential avoidance, and problem-solving coping style were considered as potential mediators for the effects of MBI. All mediating analyses are summarized in Table 4.

The indices of the model demonstrated its goodness of fit: $\chi^2 = 11.43$, $df = 10$, $p = 0.325$, CFI = 0.99, RMSEA = 0.05, TLI = 0.93, and SRMR = 0.05. Enhanced self-efficacy significantly mediated the MBI effects on reducing caregiving burden (indirect effect = −0.13, 95% *CI* = −0.30 to −0.01) and anxiety (indirect effect = −0.17, 95% *CI* = −0.27 to −0.01). Change in experiential avoidance significantly mediated the MBI effects on depression reduction (indirect effect = −0.12, 95% *CI* = −0.24 to −0.01). Improvements in problem-solving coping style marginally mediated the relationships between the MBI and the reductions in depression (indirect effect = −0.15, 95% *CI* = −0.30 to 0.00), and showed its significant mediating role in anxiety (indirect effect = −0.37, 95% *CI* = −0.70 to −0.08). The model pathways are illustrated in Table 4.

Dosage, Participant Satisfaction, and Program Fidelity

The attendance of the MBI and PSY was notably high. Across the four-session programs, the mean (*SD*) attendance for MBI was 3.91 (0.30), and those for PSY were 3.57 (0.74).

Among the MBI participants, all completers responded to the question about time spent on mindfulness exercises per day. The average time spent was 20.7 min (*SD* = 19.8 min).

All caregivers who completed the post-program questionnaires also responded to a satisfaction survey. Caregivers in the MBI group gave a mean satisfaction score of 2.98 (*SD* = 0.25) on a 4-point scale. Those in the PSY group gave a mean score of 3.00 (*SD* = 0.27) on the same scale.

An independent assessor, with expertise in MBCT and 10 years of experience in delivering MBIs, conducted a fidelity test using MBI: TAC. The assessment revealed that the average rating for the MBI on a 6-point scale was 3.75 (*SD* = 0.81, range 3.0–5.0).

Discussion

This study contributes to the literature by examining outcomes and mechanisms of a brief MBI for caregivers of frail older adults within a three-arm randomized controlled trial. Previous research has highlighted the feasibility and effectiveness of standard 8-week or longer programs for family caregivers (Fernández-Portero et al., 2021; Hou et al.,

Table 3 Group × time interaction effects on outcomes variables ($n = 93$)

