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Mindfulness to Promote Healthy Aging in Older Adults with Mild Cognitive Impairment and their Caregivers: A Mixed Methods Feasibility and Acceptability Study

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MINDFULNESS TO PROMOTE HEALTHY AGING IN OLDER ADULTS WITH MILD COGNITIVE IMPAIRMENT AND THEIR CAREGIVERS: A MIXED METHODS FEASIBILITY AND ACCEPTABILITY STUDY

by

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Dedication

This project is dedicated to all those who have been touched by age-related cognitive impairment. May we continue to find creative and heartfelt ways to move toward cessation of suffering, together.

Acknowledgment

I would like to express my appreciation to Professor Jeffrey Greeson for his guidance, co-facilitation, and encouragement throughout this research. I will carry the skills and knowledge I have gained from our mentorship relationship into my future professional endeavors.

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Abstract

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Mild cognitive impairment (MCI), thought be a precursor to dementia, is characterized by cognitive decline without functional impairment. As the population ages and the prevalence of MCI increases, non-pharmacologic interventions are needed to address well-being and disease progression in this population of older adults and their caregivers. In response to growing interest in mindfulness-based interventions (MBIs) as an adjunct to integrated care for this population, this single arm, mixed methods pilot study trialed a lightly adapted, 6-week MBI for both MCI patients and their caregivers (n=24). The intervention was feasible and acceptable in both groups. There was a trend toward improved Immediate Memory in MCI Patients and a significant improvement in their self-reported Social Functioning, but several other self-report measures lacked reliability and validity in this group. Caregivers reported increased trait mindfulness and application of mindfulness skills in daily life, as well as decreased sleep disturbance. However, Caregiver Burden did not improve. Thematic analysis showed acquisition of basic mindfulness skills in both groups, with a particular emphasis on meditation as a way for MCI patients to relax and generate positive affect. Several recommendations for future research are provided, and additional randomized controlled trials with larger sample sizes are required to replicate these findings and isolate mindfulness-specific treatment effects.

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Chapter 1

Introduction

Dementia is a progressive disorder characterized by a wide number of cognitive disabilities resulting in significant loss of functional abilities and alterations in behavior (Larson, 2020). In the United States, an estimated 5.8 million people (1 in 10) aged 65 or older had a diagnosis of Alzheimer's disease (AD) or another form of dementia in 2020 (Alzheimer's Association, 2020). As the Baby Boomer generation ages, the number of people over age 65 will increase an estimated 62% by 2050 and, along with it, the prevalence of dementia is expected to almost triple (Alzheimer's Association, 2020). The etiologies of AD and other dementias are heterogenous, and both disease-specific and disease-modifying treatments are still in their infancy, despite intensified funding and numerous pharmaceutical trials (Cummings, Morstorf, & Zhong, 2014; Press & Alexander, 2020). Disease management, therefore, focuses on symptom management, with variable success (Press & Alexander, 2020). Furthermore, healthcare institutions providing care to older populations continue to struggle with rising health care costs and side effects of over-prescribing and polypharmacy (Centers for Disease Control and Prevention, 2013). As the prevalence of this difficult to treat condition increases, providers anticipate a major strain on patient well-being, the geriatric health care system, and the health of caregivers (Bartels & Naslund, 2013).

The rising prevalence of AD and other dementias may be addressed, in part, by addressing the precursor to dementia: Mild Cognitive Impairment (MCI). MCI is commonly understood as cognitive decline in one or more domains (e.g., attention, memory, language, etc.) with relative preservation of normal daily functioning (Langa &

Levine, 2014; Petersen, 2020a). MCI does *not* refer to the cognitive changes frequently seen in normal aging, which are neuropsychologically and biologically distinguishable from MCI (Bondi et al., 2014; Edmonds et al., 2015). However, there is heterogeneity within this diagnosis and research on subgroups within MCI continues to clarify it as a clinical construct (Libon et al., 2010). Additionally, diagnosis is a multimethod process, and emerging research continues to redefine best practices for using neuropsychological testing, neuroimaging, biomarkers, self/informant-report, functional impairment, and clinical judgment in the diagnostic process. Conventionally, MCI is diagnosed using a combination of psychometric testing, subjective and family report, and clinical judgment (Petersen, 2020a), but is increasingly assessed using a combination of neuropsychological, neuroimaging, and biomarker methods (Bondi & Smith, 2014).

Although clinical presentations vary, MCI is generally thought to represent prodromal stages of Alzheimer's and other dementias. Accurate and early diagnosis of MCI thereby enables early detection and intervention for full dementia (Edmonds et al., 2019; Petersen, 2004). However, it is important to note that not all cases of MCI are progressive, with a minority of patients remaining stable and others improving if a treatable cause is identified (Koepsell & Monsell, 2012; Larrieu et al., 2002; Palmer et al., 2002). That said, a diagnosis of MCI continues to be associated with eventual progression to full dementia and recent large-scale longitudinal studies seem to indicate that most MCI patients progress within 1-5 years of the initial diagnosis (Lopez et al., 2012; Roberts et al., 2014). Diagnosis and intervention at this stage is crucial - the available literature suggests that up to 30% of dementia cases could be preventable via behavior change and modification of risk factors (Galvin, 2017; Mitchell et al. , 2017; Yu

et al., 2020). More concretely, if early identification and treatment of MCI could delay progression to dementia for even 1 year, we would see up to 9.2 million fewer cases of dementia in 2050 (Brookmeyer et al., 2007).

Although the core feature of both MCI and dementia is progressive cognitive decline, behavioral and psychological symptoms (e.g. depression, anxiety, sleep impairment, agitation) co-occur for up to 90% of patients (Cerejeira et al., 2012; Millán-Calenti et al., 2016). These symptoms not only correlate strongly with both cognitive and functional impairment (Cerejeira et al., 2012), but may also be directly implicated in disease progression over time (Pankratz et al., 2015). Therefore, pharmacologic and non-pharmacologic interventions for behavioral and psychological health may not only improve psychological well-being in patients, but also reduce functional impairment, caregiving burden, and buffer the risk of disease progression. This dissertation will address one potential non-pharmacological intervention for behavioral and cognitive health in MCI: mindfulness training. In so doing, we hope to support the development of novel, effective, and low-cost behavioral interventions capable of improving quality of life and buffering disease progression as part of integrated care for this growing population of patients.

Understanding Mild Cognitive Impairment (MCI)

As the population of older adults in the United States continues to grow, diagnoses of MCI will rise along with diagnoses of full dementia (Stawski et al., 2019). As in full dementia, prevention of and treatment for MCI is currently limited (Petersen, 2020b). In addition, presentations and prognoses for MCI are variable. Patients may present with changes in memory (misplacing things, missing appointments), changes in

language (trouble finding words), changes in visuospatial functioning (difficulty driving and way finding), and/or changes in attention/executive functioning (distractibility, trouble planning meals or outings; Langa & Levine, 2014). Relatedly, these presentations can be explained by several possible etiologies. Some represent a misdiagnosis of idiopathic prodromal dementia and respond to intervention by treating underlying sleep disorders, depression, hypertension, vitamin B12 deficiency, hyperthyroidism, and/or polypharmacy (Petersen, 2020a). Others, such as medial temporal atrophy, abnormal levels of beta-amyloid and tau proteins, or cerebrovascular disease suggest underlying disease processes linked to AD or other dementias, for which prevention and treatment is more limited (Alzheimer's Association, 2020).

Diagnosing MCI

There are several diagnostic paradigms for MCI, and the standard of practice continues to evolve with emerging research. Conventionally, to receive an MCI diagnosis, patients must (1) report subjective cognitive impairment; (2) demonstrate objective cognitive impairment in one or more domains (one test per domain), commonly defined as performance ~1.5 standard deviations below age- and education-corrected norms, and (3) show preserved global cognitive functioning and relatively unimpaired activities of daily living (Petersen, 2020a; Petersen & Morris, 2005; Winblad et al., 2004). There are several valid criticisms of this paradigm, here referred to as the Petersen/Winblad or conventional approach. First, single time-point or one-test subjective reports, clinician interviews, and objective measures of a single cognitive domain can be confounded by low mood, lack of sleep, and chronic pain, all of which are common in the older adult population (Riedel-Heller et al., 1999; Saxton et al., 2009; Tobiansky et al.,

1995). Second, this paradigm has been soundly criticized for low reliability and over-reliance on clinical acumen, which may lead to substantial diagnostic error (Bondi et al., 2014; Bondi & Smith, 2014, Edmonds et al., 2015).

For example, the Alzheimer's Disease Neuroimaging Institute (ADNI) criteria for MCI use the conventional paradigm described above: (1) subjective memory complaint reported by the patient, an informant, or the clinician; (2) objective memory loss operationalized as a score below education-adjusted cut-offs on one subscale of the WMS-R Logical Memory Test (Story A); (3) a global Clinical Dementia Rating (CDR) score of 0.5; and (4) sufficiently preserved daily functioning to preclude a diagnosis of full dementia (Alzheimer's Disease Neuroimaging Initiative, 2008). However, the use of a single measure for a cognitive domain (e.g., memory) greatly reduces reliability and may result in increased false positives and diagnostic instability over time (Bondi et al., 2008; Jak et al., 2009). Indeed, isolated low memory scores in healthy older adults are common; for example, one study found that 20% of healthy older adults obtained one "impaired" score (-2 SDs) in two separate cognitive domains, but less than 5% had two or more impaired scores in the same domain (Mistridis et al., 2015). The Petersen/Winblad criteria are also overly reliant on clinical judgment; the CDR is a structured clinical interview for assessing decline across the AD spectrum via day-to-day functional impairment and is consequently more susceptible to biases and assumptions than objective measures (Saxton et al., 2009). Lastly, there is a great deal of variability in the number of tests clinicians consider and the cutoffs used to separate normal cognitive functioning from MCI (Bondi et al., 2008; Jak et al., 2009). These factors together likely impact the prevalence rate estimates for MCI: Jak, Bondi and colleagues (2009) reported

a prevalence rate of MCI among older adults ranging from 11%-74%, depending on the numbers of tests considered and the cutoffs adopted.

In response, several researchers have proposed actuarial diagnostic criteria for MCI, which aim to (1) balance sensitivity and reliability using comprehensive neuropsychological assessment and (2) incorporate functional impairment (e.g., identifiable difficulties with activities of daily living) into diagnostic methodology (Bondi et al., 2014; Bondi & Smith, 2014). Specifically, the Jak/Bondi actuarial approach considers patients to have MCI if any one of the following are met: (1) a score >1 SD below an age-corrected normative mean on *two* measures within at least one cognitive domain; (2) one score >1 SD below an age-corrected normative mean in three different cognitive domains; or (3) a score ≥9 on the Functional Activities Questionnaire (FAQ), which would indicate dependence/impaired function on at least three activities of daily living (ADLs; Jak et al., 2009). Analyses comparing the Jak/Bondi approach to the ADNI classification described above are striking. In a dataset of 1150 older adults, the actuarial neuropsychological criteria classified significantly fewer participants as having MCI and significantly more as cognitively normal (CN), compared to the ADNI diagnostic criteria (Actuarial: 35% MCI, 65% CN; ADNI: 74% MCI, 26% CN; Bondi et al., 2014). Moreover, person-centered statistical techniques such as cluster analyses showed that using the ADNI criteria resulted in three subgroups of MCI: *Amnestic*, *Dysexecutive/Mixed*, and a third group termed *Cluster-Derived Normal*. The latter group represented almost one third of the ADNI-defined MCI sample but performed within normal limits on all six neuropsychological measures included in the cluster analysis. This group also showed cerebrospinal fluid (CSF) biomarker levels that were not

significantly different from CN participants but *were* significantly different from the two other MCI subgroups. Interestingly, the *Cluster-Derived Normal* group also reported significantly more depressive symptoms and less ADL impairment than the *Amnesic* or *Dysexecutive/Mixed* subtypes. In contrast, cluster analysis using the actuarial method resulted in three uniquely impaired subgroups (*Amnestic*, *Impaired Language*, and *Dysexecutive/Mixed*), all of which showed abnormal levels of almost all CSF biomarkers for AD. Lastly, less than 1% of those diagnosed with MCI using Jak/Bondi criteria reverted to CN, whereas those in the *Cluster-Derived Normal* subgroup under ADNI criteria were as likely to revert to CN as to progress to dementia (~9%).

Similar cluster analyses preceded these findings (Clark et al., 2013) and have replicated them (Edmonds et al., 2018; Edmonds et al., 2015). For example, in a sample of 825 older adults diagnosed with MCI under the ADNI criteria, Edmonds et al. (2015) found four subtypes (*Dysnomic, Dysexecutive, Amnestic,* and *Cluster-Derived Normal*) wherein the *Cluster-Derived Normal* group represented ~35% of the total sample but was distinct from the three remaining groups across multiple measures: fewer *APOE* ε4 carriers (a genetic risk factor for AD), lower incidence of progression to dementia, and equivalent CSF AD biomarker profiles to CN controls.

This body of research indicates that conventional criteria for diagnosing MCI are likely to result in a high rate of false positive diagnoses, with notable downstream consequences. Specifically, the use of these criteria in clinical research may have diluted otherwise significant biomarker relationships, portrayed seemingly reduced risk of progression from MCI to dementia, and masked potential psychopharmaceutical treatment effects (Edmonds et al., 2018). The solution seems to be adopting an actuarial

method for diagnosis, which increases reliability by using multiple measures for a single cognitive domain, maintains sensitivity by adopting a cut-off point of -1 SD, and assigns less weight to subjective/clinician ratings of cognitive impairment (Bondi & Smith, 2014).

This literature also has implications for classifying subtypes of MCI accurately. MCI is a complex clinical construct, and several researchers have argued that more comprehensive neuropsychological diagnosis is necessary to understand heterogenous cognitive impairment in MCI (Bondi & Smith, 2014). Conventionally, amnesic MCI (aMCI) is thought of as a precursor to Alzheimer's Dementia (AD) and describes individuals for whom episodic memory impairment is primary but who do not meet criteria for dementia (Petersen, 2020a). Although prevalence ratios vary across studies, this subtype seems to be the most common, occurring at an approximate ratio of 2:1, compared with non-amnesic MCI (naMCI; Roberts et al., 2008). In naMCI, patients may present with one or more impairments in non-memory domains (e.g., visuospatial skills, language, executive functioning), with a relative sparing of functional impairment. It is hypothesized that patients in this category are more likely to progress to other forms of dementia, including vascular cognitive impairment, frontotemporal dementia, or corticobasal degeneration (Matthews et al., 2008). In contrast, cluster analysis following comprehensive sampling of neuropsychological function across multiple measures has revealed homogenous subgroups that do not map directly on to the conventional aMCI/naMCI distinction.

Using this methodology, Libon and colleagues (2010) found evidence for *amnestic, dysexecutive*, and *mixed* (impaired memory and language) subgroups of MCI

patients. The same authors have since demonstrated that these empirically derived subgroups may have dissociable neuropsychological profiles across measures of forgetting, temporal gradients, interference, and errors (Eppig et al., 2012; Libon et al., 2011). Furthermore, these empirically derived subgroups may exhibit dissociable white matter lesion pathology, providing an important biological basis for this classification system (Delano-Wood et al., 2009).

