Mindfulness and psychoeducation to manage stress in amnestic mild cognitive impairment

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Acknowledgements

This study was supported by operating grants from the *Réseau québécois de recherche sur le vieillissement*, the *Société Alzheimer de Québec*, and the *Caisse Desjardins de Québec*. Hudon was also supported by a salary award from the *Fonds de recherche du Québec – Santé*.

Mindfulness and psychoeducation to manage stress in amnestic mild cognitive impairment: a pilot study

Abstract

Objectives: Amnestic mild cognitive impairment (aMCI) often corresponds to the prodromal stage of Alzheimer disease (AD). The aMCI stage represents a crucial time window to apply preventive interventions in an attempt to delay cognitive decline. Stress, one of AD's modifiable risk factors frequently co-occurring with aMCI, stands out as a key intervention target. The goal of this study was to assess the impacts of two non-pharmacological interventions, mindfulness and psychoeducation, on stress at the psychological and physiological levels among aMCI older adults.

Methods: Forty-eight aMCI participants were randomized between a mindfulness-based intervention (MBI) and a psychoeducation-based intervention (PBI) for eight weekly sessions. Anxiety symptoms, perceived stress levels, cortisol awakening response (CAR), and coping strategies were assessed pre- and post-intervention. Mindfulness attitudes and time dedicated to at-home meditative practices were evaluated in the MBI group.

Results: The main results revealed a slight reduction of the CAR among MBI participants who practiced meditation at home the most and a decrease in perceived stress levels in the PBI group. Both interventions enhanced problem-focused coping strategies.

Conclusion: In sum, this pilot study supports the potential of MBI and PBI to reduce stress at the physiological and psychological level, respectively, and increase coping strategies in older adults at risk for AD.

Keywords: **Amnestic mild cognitive impairment; mindfulness; psychoeducation; stress; cortisol**

Introduction

Amnestic mild cognitive impairment (aMCI) often corresponds to the prodromal stage of Alzheimer disease (AD). This is supported by the fact that 10-15% of patients with aMCI progress to the dementia stage of AD each year compared to 1-2% in the general population (Petersen et al., 2001). The diagnostic criteria for aMCI encompass a subjective memory complaint, an objective memory impairment (i.e., ≥ 1.5 standard deviation below age- and education-stratified norms), and generally preserved functional autonomy (Albert et al., 2011). According to the Lancet Commission on dementia prevention (Livinston et al., 2017), interventions should be directed toward older adults at risk for dementia rather than the general population. About a third of AD's cases are potentially attributable to modifiable risk factors (i.e., chronic stress, depression,vascular conditions, etc.) and reducing them could prevent millions of AD's new cases in the future (Norton et al., 2014). Thus, the aMCI stage represents a crucial time window to apply preventive interventions in an attempt to delay cognitive decline before brain damage is too severe and dementia becomes inevitable (Sperling, 2011). Multiple pharmacological trials came short of discovering treatments that effectively prevent deterioration towards AD (Mangialasche, Solomon, Winblad, Mecocci & Kivipelto, 2010). This situation urges for the development of non-pharmacological interventions administered during the aMCI stage (for a review of existing non-pharmacological interventions see Rakesh et al., 2017), aimed at: 1) offering alternative tools to cope with cognitive difficulties and associated preoccupations, such as fear of AD; 2) improving well-being and quality of life; and 3) acting on AD modifiable risk factors (Eshkoor, Hamid, Mun & Ng, 2015).

Stress stands out as a key intervention target, because its presence may accentuate cognitive decline (Rothman & Mattson, 2010). In addition, stress underlies

or is compounded with other modifiable risk factors of AD (Tortosa-Martinez & Clow, 2012), such as depression (Daulatzai, 2014), cardiovascular diseases (Batelaan, Seldenrijk, Bot, van Balkom & Penninx, 2016), diabetes (Nader, Chrousos & Kino, 2010), obesity (Sinha & Jastreboff, 2013), and physical inactivity (Kyrou & Tsigos, 2009). Chronic or excessive psychological stress dysregulates the hypothalamic–pituitary–adrenal (HPA) axis, resulting in aberrant patterns of cortisol secretion (McEwen, 2007). In comparison to healthy controls, older adults with aMCI display higher levels of psychological stress and a larger cortisol awakening response (CAR; Forsell, Palmer & Fratiglioni, 2003; Lind, Edman, Nordlund, Olsson & Wallin, 2007). Therefore, it appears that aMCI is often accompanied with psychological and physiological stress, which could represent reactions to cognitive difficulties or long-term risk factors contributing to the development of AD.