Variables		MBI ($n = 32$)	PSY ($n = 35$)	TAU ($n = 26$)	Effects	MBI vs. TAU			MBI vs. PSY		
						T0 vs. T1	T0 vs. T2	T0 vs. T1 vs. T2	T0 vs. T1	T0 vs. T2	T0 vs. T1 vs. T2
		M (*SD*)	*M* (*SD*)	*M* (*SD*)		η^2, *p*	η^2, *p*	η^2, *p*	η^2, *p*	η^2, *p*	η^2, *p*
Depression	T0	9.75 (4.50)	9.46 (4.93)	9.23 (3.91)	Time	$\eta^2 < 0.01$, 0.737	$\eta^2 < 0.01$, 0.962	$\eta^2 < 0.01$, 0.947	0.01, 0.387	0.05, 0.079	0.03, 0.185
	T1	8.16 (4.65)	8.99 (5.01)	9.73 (4.14)	Group	$\eta^2 < 0.01$, 0.585	$\eta^2 < 0.01$, 0.825	$\eta^2 < 0.01$, 0.502	$\eta^2 < 0.01$, 0.809	$\eta^2 < 0.01$, 0.802	$\eta^2 < 0.01$, 0.911
	T2	10.02 (4.96)	9.82 (3.87)	10.57 (3.52)	Time × group	**0.07, 0.043**	0.03, 0.233	0.03, 0.164	0.03, 0.163	$\eta^2 < 0.01$, 0.931	0.01, 0.444
Caregiving burden	T0	50.88 (15.70)	51.15 (18.62)	48.77 (12.23)	Time	0.03, 0.242	$\eta^2 < 0.01$, 0.894	0.01, 0.492	**0.08, 0.025**	**0.07, 0.028**	**0.05, 0.054**
	T1	49.16 (17.01)	49.36 (15.98)	47.42 (13.67)	Group	$\eta^2 < 0.01$, 0.498	$\eta^2 < 0.01$, 0.542	$\eta^2 < 0.01$, 0.773	$\eta^2 < 0.01$, 0.954	$\eta^2 < 0.01$, 0.995	$\eta^2 < 0.01$, 0.989
	T2	52.25 (17.63)	51.93 (12.87)	54.71 (13.79)	Time × group	$\eta^2 < 0.01$, 0.712	0.04, 0.154	0.03, 0.242	$\eta^2 < 0.01$, 0.972	$\eta^2 < 0.01$, 0.867	$\eta^2 < 0.01$, 0.951
Anxiety	T0	12.00 (5.91)	11.53 (5.81)	12.46 (6.15)	Time	0.02, 0.299	0.02, 0.309	0.03, 0.230	0.02, 0.299	$\eta^2 < 0.01$, 0.487	$\eta^2 < 0.01$, 0.626
	T1	11.56 (6.57)	11.75 (6.29)	12.88 (6.01)	Group	0.01, 0.392	0.06, 0.070	0.05, 0.111	$\eta^2 < 0.01$, 0.925	$\eta^2 < 0.01$, 0.591	$\eta^2 < 0.01$, 0.706
	T2	14.01 (6.01)	15.67 (3.46)	16.98 (3.26)	Time × group	0.05, 0.093	0.05, 0.096	0.04, 0.155	0.02, 0.277	0.04, 0.110	0.03, 0.186
Spiritual well-being	T0	7.48 (2.56)	7.45 (2.06)	7.90 (2.50)	Time	$\eta^2 < 0.01$, 0.585	$\eta^2 < 0.01$, 0.586	0.01, 0.589	$\eta^2 < 0.01$, 0.684	$\eta^2 < 0.01$, 0.883	$\eta^2 < 0.01$, 0.914
	T1	8.06 (2.49)	7.38 (2.31)	7.74 (2.48)	Group	$\eta^2 < 0.01$, 0.729	$\eta^2 < 0.01$, 0.668	$\eta^2 < 0.01$, 0.803	$\eta^2 < 0.01$, 0.511	$\eta^2 < 0.01$, 0.509	0.01, 0.372
	T2	8.68 (2.29)	8.02 (2.33)	8.41 (2.12)	Time × group	0.04, 0.138	0.03, 0.205	0.02, 0.319	0.04, 0.099	0.05, 0.072	0.03, 0.158
Family functioning	T0	5.44 (3.89)	6.46 (3.14)	6.12 (3.23)	Time	$\eta^2 < 0.01$, 0.687	0.06, 0.071	0.05, 0.081	$\eta^2 < 0.01$, 0.759	0.03, 0.170	0.03, 0.155
	T1	6.34 (3.78)	6.46 (3.11)	5.46 (3.43)	Group	$\eta^2 < 0.01$, 0.850	$\eta^2 < 0.01$, 0.566	$\eta^2 < 0.01$, 0.922	$\eta^2 < 0.01$, 0.482	$\eta^2 < 0.01$, 0.437	$\eta^2 < 0.01$, 0.578
	T2	7.86 (2.95)	7.82 (2.49)	7.56 (3.07)	Time × group	**0.13, 0.006**	0.02, 0.323	0.03, 0.229	0.04, 0.089	0.02, 0.233	0.02, 0.316
Family conflicts	T0	7.66 (6.47)	7.69 (6.46)	7.58 (5.46)	Time	0.02, 0.349	**0.07, 0.049**	0.06, 0.065	$\eta^2 < 0.01$, 0.751	0.007, 0.517	0.008, 0.509