In addition to diagnostic paradigms, there are several other factors that influence diagnosis in MCI. One such factor is psychopathology, and due to this project's focus on behavioral health it is worth discussing the relationship between MCI and psychopathology. Neuropsychiatric symptoms are more common in patients with MCI than in age-matched controls. Research shows that up to 90% of MCI patients will present with symptoms of behavioral or psychological distress (Geda et al., 2008; Okura et al., 2010). The relationship between cognitive impairment and psychopathology, particularly depression, is complex and likely bidirectional. Clinical depression is present in 25-40% of MCI patients (Ismail et al., 2017), but cognitive impairment is also a potential symptom of major depressive disorder (MDD). It follows that, if MDD is the sole etiology of a given patient's cognitive impairment, cognitive symptoms may remit once patients are no longer depressed (Petersen, 2020a). However, some studies suggest that MDD, even in the absence of cognitive symptoms, may be an early indicator of cognitive decline (Caracciolo et al., 2011; Goveas et al., 2011), although other studies have found no relationship (Vinkers et al., 2004; Wilson et al., 2008). To complicate matters further, some researchers have suggested that the MCI diagnosis itself may represent a stressor for many patients, and therefore increase the likelihood of a

depressive episode for patients with pre-existing vulnerability (Wells et al., 2019). Lastly, older adults presenting with MDD in isolation may be over-represented in studies on MCI due to the Petersen/Winblad diagnostic criteria for MCI described above. For example, subjective memory complaints can be related to both symptoms of depression and personality features (e.g. neuroticism; Reid & MacLullich, 2006), which may lead to patients reporting enough difficulty managing that they receive a CDR score of 0.5 (Saxton et al., 2009). Overall, it appears likely that MDD and subclinical depressive symptoms are risk factors for progression from MCI to dementia and it is possible that these symptoms are an early manifestation of some types of cognitive decline for some patients. At the same time, other patients may present with depression unrelated to prodromal dementia, and increased reliance on comprehensive neuropsychological diagnosis may help distinguish prodromal dementia from false positive MCI due to MDD.

Like clinical depression, prolonged, highly stressful experiences have been associated with both increased risk of MCI (Koyanagi et al., 2019) and higher risk of progression to dementia from MCI (Peavy et al., 2012). Furthermore, older adults who are highly reactive to stress may also be more likely to experience age-related cognitive decline (Stawski et al., 2019). The associations between psychological distress and cognitive decline likely have biological correlates. Importantly, neuropsychiatric symptoms and poor psychological well-being have been associated with cerebral amyloid deposition (Bensamoun et al., 2016), APOE ε4 (Pink et al., 2015), and both Aβ42 and total tau in CSF (Ramakers et al., 2013), all markers of AD pathology. As research on the relationship between psychopathology and MCI continues, diagnosing clinicians are

encouraged to assess stress, mood and behavioral change in patients presenting with cognitive impairment as a key part of the diagnostic process (Petersen, 2020a).

Prognosis

At the group level, individuals with MCI will progress to dementia at a higher rate than cognitively normal controls (Ganguli et al., 2011). However, both rates of progression to dementia and reversion to normal cognitive functioning can be quite variable and may reflect the way MCI has been poorly operationalized in clinical research. For example, one population-based sample of 1982 adults 65 years and older found that the 1-year progression rate varied from 0-20% and the 1-year reversion rate from 6-53%, depending on the way MCI was operationalized (Ganguli et al., 2011). High reversion rates may be explained by the conventional diagnostic strategy described above, in which a subset of patients given an MCI diagnosis under these criteria do not actually have prodromal dementia, thereby leading to inflated reversion (Edmonds et al., 2015).

That said, several biopsychosocial factors are associated with increased risk of disease progression, including advanced age, male sex, low education, medical comorbidities, high vascular risk, depression, anxiety, high degree of impairment at baseline, medial temporal atrophy, presence of CSF biomarkers for dementia, and slow gait speed (DeCarli et al., 2004; Farias et al., 2009; Heister et al., 2011; Pankratz et al., 2015). In addition, the presence of multiple risk factors may be more predictive than any one risk factor alone (Heister et al., 2011), and multidomain or mixed MCI (e.g., both language and memory impairment) may increase the risk of conversion to dementia (Summers & Saunders, 2012).

Recent research using cluster analysis has allowed for a more nuanced understanding of prognosis based on statistically derived subgroups using comprehensive neuropsychological measures. For example, results of Edmonds et al. (2015), using the cluster analysis described in the previous section, suggest slightly higher conversation rates in the *Dysexecutive* subgroup (55.6%), as compared to the *Dysnomic* (40.6%) and *Amnestic* (34.7%) subgroups, and all three are significantly higher than the *Cluster-Derived Normal* (false positive) group (10.7%). This may indicate increased risk of progression in the *Dysexecutive* subgroup, but the authors also note that this group was older, impaired in multiple domains, and had a higher percentage of participants with positive CSF AD biomarkers (Edmonds et al., 2015). More broadly, this body of work strongly suggests that improved diagnostic accuracy using an actuarial approach reduces heterogeneity in prognosis and will improve prediction models for progression to dementia moving forward (Edmonds et al., 2019). Building on this work, Edmonds et al. (2019) used a neuropsychological staging approach to map rates of progression to dementia across three subgroups identified via cluster analysis: False Positives, Neuropsychological (NP)-Early MCI, and NP-Late MCI. Survival curves for rates of progression showed *no difference* between the False Positive and Cognitively Normal groups, and the NP-Late MCI curve was steeper than the NP-Early MCI curve, as expected. Biomarker profiles (CSF AD biomarkers, cortical thinning) also distinguished the groups, with the NP-Late MCI group showing more severe AD pathology than the NP-Early MCI group. Again, this seems to indicate that prognosis in MCI should be informed by research using multiple neuropsychological measures to operationalize and distinguish subtypes of MCI.

Cost

Across subtypes, the costs of assessing for and managing MCI are significant and expected to increase as the overall population of older adults increases (Centers for Disease Control and Prevention, 2013). Current estimates for societal costs of MCI are not currently available, but the total national cost of caring for people with Alzheimer's and other dementias is projected to reach $305 billion USD in 2020, making this condition one of the costliest to American society (Alzheimer's Association, 2020). This estimate does not include the approximately $244 billion in unpaid caregiving provided by patients' families and friends (Alzheimer's Association, 2020). On an individual level, direct medical costs are an average of 44% higher for patients with MCI than for those without, after controlling for clinical and demographic characteristics, and MCI patients are five times more likely to use informal care (indirect medical costs) than those without MCI (Zhu et al., 2013). Personal costs to patients and families are also significant. Although MCI is defined by the relative preservation of activities of daily living (ADLs), the concept of MCI is easily poorly understood and distressing to patients and loved ones, particularly given the lack of clarity about prognosis, clear biomarkers, or treatment options. In addition, in comparison to patients with full dementia who are not aware of their impairment, patients with MCI are often particularly distressed by their condition given their relatively preserved awareness of cognitive deficits (Petersen et al., 2001). Patients must also proactively engage in long-term planning including advanced directives, power-of-attorney designations, financial decisions, and living wills (American Academy of Neurology, 2017). Lastly, the burden of MCI is likely influenced by racial and socioeconomic disparities, although little research has investigated social

disparities in MCI outcomes to date. However, there is ample data showing that older Black and Hispanic adults are disproportionately more likely to have AD or another dementia than older white adults (Alzheimer's Association, 2020). It is likely that this disparity extends to MCI and is explained by inequity in treatment and prevention of chronic medical conditions, reduced access to health-related behavior interventions, greater exposure to adverse life events and discrimination, and socioeconomic risk factors (Alzheimer's Association, 2020).

Integrated Care for MCI

Recommended care for MCI typically integrates biological and psychosocial factors, focusing on psychoeducation, ensuring adequate social support, assessing for reversible causes of MCI, maintaining vascular health, and encouraging beneficial behavioral interventions. This section will review standard integrated care for MCI, with an emphasis on the growing interest in nonpharmacologic interventions.

As discussed, a meaningful minority of MCI patients remain stable over time and a minority of cases (false positives) have a reversible cause that may be responsible for some or all of their symptoms. These may include medication side effects, polypharmacy, insomnia, depression, vitamin B12 deficiency, and hypothyroidism (Petersen, 2020a). Drug classes and/or combinations that have been implicated in cognitive impairment include anticholinergics, opiates, benzodiazepines, antihistamines, tricyclic antidepressants, and muscle relaxants (Langa & Levine, 2014). Clinicians are advised to first evaluate new cases of MCI for the above modifiable features and treat accordingly (Petersen, 2020b). That said, reducing the possible effects of polypharmacy is particularly

difficult in the older adult population where physical health comorbidities are common. In addition, several of the medications listed above are also used as pharmacotherapy for anxiety or mood disorders, which are themselves highly comorbid with MCI and implicated in symptom severity and disease progression, making decisions about polypharmacy particularly difficult.

Recent research using an actuarial psychometric approach is clarifying the role of pharmaceuticals in MCI treatment. Using the conventional diagnostic approach, a large, double-blinded, placebo-controlled RCT examining the effect of vitamin E vs. donepezil (an acetylcholinesterase inhibitor approved for AD) on rate of progression from MCI to AD documented no difference between the groups (Petersen et al., 2005). However, these data were revisited by Edmonds et al. (2018) using the actuarial methods discussed previously and cluster analysis to identify and exclude the ~30% of patients who appear to be false positives. The new MCI sample was then re-analyzed for treatment effects and showed a significantly lower rate of progression in the donepezil group (29%) compared to the placebo/vitamin E group (40.2%) after 36 months. The donepezil group also had significantly better Alzheimer's Disease Assessment Scale-Cognitive Subscale (ADAS-Cog) and immediate memory performance than the placebo group throughout the trial. These data strongly suggests that the beneficial effects of donepezil may have been masked in earlier clinical trials using conventional diagnostic criteria, and that prescribing physicians should consider donepezil as a means of reducing the risk of progression to full dementia in MCI (Edmonds et al., 2018).

In addition, several studies have reported an association between MCI and vascular risk factors, including atherosclerosis and cerebrovascular pathology (Peterson, 2020a). Given these observations, some researchers have suggested that clinicians should consider treating vascular risk factors aggressively in patients with MCI (Chertkow et al., 2008). At present, clinicians treating MCI in individuals already diagnosed with hypertension or diabetes are advised to pay special attention to managing blood pressure and hyperglycemia as these may influence MCI symptoms (Langa & Levine, 2014). There is also some indication that treatment of hypertension in the general population may reduce the incidence of later dementia (Gorelick et al., 2011). Similarly, there is research suggesting that pharmaceutical treatment with antihypertensives may protect against cognitive deterioration in MCI (Rozzini et al., 2008), possibly via prevention or clearance of neurofibrillary tangles (Wharton et al., 2019). However, some systematic reviews have found little to no evidence that antihypertensives alter dementia risk (Fink et al., 2017; Yasar et al., 2016). Of course, these findings may be explained in the future by the same masking effect seen in Edmonds and colleagues' (2018) re-analysis of donepezil. Beyond pharmaceutical treatment, lifestyle changes related to cardiovascular risk, such as quitting smoking and abstaining from heavy alcohol use, are universally recommended and may improve cognitive symptoms by reducing vascular disease risk (Langa & Levine, 2014).

A wide body of literature has developed on nonpharmacologic interventions to prevent or slow progression to dementia in MCI. Contrary to popular belief, older adults with MCI still enjoy brain plasticity (Calero & Navarro, 2004). This can be leveraged via behavioral interventions which teach adults with MCI new skills with the goal of

decreasing functional impairment and possibly slowing disease progression. Although this dissertation will focus on mindfulness training as one such intervention, there are many behavioral interventions for MCI currently under study. For example, there is a small body of research supporting both physical exercise and cognitive training for MCI. A recent meta-analysis of 11 small trials (total n = 1497) found that medium duration exercise programs (6-12 months) improved cognitive functioning in participants with MCI by 1 point (CI 0.5-1.45) on the Mini-Mental State Examination (MMSE), on average. Exercise was also associated with specific improvements in immediate and delayed recall, but not with improvements in other cognitive domains (Zheng et al., 2016). Although these results are promising, these trials generally did not include longer-term follow-ups, nor did they assess whether exercise may affect progression rates of MCI to dementia. Similarly, a growing number of clinical trials have investigated the use of cognitive training programs for MCI, with mixed results (Hill et al., 2017; Jean et al., 2010). Recent meta-analyses have found small to moderate effects of cognitive training (e.g., memory training, computerized cognitive games) on both global and specific facets of cognitive functioning, with potential positive effects on psychosocial functioning as well. However, larger scale trials are still pending, and longitudinal methods are needed to assess whether cognitive training reduces the risk of progression to dementia (Hill et al., 2017). That said, cognitive rehabilitation interventions for older adults are generally inexpensive and carry no risk of side effects, so clinicians are encouraged to inform patients that these activities may be of benefit (Peterson, 2020b). Lastly, some studies suggest that regular social engagement may help preserve cognitive functioning, possibly by providing another means of cognitive stimulation (Ertel et al., 2008). Given the

difficulty MCI patients may begin to have with IADLs over time, it is recommended that clinicians continuously assess social support in MCI patients, both because social contact may preserve cognitive functioning and to ensure patients are supported in activities of daily living (Langa & Levine, 2014).

Exercise, cognitive training, and social support are promising non-pharmacologic interventions for MCI but may not directly target the mood and anxiety disorders commonly seen in MCI patients (Pankratz et al., 2015). Indeed, researchers and clinicians hope that targeting neuropsychiatric symptoms, such as depression, anxiety, and stress, may prevent or delay progression to dementia, improve psychological well-being, and avoid potential adverse effects of medications (Acosta et al., 2018; Wells et al., 2019). In addition, depression in older adults can sometimes masquerade as MCI, and in fact represents a possible (and potentially reversible) *cause* of cognitive symptoms in some patients (Petersen, 2020b), perhaps particularly those diagnosed under the Petersen/Winblad criteria (Saxton et al., 2009). In addition to treating other potential etiologies for reversible cognitive impairment, physicians are also advised to evaluate and treat psychological symptoms implicated in cognitive functioning (Petersen, 2020b). Unfortunately, drug classes and/or combinations that have been implicated in cognitive impairment include some medications used to treat depression and anxiety, such as benzodiazepines and tricyclic antidepressants (Langa & Levine, 2014). In response, researchers have investigated traditional behavioral interventions for mood and anxiety, adapted for patients with MCI. For example, several studies suggest that individual psychotherapy is effective in reducing anxiety and depression in individuals with MCI and dementia (for review see Orgeta et al., 2015 and Regan & Varanelli, 2013). There is

also some indication that cognitive behavior therapy (CBT) for this population is effective in a group format (Banningh et al., 2008) and that effects may be maintained at long-term follow-up, particularly when the intervention includes ongoing support (Banningh et al., 2011). The following section will introduce another group-based behavioral intervention which may address neuropsychiatric symptoms and slow disease progression: mindfulness training. The feasibility, acceptability, and effectiveness of this intervention as a part of integrated care for MCI will be the focus of the present study.

Mindfulness-Based Interventions (MBIs) for MCI

Mindfulness-based interventions (MBIs) are a class of behavioral interventions that teach participants mindfulness: the capacity to be aware of the present moment (thoughts, sensations, emotions, etc.), on purpose and without judgment (Kabat-Zinn, 1990). The practices currently taught in the West derive from Buddhist philosophy, specifically Theravada Buddhism, but are taught in a secular context (Gunaratana & Gunaratana, 2011). These practices, mainly in the form of mindfulness meditation, have been widely adapted into behavioral interventions for a Western audience. Group-based interventions such as Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn, 1990) and Mindfulness-Based Cognitive Therapy (MBCT; Segal et al., 2004) have now been standardized and studied as means of improving physical and psychological health in clinical populations, with generally positive results across a variety of mental, physical, and behavioral measures of health and well-being (de Vibe et al., 2017; Galante et al., 2021; Goldberg et al., 2018; Greeson & Chin, 2019). These interventions instruct participants in a variety of mindfulness practices meant to cultivate present-moment

awareness and openness to experience. Practices can include (but are not limited to) seated breath awareness, deep breathing, body awareness, mindful movement, and compassion practices (Baer, 2003). Although a thorough review of the mechanisms of mindfulness is beyond the scope of this project, increased moment-to-moment attention and openness to experience are thought to drive improvements across physical, mental, and behavioral health outcomes in both clinical and healthy populations (Lindsay & Creswell, 2017; Shapiro et al., 2006).