Mindfulness-Based Interventions (MBIs) stemming from Mindfulness-Based Stress Reduction (Kabat-Zinn, 1990) have received particular attention in the context of neurodegenerative diseases (Larouche, Hudon & Goulet, 2015). The practice of mindfulness requires paying attention to the present moment with a benevolent non-judgmental attitude that is developed through four formal practices, namely body scan, conscious movements, seated meditation, and walking meditation, as well as informal everyday practices (Kabat-Zinn, 1990). Studies conducted thus far show that MBIs are accessible to older adults with physical or cognitive limitations, are inexpensive to implement (Lenze et al., 2014), and could impact modifiable risk factors of AD (Marciniak et al., 2014). The beneficial effects of MBIs, such as reduced reactivity to stress, improved well-being, and greater acceptance and awareness of cognitive difficulties, have been demonstrated in various elderly populations (Foulk, Ingersoll-Dayton, Kavanagh, Robinson & Kales, 2013; Lenze et al., 2014; Wells, Kerr et al.,

2013; Innes, Selfe, Brown, Rose & Thompson-Heisterman, 2012). Regarding the physiological stress response, two studies observed a decrease of CAR post-MBI associated with positive outcomes, such as improved sleep and mindfulness skills, among novice and long-term meditators (Brand, Holsboer Trachsler, Naranjo & Schmidt, 2012) and adults in a therapeutic community (Marcus et al., 2003). In contrast, Matousek, Pruessner, and Dobkin (2011) reported a rise of CAR post-MBI in women who had completed breast cancer treatment and suffered a basal blunted CAR due to depression. Thus, MBI appears to normalize HPA axis activation and cortisol secretion based on samples' basal characteristics (e.g., presence of a physical and/or mental disorder). In sum, these findings support the possibility that mindfulness practice plays a protective role by reducing psychological stress, normalizing the physiological stress response, and optimizing adaption to daily stressors.

Psychoeducation-based intervention (PBI) is another non-pharmacological option increasingly used in the context of degenerative diseases with the aim of reducing anxiety surrounding health conditions (O'Halloran et al., 2015). PBI is also an essential feature of the person-centered medical approach, which recognizes patients as active partners in healthcare decisions and thus, entitled to be informed about their condition. It has been demonstrated among various populations that PBI bears beneficial impacts on important health variables, such as psychological stress, stigma, and self-confidence (O'Halloran et al., 2015; Yanagida, Uchino & Uchimura, 2017). Gilhooly et al., (2016) reported in a systematic review that psychoeducational interventions are effective in reducing psychological stress among people with dementia and their caregivers. To our knowledge, however, there is no data showing reliable beneficial impacts of PBI on the physiological stress response.

Based on the paucity of available effective preventive strategies and the necessity to intervene on key modifiable risk factors during the aMCI stage to delay or prevent AD, the goal of this study was to assess, among older adults with aMCI, the efficacy of a MBI and a PBI in: 1) reducing stress at the psychological (i.e., anxiety symptoms and perceived stress level) and physiological (i.e., CAR) levels and; 2) enhancing coping strategies used in stressful situations. Additional objectives evaluated the impacts of MBI on mindfulness attitudes and the influence of time dedicated to at-home meditative practices on psychological and physiological stress, coping strategies, and mindfulness attitudes. This is a non-inferiority trial study with MBI and PBI being positioned as two active interventions based on ethical (i.e., a placebo control condition would not be ethical with aMCI participants) and methodological (i.e., a priory hypothesis that both MBI and PBI could have positive impacts) considerations.

It is expected that MBI and PBI may lead to a reduction of psychological stress, as the beneficial effects of both interventions have been demonstrated in a variety of populations. Regarding physiological stress, it is anticipated that MBI will decrease CAR, based on previous studies' results. Such effects are not expected for PBI because no practice involving a physiological mechanism of action is taught in this condition.

Methods

Participants

First, 142 volunteers, recruited from newspaper ads and medical references related to memory concerns from Quebec City's physicians, were screened to secure a sample of 48 participants. They were aged at least 55 years old and suffered from aMCI according to the diagnostic criteria of Albert et al. (2011). Exclusion criteria included: 1) moderate or severe head injury; 2) stroke; 3) delirium in the last 6 months; 4) encephalitis or bacterial meningitis; 5) psychotic symptoms or manic episode; 6)

electroconvulsive therapy in the last 12 months; 7) intracranial surgery; 8) cancer treatment in the last 12 months; 9) general anesthesia in the last 6 months. They also included: 10) neurological disorders (i.e., except suspected prodromal AD); 11) untreated medical or metabolic conditions; 12) current major depressive disorder according to the diagnostic criteria of the DMS-5 (APA, 2013); 13) current substance abuse disorder; 14) uncorrected vision or hearing problems; 15) recent experience with psychotherapy or cognitive restructuring that might impact cognition; 16) significant experience with meditation or other contemplative approaches; and 17) not being able to attend one of the first four sessions of either the MBI or the PBI program.