	T1	7.94 (6.68)	7.18 (5.92)	7.58 (5.84)	Group	$\eta^2 < 0.01$, 0.874	$\eta^2 < 0.01$, 0.561	$\eta^2 < 0.01$, 0.699	$\eta^2 < 0.01$, 0.813	$\eta^2 < 0.01$, 0.833	$\eta^2 < 0.01$, 0.964
	T2	10.47 (6.96)	11.00 (5.69)	11.32 (5.51)	Time × group	$\eta^2 < 0.01$, 0.523	$\eta^2 < 0.01$, 0.634	$\eta^2 < 0.01$, 0.567	0.02, 0.231	$\eta^2 < 0.01$, 0.735	$\eta^2 < 0.01$, 0.492
Self-efficacy	T0	5.61 (1.30)	5.53 (1.21)	5.74 (1.02)	Time	0.02, 0.323	0.02, 0.281	0.01, 0.437	**0.15, 0.001**	**0.09, 0.013**	**0.09, 0.005**
	T1	6.02 (1.16)	5.97 (1.03)	5.71 (1.05)	Group	$\eta^2 < 0.01$, 0.770	$\eta^2 < 0.01$, 0.812	$\eta^2 < 0.01$, 0.978	$\eta^2 < 0.01$, 0.726	$\eta^2 < 0.01$, 0.571	$\eta^2 < 0.01$, 0.685
	T2	6.21 (1.11)	6.05 (1.12)	5.86 (1.11)	Time × group	**0.113, 0.011**	**0.070, 0.046**	**0.058, 0.043**	0.015, 0.328	$\eta^2 < 0.01$, 0.794	$\eta^2 < 0.01$, 0.657
Experiential avoidance	T0	54.59 (9.52)	52.72 (7.40)	51.58 (8.70)	Time	0.01, 0.419	$\eta^2 < 0.01$, 0.818	$\eta^2 < 0.01$, 0.730	0.04, 0.128	0.01, 0.418	0.01, 0.398
	T1	52.13 (8.43)	54.52 (8.12)	54.31 (9.93)	Group	$\eta^2 < 0.01$, 0.602	0.3, 0.180	0.01, 0.466	$\eta^2 < 0.01$, 0.889	$\eta^2 < 0.01$, 0.516	$\eta^2 < 0.01$, 0.959
	T2	54.24 (11.67)	53.43 (8.35)	52.40 (9.76)	Time × group	**0.10, 0.016**	$\eta^2 < 0.01$, 0.557	0.05, 0.052	**0.09, 0.018**	$\eta^2 < 0.01$, 0.599	0.04, 0.089
COPE-accommodation	T0	2.88 (0.56)	3.04 (0.61)	3.11 (0.68)	Time	$\eta^2 < 0.01$, 0.690	0.02, 0.348	0.02, 0.395	0.01, 0.391	$\eta^2 < 0.01$, 0.796	$\eta^2 < 0.01$, 0.698
	T1	3.05 (0.59)	3.05 (0.47)	3.11 (0.62)	Group	0.03, 0.210	0.02, 0.319	0.02, 0.310	$\eta^2 < 0.01$, 0.523	$\eta^2 < 0.01$, 0.580	$\eta^2 < 0.01$, 0.698
	T2	3.01 (0.53)	2.99 (0.53)	3.06 (0.72)	Time × group	0.02, 0.358	0.03, 0.213	0.02, 0.425	0.03, 0.208	0.03, 0.167	0.02, 0.318
COPE-problem solving	T0	2.83 (0.60)	3.03 (0.52)	3.12 (0.57)	Time	0.04, 0.137	0.02, 0.290	0.02, 0.368	0.02, 0.309	$\eta^2 < 0.001$, 0.953	0.01, 0.511
	T1	3.20 (0.50)	3.09 (0.52)	3.12 (0.61)	Group	0.01, 0.418	0.04, 0.154	0.01, 0.413	$\eta^2 < 0.01$, 0.698	0.02, 0.311	$\eta^2 < 0.01$, 0.694
	T2	3.11 (0.50)	3.15 (0.55)	3.18 (0.62)	Time × group	**0.13, 0.007**	0.03, 0.167	**0.05, 0.048**	**0.08, 0.022**	0.02, 0.228	0.04, 0.064
COPE-denial	T0	1.56 (0.59)	1.77 (0.71)	1.46 (0.53)	Time	0.01, 0.393	$\eta^2 < 0.01$, 0.878	0.01, 0.532	$\eta^2 < 0.01$, 0.832	$\eta^2 < 0.01$, 0.851	$\eta^2 < 0.01$, 0.921
	T1	1.53 (0.47)	1.73 (0.57)	1.62 (0.62)	Group	$\eta^2 < 0.01$, 0.877	$\eta^2 < 0.01$, 0.671	$\eta^2 < 0.01$, 0.974	0.04, 0.112	$\eta^2 < 0.01$, 0.721	0.01, 0.407
	T2	1.67 (0.54)	1.56 (0.63)	1.54 (0.55)	Time × group	0.02, 0.268	$\eta^2 < 0.01$, 0.977	0.02, 0.427	$\eta^2 < 0.01$, 0.967	**0.06, 0.042**	**0.05, 0.046**