There are several promising indications that MBIs may be a useful adjunct to integrated care for MCI: (1) promising feasibility and acceptability trials of MBIs for older adults, (2) the impact of meditation training on cognitive functioning, and (3) the effect of meditation training on psychological factors implicated in disease progression in MCI. The rationale for each will be briefly reviewed, followed by a review of MBI trials for MCI conducted on each topic.

Feasibility and Acceptability

At present, mindfulness training is an encouraging nonpharmacological intervention for mind-body health in older adults. In fact, older adults show a higher than usual adherence rate to MBIs, which appears to persist through long-term follow-up sessions at 6 or even 12 months (Felsted, 2020). In a recent review of mindfulness, stress, and aging, Dr. Katarina Felsted suggests several factors that may explain this high adherence rate: the rich life experiences older adults bring to mindfulness practice, increased interest in nonpharmacological treatments, responsiveness to interventions focused on coping with conditions outside of our control (e.g. chronic illness, mortality), and increased time to

spend learning new skills in retirement (Felsted, 2020). That said, older adults with MCI experience some disease-related factors which may make mindfulness training less feasible and acceptable for them. For example, patients may be unable to drive themselves to the intervention site, may struggle to learn concepts from classes without frequent repetition, and may have difficulty remembering to meditate at home. Fortunately, there are now enough trials of MBIs for MCI to briefly review the feasibility and acceptability of mindfulness training for this population.

Of note, when the grant for the present project was submitted in 2018 there were, to the author's knowledge, 4 trials of an MBI for MCI (Larouche et al., 2016; Ng et al., 2016; Wells, Kerr et al., 2013; Wong et al., 2017). At the time of writing, this number has doubled, with 4 new unique trials now published (Fam et al., 2020; Khine et al., 2020; Larouche et al., 2019; Marciniak et al., 2020). Additional data from previous trials has also become available, with 4 new quantitative analyses of one previous clinical trial (Ng et al., 2016) now published (Klainin-Yobas et al., 2019; Ng, Fam et al., 2020; Ng, Slowey, et al., 2020; Yu et al., 2021) and 1 qualitative acceptability analysis (Wells et al., 2019) of Wells et al. (2013). There are also 2 new RCTs in progress (Tran et al., 2020; Wetherell et al., 2020). These studies exist along the spectrum of intervention development in clinical science (Onken et al., 2014), with some firmly in the intervention generation/refinement phase and others addressing efficacy in detail and in comparison with other evidence informed behavioral interventions for MCI. The characteristics of the available literature are summarized in Table 1. In this section, we hope to reflect guidelines for translational clinical science by first reviewing feasibility and acceptability of MBIs in this population, followed by efficacy/effectiveness research published so far.

Table 1

Clinical Trials of Mindfulness-Based Interventions for Mild Cognitive Impairment

Clinical Trials	N	Controlled?	Adaption?	Published Analyses	Feasibility Data?	Acceptability Data	Cognitive Functioning	Psychological Distress	Perceived Health?	Mindfulness	Qualitative	Biomarkers	Diagnostic Approach
Wells et al.	14	Yes (TAU)	No (MBSR)	2013a	Yes	No	Yes	Yes	No	Yes	No	No	P/W
				2013b			No	No		No		Yes	
				2019		Yes		Yes	Yes	Yes	Yes	No	
Mahendran et al.	55	Yes (HE)	No (MAP)	Ng et al. (2016)	Yes	No	Yes	No	No	No	No	Yes	P/W
				Klainin-Yobas et al. (2019)				Yes					
				Ng et al. (2020a)			No	No					
				Ng et al. (2020b)				No				No	
				Yu et al. (2021)			Yes	No				Yes	
Larouche et al.	22	Yes (HE)	No (general MBI)	2016	Yes	No	Yes	Yes	No	No	No	No	NR
Wong et al.	14	No	Yes	2017	Yes	No	Yes	No	No	Yes		No	NR
Larouche et al. (2)	45	Yes (HE)	Yes (MBSR)	2019	Yes	No	Yes	Yes	No	Yes	No	No	P/W
Fam et al.	47	Yes (HE)	No (MBI)	2020	Yes	No	Yes	No	No	No	No	Yes	P/W
Marciniak et al.	28	Yes (COG)	No (MBSR)	2020	Yes	Yes	Yes	Yes	No	No		No	P/W
Khine et al.	28	No	No (MAP)	2020	No	No	Yes	No	No	No	No	No	NR

Note: TAU = Treatment as usual; HEC = Health education; COG = Cognitive training; MBSR = Mindfulness-Based Stress Reduction; MAP = Mindful Awareness Program; P/W = Petersen/Winblad; NR = Not reported.

With the exception of one study that did not report on retention and intervention completion (Wells, Kerr et al., 2013) each trial found that mindfulness training was broadly feasible in patients with MCI. Retention, most often measured as the number of participants who completed the post-intervention assessment, ranged from 78-96%. The MBIs studied thus far range from 6 weeks to 3 months in length, with no discernible change in retention rates for longer interventions. All studies with follow-up time points (6 or 9 months) reported additional attrition at follow-up. Reasons for attrition at all time points included MCI-related and MCI-unrelated health concerns, loss of interest, scheduling conflicts, and health concerns in a close family member. Interestingly, there does not appear to be a difference in retention between studies using standardized, un-adapted MBIs (e.g. MBSR, MAP) and studies which adapted mindfulness training for MCI specifically. That said, only two studies have offered an adapted MBI (Wong et al, 2017; Larouche et al., 2019) and, as described in the following section on cognitive functioning, they did so differently from one another. Therefore, conclusions about feasibility and intervention adaptation are limited at present. Similarly, only three studies (Wells et al., 2013; Larouche et al., 2019; Marciniak et al., 2020) reported on adherence to home meditation practice, although all study interventions included home practice as a component of the intervention. The data reported suggest that participants practiced regularly, but less than the amount recommended in the intervention. Specifically, participants in Marciniak et al. (2020) practiced an average of 5.1 days per week, rather than 6, and participants in Wells et al. (2013a) and Larouche et al. (2019) report practicing for an average of 26 and 20 minutes per day, respectively, rather than 30-45 minutes as recommended. Overall, this data is quite promising, suggesting the vast

majority of patients with MCI are able to complete the intervention successfully and practice meditation at home. In addition, the home practice data reported is roughly commensurate with a recent meta-analysis of home practice during MBSR and MBCT, which showed an average of 30 minutes of home practice with significant heterogeneity across studies (Parsons et al., 2017). Of note, although adherence rates across studies are good, most trials reported difficulty with the recruitment phase. The three trials that have published data on recruitment rates found that only 26% (Marciniak et al., 2020), 30% (Larouche et al., 2019), and 64% (Klainin-Yobas et al., 2019) of eligible patients with MCI agreed to participate, respectively. Unfortunately, the challenges of recruiting older adults into clinical trials are well documented (Knechel, 2013), and additional difficulties (aversion to medical settings, limited insight into or denial of illness, inability to drive themselves to the intervention site, difficulty remembering to follow-up) are more likely to apply to patients with MCI (Sanders et al., 2018). With this in mind, several authors note that recruitment difficulties in this population are likely to lead to some selection bias, such that enrolled participants may be more motivated for behavioral interventions, have increased social support to facilitate participation, or exhibit less functional impairment than the adults with MCI who do not choose to participate.

Only two out of nine studies thus far have reported on acceptability. First, Marciniak et al. (2020) reported the results of a post-intervention acceptability questionnaire designed for the study; participants in the mindfulness group (n=14) checked only positive or neutral responses about the attractiveness of the intervention, the length of the sessions, and the inclusion of home practice. Participants also provided feedback about the intervention. On average, they suggested one class per week, a 1.9

hour class length, and home practice of 25 minutes per day. Forgetting to practice, not having enough time, inability to concentrate, or believing meditation would not be helpful were the most frequently reported reasons for not completing home practice. Similarly, finding it hard to practice, finding time for practice, and practice not being helpful were the most frequently reported challenges. In contrast, participants reported that the most helpful parts of the intervention were meeting the instructor, the inclusion of poems in the intervention, learning mindfulness theory, and meeting every week. Also of note, simple practices like breathing and body scan were by far the most popular. Second, Wells et al. (2019) reported qualitative theme analyses from their initial pilot randomized controlled trial published in 2013. Following the intervention, qualitative interviews were conducted with 9 MCI patients in the MBSR group. Seven themes emerged following content analysis, with three directly relevant to acceptability: (1) positive perceptions of the class (e.g. sad class is over, enjoyed class), (2) developing mindfulness skills (e.g. improving attention, increased awareness of the environment), and (3) benefits from the group experience (e.g. feeling comradery, hearing about others' meditation practice). 8 out of 9 participants reported that they would recommend the program to others with MCI. Of note, one participant noted difficulty with the floor exercises included in MBSR's moving meditation module. This data is summarized in Table 2.

Table 2

Feasibility and Acceptability in Clinical Trials of MBIs for MCI

Clinical Trials	**N**	**Recruitment** (% of otherwise eligible participants enrolled	**Retention** (% enrolled immediately post-intervention)	**Adherence**	**Acceptability**
Wells et al.	14			26 min/day 88% attendance	Positive perceptions of class; enjoyment of group experience; perceived ability to develop mindfulness skills; difficulty with moving meditation
Mahendran et al.	55	64%	93%	88% attendance	
Larouche et al.	22		91%		
Wong et al.	14		93%†		
Larouche et al. (2)	45	30%	83%†	20 min/day	
Fam et al.	47		83%		
Marciniak et al.	28	26%	78%	5.1 days/week	Exclusively positive or neutral responses to feedback questionnaire; common barriers to practice reported; suggested 1.9 hr class with 25 min practice/day
Khine et al.	28		96%		

†In these studies, retention was reported as (1) the number of participants who completed at least 6/8 sessions and (2) the number of participants who completed at least 70% of the intervention.

Note: Adherence refers here to the average minutes of meditation practice reported per day, the average number of classes attended, and/or the average number of days per week participants reported practicing.

In summary, a small but growing number of MBI trials indicate that this intervention is feasible for patients with MCI; although recruitment proceeds more slowly in this population, retention and adherence appears very strong. Limited data on acceptability appears to show moderate to strong enjoyment of the intervention. Additional qualitative data, in particular, is needed to more fully address recommendations for program design, barriers to participation, and adaptations for MCI.

Cognitive Functioning

In the general population, a growing body of research indicates that mindfulness training is associated with improvements in attention, working memory, cognitive flexibility, meta-awareness, and some aspects of executive function (Chiesa et al., 2011; Jha et al., 2019; Vago et al., 2019). Improvements in cognitive functioning are thought to vary based on the type of mindfulness practice and phase of training, with single-pointed focus practices (often taught early on) associated with selective attention and executive function, and open monitoring practices (often taught later) associated with cognitive flexibility, meta-awareness, and unfocused sustained attention (Chiesa et al., 2011). Of note, MBI-related improvements in healthy adults' cognitive functioning may be *less* apparent when measured via neuropsychological testing, versus self-report. A recent review including only objective neuropsychological measures found that, contrary to theoretical expectations, there was little evidence of improvement in selective *or* sustained attention, although there was evidence for improvement in working and autobiographical memory (Lao et al., 2016). In contrast, studies investigating biological correlates of improved cognitive functioning following mindfulness training have shown

larger hippocampal volume and gray matter concentration (Luders et al., 2009), structural and functional changes in fronto-parietal networks associated with attention (Fox et al., 2016), and increased neurological efficiency in these regions during attention tasks (Kozasa et al., 2018). In general, theoretical accounts of mindfulness training (e.g. Lindsay & Creswell, 2017; Vago & Silbersweig, 2012) strongly suggest that meditation training should improve cognitive functioning, both directly by targeting selective and sustained attention and indirectly by liberating attentional resources normally directed at stress-related discursive thought. Subjective, neuropsychological, and biological support for this account is growing but may vary by measurement strategy, population (e.g. long-term meditators vs. MBSR participants), and type of MBI. Fortunately, there is now sufficient literature to discuss MBIs and cognitive functioning in older adults, specifically.

Changes in cognitive functioning are a normal part of the aging process (Aine et al., 2011; Linden & Collette, 2002). However, healthy older adults experience different degrees of age-related change in cognitive functioning (Aine et al., 2011). Several researchers have observed that long-term meditation practice may protect against expected age-related impairments in cognitive functioning (Prakash et al., 2012; Sperduti, Makowski, & Piolino, 2016; van Leeuwen, Müller, & Melloni, 2009). Long-term meditators are thought to have greater "cognitive reserve" (Wells et al., 2019), a term used to refer to cognitive capacities that neuroprotective activities, like meditation, help build prior to the development of early-stage dementia (Stern, 2012). Specifically, an individual with high cognitive reserve would theoretically have the neurological capacity to cope better (via pre-existing neurobiological and/or cognitive mechanisms) with the

same amount of pathology than an individual with low cognitive reserve (Stern, 2012). In theory, meditation may represent a cognitively stimulating activity capable of slowing the rate of neural degeneration in normal aging, and even delaying or preventing AD pathology (Wells et al., 2019). However, demographic and lifestyle differences may confound comparisons of self-selected long- and short-term meditators, and most adults are unlikely to commit to decades of meditation practice to prevent later cognitive decline. To accommodate this, there are now several randomized control trials of MBIs for cognitive functioning in otherwise healthy older adults. The results of these trials have been favorable, suggesting that short (8 to 12 weeks) MBIs may improve visuospatial attention (Malinowski et al., 2017) and executive function (Moynihan et al., 2013) in healthy older adults.

These results are consistent with theoretical accounts of brief mindfulness training for older adults: MBIs enhance attentional processes (Lutz et al., 2009) via changes in neurocircuitry (Farb et al., 2007; Hölzel et al., 2011; Tang et al., 2012; Tang et al., 2010) that are themselves associated with age-related cognitive decline (Andrews-Hanna et al., 2007). More simply, the effort involved in learning mindfulness meditation, particularly awareness practices like body scan or breath awareness, may engage cognitive processes that are already at risk in age-related cognitive decline. Furthermore, successfully engaging in meditation as a daily cognitive activity *and* attending weekly classes may promote self-efficacy for engaging in other activities that built cognitive reserve, such as social engagement and exercise (Wells et al., 2019).

Extending this rationale to clinically significant levels of cognitive impairment, there is prior research showing that patients with MCI retain neuroplasticity (Calero & Navarro, 2004). More specifically, patients with MCI are more likely to retain forms of implicit memory (e.g. repetition effects, procedural learning), relative to explicit memory (Fleischman, 2007; Fleischman et al., 2005). Therefore, some have argued that daily meditation practice may specifically increase cognitive reserve, even *after* a diagnosis of MCI, by leveraging intact capacities for procedural learning (Malinowski & Shalamanova, 2017). It follows that MBIs may improve or maintain cognitive functioning in older adults experiencing a clinically significant degree of cognitive impairment. The following paragraphs review the 8 unique clinical trials and 14 published papers that have addressed this research question to date. This data is also summarized in Table 3.