Procedures

Eligibility of participants was determined during a screening session with a trained clinician, which included a complete description of the study protocol, approved by the Research Ethics Board of the *Institut universitaire en santé mentale de Québec* (IUSMQ, attestation #398), a written informed consent, as well as clinical and neuropsychological measures (see Table 1). Eligible participants were randomly assigned to MBI or PBI with a fixed simple randomisation including a freelance procedure. Then, they were invited to take part in a pre-intervention session during which they completed self-reported efficacy measures and received instructions and devices to collect salivary samples at home. Two days prior to the first session of MBI or PBI and the post-intervention session, participants were instructed to collect salivary samples at home and bring them back to the CERVO Brain Research Centre. After the completion of MBI or PBI, participants took part in a post-intervention session and completed the same self-reported efficacy measures administered at the pre-intervention session. Screening as well as pre- and post-intervention sessions were administered by

trained research assistants at the CERVO Brain Research Centre and 20$ was given to participants for time compensation.

(Insert Table 1)

Interventions

Both MBI and PBI were held in groups of 12 participants over a period of eight weeks. Each weekly session lasted 2.5 hours and included a 15-minute break mid-session (see Table 1).

MBI. The MBI program developed by Larouche, Goulet, and Chouinard (2015) was based on Kabat-Zinn's Mindfulness-Based Stress Reduction (1990) and several other sources (Bartley, 2011; Carlson & Speca, 2010; Fournier, 2011; Monestès & Villate, 2011; Segal, Williams & Teasdale, 2012). The MBI program was designed with the specific needs and limitations of older adults in mind, based on the recommendations published by McBee (2008) and the results of a pilot study (Larouche, Chouinard, Hudon & Goulet, 2015). For instance, all meditative practices were performed in a sitting position on a chair, at-home meditative practices were shortened to 30 minutes daily rather than the more common duration of 45 minutes, and instructions were simplified and supported by concrete examples. The essence and goals of leading mindfulness programs were respected. Every session comprised a guided meditation (i.e., body scan, mindful movement, mindful walking, sitting meditation, and meta-meditation), group discussions, and psychoeducation about mindfulness themes along with stress management. Participants were instructed to practice mindfulness meditation at home, about 30 minutes per day, six days a week. As support for at-home meditative practices, participants were given CDs with guided meditations, written instructions, and short texts about the theme of the week's session. They also received a weekly call from one of the instructors to ensure adherence, respond to questions, and

prevent withdrawal. The MBI was administered by its three developers whose credentials can be provided upon request.

PBI. The psychoeducation program was developed by Parent, Larouche, Chouinard, and Hudon (2015). Participants assigned to the PBI received psychoeducational information about cognitive aging that did not refer to mindfulness or strategies to improve cognition. Topics covered were related to the distinction between normal and pathological cognitive aging. Every session comprised psychoeducation about a weekly theme (i.e., normal vs pathological aging), an oral presentation, group activities (e.g., doing a healthy recipe) and discussions. The psychoeducational information was provided with the support of a visual presentation and written summaries. The PBI was administered by three trained instructors.

(Insert Table 2 here)

Materials

Primary efficacy measures

Psychological stress. Psychological stress was assessed using the Geriatric Anxiety Inventory (GAI; Champagne, Landreville, Gosselin & Carmichael, 2015; Pachana et al., 2007) and the Perceived Stress Scale (PSS; Cohen, Kamarck & Mermelstein 1983; Lesage, Berjot & Deschamps, 2012). These self-reported questionnaires were selected because they were both validated with the aMCI population and showed great validity and reliability (PSS: Ezzati et al., 2014; GAI: Rozzini et al., 2009). The GAI, designed for older adults (Pachana et al., 2007), is a 20-item questionnaire asking participants to indicate whether they "agree = 1" or "disagree = 0" with an item based on how they felt during the last week. Total scores range from 0 to 20 and higher scores represent higher levels or frequencies of anxiety symptoms. A score between 8 and 10 suggests a clinical level of anxiety and a score above 10

indicates a strong possibility of generalized anxiety disorder. The PSS is one of the most commonly used self-reported questionnaires in psychophysiological research because of its positive association with cortisol (Ezzati et al., 2014). It is a 10-item questionnaire with a five-point Likert scale ranging from "never = 0" to "very often = 4". Maximum score is 40, with higher scores indicating higher levels of perceived stress.

CAR. Participants were instructed to collect saliva samples at home using specific collection devices (Salivettes® cortisol, Sarstedt, Germany) according to the manufacturer's instructions. On two consecutive days, participants collected a saliva sample immediately after awakening and 30 minutes later to allow for CAR calculation. During these two days, participants were asked to record, in a journal, the exact time at which they collected saliva samples as well as any behaviors that might have influenced the endocrine system (e.g., alcohol consumption). Participants were asked to store saliva samples in their home freezers until they returned them to the CERVO's Genomics Laboratory where they were stored at -20 °C. Purified saliva was extracted from the Salivettes® cortisol by centrifugation at 1000 x g for two minutes. Salivary cortisol concentrations were assessed using the Salimetrics® Cortisol Enzyme Immunoassay Kit (Salimetrics®, Cedarlane Laboratories, Ontario, Canada), a validated assay to measure in vitro quantitative salivary cortisol (Salimetrics®, 2014). CAR was calculated using raw salivary cortisol levels and corresponds to the mean levels of salivary cortisol in the first saliva sample collected immediately upon awakening subtracted from the second sample collected 30 minutes post-awakening.