Note: Age of the caregivers was controlled as a covariate

Table 4 Mediation analysis of coping strategies among the caregivers in the MBI and PSY

Mediator	DV	a-path	b-path	Total effect	Direct effect	Indirect effect	95% *CI*
Self-efficacy	Depression	0.35**	−0.33*	−0.28*	−0.16	−0.12	−0.22, 0.01
	Caregiving burden	**0.35****	**−0.37****	**−0.05**	**0.08**	**−0.13***	**−0.30, −0.01**
	Anxiety	**0.35****	**−0.50****	**−0.24**	**−0.06**	**−0.17***	**−0.27, −0.01**
	Spiritual well-being	0.35**	0.31*	0.20	0.10	0.11	−0.04, 0.26
	Family functioning	0.35**	<0.01	0.37**	0.37**	<0.01	−0.10, 0.10
	Family conflicts	0.35**	0.06	0.09	0.07	0.02	−0.07, 0.11
Experiential avoidance	Depression	**−0.33***	**0.36****	**−0.28***	**−0.16**	**−0.12***	**−0.24, −0.01**
	Caregiving burden	−0.33*	0.02	−0.05	−0.05	−0.01	−0.13, 0.11
	Anxiety	−0.33*	0.12	−0.24	−0.19	−0.04	−0.13, 0.05
	Spiritual well-being	−0.33*	−0.22	0.20	0.13	0.07	−0.03, 0.17
	Family functioning	−0.33*	0.12	0.37**	0.41**	−0.04	−0.14, 0.06
	Family conflicts	−0.33*	−0.13	0.09	0.05	0.04	−0.06, 0.14
Coping strategy of problem-solving	Depression	**0.37****	**−0.40****	**−0.28***	**−0.13**	**−0.15***	**−0.30, 0.00**
	Caregiving burden	0.37**	−0.32	−0.43	−0.31	−0.12	−1.00, 0.7
	Anxiety	**0.37****	**−1.00*****	**−0.54**	**−0.17**	**−0.37***	**−0.70, −0.08**
	Spiritual well-being	0.37**	0.44*	0.31	0.14	0.17	−0.03, 0.36
	Family functioning	0.37**	0.12	0.80**	0.76*	0.04	−0.22, 0.31
	Family conflicts	0.37**	−0.51	0.24	0.43	−0.19	−0.63, 0.25

Note. Age of the caregivers was controlled as a covariate and coefficients were standardized; *DV*, dependent variable; *a-path*, effects of mindfulness on mediators; *b-path*, effects of mediators on independent variables; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

2014; Kor et al., 2021). This study builds on the success of low-intensity MBIs for parents and caregivers, with the program lasting 10 h (Lo et al., 2019, 2020, 2022a; Zhang et al., 2023). A scarcity of studies focusing on low-intensity MBI exists, and this three-arm study design enriches the evidence base by allowing researchers to contrast the effects of MBI with an active control and treatment-as-usual. The attendance, engagement in homework practice, and positive participant satisfaction indicate that caregivers favored the program. In addition, this study focused on caregivers of frail older adults, which is a growing population in many aging societies globally. It shows that caregiver stress and consequences of other mental health symptoms could be prevented through strengthening of their coping mechanisms (Lazarus & Folkman, 1984).

The first hypothesis of the study received partial support, with the MBI showcasing greater reductions in experiential avoidance compared to usual care. the mindfulness group exhibited significantly greater improvements in depression, family functioning, self-efficacy, and problem-solving, when compared to the usual care group. These outcome measures were reported to have medium effect sizes. The results indicated that the outcomes of the brief MBI were comparable to those of a standard 8-week MBI at post-intervention, significantly ameliorating caregivers' coping skills relating to problem-solving and self-efficacy (Chacko et al., 2022; Erdoğan Yüce et al., 2024; Han, 2022). However, the study did not observe significant improvements in caregiver burden, aligning with the findings of the systematic review by Saragih et al. (2024). They suggested that caregiver burden, being a multi-component variable encompassing both objective and subjective dimensions of caregiving, may be less responsive to change. Future studies could delve into integrating perceived stress as a primary outcome variable, as it could potentially be more sensitive to interventions when contrasted with caregiver burden. Perceived stress encompasses caregivers' overall appraisal, extending beyond their worries solely about the care recipient (Schulz & Sherwood, 2008). Contrary to the majority of reviews (Chacko et al., 2022; Erdoğan Yüce et al., 2024; Han, 2022), this study did not demonstrate significant improvements in anxiety and stress. This discrepancy might indicate varying effects on mental health outcomes post a low-intensity MBI, with the possibility that heightened awareness of internal experiences and reduced avoidance could potentially elevate anxiety and perceived stress levels in some participants.