Table 3

Cognitive Functioning in Clinical Trials of MBIs for MCI

Clinical Trial	Published Analyses	Immediate Memory	Visuospatial Skill	Language	Attention	Delayed Memory	General
Wells et al.	2013a		Trail Making	RAVLT			ADAS-cog
Mahendran et al.	2016	Recognition	Block Design			Delayed Recall	
	2019						MMSE & CDR
	2021	Immediate recall	Block Design	Semantic Fluency	Color Trails	Delayed Recall	
Larouche et al.	2016	Verbal free recall					
Wong et al.	2017						MoCA
Larouche et al. (2)	2019	Free recall word list				Delayed Recall	
Fam et al.	2020	RAVLT Recognition	Block Design			RAVLT Delayed Recall	MMSE
Marciniak et al.	2020	Cogstate One Back	Cogstate One Card		Cogstate Identification	PVLT	
Khine et al.	2020	Recognition	Block Design	Semantic Fluency	Color Trails	Delayed Recall	

Note: Green indicates statistically significant results in the expected direction following either repeated measures analyses or in comparison to a control group, if available. Yellow indicates equivalence to an active control group, in the expected direction. Red indicates lack of improvement (there have been no reports of deterioration). Long-term follow-up data are not included. DS = Digit Span; RAVLT = Rey Auditory Verbal Learning Test; PVLT = Philadelphia Verbal Learning Test; ADAS = Alzheimer's Disease Assessment Scale; MMSE = Mini Mental Status Exam; CDR = Clinical Dementia Rating Scale; MoCA = Montreal Cognitive Assessment

In 2013, Wells, Kerr et al. recruited 14 adults aged 55 to 90 with a diagnosis of MCI given by a neurologist via clinical history and neuropsychological examination (Wells, Kerr, et al., 2013). Participants were then randomized 2:1 to standard MBSR or waitlist control and cognitive functioning was measured before and after using seven assessments administered by a blinded neuropsychologist. In addition, the researchers measured two neurological markers of dementia-related cognitive decline: functional connectivity of the default mode network (DMN) and hippocampal atrophy (Wells, Yeh, et al., 2013). Data did not suggest differences between the groups on neuropsychological measures, although the study was likely not sufficiently powered to detect even a large effect on cognitive functioning. However, the MBSR group did show increased functional connectivity between the posterior cingulate cortex (PCC) and bilateral medial prefrontal cortex (mPFC) and between the PCC and left hippocampus (areas implicated in the DMN), as well as a trend toward less hippocampal atrophy, as compared to the control group. Given that functional connectivity in the DMN in specifically affected in Alzheimer's Disease (AD) and hippocampal atrophy is a marker of disease progression, these results suggested future study of MBIs as a neuroprotective intervention for MCI was warranted. Several small pilot trials followed. Larouche et al. (2016) randomized 22 older adults with MCI to either an 8-week MBI or waitlist control and found less memory deterioration in the MBI group, as measured by a verbal free-recall memory test. A slightly larger RCT (n=54) by Ng et al. (2016) was published concurrently as a conference proceeding, wherein participants were randomized to either 3-month Mindful Awareness Practice (MAP) or an active control program (Health Education Program). Booster sessions were also held monthly for 6 months following the interventions,

making this the first trial to include a long-term follow-up point. Although paired t-tests showed that the intervention group improved in delayed recall, recognition, and visuospatial skills, only improvements in recognition were significant when compared to the control group and no significant differences were observed at nine-month follow-up. Interestingly, it appears that the same data were later published by Yu et al. (2021) and analyzed via MANOVA. In this case, only digit span forward and the Color Trails Task (measures of working memory and attention not analyzed in the 2016 publication) showed significant group by time effects, and *only* at 9-month follow-up. There was still an effect of time on delayed recall, immediate recall (not reported initially), and visuospatial skills, such that both the MAP and HEP groups had improved at nine months. Still more cognitive data was published from this sample in 2019 (Klainin-Yobas et al., 2019) showing that general measures of cognitive functioning (MMSE and Clinical Dementia Rating (CDR) remained stable over both 3-month interventions without differences between the groups.

Of note, all trials through 2016 had used a standard MBI, rather than modifying the intervention for MCI specifically. In 2017, Wong et al. published the first trial in which the MBI was customized for participants with MCI (n=14). The 8-week program had a shorted class time (1.5 hours vs. 2.5 hours in MBSR), no full day retreat, additional time spent on informal mindfulness practices (e.g. walking, eating, reading) relevant to activities of daily living, and increased class discussion on mental flexibility and problem solving. Repeated measures analyses showed significant improvement in cognitive functioning (Montreal Cognitive Assessment (MoCA)) following the class, but not at 1-year follow-up. However, self-reported meditation practice after the program ended was

positively correlated with cognitive functioning at follow-up, suggesting that continued meditation practice may be required to sustain intervention effects (Wong et al., 2017).

The present study was proposed and funded in 2018, in response to the literature reviewed above. Since that time, several studies relevant to MBIs for cognitive functioning in MCI have been published. First, Larouche et al. (2019) randomized 48 older adults with aMCI to either an adapted 8-week MBI or a psychoeducation-based intervention for healthy aging. As in Wong et al. (2017), the class time was shortened and there was no full-day retreat. In addition, the researchers describe minor adaptions for MCI such as more concrete language, continuous verbal guidance throughout meditation practice, supportive weekly phone calls, and meditation practice in the first half of class when concentration is better. They did not observe any group by time effects for either immediate or delayed recall, which were the only two cognitive domains measured. Building on these findings, a smaller study (n=28) by Marciniak et al. (2020) compared standard 8-week MBSR to a cognitive training program of the same length. Although the study was likely underpowered and the interventions were shorter by one month, both showed improvements in psychomotor speed at medium-to-large effect size ($d > .5$), with the MBSR group showing significantly greater improvement than cognitive training immediately post-intervention, but not at 6-month follow-up. However, five other domains of cognitive functioning were also tested and showed only small, variable improvements across time and no group by time effects. Similarly, Fam et al. (2020) randomized 47 older adults with MCI to an unstandardized, lightly adapted mindful awareness program or a health education program. Recognition improved in the mindfulness group but not in the psychoeducation group, but there were no group by time

effects for the three other cognitive assessments administered. Khine et al. (2020) published similar findings following a repeated measures trial of MAP with 28 MCI patients. Again, recognition improved significantly, but the five other cognitive domains tested did not. Because MCI is a progressive illness, one possible interpretation for these finding is that both active control and mindfulness-based interventions effectively prevent deterioration in cognitive functioning, although RCTs using a TAU control condition would be needed to address this hypothesis directly. Lastly, these same studies have not only addressed cognitive functioning from a neuropsychological perspective, but a biological one as well.

In general, research on biological correlates of cognitive impairment following MBIs has continued with mixed results. In two papers using the dataset from Ng et al. (2016), researchers compared the effect of Mindful Awareness Program (MAP) with a Health Education Program (HEP) for MCI on salivary amyloid beta-42 (Aβ-42; Ng, Stowey, et al., 2020a) and biomarkers of systemic inflammation (n=55) (Ng, Fam, et al., 2020). Neither intervention improved salivary Aβ-42, nor was there any moderating effect of disease severity or type of MCI. In the second paper (Ng, Fam, et al., 2020), the authors found significantly lower plasma high-sensitivity c-reactive protein (hs-CRP) in the MAP group at the 9-month follow-up point, but no group by time effects for the five other inflammatory biomarkers tested (IL-1β, IL-6, plasma BDNF, salivary cortisol, DHEA-S), at any time point. Exploratory analyses also showed that the group by time effect for hs-CRP was specific to females and aMCI. The authors describe pathophysiological mechanisms linking both Aβ-42 and hs-CRP to cognitive decline in MCI and suggest

MBIs may protect against cognitive decline by ameliorating some, but not all, biomarker perturbations implicated in disease progression.

Neurological findings have been slightly more promising. Fam et al. (2020) were the first to measure the effects of an MBI on dynamic functional neural connectivity, using fMRI. They found that global and regional (medial temporal lobe) efficiency, fMRI measures of information transmission in neural networks which degrade with advancing dementia, were preserved in the MBI group versus the psychoeducation control group. Similarly, Yu et al. (2020), again using the dataset from Ng et al. (2016), found an effect of MAP training on cortical thickness that, while apparent post-intervention at large effect size, did not persist to the 9-month follow-up.

Interestingly, 5 out of 8 clinical trials used samples of MCI patients diagnosed using Petersen/Winblad criteria, and the remaining 3 did not specify. Although any interpretation of the impact of this on results must be speculative, it is possible that a subset of the participants included thus far would be categorized as false positives under a Jak/Bondi approach. Reversion of a subset of the sample to normal levels of cognitive functioning could explain the lack of cognitive deterioration across the intervention timeline in all studies or may contribute to the variability in cognitive outcomes seen across studies.

To summarize, recent literature suggests that improvements in some, but not all, domains of cognitive functioning can be expected following mindfulness training, and there have been no reports of deterioration across the intervention timeline (see Table 3). In addition, preliminary bio- and neurobiological findings support the hypothesis that

neural plasticity is maintained in MCI, and that relevant networks may be responsive to mindfulness training. However, effects may not be specific to MBIs; health education control programs, which also involve in-person socialization, socio-emotional learning, and facilitator attention, may also improve or maintain cognitive functioning in MCI. Furthermore, studies have assessed similar domains of cognitive functioning (recognition memory, long term memory, executive function, visuospatial skills), but there has been wide variation in the neuropsychological measures used (MMSE, WAIS, MoCA, CDR) and no studies using comprehensive neuropsychological assessment to recruit the study sample. Similarly, a variety of MBIs have been tested, some of which have been specifically adapted for MCI and others which have been delivered in the standard format. The effect of specific practices, adaptations, or practice effects on cognitive functioning has not been specifically addressed. Lastly, it is likely that the relationship between cognitive functioning and psychological distress is bidirectional, with both factors directly and indirectly influenced by mindfulness training. The following section will review the rationale for these relationships and research addressing psychological distress in MCI to date.

Psychological Distress

MBIs have been widely studied as interventions for reducing distress and increasing well-being in both healthy and clinical populations. Indeed, there is now sufficient literature to briefly review MBIs for psychological distress in older adults, before moving to a discussion of MCI. A 2020 meta-analysis of nineteen RCTs of MBIs for depression in older adults concluded that mindfulness training reliably improves

depressive symptoms in older adults, at medium effect size (Reangsing et al., 2020). Similarly, a review of 7 RCTs using MBSR or MBCT to treat geriatric anxiety suggested similar improvements in anxiety following MBCT, even in the absence of depression (Hazlett-Stevens et al., 2019). Although geriatric depression and anxiety appear to be the most studied outcomes of mindfulness training to date, other studies have shown improved stress, loneliness, sleep quality, and posttraumatic coping in older adults following mindfulness training (for review see Felsted, 2020).

As discussed, clinically significant psychological distress is highly comorbid with MCI, and may play a role in disease progression. For example, high levels of chronic stress have been shown to negatively impact the hippocampus, perhaps via excess levels of cortisol. Hippocampal atrophy is, in turn, associated with more severe cognitive impairment and is a key neurobiological marker of AD (Barnes et al., 2009). Stress-reducing interventions, mindfulness included, may interrupt the progression of MCI by decreasing chronic stress and thereby preserving neural functioning. Indeed, previous studies have demonstrated selective hippocampal activation during meditation (Luders et al., 2009), as well as increased gray matter density in the hippocampus following MBSR (Hölzel et al., 2011). Similarly, mindfulness training is thought to decrease stress and improve psychological well-being by reducing overall hypothalamic-pituitary-adrenal axes hyperactivity and systemic inflammation (Ng, Fam, et al., 2020; Wetherell et al., 2020). These changes in stress-related physiology may correlate with the degree to which participants reduce their psychological distress, which could incur beneficial downstream effects on brain health in turn (Ashton et al., 2017; Wetherell et al., 2020). Furthermore, by reducing psychological distress and improving emotional well-being, mindfulness

training may also facilitate other behaviors which maintain cognitive reserve, including social engagement, health behaviors, and self-efficacy for engaging in other kinds of cognitive training (Stern, 2012; Wells et al., 2019). Lastly, due to its emphasis on acceptance and focus on the present-moment, mindfulness training may improve patients' ability to cope with MCI and the risk of progression to dementia, thereby improving quality of life and reducing distress, regardless of the effect of meditation on disease progression (Shim et al., 2020).

There is now a small body of literature investigating the effect of mindfulness training on psychological distress in MCI. Again, this body of research is growing quickly, with a total of 6 analyses published at present on five datasets, three of which were published after this project was funded in 2018. Data from these studies is summarized below and in Table 4.

Table 4

Psychological Distress and Mindfulness in Clinical Trials of MBIs for MCI

Clinical Trials	Published Analyses	Depression	Anxiety	Mindfulness
Wells et al.	2013a	CESDS		MAAS
	2019	Improved (qualitative)	Improved (qualitative)	Moderate understanding (qualitative)
Mahendran et al.	Klainin-Yobas et al. (2019)	GDS (health education superior)	GAI (health education superior)	
Larouche et al.	2016	GDS		
Wong et al.	2017	DASS	DASS	FMI
Larouche et al. (2)	2019	GDS	GAI	FFMQ
Fam et al.	2020			
Marciniak et al.	2020	GDS	BAI	
Khine et al.	2020			

Note: Green indicates statistically significant results in the expected direction following either repeated measures analyses or in comparison to a control group, if available. Yellow indicates equivalence to an active control group, in the expected direction. Red indicates lack of improvement and/or superior results in the control group. Long-term follow-up data are not included. CESDS = Center of Epidemiological Studies Depression Scale; GDS = Geriatric Depression Scale; DASS = Depression Anxiety and Stress Scale; GAI = Geriatric Anxiety Inventory; BAI = Beck Anxiety Inventory; MAAS = Mindful Attention Awareness Scale; FMI = Freiberg Mindfulness Inventory; FFMQ = Five Facet Mindfulness Questionnaire.

In one of the first trials of an MBI for MCI, Wells et al. (2013) found no group differences between MBSR and a waitlist control group on measures of resilience, stress, quality of life (QoL), hope, depression, or mindfulness. However, the study was underpowered (n=14) and the researchers also found increased functional connectivity in some areas of the DMN and a trend toward reduced hippocampal atrophy in the MBSR group (discussed in previous section). The authors note that some components of these changes are thought to be stress-related and suggest that meditation practice may buffer stress-related neurological disease processes in MCI, even though self-reported stress remained unchanged. In a later publication (Wells et al., 2019), the authors conducted a qualitative analysis of semi-structured post-intervention interviews from the same dataset (n=9). Seven themes emerged, six of which suggest reduced psychological distress post-intervention: (1) developing mindfulness skills (e.g. improving attention, increased awareness of the environment), (2) benefits from the group experience (e.g. feeling comradery, hearing about others' meditation practice), (3) enhanced well-being (e.g. improved mood, increased motivation), (4) shift in perspective about MCI (e.g. increased acceptance of MCI), (5) decreased stress reactivity and increased relaxation (e.g. decreased rumination, use of relaxation practices in daily life), and (6) improvement in interpersonal skills (e.g. kinder with others, appreciation of social connections). Interestingly, the interviewers also rated participants' perceived understanding of the intervention and their perceived benefit from the intervention. Both ratings were significantly correlated with the amount of home practice reported, with those who reported more home practice exhibiting greater understanding and benefit. However, the improvements in mood and psychological well-being participants reported during the

qualitative interviews were not reflected in the self-report measures of stress, hope, or depression published in Wells et al. (2013). This may be because the study was underpowered, or it may reflect differences in assessment modality, such that MCI patients may find it easier to report on their well-being during a conversation than via a written questionnaire.