Secondary efficacy measures

Coping strategies. Coping strategies used by participants when under stressful conditions in everyday life were evaluated with the dispositional scale of the Brief-COPE (Carver, 1997), the short version of the COPE Inventory (Carver, Scheier

&Weintraub, 1989). The dispositional scale of the Brief-COPE is a 28-item questionnaire with a four-point Likert scale ranging from "not at all = 0" to "completely = 3". The tool assesses 14 different coping strategies, which can be grouped under three categories: 1) emotion-focused coping strategies (e.g., positive reinterpretation); 2) problem-focused coping strategies (e.g., planning); 3) dysfunctional coping strategies (e.g., denial). Emotion- and problem-focused coping strategies were both considered adaptive. An overall score was calculated for each category and for each of the 14 strategies, with higher scores indicating more frequent use of the coping strategy or category.

Mindfulness attitudes. The Five Facets Mindfulness Questionnaire (FFMQ; Baer, Smith, Hopkins, Krietemeyer & Toney, 2006) assesses five different mindfulness attitudes: 1) observation (i.e., to observe internal and external experiences with mindful awareness); 2) description (i.e., to describe or label internal experiences with words); 3) acting with awareness (i.e., to act with concentration and awareness instead of performing daily life activities on automatic pilot); 4) non-judgment (i.e., to take a non-evaluative stance toward internal and external experiences); and 5) non-reactivity (i.e., to allow and accept internal experiences without being carried away or submerged by them) (Baer et al., 2006; Heeren, Douilliez, Peschard, Debrauwere & Philippot, 2011). The FFMQ includes 39 items with a Likert scale ranging from "never or rarely true = 1 " to "very often or always true = 5." Each mindfulness attitude represents a subscale associated with a score. Overall scores of mindfulness range from 39 to 195, with higher scores indicating higher mindfulness attitudes.

At-home meditative practices. The amount of time devoted to at-home meditative formal practices was used to quantify its integration into daily life and to assess the comparative effects of regular versus low mindfulness practice on certain

variables. At-home meditative practices time was self-reported on a paper calendar provided to MBI participants every week. The total amount of practice time for each participant was used in the analyses (see section Complementary analyses below).

Statistical analyses

Preliminary analyses

Data analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 24.0. The significance level was set at $p < .05$. All variables were tested for normality and homogeneity of variance assumptions with Shapiro-Wilk's and Levene's statistical tests. Pre-intervention equivalence between the MBI and PBI groups was assessed based on sociodemographic and clinical variables (i.e., sex age, education, medication, and Montreal Cognitive Assessment). The Student's *t* test for independent samples was selected for normally distributed continuous variables (i.e., age, education and Montreal Cognitive Assessment) and a Chi-Square test was applied to nominal variables (i.e., sex and medication). In addition, the Student's *t* test and the Mann-Whitney's U test for independent samples were used to compare time of saliva sampling, ensuring both groups collected their samples at similar moments and respected the cortisol sampling protocol pre- and post-intervention.

Efficacy analyses

A linear mixed model with Intervention as the between-subjects factor (i.e., MBI and PBI) and Time as the within-subjects factor (i.e., pre- and post-intervention) was carried out for each category of primary (i.e., psychological stress and physiological stress) and secondary (i.e., coping strategies) efficacy variables to assess the impacts of each intervention individually and compare them. Percentages of change and effect sizes (i.e., Cohen's *d*; Cohen, 1988) were also calculated.

Complementary analyses

Firstly, a Student *t* test for dependent samples was used to determine the impacts of MBI on mindfulness attitudes from pre- to post-intervention. Secondly, MBI participants were divided in two subgroups according to the total amount of time dedicated to at-home meditation during the eight-week program (i.e., MBI+: total time above the mean; MBI-: total time below the mean) to verify the influence of practice on psychological and physiological stress, coping strategies, and mindfulness attitudes. The two subgroups were compared with Student's *t* tests for independent samples on the pre- and post-intervention values and on the percentages of change of the primary and secondary efficacy variables. To add to these results, a multiple linear regression model using the stepwise method was applied to determine if some participant's characteristics (e.g., age, sex, perceived stress level, etc.) predicted the amount of time dedicated to at-home meditative practices.

Results

Participants' characteristics

From the initial sample (n = 48), seven participants dropped out for various reasons (e.g., lack of time) (see Figure 1). Therefore, results refer to pre- and post-intervention data from 41 participants. Both MBI (n = 20) and PBI (n = 21) were equivalent regarding sex (χ^2 (1, N = 41) = .27 , p = .61), age (t (39) = .98 , p = .33), education (t (39) = .44 , p = .66), general cognitive functioning (i.e., MoCA score; t(39) = .037 , p = .97), any type of medication (χ^2 (1, N = 41) = .24 , p = .62), and medication that might affect the endocrine system (χ^2 (1, N = 41) = .62 , p = .43) (see Table 3). Prescription drugs that might affect the endocrine system listed from the participants were: 1) inhibitors of angiotensin converting enzyme; 2) antihypertensive; 3) sedatives; and 4) hypnotics.