At the 6-month follow-up, the effects of MBI on self-efficacy persisted, remaining superior to usual care with a medium effect size, and the effects of MBI on problem-solving coping style maintained across three time points with a small effect size. However, apart from self-efficacy and problem-solving coping style, most outcomes did not sustain at the 6-month follow-up. Fiocco and Hytman (2022) found the effects of MBSR on family caregivers sustained at 1-year follow-up, but no significant difference was found when compared to psychoeducation. In their

follow-up interviews of participants, continued practice would be a key factor that contributes to sustainability of program effects. This study aligns with their findings, suggesting the need for a shorter follow-up period or the integration of booster sessions to maintain the effects of the brief MBI.

The study provides further evidence that a brief MBI can enhance family functioning and reduce experiential avoidance. Compared to the findings of Wang et al. (2024), the brief MBI in this study was more effective at improving family functioning. In contrast, general family-centered interventions showed no significant improvement. Being inspired by Cooper et al. (2016), the effects of MBI on reducing caregiver abusive behaviors were investigated. Unexpectedly, the scores of family conflicts increased in all three groups at the follow-up assessment. However, it is noteworthy that the levels of abusive behaviors among the participants in this study remained very low.

The study's second hypothesis receives full support as the group × time interaction analyses revealed no significant differences between the outcomes of the mindfulness group and psychoeducation group in terms of their effects in the group × time interactions, with all effect sizes (η^2) being less than or equal to 0.06. Both the MBI and the PSY showed their significant effects on reducing caregiving burden across three time points. It suggests that the effects of MBI are similar to psychoeducation across all outcome measures, further reinforcing the feasibility and effectiveness of this unique approach in promoting caregiver mental health and well-being.

Regarding the third hypothesis, it is partially supported. When compared to psychoeducation, the mindfulness group demonstrated larger improvements in experiential avoidance at T1, and unexpectedly, a similar pattern was observed in problem-solving. The effect of MBI in experiential avoidance appears to be treatment specific, potentially indicating that caregivers are learning to accept the aging and declining health of their family members, rather than adhering strictly to traditional belief of wishing their parents longevity. In addition, caregivers in the mindfulness group may experience enhanced cognitive flexibility and they are more willing to initiate practical and positive actions in daily caregiving routines. Minimal changes in accommodation were noted between the two groups and both the MBI and PSY groups significantly promoted the caregivers' self-efficacy across three time points. However, a significantly greater increase in denial was unexpectedly observed in the mindfulness group compared to the psychoeducation group across time points, contradicting the initial hypothesis. Given the low reliability of the denial subscale, further studies may consider employing a different coping scale and qualitative research methods to delve deeper into caregiver's coping strategies.

The fourth hypothesis of this study is partially supported. The hypothesis posited intervention-specific mediating effects, suggesting that changes induced by the MBI would be mediated by their self-efficacy, experiential avoidance, and problem-solving coping strategy. As previously discussed, MBI had effects on all three mediators. Further analysis revealed indirect effects of self-efficacy on caregiving burden and anxiety within the multiple-mediation model. Experiential avoidance had indirect effects on depression, while problem-solving coping had a marginal indirect effect on depression and an indirect effect on anxiety. Although the mediating analysis did not support all outcome variables, it highlighted an intervention-specific pattern in predicting different outcomes for caregivers. This complexity suggests that the needs of caregivers are multi-faceted, warranting further studies to enhance our understanding of which process outcomes are most beneficial for caregivers. A larger sample size may be necessary to explore who benefits more from which intervention. Recent research involving 281 participants randomly assigned to an integrative body-mind-spirit (IBMS) program or qigong intervention for relieving their sleep disturbance and depression indicated that IBMS was more effective for older, more educated females, experiencing physical pain and illness, while younger, less educated males, not in full-time working status benefitted more from the Qigong intervention (Ng et al., 2024). This clinical data mining strategy can enhance our comprehension of caregivers' service needs, offer more precise service mapping, and improve cost-effectiveness in service planning and provision (Epstein, 2009).