Other small pilot trials have found stronger quantitative effects on psychological distress. For example, Larouche et al. (2016) found a greater decrease in depressive symptoms and a greater increase in quality of life in MCI patients who completed an 8-week MBI, compared to a waitlist control (n=22). In a pretest posttest repeated measures trial (n=14), Wong et al. (2017) found increased self-reported mindfulness following an 8-week MBI adapted for MCI, but depression, anxiety, stress, and activities of daily living did not improve. Similarly, Larouche et al. (2019) found improvement in depression, anxiety, and quality of life following *both* an adapted MBI and a psychoeducation-based intervention for healthy aging (n=48), but the degree of improvement was not different between the groups. In fact, another RCT (n=55) has found *superior* improvements in depression and anxiety in a 3-month psychoeducation-based control group (Health Education Control) versus a standardized MBI (Mindful Awareness Program) (Klainin-Yobas et al., 2019). This equivalence may be specific to psychoeducation-based control groups; Marciniak et al. (2020) tested MBSR against a cognitive training control group and found decreased depressive symptoms in the MBSR group, but not in the cognitive training group, and the effect of MBSR on depression persisted to 6-month follow-up.

It is worth noting that a combination of informant report, clinician assessment, and patient self-report is typically used to assess psychological distress in MCI patients (Ismail et al., 2017). However, the above trials relied on self-report measures almost exclusively, the completion of which requires some degree of metacognition and insight that may be difficult for patients with MCI to access, depending on disease severity. This difficulty in obtaining a valid self-report of psychological distress may explain some of the heterogeneity seen in trials thus far. Similarly, due the use of diagnostic Petersen/Winblad approach in the majority (if not all) of the trials presented here, it is likely that a subset of patients would not meet Jak/Bondi criteria for prodromal dementia and may have met Peterson/Winblad criteria due to elevated psychopathology at diagnosis (e.g. "worried well"; Saxton et al., 2009). It is difficult to speculate about how this may impact participants' response to mindfulness training, but it is possible that rates or severity of depressive symptoms were higher at baseline in these samples overall, elevated by increased depressive symptoms found in *Cluster-Derived Normal*/false positive subgroups (Bondi et al., 2014). There is also some indication that common factors, such as a group-based intervention, facilitator attention, and skills training, may drive improvements psychological distress over and above the specific content of the group (e.g. mindfulness vs. health education). Similarly, although some studies have addressed neurological correlates of reduced psychological distress in MCI, no studies have assessed vascular risk factors as a potential correlate of lower stress following mindfulness training. Indeed, high vascular risk is a risk factor for disease progression in MCI, and there is some research suggesting MBIs can lower blood pressure in patients with hypertension (Conversano et al., 2021). Therefore, vascular risk factors may be a

particularly relevant objective measure of treatment response in MCI and may also provide a biological correlate of reduced stress that is not dependent on self-report. Furthermore, few studies collected self-report measures of perceived health that may be particularly relevant to older adults, such as pain interference, sleep quality, and social interaction. Lastly, only three studies (Larouche et al., 2019; Wells, Kerr, et al., 2013; Wong et al., 2017) assessed self-reported mindfulness. Increases in trait mindfulness are hypothesized to partly drive improvements in psychological well-being following mindfulness training (Larouche et al., 2019) and one recent cross-sectional study suggests that high trait mindfulness is associated with better cognitive functioning in MCI (Innis et al., 2021). Therefore, future studies may benefit from assessing self-reported mindfulness as a potential mechanism of treatment response following mindfulness training.

Summary

Interest in mindfulness training as a component of integrated care for MCI is growing. MBIs appear to be both feasible and acceptable in this population, but more qualitative feedback is needed, and it is difficult to generalize across the variety of MBIs studied thus far. In addition, MBIs may help maintain or improve some aspects of cognitive functioning in MCI, although variability in cognitive assessment and heterogenous effects across studies make it difficult to discern which domains of cognitive functioning are most likely to be impacted by mindfulness training. At present, immediate memory and/or working memory, as measured via recognition and immediate recall tasks, appears to be the most likely to improve following mindfulness training. Lastly, psychological distress may improve following mindfulness training, with direct

implications for quality of life and indirect implications for disease progression. However, several controlled studies have found similar benefits following psychoeducation-based programs, meaning results may be expected following participation in any socially, emotionally, and cognitively stimulating group intervention. Furthermore, some studies reported no improvements in psychological distress following mindfulness training despite strong adherence to the intervention. This may reflect difficulty completing self-report measures which rely on metacognition, and points to the need for both further qualitative research on psychological outcomes and objective measures of chronic stress.

Of note, several review and theory papers have been published on this topic in the last 5 years, many of which have been cited throughout the previous sections (Berk et al., 2018; Klimecki et al., 2019; Russell-Williams et al., 2018; Shim et al., 2020; Wayne et al., 2018). However, all reviews published to date have addressed the entire dementia continuum, from cognitive concerns related to healthy aging to clinical dementia. Due to the growing amount of research specifically addressing MCI, studies investigating mindfulness training for healthy older adults and older adults with full dementia are not reviewed in detail here. Interested readers are directed to the above reviews, noting that there is now a relatively large body of research supporting MBIs as a preventative measure for healthy older adults, and as a stress-management intervention for patients with dementia.

Lastly, readers may have noticed that caregivers for patients with MCI have not yet been addressed in detail. In fact, although some studies have investigated MBIs as a

stand-alone intervention for caregiver burden, none of the MCI trials reviewed above have included caregivers in the intervention. The impact of MCI on caregivers and the rationale for extending mindfulness training to these individuals will be reviewed in the following section.

MBIs for Patients and Caregivers

As MCI progresses, caregivers play increasingly important roles facilitating activities of daily living, managing care coordination, and providing emotional support for patients. The impact of caregiving, called caregiver burden, has been widely studied across chronic and/or terminal illnesses. In general, caregiver burden impacts caregiver's emotional, social, financial, and physical functioning (Hudson et al., 2020). This creates increased risk of adverse health outcomes including, but not limited to, social isolation and anxiety (Anderson et al., 1995), depression (Denno et al., 2013), mortality (Schulz & Beach, 1999), decreased quality of life (McCullagh et al., 2005), and cardiovascular disease (Haley et al., 2010). Furthermore, a significant minority (36%) of caregivers are themselves older adults experiencing poor health, resulting in increased adverse health outcomes for those who are most vulnerable, as well as increased burden over time as chronic conditions progress in both caregiver and recipient (Navaie et al., 2002). Lastly, caregiver burden also negatively impacts patients; high caregiver burden is longitudinally associated with more frequent hospitalizations and earlier mortality in care recipients (Kuzuya et al., 2011; Mohamed et al., 2010).

In the case of MCI and dementia, caregivers are not only at risk for the adverse outcomes described above, but may also be at increased risk of cognitive impairment

themselves, likely due to the increase in psychosocial risk factors for cognitive impairment (e.g. depression, limited social contact, reduced physical activity, stress-induced inflammation) already associated with caregiver burden (Vitaliano et al., 2011). In addition, caregivers for patients with MCI or dementia are also coping with ambiguous loss; their loved one may grow increasingly less able to converse with and support them, despite remaining physically present (Shim et al., 2020). There is, therefore, a clear need for interventions which reliably reduce caregiver stress and burden in this population.

Several such interventions have been studied in older adult caregivers, including psychoeducation, skill building, and cognitive behavioral therapy (CBT) (for review see Gallagher-Thompson & Coon, 2007; Olazaran et al., 2010). As in research on nonpharmacological interventions for MCI itself, there has been increasing interest in mindfulness-based interventions (MBIs) to reduce burden in caregivers of patients with MCI or dementia. In fact, some researchers have theorized that MBIs may be a superior approach to caregiver burden in this population due to the increased risk for cognitive impairment in caregivers. In contrast to traditional talk therapy or CBT, MBIs build simple skills (e.g., present-moment awareness and non-judgment) through multisensory exercises that do not require verbal communication with the care recipient and accommodate possible deficits in explicit learning (Shim et al., 2020). In addition, there is recent evidence showing that high trait mindfulness, caregiver's self-reported level of mindfulness before meditation training, is associated with lower caregiver depression, more positive appraisals of caregiving, better preparedness for caregiving, and higher care confidence (Innis et al., 2020).

At the time of this writing, there have been no intervention studies examining an MBI for caregivers of patients with MCI, specifically. However, several trials looking at MBIs for caregivers of patients with dementia or patients across the dementia spectrum (subjective cognitive impairment through full dementia) have been published. For patients with dementia, MBIs have produced some of the largest treatment effects on caregiver's perceived stress among behavioral interventions studied to date, with effect sizes in the small to medium range (for review see Shim et al, 2020 and Berk et al., 2018). Interestingly, it has also been suggested that MBIs may be particularly effective at helping caregivers attune to the needs of patients with dementia, which patients are often unable to communicate verbally (Pierotti & Remer, 2017). In contrast, improvements in caregiver anxiety and depression may be less reliable, with only 3 out of 7 studies reporting a significant improvement (relative to a control group) in either depression or anxiety in caregivers of patients with dementia (Shim et al., 2020). Similarly, only 1 out of 3 studies assessing caregiver burden pre- and post-MBI reported improvements, again in caregivers of patients with dementia (Shim et al., 2020). In the study that did report an improvement in caregiver burden following MBSR (Brown et al., 2016), group differences did not persist to the 6-month follow-up. Lastly, none of the nine studies published thus far found improvements in mindfulness, fatigue, sleep, or social support (Shim et al., 2020). Because the trials published to date have not distinguished between care recipients with MCI vs. full dementia *or* have just included care recipients with full dementia, it is difficult to know whether MBIs are insufficient for improving caregiver well-being in MCI or whether the increased severity of dementia renders MBIs less effective for caregivers.

One possible adaptation of mindfulness training for patients with MCI and their caregivers is to include both in the same intervention. Thus far, only one study has investigated an MBI with a mixed group of patients with age-related cognitive decline and their caregivers (Paller et al., 2014). The authors suggest that providing a simultaneous intervention for both patients and caregivers may address feasibility concerns common in this population. For example, caregivers may be able to improve adherence by supporting home practice and accompanying patients to and from sessions. In addition, participating together may constitute a mutually enjoyable opportunity for social interaction, thereby reducing distress in both parties. The final sample was comprised of 37 participants, 8 of whom were participating individually and 29 who were part of a patient-caregiver pair or triad (2 caregivers attending with the same patient). The majority of patients (10 out of 17) had a diagnosis of AD or another full dementia, and only 2 patients had a physician-confirmed diagnosis of MCI. All participants completed a lightly adapted 8-week MBI (slow instruction, limited physical exertion, no retreat, psychoeducation about health behaviors, shorter meditations), loosely based on MBSR. No feasibility flowchart was provided, but the authors report that 6 participants dropped out before completing the final procedure, suggesting 84% adherence. Acceptability was good; the vast majority (80-90%) of participants felt they benefited from the program, intended to continue practicing mindfulness, and would recommend the program to others, although this data was not reported for caregivers vs. patients. Using pretest posttest repeated measures analyses, the study found statistically significant improvements in patient's self-reported quality of life and geriatric depression, but no improvements in sleep quality or anxiety. There was a small improvement in executive

function (Trail-Making Test B), but none of the 7 other neuropsychological measures of cognitive functioning improved. Caregiver's quality of life and anxiety also improved, but sleep, activities of daily living, physical health, emotional health, and social health were unchanged. However, caregivers did report improvements in both caregiver-related physical issues and caregiver-related emotional issues, and 50% of the entire sample reported improvement in their relationships. The authors conclude that the simultaneous MBI was feasible and acceptable in both patients are caregivers, and suggest further research is needed with a less heterogenous sample. This brings us to the present study, which will attempt to not only further our understanding of MBIs for MCI, but also explore whether delivering the intervention simultaneously to patients and caregivers is feasible, acceptable, and effective in this population.

Mindfulness and Healthy Aging (MaHA)

Mindfulness-based interventions for mild cognitive impairment are a promising class of behavioral interventions which may improve quality of life and slow disease progression in MCI. Interest in MBIs for MCI has grown rapidly over the past 5 years and suggests that mindfulness training (1) is feasible and acceptable in this population, (2) may improve or maintain some aspects of cognitive functioning, and (3) may reduce patients' psychological distress. In addition, MBIs may also improve burden and distress in caregivers, which may further reduce patient distress in turn. However, detailed quantitative and qualitative data on acceptability are lacking, more long-term follow-up data are needed, and it is not clear whether delivering this intervention simultaneously to both patients and caregivers is feasible or acceptable with this population.

This multimethod pilot study attempts to add to the growing literature on MBIs for MCI by constructing a lightly adapted, 6-week, group-based mindfulness intervention treatment paradigm with a 3-month follow-up. Although this pilot study was not funded to include a control group, study design was optimized to replicate previous studies as closely as possible. Specifically, we limited patient inclusion criteria to individuals with a confirmed diagnosis of MCI, assessed cognitive functioning using a repeatable neuropsychological test battery, and trialed an MBI lightly adapted from MBSR. To build on previous research, both patients with MCI and their caregivers were included, and both quantitative and written qualitative data were collected on home practice adherence, acceptability, and effectiveness for psychological distress. In addition, resting heart rate, blood pressure, and BMI were collected pre- and post-intervention to provide objective biological measures of vascular risk. Lastly, self-report measures of health concerns relevant to older adults and self-report measures of mindfulness were collected to better assess overall well-being and treatment response. In so doing, we hope to contribute to the evolving literature addressing mindfulness-based interventions for patients with MCI and their caregivers.

The current study has three main hypotheses:

(1) Feasibility. We hypothesized that a group-based mindfulness training program tailored to meet the needs of MCI patients and their caregivers will be feasible, as measured by rates of recruitment, enrollment, class attendance, attrition, and home practice adherence.

(2) Acceptability. Second, we hypothesized that the mindfulness program for healthy aging will be acceptable, as measured by both quantitative and qualitative feedback.

Acceptability is defined here as the extent to which participants perceive the intervention to be appropriate for their concern, helpful, and enjoyable (Sekhon, Cartwright, & Francis, 2017).

(3) Effectiveness. Third, we hypothesized that the mindfulness program would positively impact cognitive functioning (MCI patients only), psychological distress, caregiver burden (caregivers only), perceived health status, mindfulness, and vascular risk, and that these changes would be maintained at 3-month follow-up. For vascular risk specifically, we hypothesized that mindfulness training would lower (1) resting heart rate, (2) blood pressure, and (3) BMI in participants who show a pre-intervention resting heart rate ≥100 bpm, elevated or high blood pressure (SBP≥120, DBP≥80), and/or a BMI ≥ 25.0 (overweight).

Chapter 2

Methods

Study Design

The primary purpose of this non-randomized, pre/post pilot study (n=28) was to evaluate the feasibility, acceptability, and initial clinical effectiveness of an adapted 6-week, group-based mindfulness training program for older adults with MCI and their caregivers at a local integrated primary care site for older adults: The New Jersey Institute for Successful Aging (NJISA). Our study proposed three Specific Aims: (1) Feasibility. Examine whether the proposed training program is feasible in this population via rates of recruitment, enrollment, class attendance, attrition, and home practice adherence. (2) Acceptability. Examine whether the proposed training program is acceptable in this population using self-report quantitative and qualitative feedback. (3) Effectiveness. Examine the impact of the proposed training program on cognitive functioning, psychological distress, caregiver burden, perceived health status, mindfulness, and vascular risk (heart rate, blood pressure, BMI) both immediately post-intervention and at 3-month follow-up.

We aimed to recruit 28 participants aged 55 or older (14 patients diagnosed with MCI, 14 caregivers 18+ years of age) within a five-month period (June 2019 through Oct 2019). We anticipated that recruitment would proceed in such a way that two courses of 14 participants each would be started within this time. As expected, two cohorts of participants were scheduled to complete the program in September 2019 and November 2019, respectively.