(Insert Figure 1 here)

Overall, the majority of participants attended most of the MBI and PBI sessions, with an average participation rate of 93.8% and 92.3%, respectively. The analysis of the calendars completed by MBI participants indicated that they accumulated an average of 2.5 hours of at-home meditative practices per week, fairly on par with the instructions (i.e., ≈ 3 hours/week).

(Insert Table 3 here)

Primary efficacy measures

Psychological stress

Scores on both the GAI and the PSS were not significantly influenced by the factors Intervention (GAI: F (1, 39) = .001, p = .978, d = .01; PSS: F (1, 39) = .192 , p = .664, d = .14) and Time (GAI: F (1, 39) = 1.307 , p = .260, d = .16; PSS: F (1, 39) = 3.702 , p = .062, d = .62), and did not vary as a function of the Intervention x Time interaction (GAI: F (1, 39) = .127 , p = .724, d = .11 ; PSS: F (1, 39) = 1.399 , p = .244, d =.38). Based on visual inspection of data (see Table 4), however, follow-up comparisons of the simple effects comprising the Intervention x Time interaction were carried out and confirmed a significant reduction of perceived stress levels from pre- to post-intervention only in participants of the PBI intervention (F (1, 39) = 4.95, p = .032).

Physiological stress

Adherence to the salivary cortisol collection protocol was assessed with the journals filled by the participants. Inspection of the journals indicated that the main instructions (e.g., do not eat 30 minutes before taking a saliva sample) were well respected. In addition, the Student's *t* test and the Mann-Whitney's U test for independent samples showed no significant difference between times of saliva collection among MBI and PBI pre- and post-intervention.

Mean concentrations of salivary cortisol collected at awakening and 30 minutes later were within the expected standards based on age and sex, issued by Salimetrics® (2014). Similar to psychological stress scores, the CAR was not significantly affected by Intervention (F (1, 39) = .81, p = .37, d= .29) and Time (F (1, 39) = .98, p = .33, d= 0.32), and the Intervention x Time interaction was not significant (F (1, 39) = .13, p = .73, d = .12). The effect sizes for each group suggested that PBI generated low to no impact (i.e., effect size < d=.2) on CAR, whereas MBI seems to have induced a slight decrease post-intervention (see Table 4).

(Insert Table 4 here)

Secondary efficacy measures

Coping strategies

Coping strategy variables were not significantly influenced by Intervention and the Time x Intervention interaction was not significant. However, Time positively influenced problem-focused coping strategies (F (1, 39) = 4.378, p = .043, d = .67), particularly active coping (i.e., take concrete actions to improve stressful situations) (F (1, 39) = 9.146, p = .004, d = .97) for MBI and PBI combined (see Table 5).

(Insert Table 5 here)

Mindfulness attitudes

Results revealed a significant increase from pre- to post-MBI on the FFMQ total (t (19) = -6.52, p = .000) and the subscales observation (t (19) = -2.6, p = .018), non-reactivity (t (19) = -3.72, p = .001), and non-judgement (t (19) = -6.79, p = .000) (see Table 6).

(Insert Table 6 here)

At-home meditative practices

Results of the multiple regression analysis showed that a lower pre-intervention score on the subscale non-reactivity of the FFMQ (i.e., higher tendency to react or being submerged by internal experiences) significantly predicted the amount of time dedicated to at-home meditative practices ($F (1, 18) = 15.56$, $p < .001$, $R^2 = .46$).

Examination of the physiological ramifications of at-home meditative practices indicated that participants with total practice times above the mean (MBI+: $n = 11$; $M > 15.30$, $SD = 5.77$) had a significantly lower CAR post-intervention ($t (18) = -1.97$, $p = .049$, $d = .88$) than those with total practice time under the mean (MBI- : $n = 9$; $M = < 15.30$, $SD = 5.77$).

Additional Student's *t*-tests for independent samples revealed that MBI+ participants used significantly more religious ($t (18) = 2.42$, $p = .015$, $d = 1.09$) and planning ($t (18) = 2.16$, $p = .031$, $d = .97$) coping strategies and displayed significantly higher percentages of change on the subscales observation ($t (18) = 2.51$, $p = .012$, $d = 1.13$) and non-reactivity ($t (18) = 2.04$, $p = .041$, $d = .92$) of the FFMQ, post-intervention, compared to MBI- participants.