Limitations and Future Directions

Several limitations of the study have been identified. Firstly, we encountered significant challenges in recruitment, largely due to the impact of the COVID-19 pandemic. Despite investing in Facebook advertisements and distributing promotional leaflets to relevant service units, we faced a low response rate from caregivers following the successive waves of COVID-19. Many expressed concerns about participating in face-to-face programs, fearing that such gatherings could jeopardize the health of both older adults and themselves. Consequently, this study only reached approximately half of the intended sample size outlined in the protocol (Lo et al., 2022a, 2022b). While we were able to complete all program rounds due to the funder restrictions, the actual number of participants fell below expectations. As a result of the diminished sample size, the intervention effects of some outcome variables did not reach statistical significance in the analysis.

Secondly, the research team opted for a relatively long follow-up period for an intervention featuring 4 weekly sessions spanning 1 month. While there are no strict guidelines for determining the ideal follow-up duration,

setting the time point at 2 or 3 months might have provided more insightful results. Further studies with appropriately timed follow-ups could potentially reveal the sustainability of intervention effects more effectively.

Thirdly, our study employed a common measure of coping style but encountered challenges in its interpretation. Specifically, the reliability of the denial subscale in our study was found to be unsatisfactory, with McDonald's omega of 0.53. Notably, a previous validation study reported Cronbach's alpha of 0.66, which also fell below the generally accepted threshold (Tang et al., 2016). These results underscore the necessity for considering an alternative measure or variable to more accurately assess the coping style and service needs of family caregivers.

Lastly, while we assessed the outcomes based on the caregivers' perceptions, the outcome assessment is subject to bias. Although this study reported significant improvement in family functioning, it did not incorporate the perspectives of the care recipients, and alternative measures such as biomarkers or behavioral observations may be considered to reduce the subjective bias of the caregivers. Moreover, according to our research objectives and theoretical framework, the current study decided to explore the effectiveness of the brief MBI program by examining the changes in mental health outcomes of caregivers and their family functioning. Its influencing mechanism was explored by examining the changes in their coping strategies based on previous studies and the coping and stress reactivity model, which was thought to be the key theoretical framework of MBIs (Koerbel & Meleo-Meyer, 2019). However, this stage of the study did not assess their improvement in mindfulness level, and the exploration of the impacts on this direct embodiment might also add tremendous value in explaining the effectiveness and influencing mechanisms of MBIs. This direction of measurement and analyses will be considered in our near-future study.

As a recommendation for future directions, this study suggests a heightened focus on developing a range of program structures and delivery modes to cater to the intricate needs of caregivers. There has been a recent surge in online or blended interventions utilizing mindfulness approach for parents and caregivers. The global pandemic, along with associated lockdowns and social isolations, has posed challenges for older adults and their caregivers in accessing support services. Several studies have showcased promising outcomes for parents and caregivers who have engaged in online MBIs (e.g., Goodridge et al., 2021; Juberg et al., 2023; Lo et al., 2024). While certain caregivers may face limitations in accessing online MBIs, providing additional support can aid in bolstering their ability to utilize these tools effectively, thereby enhancing their quality of life (Abeysinghe Mudiyanselage et al., 2024). At the same time, low-intensity MBIs similar to the program in this study should be provided based on participant preferences.

This study has demonstrated a significant improvement in depression, family functioning, self-efficacy and problem-solving and decreased experiential avoidance. It offers preliminary evidence on the mediating role of self-efficacy in the outcomes of mindfulness-based interventions. These insights provide valuable guidance to program designers and researchers in developing brief and impactful caregiver intervention programs.

To mitigate caregivers' subjective bias, additional measures can be implemented. For instance, a study on MBI for caregivers of early psychosis gathered data from young adults in recovery who were not involved in the MBI. Their assessments of caregivers' expressed emotions revealed that mindfulness resulted in better outcomes by reducing over-involvement and hostility (Zhang et al., 2023). In a similar vein, Singh et al. (2023) utilized videotaped recordings and coding to evaluate challenging or positive behaviors in care recipient, caregiver attentional responses, and other caregiving qualities. Future studies could consider integrating diverse measures to assess care recipient's experiences subsequent to caregiver participation in an MBI.

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Data Availability Data is accessible upon request by contacting the corresponding author of the study.

Declarations

Ethics Statement This study was approved by the Institutional Review Board of the Hong Kong Polytechnic University (ref: HSEARS20190913002).

Informed Consent Statement Informed consent was obtained from all participants involved in the study.

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