Patient-caregiver dyads completed a pre-intervention assessment visit, 6 weekly mindfulness classes, one post-intervention assessment visit, and 3 monthly booster sessions. Potentially eligible participants completed a phone-screening interview to confirm eligibility, register for the mindfulness class, and schedule their pre- and post-intervention assessments. The pre-intervention assessment was scheduled either 1 or 2 weeks before the class start date and consisted of (1) neuropsychological testing (MCI patients only) (2) self-report measures of psychological distress, caregiver burden (caregivers only), perceived health status, and mindfulness, (3) physical health assessment (resting heart rate, blood pressure, BMI) and (4) a demographics questionnaire. Participants also completed the study informed consent form at the outset of this visit. The pre-intervention assessment took approximately 45 minutes and occurred at the NJISA.

Next, participants completed a 6-wk, group-based mindfulness training program, tailored to address common issues/challenges faced by persons with MCI and their partners and held at the NJISA. The program included 6-weekly, 1.5 hour in-person class meetings, with daily mindfulness practice at home each week. During the course participants received take-home materials, including CDs of recorded mindfulness exercises, reading assignments, handouts to reinforce core mindfulness concepts, and meditation logs. Participants were asked to submit their completed mindfulness logs to the study coordinator each week and were also asked to complete a measure of mindfulness skill use in everyday life at weeks 2, 4, and 6. At the end of the last class we collected written qualitative feedback and asked participants to complete the Client Satisfaction Questionnaire (CSQ-8) to assess acceptability.

Following the intervention, participants completed a post-intervention assessment which mirrored the pre-intervention assessment, scheduled within 1 or 2 weeks of the final class. Finally, the study team offered 3 monthly "booster" sessions to encourage ongoing practice and integration of mindfulness skills into daily life. Booster sessions took place in the same location and lasted for 1.5 hours. At each booster session participants completed measures of psychological distress, perceived health status, and mindfulness. At the third booster session participants also completed a final physical assessment.

Participants

This pilot study was a first step toward implementing mindfulness-based programming for individuals with MCI at NJISA. The main goal was to assess feasibility and acceptability to support future programming and grant applications. For feasibility purposes, this initial investigation aimed to recruit 28 participants. Very few prior studies have examined the feasibility and acceptability of mindfulness-based interventions for older adults with MCI, and no prior studies have examined these interventions with patient-caregiver dyads. As such, there were few data upon which to base a formal power analysis and sample size determination. Although it therefore remains possible that this study is underpowered, these pilot data are critically important in establishing effect sizes that can be used to support future program implementation and research grant applications. Furthermore, using a repeated-measures, within-subjects design with n=28 consented participants allowed us to use robust, repeated measures analyses to measure changes in cognitive functioning, psychological distress, perceived health status, and vascular risk, thereby providing greater statistical power.

This study utilized a sample of NJISA patients and their caregivers who were able to attend and participate in physical and cognitive assessments and mindfulness-based group programming for 20-weeks (6 weekly mindfulness classes, followed by 3 monthly 'booster' sessions). All NJISA patients and their caregivers who were able to attend study sessions and who met the inclusion criteria below were eligible to participate.

Recruitment was achieved entirely via referrals from four NJISA neuropsychologists and physicians. Care providers were briefed on the study procedures and instructed to identify MCI-caregiver dyads who met inclusion/exclusion criteria and who may be interested in participating. Recruitment was accomplished in the context of already existing in-person visits with study-affiliated physicians. Physicians also asked potential participants to complete a standardized screening form, which was then given to study staff. Upon receipt, study staff contacted potentially eligible participants to complete the phone screening interview. Additionally, referring providers identified potential participants who did not have pre-scheduled visits during the recruitment period, but who had previously expressed interest in participating. The study coordinator then contacted these individuals via phone and/or email. Physicians aimed to approach at least 50 dyads for recruitment, to allow for screen failures and/or dropouts. All MCI participants were referred via NJISA, and therefore their diagnosis was based on previously established clinical criteria for MCI, with an emphasis on comprehensive neuropsychological assessment in accordance with Jak/Bondi criteria: (1) impaired performance (≥1 SD below age- and education-matched controls) on at least two out of three tests in a single cognitive domain or (2) one score ≥1 SD below age-corrected normative means in three different cognitive domains, and (3) not sufficiently impaired,

cognitively or functionally, to meet diagnostic criteria for clinical dementia. Caregiver participants were adults of all demographic backgrounds over 18 years of age and not diagnosed with MCI. Participants had to be able to travel to NJISA for 11 scheduled visits and had to be available on the scheduled class and booster session dates. These eligibility criteria were assessed via phone screening interview in advance of the pre-intervention visit and were assessed again on the pre-intervention visit day. Individuals who had a diagnosis of severe and persistent mental illness (i.e., schizophrenia-spectrum, bipolar disorder) or who were deemed by the study neuropsychologist to be unlikely to benefit from a mindfulness-based group intervention were ineligible for participation. In addition, MCI patients for whom participation in the intervention was not feasible due to more advanced cognitive or functional impairment were ineligible for participation at the discretion of the study neuropsychologist. Those who did not agree or were unable to provide informed consent to participate in this study were also ineligible.

Intervention

All study participants participated in a 6-week mindfulness-based intervention followed by 3 monthly "booster sessions". This program was called Mindfulness and Healthy Aging, or MaHA for short. MaHA drew significantly from the Mindfulness-Based Stress Reduction (MBSR) curriculum, which the study PI (Jeffrey Greeson, Ph.D). is professionally trained to teach. However, it was adapted into a shorter program tailored to address common issues/challenges faced by persons with MCI and their caregivers. Class time was reduced from 2.5 hours in standard MBSR to 1.5 hours, to minimize participant burden, and course duration was shortened from 8 weekly in-person meetings and one day-long retreat to 6 weekly in-person meetings without a retreat. Participants

were asked to practice meditation for 15 minutes/day for the duration of the intervention. Guided meditations were written by the study coordinator (Emma McBride, M.A.) and professionally recorded by both the coordinator and the study PI at Rowan University. Participants received take-home materials, including CDs of recorded mindfulness exercises, reading assignments, handouts to reinforce core mindfulness concepts, and meditation logs. Both MaHA cohorts were taught by the study PI and one student instructor. The study coordinator co-facilitated the first cohort's class, and a medical student trained in mind-body interventions (Andrea Radossi, M.A.) co-facilitated the second class. The MaHA syllabus and the facilitator protocol for a typical class are included in Appendix A.

Measures

Feasibility

To examine the feasibility of MaHA for older adults with MCI and their caregivers, we assessed the recruitment rate, number of participants enrolled relative to desired sample size (% of participants who remained enrolled post-intervention and at 3-month follow-up), and attendance (% of classes attended). We recorded the number of participants screened, deemed eligible, consented/enrolled, who started the intervention, who completed the intervention in full, and who completed the booster sessions. We also report perceived barriers to participation and reasons for attrition. Lastly, we also addressed adherence by collecting home practice data to assess how frequently patients and caregivers completed formal meditation practice at home over the course of the intervention.

Acceptability

Client Satisfaction Questionnaire (CSQ-8) (Larsen et al., 1979). This 8-item measure is used to assess client satisfaction with health and/or human services programs. It was modified to better reflect mindfulness-based interventions (Cox et al., 2019). Responses are rated on a 4-point Likert scale and include questions like "To what extent has the mindfulness training program met your needs?" A total score is generated, with a maximum possible score of 32.

Qualitative feedback form. Qualitative data were collected via a written post-intervention feedback form to explore participant acceptance of the class format, content, time commitment, homework, teaching style, and resources. Participants were also asked open-ended questions about their use of mindfulness skills, the value of the skills in their daily lives, the acceptability of the material, and ways the intervention could be improved. This form is included in Appendix B.

Meditation Logs. Days/week of formal home meditation practice were recorded via five weekly meditation logs given to the instructor each week (see Appendix B). Written qualitative data from participant's meditation logs were recorded and analyzed to identify themes related to perceived supports and barriers to mindfulness practice (see Qualitative Analysis).

Effectiveness

Cognitive Functioning.

Repeatable Battery for the Assessment of Neuropsychological Status Update *(RBANS;* Randolph et al., 1998). The RBANS is a brief, individually administered neuropsychological battery designed to measure cognitive decline across the following

domains: Immediate Memory, Visuospatial/Constructional, Language, Attention, and Delayed Memory. Subtest and index scores are generated using norms based on age. Completion time is approximately 20 minutes. Alternate forms are provided to enable repeat evaluations, which were used at the post-intervention assessment to control for practice effects.

Psychological Distress and Perceived Health Status.

NIH PROMIS-29 (Cella et al., 2019). To reduce participant burden, and to optimize measurement reliability, validity, and comparability, we used the nationally normed NIH PROMIS-29 measure of emotional and physical well-being. This battery assesses well-being within the general domains of (1) Anxiety, (2) Depression, (3) Fatigue, (4) Pain Interference, (5) Physical Function, (6) Sleep Disturbance, (7) Ability to Participate in Social roles and Activities, and (8) Pain Intensity. Each domain exempting Pain Intensity, which has only a single item, is a 4-item short form. Items are scored on a 5-point Likert scale and reference only the previous 7 days. Example items include "In the past seven days...have you been able to go up and down stairs at a normal pace?", and "In the past 7 days...I felt hopeless." All items were scored using the authorized web based PROMIS Adult Profile Scoring Service, which is publicly available at https://www.assessmentcenter.net/ac_scoringservice.

Short Form Zarit Burden Interview (*ZBI-12*; Hebert et al., 2000). The ZBI-12 is designed to assess role strain and personal strain among caregivers. It consists of 12 items rated on a 5-point Likert scale (0=Never, 4=Nearly Always). One total score is generated, with higher scores indicating more severe caregiver burden (0-10 = "No to mild burden", 11-20 = "mild to moderate burden", >20 = "high burden"). Example items include "Do

you feel that your health has suffered because of your involvement with your relative?" and "Do you feel angry when you are around your relative?"

Mindfulness.

Mindful Attention Awareness Scale (*MAAS;* Brown & Ryan, 2003). This measure is used to assess open, receptive awareness of and attention to the present moment, a core characteristic of mindfulness. The scale consists of 15 items rated on a 6-point Likert scale (1=Almost Always, 6=Almost Never). Items include statements like "I find it difficult to stay focused on what's happening in the present." and "I rush through activities without being really attentive to them." Of note, all items ask about mindlessness, rather than mindfulness, which makes the measure particularly appropriate for populations who are not familiar with mindfulness. One total score is generated, with higher scores indicating higher levels of mindfulness.

Applied Mindfulness Process Scale *(AMPS*; Li et al., 2016*)* The AMPS is used to assess the application of mindfulness practices in daily life among individuals participating in mindfulness-based interventions. It consists of 15 items rated on a 5-point Likert scale (0=Never, 4=Almost Always) and yields subscales for three domains of applied mindfulness processes: Decentering, Positive Emotion Regulation, and Negative Emotion Regulation. Items refer to the previous 7 days and include statements like "I used my mindfulness practice to relax my body when I am tense."

Vascular Risk Factors. Elevated resting heart rate (HR≥100 bpm), systolic blood pressure (SBP≥120), diastolic blood pressure (DBP≥80), and body mass index (BMI≥ 25.0) are risk factors for vascular disease (Arnold et al., 2008; Viswanathan et al., 2009) which has, in turn, been linked to age-related cognitive impairment. Each measure of

vascular risk was collected by NJISA staff pre-intervention and post-intervention. However, NJISA staff were not available at the 3-month follow-up, therefore HR, SBP, DBP and weight were collected using a portable blood pressure cuff (Datascope Accutorr Plus) and scale provided by the Principal Investigator. HR, SBP, and DBP data for the 3-month follow-up were later omitted upon consultation with the Principal Investigator, due to the measurement confound.

Qualitative Analysis of Effectiveness. Participants completed written reflections on the intervention and daily mindfulness practice using the two measures below. These were analyzed as measures of narrative, firsthand experience with the intervention, as a complement to quantitative assessments of effectiveness.

Qualitative feedback form. Qualitative data were collected via a written post-intervention feedback form to explore participant's perceptions of the ways in which they benefited from the course (or not), including impressions of specific program elements, such as course format, guided meditations, and teaching quality. This form is included in Appendix B.

Meditation Logs. Written qualitative data from participant's meditation logs (see Appendix B) were recorded and analyzed to identify themes related to perceived understanding of mindfulness concepts and benefits of mindfulness practice (see Qualitative Analysis).

Quantitative Analysis

Descriptive statistics (means, SD, skewness, kurtosis, 95% CI, box plots, outlier analysis) were generated to characterize the dataset. For effectiveness analyses, an intention to treat (ITT) approach, which includes every enrolled participant, was used to

preserve sample size and reduce Type I error (McCoy, 2017). Multilevel linear models (MLM) were used to analyze within-subject change over time. Of note, MLM is superior to repeated measures ANOVA in this instance since it naturally handles missing data, is robust to violations of sphericity and does not require fixed timepoints (Field, 2012). To summarize, in this type of growth analysis we are primarily interested in the fixed effect of time, which in this case is completion of the intervention. Five linear models are built: (1) a baseline model predicting the outcome variable (e.g. MAAS scores) from only the intercept; (2) a model with random intercepts across participants; (3) a model with random intercepts across participants *and* time as a predictor of the outcome variable; (4) a model with random intercepts, time as a predictor, *and* a random effect of time over participants (5) a model with random intercepts, time as a predictor, a random effect of time over participants, *and* an autoregressive covariance structure appropriate to the separation between timepoints (Field, 2012). In other words, the first model predicts the outcome variable from only its aggregate baseline values, and each subsequent model adds to that, either by adding a new variable (e.g. intervention completion) or by allowing baseline values/change over time to vary. We are interested in model 3 because this is the model that answers our research question - whether intervention completion has a meaningful impact on the outcome variable. Models (4) and (5) may improve on model (3) if there is a significant difference in the direction of change over time across participants, but we do not expect this to be the case, particularly with a small sample size. Once the nested models are built, their relative fit is then simultaneously compared using the log-likelihood test. A significantly lower log-likelihood value for a given model indicates a significant improvement in fit, relative to the previous model. We expect this

to occur when the fixed effect of the intervention (time) is added in model 3. Either way, the parameter estimates and confidence intervals for model 3 are then reported to reflect both statistical significance and effect size. In general, in the reporting of results emphasis will be placed on effect sizes and confidence intervals due to the small sample size and exploratory nature of this pilot project. Analyses will be performed using SPSS, and R Studio. Syntax for all analyses conducted in R are presented in Appendix D.

Qualitative Analysis

Qualitative analyses centered on two research questions: (1) "Was the MaHA program perceived as appropriate, helpful, and enjoyable to patients and caregivers?" and (2) "Did patients and caregivers feel they benefitted from MaHA, and if so, how?" The qualitative software package NVivo V.12 (QSR International) was used to conduct both analyses.

Acceptability was addressed using both the written qualitative feedback form and participant's meditation logs. The former prompted participants to reflect on what they gained from the program, to share what they found most and least helpful, and to provide feedback about the course instruction and format. The latter provided an unstructured opportunity for participants to log any reflections on their mindfulness practice they wished to on that day. Participants frequently logged barriers to practice and reflections on which types of practice they like best, hence the inclusion of this data under acceptability. Similarly, effectiveness was also addressed using both the written qualitative feedback form and participant's meditation logs. The former provided an opportunity for participants to write down whether they feel more mindful now and what the found most helpful about the program. The latter contains participant reflections

immediately post-meditation, insights on the impact of mindfulness practice in participants' daily lives, and reflections on the developmental trajectory of mindfulness skills over the 6-week program. Of note, Isbel et al. (2020) recently published a detailed qualitative analysis of the developmental trajectory of learning mindfulness across an 8-week MBSR program. Although this analysis informed the present study, participants in Isbel et al. (2020) were healthy adults and were generally able to complete meditation logs in full, enabling the authors to omit logs that were not descriptive (e.g. one- or two-word entries) or where participants had missed several days. Because some participants with MCI had trouble translating their thoughts into text, we opted to include all diary entries regardless of descriptive quality in order to capture all patient reflections possible.