Discussion

The main objective of this pilot study was to determine the impacts of MBI and PBI on psychological and physiological stress of older adults with aMCI. The key findings were a reduction of perceived stress level for PBI and a slight decrease in CAR after MBI only in those participants who meditated at home the most (i.e., MBI+). The present data fit well with previous studies showing that a reduction in CAR post-MBI is associated with meditation experience (Brand et al., 2012) and treatment engagement (Bergent-Cico, Possemato & Pigeon, 2014). Unforeseen was the observation that MBI+ participants had a higher baseline level of reactivity on the FFMQ scale. Increasing the time window between stimulus and response to calm down automatic reactivity to

stressors was a topic addressed early on during the course of the MBI program (i.e., weeks 3 and 4). It may have resonated particularly well with participants who were aware of shortcomings with that respect, resulting in a heightened motivation to change through the prescribed at-home meditative practices. Among MBI+ participants, reductions in CAR post-MBI was also compounded with positive impacts of MBI, such as the propensity for adaptive coping strategies (i.e., pray, meditate, or plan a strategy in the presence of a stressful situation) and more developed mindfulness attitudes (i.e., observation of internal experiences and non-reactivity to internal experiences). These latter are known to entail a shift in perspective in relation to internal experiences, indicating that sensations, emotions, and thoughts are appraised with more distance as though being transient mental events (Daubenmier et al., 2014). This shift toward a more mindful attitude is believed to promote less HPA reactivity (Brown, Ryan & Creswell, 2012). In fact, Daubenmier et al. (2014) demonstrated that dispositional mindfulness is negatively correlated with CAR and could buffer the negative impacts of psychological stress at the physiological level. Thus, the CAR decrease among MBI+ participants might be attributed to an enhanced mindful attitude involving a better capacity to respond with adaptive coping strategies, rather than react automatically.

In contrast, PBI was effective in reducing perceived stress level, possibly because educational content central to the intervention focuses on cognitive aging and addresses questions and concerns of older adults with aMCI. This content, which was not part of the MBI, may have fostered feelings of normalisation and reassurance in participants. Therefore, it could be good advice to refer older adults with higher perceived stress level to a PBI. However, one should take into account that pre-intervention GAI and PSS scores were indicative of low psychological stress at

baseline, thus leaving little room for improvement after both interventions, especially in the case of the GAI.

MBI did not significantly reduce anxiety and perceived stress levels in aMCI participants. Interestingly, a study by Marcus et al. (2003), which assessed the impact of an eight-week MBI program on perceived stress levels and CAR among adults in a therapeutic community for addiction disorders, obtained a similar pattern of results: a decrease of CAR post-MBI with no significant change on the PSS. The authors interpreted the results as attributable to the nature of the intervention itself: because mindfulness practice requires bringing voluntary attention to sensations, feelings and thoughts, including stressful ones, stress continues to be perceived as present. This may cultivate increased meta-awareness of psychological stress but in a more contemplative and less reactive way, explaining, at least in part, the stress reduction only at the physiological level. Future research should test this hypothesis.

Finally, both MBI and PBI led to an increase in problem-focused coping strategies, particularly active coping, post-intervention. These results confirm the potential of these two interventions to give participants effective tools to plan and take action when they face adversity. In fact, one of MBI's session theme was obstacle management. Moreover, most group discussions during the course of the eight-week MBI program involved sharing between participants and instructors about strategies to deal with daily life stressors (e.g., stressful thoughts, conflictual relationships, etc.). Alternatively, PBI instructed a problem resolution strategy that requires planning step-by-step concrete actions to resolve stressful situations. Thus, in both interventions, specific program features encouraged a reliance on problem-focused coping. These findings are particularly interesting, because such category of strategies was shown

effective to counteract daily life consequences induced by cognitive difficulties associated with aMCI (Souza-Talarico et al., 2009).

Limitations

These preliminary findings are promising and open the door for follow-up investigations. A few methodological considerations must be taken into account in order to nuance their interpretation such as sampling errors during saliva collection, low pre-intervention level of psychological stress that may have induced a floor effect and more generally, the small sample size could have limited statistical power to detect intergroup differences. Thus, future replications with larger sample sizes and follow-up studies are needed to confirm the reliability of the current findings, the mechanisms of action involved in each intervention, as well as their long-term effects in the prevention of cognitive decline in the context of aMCI.

Conclusion

In sum, this pilot study supports the promise of MBI and PBI to reduce stress at the physiological and psychological level, respectively, which is known to be deleterious to cognitive and cerebral functioning particularly in older adults at risk for AD. Both interventions appeared as feasible and relevant among this population, for whom very few therapeutic options are available. In this context, findings from this present study encompass several clinical benefits such as: 1) promoting coping skills to deal with daily life stressors; 2) reducing feelings of helplessness related to aMCI; and 3) being able eventually to offer a selection of interventions to aMCI older adults on the basis of their needs, interests, and level of willingness to self-invest. Finally, these preliminary findings highlight a potential role of MBI and PBI in the aMCI care process and thus, support the importance of future research, especially considering the increasing prevalence of aMCI due to longer life expectancy and population aging.

Table 1.

Clinical and neurosychological screening measures

Measures	**Domains**
Clinical interview (home made)	Sociodemographic and medical information
Cognitive complaint questionnaire (Thomas-Antérion et al., 2004)	Cognitive complaints
Alzheimer's disease Cooperative Study – Activities of daily living inventory (Galasko et al., 1997)	Functional autonomy
Structured Clinical Interview for DSM Disorders-I (Spitzer, Williams, Gibbon et First, 1992)	Episodic depressive disorder
Geriatric depression scale (Bourque, Blanchard et Vézina, 1990)	Depressive symptoms
Free and cued recall 16 items (Van der Linden et al., 2004)	Verbal episodic memory
Rey-Osterrieth complex figure (Osterrieth, 1944; Rey, 1941)	Visuoconstructive abilities and visual episodic memory
Birmingham Object Recognition Battery (Riddoch et Humphreys, 1993)	Visual perception
Digit symbol test from WAIS-III (Wechsler, 1997)	Processing speed
Verbal fluency TNP-Animals (Consortium des Universités de Montréal et de McGill, 1996)	Lexical access
Boston Naming Test 15 items (Calero et al., 2002)	Denomination
The Pyramids and Palm Trees Test (Howard et Patterson, 1995)	Semantic memory
Stroop from D-KEFS (Delis, Kaplan et Kramer, 2001)	Processing speed, inhibition, flexibility
Trait-making test from D-KEFS (Delis et al., 2001)	Processing speed, attention, flexibility

Table 2.

MBI and PBI sessions' themes.

	MBI	PBI
Session 1	Autopilot vs. mindfulness	Normal vs. pathological cognitive aging
Session 2	Handling obstacles and supporting meditation practice efforts	Dementia continuum and types of dementia
Session 3	Wandering mind	Memory function and other cognitive issues in aMCI
Session 4	Acknowledging stress and its impact of one's life to better manage it	AD risk factors and pharmacological treatments
Session 5	Reflecting on how one could live in increased acceptance of one's situation	Medical follow-ups and discussions with physicians about cognitive concerns
Session 6	The role thoughts play in the maintenance of distress and stress	Relationships and discussions about cognitive decline with close relatives
Session 7	How to take better care of oneself	Everyday living with cognitive decline and coping with difficulties
Session 8	Sustaining a meditation practice beyond the program	What to do next with all the new knowledge participants acquired in the program

Note. AD: Alzheimer disease; MBI: Mindfulness-based intervention; PBI: Psychoeducation-based intervention.

Table 3.

Characteristics of participants.

	MBI (n=20)	PBI (n=21)	*P*
Sex	13M, 7W	12M, 9W	0.61[a]
Medication	12Y, 8N	11Y, 10N	0.62[a]
Medication ES	7Y, 13N	5Y, 16N	0.43[a]
Age	72.7 (±7.0)	70.7 (±5.6)	0.33[b]
Education	13.7 (±3.1)	14.1 (±3.4)	0.66[b]
MoCA	24.4 (±2.9)	24.4 (±2.5)	0.97[b]

Note. MBI: Mindfulness-based intervention; Medication ES: Medication that might affect the endocrine system; M: Men; MoCA: Montreal Cognitive Assessment, score ≥ 26/30 is normal, score between 25/30 and 18/30 indicates mild cognitive impairment; N: No; PBI: Psychoeducation-based intervention; W: Women; Y: Yes; [a]: Chi-square test; [b]: Student's *t* test for independent samples.

Table 4.

Means (± standard deviations) and effect sizes for psychological and physiological stress variables for both groups pre- and post-intervention.

	Group	N	Pre-intervention	Post-intervention	Effect size
GAI	MBI	20	5.80 (±5.96)	5.25 (±5.66)	0.10[a]
	PBI	21	6.10 (±5.73)	5.05 (±5.51)	0.18[a]
PSS	MBI	20	14.20 (±4.98)	13.70 (±6.61)	0.09[a]
	PBI	21	15.71 (±6.23)	13.62 (±4.61)	0.38[a]
CAR	MBI	20	0.08 (±0.27)	0.007 (±0.18)	0.32[a]
	PBI	21	0.13 (±0.21)	0.08 (±0.40)	0.16[a]

Note. CAR: Cortisol awakening response; GAI: Geriatric anxiety inventory; PSS: Perceived stress scale; MBI: Mindfulness-based intervention; PBI: Psychoeducation-based intervention; [a] : *d* de Cohen.

Table 5.

Means (± standard deviations) and effect sizes of Brief-COPE scores for both groups pre- and post-intervention.

	Group	N	Pre-intervention	Post-intervention	Effect size
Emotion-focus	MBI	20	15.45 (±4.57)	15.40 (±4.73)	0.01[a]
	PBI	21	14.33 (±5.69)	15.38 (±5.89)	0.18[a]
Problem-focus	MBI	20	10.90 (±3.23)	11.35 (±3.44)	0.13[a]
	PBI	21	10.24 (±2.68)	11.38 (±3.35)	0.38[a]
Active coping	MBI	20	3.85 (±1.18)	4.35 (±1.09)	0.44[a]
	PBI	21	3.52 (±1.03)	4.10 (±1.61)	0.43[a]
Dysfunctional	MBI	20	11.55 (±4.74)	10.85 (±4.10)	0.16[a]
	PBI	21	10.95 (±2.89)	10.76 (±3.58)	0.06[a]

Note. MBI: Mindfulness-based intervention; PBI: Psychoeducation-based intervention; [a] : *d* de Cohen.