Both the feedback form and meditation logs were coded using a hybrid approach to thematic analysis informed by relevant literature (e.g., Wells et al, 2019; Isbel et al., 2020) but also allowing for an inductive reading of the data to inform any data-driven emergent themes that may not have been previously reported (Braun & Clarke, 2006). In general, thematic analysis is a flexible, theory-neutral method for identifying, analyzing, and reporting repeated patterns of meaning within qualitative data. The present thematic analysis exists within a realist theoretical framework, meaning that the experiences, realities, and meanings of participants are reported in relative isolation, rather than in relation to discourses about mindfulness, MCI, and aging operating within society. Similarly, themes in this analysis were identified at a semantic/explicit level, meaning that discussion of the theme was explicitly present in the text, rather than existing at a latent or interpretive level.

17 out of 18 Feedback Forms were completed; one participant with MCI was unable to write at her post-intervention visit. Out of 18 potential Meditation Logs per week, 12 were collected on Week 1, 15 on Week 2, 12 on Week 3, 13 on Week 4, and 12 on Week 5. 34 logs for Caregivers were collected, versus 30 for MCI patients. Reasons for lack of completion *or* completion without reflections included forgetting to log meditation practice, losing the meditation log form, having difficulty verbalizing thoughts on practice (MCI patients), having difficulty writing due to an unrelated medical condition (e.g. Parkinson's Disease), and not attending class when logs were collected.

Two coders (the author and a research assistant, FF) independently identified passages in the dataset that represented themes related to acceptability and effectiveness. Research assistant FF was a pre-licensed clinical social worker experienced in both mindfulness-based interventions and thematic analysis, but otherwise unconnected to the trial. The six phases of thematic analysis were conducted in accordance with Braun & Clarke (2006): The coders (1) familiarized themselves with the data (re-transcribing; reading and re-reading; noting first ideas); (2) Generated initial codes (basic segments of interest drawn from the raw data) across the entire dataset and collated data for each code; (3) Collated codes into possible themes (interpreted, repeated patterns of meaning), and collated data for each theme; (4) Reviewed themes and generated a thematic map of the analysis; (5) Generated clear names and definitions for each theme; (6) Produced a report including compelling examples of each theme and relating the analysis back to previous literature. An iterative process was used over the course of regular meetings between the two coders to consolidate similar codes, agree on a codebook (MacQueen et al., 2008), and discuss and resolve the major themes (steps 4 and 5). The author kept a

detailed log of this process included in Appendix E and summarized below. Once the coders reached consensus on final themes, each measure was reviewed again for the presence of each theme, subtheme, and code. Coders then analyzed the frequency of each code across MCI Patients and Caregivers, as well as the frequency of each code present in the Meditation Logs over the 6-week intervention.

The author's first round of coding produced 79 unique preliminary codes, whereas FF's first round of coding produced 33 unique preliminary codes. Inductive, bottom-up coding was completed to derive codes and ideas for potential themes directly from the data, in accordance with Braun & Clarke (2006) and the "First Cycle Coding" methods detailed in Chapter 3 of Saldana (2016). The author and FF then met to agree on shared names for similar codes (e.g. "more acceptance" and "increased non-judgment" both became "feeling more accepting") and consolidate similar codes into singular codes (e.g. "breath awareness," "body awareness," and "awareness of emotion" all became "awareness of sense objects"). At this stage the coders also began grouping codes into potential themes, and referred to previous literature for insight on potentially similar themes (e.g. "positive perceptions of class" from Wells et al. (2019) informed Theme 1: "Positive Perceptions of the Intervention"). The author then developed a codebook following the guidelines of MacQueen et al. (2008). Specifically, the codebook was written to include a description, inclusion criteria, exclusion criteria, and an example for each code. Codes were also nested and numbered for ease of application and communication between coders. Following approval from FF, the author added the codebook to NVivo and each coder independently coded a randomly selected subset of the dataset. Coding comparison queries revealed several differences in coding, which

were discussed over a series of meetings and the codebook was updated accordingly. While most differences were trivial (e.g. coding the entire sentence vs. only the phrase of interest), the coders also explored differing perspectives on mindfulness skill acquisition. These discussions informed the eventual decision to have some codes reflect skill development during the intervention (e.g. “awareness” and “acceptance”) and others reflect outcomes of the intervention (e.g. “more present” and “more accepting”). Interrater reliability was tested after each round of coding using NVivo’s coding comparison query function. There were 4 iterations of this process, and overall unweighted kappa coefficients for each coding comparison query are reported in Appendix E. At the final round of coding the unweighted kappa coefficient was 0.81, with 64-100% agreement across the final list of codes. The remaining discrepancies were discussed until consensus was reached for all references, resulting in a final kappa of 1.00 and 100% agreement for all codes. After the coding was finalized, the data were incorporated into four themes, two reflecting acceptability and two reflecting effectiveness. Codes were not exhaustive, as question text in the Feedback Forms was not coded if participants did not answer the question and some text in Meditation Logs was not relevant to either research question, for example reports on what participants had done earlier in the day or were planning to do later. 74% of data in Feedback Forms and 91% of data in Meditation logs was coded.

Chapter 3

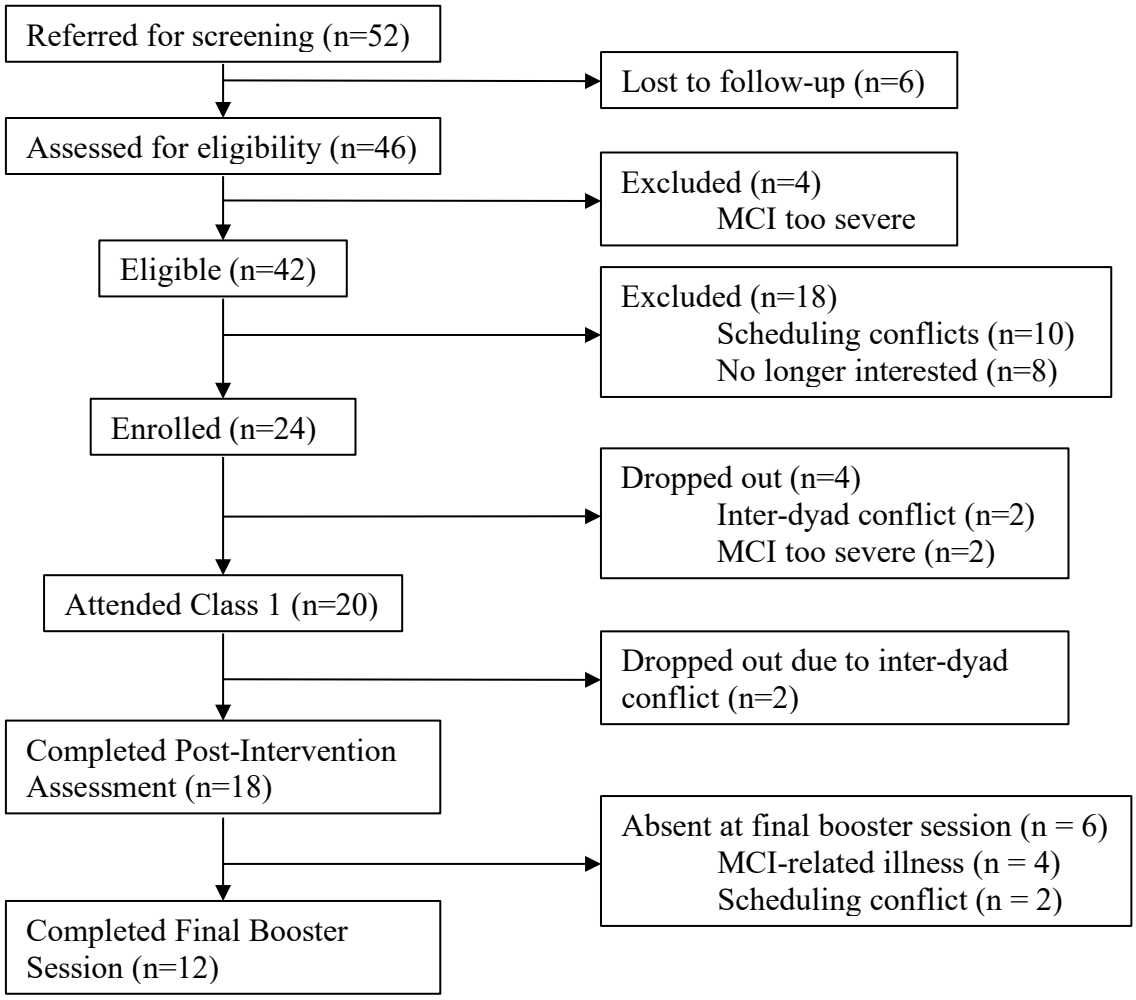
Results

Feasibility

Recruitment, screening, and retention data are presented in Figure 1. The recruitment period stretched from 6/25/2019 to 10/31/2019 (18 weeks). During that time, an average of 1.5 dyads per week were referred to the study coordinator by NJISA providers. 3 dyads were lost to follow-up, creating an average of 1.3 dyads screened per week. The most common reason for exclusion was scheduling conflicts with class dates, followed by lack of interest upon learning more about the intervention. 24 participants (12 dyads) were enrolled during this time, relative to the goal n of 28. 18 participants (75%) remained enrolled at both post-intervention and 3-month follow-up. However, only 12 participants (50%) completed the 3-month follow-up class and assessment. Of those who remained enrolled at 3-month follow-up (n=18), an average of 5 classes (83%) and 2.33 booster sessions (78%) were attended.

Figure 1

Flow Chart Showing Participants' Inclusion and Retention



Participant characteristics for MCI Patients and Caregivers (CAR) at enrollment are reported in Tables 5 and 6. Of note, the sample was exclusively White and Non-Hispanic. Of the 12 dyads enrolled, 10 were heterosexual married couples living in the same household, 1 was a parent-child dyad (living apart), and 1 was a grandparent-grandchild dyad (living together).

Table 5

MCI Sample Characteristics (n=12)

Mean Age (SD)	74.8 (5.2); range = 68-84
Gender	
Cisgender Female	n=6 (50%)
Cisgender Male	n=6 (50%)
Race	
White	n=12 (100%)
Black, Indigenous, or Person of Color	None
Education	
Some Highschool	n=1 (8%)
Highschool Graduate	n=3 (25%)
Some college	n=1 (8%)
Trade/technical/vocational training	n=2 (17%)
Bachelor's degree	n=3 (25%)
Master's degree	n=1 (8%)
Professional/doctoral degree	None
Annual Household Income	
>$25,000	n=1 (8%)
$25,000-$49,999	n=3 (25%)
$50,000-$74,999	n=1 (8%)
$75,000-$99,999	n=2 (17%)
$100,000-$149,999	n=2 (17%)
More than $150,000	n=3 (25%)
Medication	
Antihypertensive	n=7 (58%)
Antidepressant	n=5 (42%)
Statin	n=4 (33%)
Acetylcholinesterase inhibitor	n=3 (25%)
Synthetic Hormone	n=4 (33%)
Antidiabetic	n=4 (33%)
Other	n=8 (67%)
Prior Meditation or Yoga Experience (Yes)	n=2 (17%)

Note: Medication classes endorsed by 3 or more participants are reported. "Other" medications included, but were not limited to, opioids, diuretics, and NSAIDs.

Table 6

Caregiver Sample Characteristics (n=12)

Median Age (IQR)*	75.5 (14); range = 28-84
Gender	
Cisgender Female	n=7 (58%)
Cisgender Male	n=5 (42%)
Race	
White	n=12 (100%)
Black, Indigenous, or Person of Color	None
Education	
Some Highschool	None
Highschool Graduate	n=2 (17%)
Some college	n=3 (25%)
Trade/technical/vocational training	None
Bachelor's degree	n=4 (33%)
Master's degree	n=2 (17%)
Professional/doctoral degree	n=1 (8%)
Annual Household Income	
>$25,000	n=1 (8%)
$25,000-$49,999	n=2 (17%)
$50,000-$74,999	n=2 (17%)
$75,000-$99,999	n=2 (17%)
$100,000-$149,999	n=2 (17%)
More than $150,000	n=3 (25%)
Medication	
Antihypertensive	n=7 (58%)
Statin	n=5 (42%)
NSAID	n=3 (25%)
Asthma/COPD Medication	n=3 (25%)
Other	n=8 (67%)
Prior Meditation or Yoga Experience (Yes)	n=4 (33%)

Note: Medication classes endorsed by 3 or more participants are reported. "Other" medications included, but were not limited to, antidepressants, diuretics, and antihistamines.

*Median age is reported here due to two outliers (children or grandchildren of MCI patients)

Adherence to home practice is reported in Table 7. 7 out of 9 dyads (78%) completed all their meditation practice together, therefore aggregate adherence is reported rather than separating home practice by group. Median days of home practice

per week, rather than mean home practice, is reported since data were negatively skewed for all weeks. Overall median home practice per week was 5 days (IQR = 2.0-6.0). Mean home practice per week was 4.4 days (SD = 2.1) and the modal response was 6. Of note, there were 14 instances of participants practicing 7 days/week, although the recommended number of days was 6 (see Figure 2).

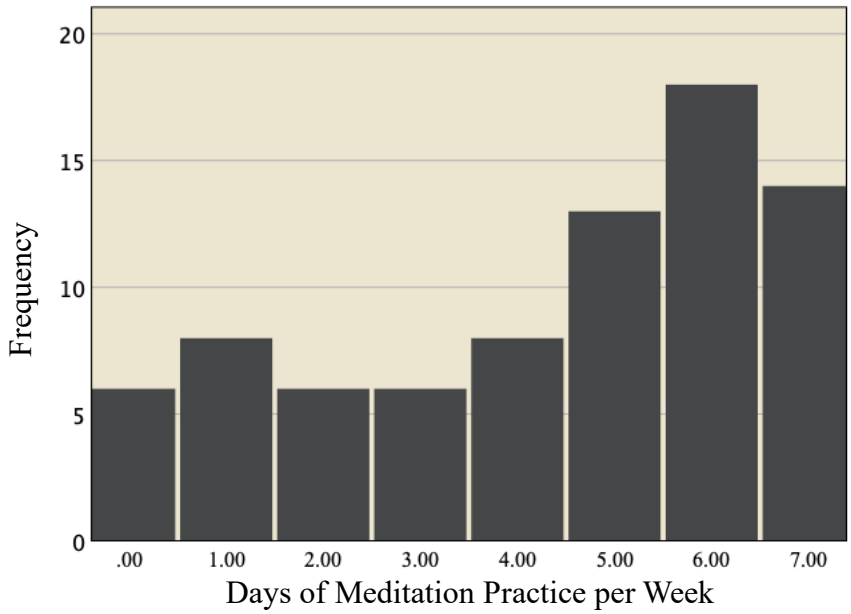
Table 7

Median Days of Home Meditation Practice per Week

	Week of Intervention				
	1	**2**	**3**	**4**	**5**
Median (IQR)	5 (1.75-6)	5 (2-7)	5 (2-5.75)	4 (2.25-6.75)	6 (3-6.25)
n	16	18	16	16	14

Figure 2

Days of Meditation Practice per Week



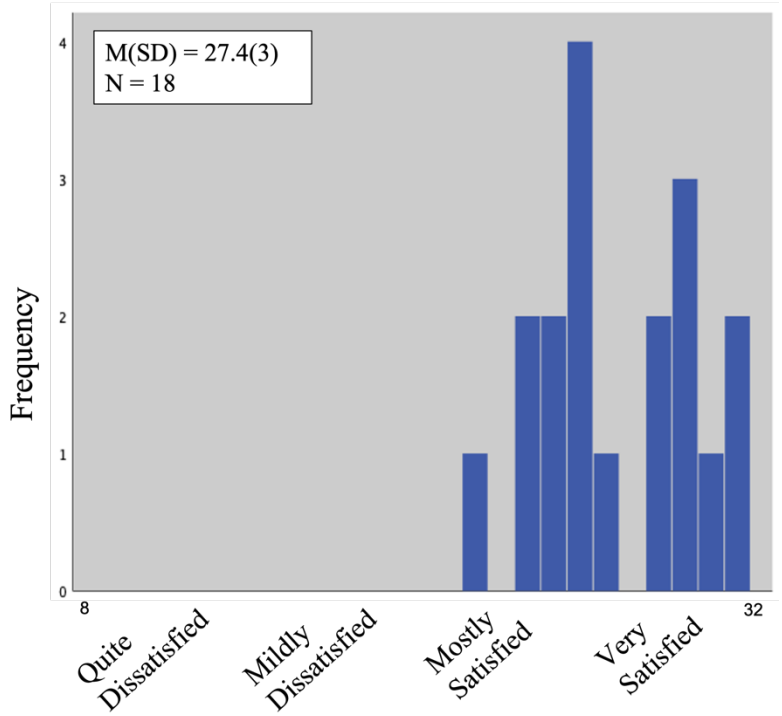
Acceptability

Quantitative

Client Satisfaction Questionnaire (CSQ-8). 18 participants completed the CSQ-8 post-intervention. Mean satisfaction with the intervention was 27.4 (3.0) out of a possible score of 32. Mean satisfaction was 27.9 (3.0) for MCI Patients and 27 (3.1) for Caregivers, with no significant difference between the groups ($t(16) = .618$, $p = 545$). All participants fell into the "mostly satisfied" or "very satisfied" range (see Figure 3).