Table 6.

Means (± standard deviations) and effect sizes of FFMQ scores for MBI group pre- and post-intervention.

	N	Pre-intervention	Post-intervention	Effect size
FFMQ total	20	102.20 (±11.79)	122.30 (±15.37)	1.47[a]
FFMQ observation	20	22.70 (±6.36)	26.70 (±6.17)	0.64[a]
FFMQ description	20	23.05 (±3.86)	24.20 (±5.44)	0.24[a]
FFMQ action	20	25.15 (±8.05)	23.40 (±4.82)	0.26[a]
FFMQ non-reactivity	20	15.90 (±6.61)	22.00 (±3.69)	1.14[a]
FFMQ non-judgement	20	15.40 (±7.98)	26.00 (±4.97)	1.59[a]

Note. MBI : Mindfulness-based intervention; [a] : *d* de Cohen.

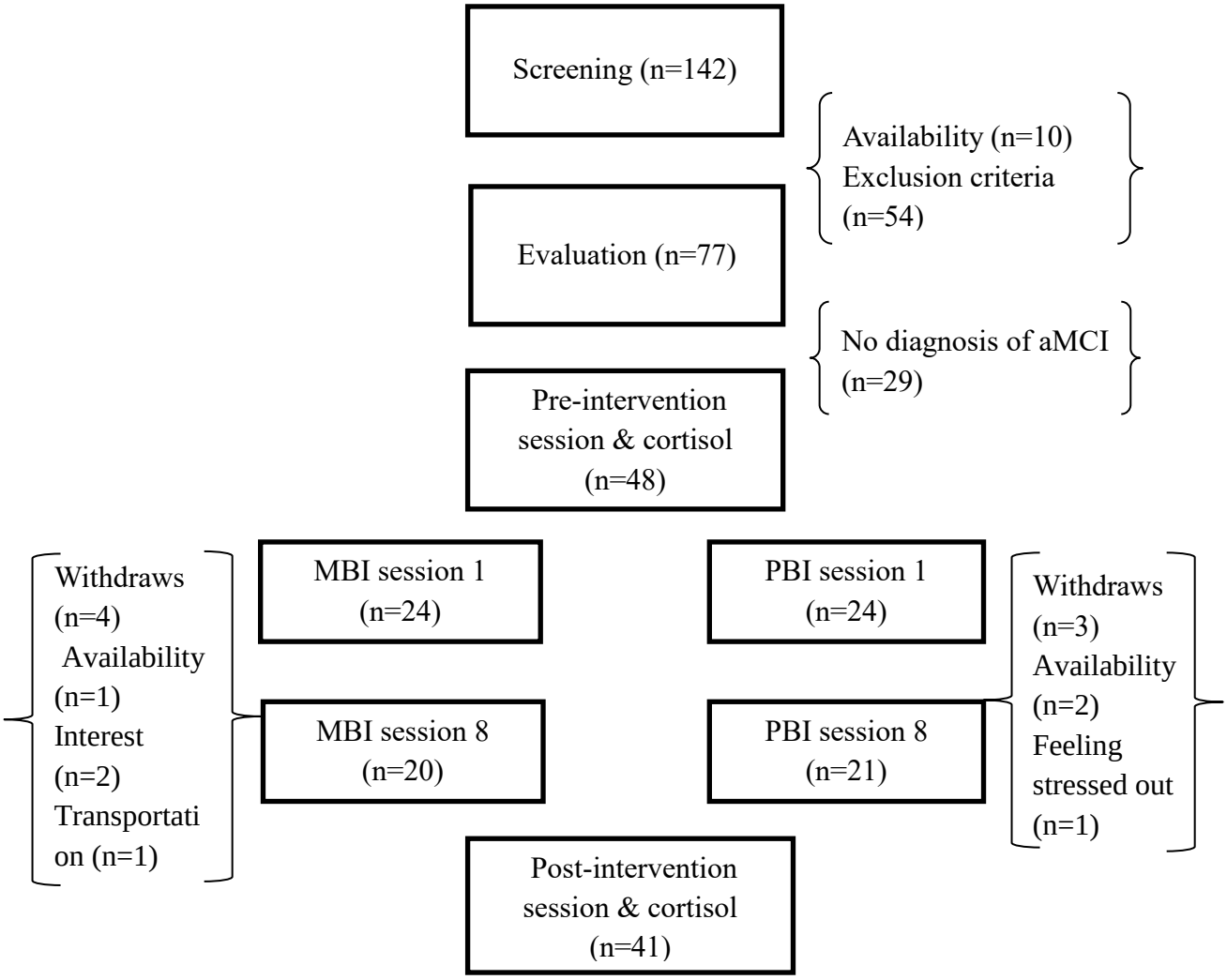

Figure 1. Flowchart of the participation through each stage of the study protocol.

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