Figure 3

Client Satisfaction Questionnaire (CSQ-8) Total Score



Post-Intervention Feedback Form. Two participants with MCI were unable to complete some or all of the post-intervention feedback form due to difficulty writing or

understanding the questions. 100% of participants indicated they would recommend the intervention to other patients with MCI and their caregivers. Patients and Caregivers used a Likert scale to provide feedback on course structure (1 = "poor," 5 = "excellent") and guided meditation exercises (1 = "not at all helpful," 5 = "extremely helpful"). Median satisfaction ratings are reported in Tables 8 and 9. While all ratings for course structure were greater than or equal to 4, Caregivers were more satisfied with the class discussion, guided meditations, teaching quality, and group support than patients with MCI. Median satisfaction for all guided meditation exercises was greater than or equal to 4. Breath Awareness and Open Awareness were the highest rated practices. Variability was highest for Chair Yoga and Meditation Poem. Some participants reported difficulty with Chair Yoga due to mobility constraints. Meditation Poem showed a bimodal response pattern, with participants rating this practice as either excellent (5) or moderate (3).

Table 8

Median Ratings of Course Structure

	MCI (IQR) n = 8	**CAR** (IQR) n = 9
Class Length (90-min)	5 (1)	5 (0.5)
Course Duration (6-weeks)	5 (1)	5 (1.5)
Class Discussion	4.5 (1)	5 (1)
Guided Meditations	4 (1)	5 (0)
Teaching Quality/Didactics	4 (1)	5 (1)
Feeling Support from Others	4 (1.75)	5 (1.5)

Table 9

Median Ratings of Guided Meditation Exercises

	MCI (IQR) n = 7	**CAR** (IQR) n = 9
Breath Awareness	4.5 (1)	4.5 (1)
Belly Breathing	4 (1.25)	4 (2)
Body Scan	4 (1.25)	4 (2)
Meditation Poem	4 (2)	4.5 (2)
Chair Yoga	4 (2.25)	4 (1.75)
Lovingkindness	4.5 (1.25)	4 (1.5)
Open Awareness	4 (1)	5 (0)

Qualitative

Post-intervention feedback forms and Meditation Logs were analyzed for content related to whether participants found the intervention appropriate, enjoyable, and helpful. Two themes relevant to acceptability emerged: (1) *Positive Perception of the Intervention* and (2) *Difficulties with the Intervention.* The themes and codes used for analysis related to acceptability are detailed in Table 10.

Table 10

Themes and Codes used for Acceptability Analysis

Theme	Sub-theme	Code	Description	Inclusion Guideline	Exclusion Guideline
1. Positive Perception of the Intervention	*1.1*	1.1 Positive Perception of Meditation/Mindfulness	Participant records a positive attitude toward meditation or mindfulness *in general*	Meditation/mindfulness is helpful and/or feels good in general; meditation/mindfulness most valuable or helpful part of intervention	Positive perception of a specific instance of meditation practice; feeling more mindful now
	1.2	1.2 Positive Perception of Intervention Format	Participant records a positive attitude toward the intervention as a whole or to specific non-mindfulness-related aspects of the intervention	Indicating any of the following were helpful, enjoyable, or appropriate: group format, facilitation, taking the class with a partner, book; mindfulness homework; having nothing to change about the intervention	Positive perception of guided meditation (coded in 1.1)
2. Difficulties with the Intervention	*2.1 Negative Perception of Meditation*	2.1.1 Adverse Effect of Meditation	Participant records an unexpected and negative effect of meditation	Finding meditation upsetting, not wanting to meditate anymore, finding a type of meditation practice inappropriate or harmful	Recording expected and benign, but still unpleasant, challenges in meditation practice (e.g. sleepiness, distraction, pain)
		2.1.2 Meditation not Helpful	Participant records meditation is not doing what they want or expect it to do	Finding meditation unhelpful; indicating meditation did not resolve a particular issue	As above
	2.2	2.2 Suggested Changes	Participant identifies barriers to engagement in the intervention or suggests changes to the intervention	Suggesting changes to class format, timing, or resources; MCI-related barriers to engagement	Recording expected and benign, but still unpleasant, challenges in group-based mindfulness interventions (e.g. hard to open up to others)

Positive Perception of the Intervention. This theme covers participants' positive experiences with and perceptions of the intervention. The definition of this theme was informed by Wells et al. (2019), who identified a similar theme, "Positive Perceptions of Class," in their analysis of adults with MCI following Mindfulness-Based Stress Reduction. Codes within the theme *Positive Perception of the Intervention* were organized into two subthemes: (1) *Positive Perception of Meditation/Mindfulness* and (2) *Positive Perception of Intervention Format*. The frequency of thematic content and sample quotations for each theme are reported in Table 11 for MCI Patients and Table 12 for Caregivers.

Difficulties with the Intervention. This theme covers participants' negative perceptions of the intervention and suggestions for its improvement. Codes within the theme *Difficulties with the Intervention* were organized into two subthemes: (1) *Negative Perception of Meditation* and (2) *Suggested Changes.* The subtheme *Negative Perception of Meditation* was divided, in turn, into two codes: (1) *Adverse Effect of Meditation* and (2) *Meditation not Helpful*. The frequency of thematic content and sample quotations for each theme are reported in Table 11 for MCI Patients and Table 12 for Caregivers.

The following tables integrate sample quotations from the Feedback Forms and Meditation Logs, as participants used both to comment on the themes in question. For context, all sample quotations from Feedback Forms are preceded by the question from the form the quote is addressing. All other sample quotations are from Meditation Logs.

Table 11

Acceptability in MCI Patients

Code	Frequency	Sample Quotations
1.1 Positive Perception of Meditation/ Mindfulness	31	**Do you feel you got something of lasting value from the course? What was meaningful to you?** • "The meditations." • "Yes, learning how to live better and be more grateful for what I can do rather than fret over what I can't do." • "Yes. Mindful breathing is already a really helpful calming influence on my life." **What did you find most helpful about the course?** • "Doing the meditations." • "…It's the first time I meditated so I'm grateful learning how easy it is to do." • "Learning how to meditate and be mindful." **From Meditation Logs:** • "Slowing down this way gives me valuable time for quiet and self-care." • "(Practicing breathing) The more I do it the better I feel." • "(Chair Yoga)…I enjoy the stretching." • "I am getting acquainted with the system now even more and am valuing the session." • "It feels good. Helps me relax."
1.2 Positive Perception of Intervention Format	26	**Do you feel you got something of lasting value from the course? What was meaningful to you?** • "...Meeting everyone else (who are dealing with similar problems) has helped me to tame my anger." **What did you find most helpful about the course?** • "It made me think more." • "Listening to others." • "I liked everything." **Please provide feedback on the Class Format (meditations, class discussion, teaching, timing):** • "…class discussions were good." • "I liked the format." • "Very good." **Please provide feedback on the Meditation logs:** • "A good idea." • "Good to watch progress."

Code	Frequency	Sample Quotations
1.2 Positive Perception of Intervention Format (continued	26	**Please provide feedback on the Textbook (Wherever You Go, There You Are):** • "Having trouble finding time to read it but when I do I like it." • "I like this." **What could the facilitators have done more (or less) of to enhance your experience?** • "They were great. I don't have any suggestions for improvement." • "They were excellent – could not have been better." **Other comments?** • "I really enjoyed the class and got a lot out of it." • "It was wonderful and I'm grateful my husband got to see/hear some of my issues and how to better work with me rather than get mad or lose patience with me."
2.1.1 Adverse Effect of Meditation	4	• "(Belly Breathing) It is upsetting me." [recorded on three consecutive days, Week 1] • [same participant, later that week] "(Belly Breathing) Makes me uncomforting me – don't want to do this anymore."
2.1.2 Meditation not Helpful	3	• "Listened to cassette; more relaxed but still anxious." • "Watch slow breath, ate dinner slowly; still anxious." [same participant] • "Listened to CD, relaxed my mind; still anxious." [same participant]
2.2 Suggested Changes	8	**What was least valuable? What would you have changed?** • "Never have it at 6:00pm, rush hour and traffic out of Lindenwold Train ridiculous and stressful." • "I can't think of anything, except I didn't like coming after dark." **Please provide feedback on the Class Format:** • "Late afternoon was poor timing." • "Do it in less classes" • "This time of year was tough – holidays plus dark coming and going." **Please provide feedback on the Meditation Logs:** • "Difficult for me to verbalize and write."

Note. "Frequency" refers to the number of unique references for each code in MCI Patients across the entire dataset. Sample quotations that are not preceded by a question in bold are from Meditation Logs.

Table 12

Acceptability in Caregivers

Code	Frequency	Sample Quotations
1.1 Positive Perception of Meditation/ Mindfulness	49	**Do you feel you got something of lasting value from the course? What was meaningful to you?]** • "Yes, I found the meditations to be meaningful. I had never meditated before." • "Yes – Learning how to meditate and remove myself from my surroundings." • "Is of lasting value but will have to keep practicing. Becoming aware that I can accept things as they are and I do not have to attempt to change things." • "Yes, I know that if I'm stressed, I can meditate to calm me down." • "Learning new techniques." **What did you find most helpful about the course?** • "Learning the various meditations and openly discussing them." • "To remember to be in the moment." • "Daily mindfulness training together." • "Love in-person guided meditation." **From Meditation Logs:** • "CD was soothing – breathing and exercise puts me at ease." • "Concentrating on body parts as described…It's a nice way to start the day." • "…was thinking about how this unwinds me." • "Needed meditation time. Set aside time – got all prepared – put on tape and started listening." • "I find this technique relaxing, short, effective and satisfying." • "Seems to work excellent for me. Having the experience and effects."
1.2 Positive Perception of Intervention Format	28	**Do you feel you got something of lasting value from the course? What was meaningful to you?** • "The group gathering, everyone's input." **What did you find most helpful about the course?** • "Discipline." • "Everyone was so nice." • "Learning new techniques and learning from each other. People were fun to be around and different informative views." • "The tape recordings were so helpful and the book."

Code	Frequency	Sample Quotations
1.2 Positive Perception of Intervention Format (continued)	28	**Please provide feedback on the Class Format (meditations, class discussion, teaching, timing):** • "I liked the personal format and activities in class." • "Everything perfect – don't change anything." • "Relaxed informed teaching." • "I got a lot from the meditation, class discussion, and teaching." **Please provide feedback on the Meditation logs:** • "Helpful in that it made me express myself." • "I think it helped me to go over what I had learned from the CD." **Please provide feedback on the Textbook (Wherever You Go, There You Are):** • "I really enjoyed it." • "Good to be able to pick it up intermittently." • "Very good in understanding meditations." **What could the facilitators have done more (or less) of to enhance your experience?:** • "Thought they were excellent!" • "They were so cheerful and nothing was too much trouble."
2.1.1 Adverse Effect of Meditation	4	• "Following our yoga med I felt very sore in the shoulders and neck." • [same participant, the following day] "…Still sore." • [same participant, later that week] "Chair yoga) This yoga causes lingering pain in the shoulders and neck. It seems to mimic symptoms of meningitis for which I am at risk because of medications. Do not want to risk not recognizing the symptoms of meningitis."
2.1.2 Meditation not Helpful	5	**What was least valuable to you? What would you have changed?"** • "Least helpful was the body scan due to personal health issues. Also yoga." **Do you feel you got something of lasting value from the course? What was most meaningful to you?** • "Medium. I did not find it pointless at all, however as someone who has meditated for a few years now it felt kind of slow/beginning." **From Meditation Logs:** • [Regarding Lovingkindness meditation] "I have a personal issue with this concept as a whole." • "(Listened to CD) It wasn't that helpful. I lost interest quickly." • "Do not like the effects of body scan because it makes me aware of chronic pain and issues."

Code	Frequency	Sample Quotations
2.2 Suggested Changes	16	**What was least valuable? What would you have changed?** • "I would have liked more discussions on the book. I think the caretakers definitely benefitted more from it." • "More discussions about how meditation can be done in varied ways." • "It felt redundant, it seemed like we did the same thing each week." • "Time of year: tough to do with so many." **Please provide feedback on the Class Format:** • "If anything, probably more interaction, but you would need a larger group." • "I liked this. It just needs to be a shorter class." • "Late – dark – long drive." **Please provide feedback on the Meditation Logs:** • "This was hard for my husband." **Other comments?** • "It was very hard for me and my dad to get there by 6pm. It's much easier to get here during the day. Also, 6 weeks felt like it was too long. I think 2 classes would better." • "Better to have during better weather. Nov and Dec were too cold and raining." • "I wanted to use other meditations than what was provided, that was discouraged. I feel like if it was allowed, I probably would have meditated more."

Most participants found the intervention helpful, enjoyable, and appropriate, as evidenced by the high frequency of codes for "Positive Perception of the Intervention" in both MCI Patients and Caregivers. "Difficulties with the Intervention" were far less frequent, for both MCI Patients and Caregivers. When asked what they would change, nearly half of participants (n = 7) reported they would not change anything about the intervention. Participants appeared to enjoy both the mindfulness-specific and general aspects of the intervention, with a slightly greater emphasis on mindfulness and meditation. Many participants reported that meditation practice and/or mindfulness skills were the most helpful aspects of the course for them. In fact, several participant responses suggest that generalizing mindfulness skills to daily life was among the most helpful aspects of the intervention ("…learning how to live better and be more grateful for what I can do rather than fret over what I can't do." "Habit of being more mindful, focus on what we can control, not accentuating the wrong – we have more right than wrong"). Other participants found establishing a meditation practice most valuable ("…I know that if I'm stressed, I can meditate to calm me down." "Mindful breathing is already a really helpful calming influence on my life"). Participants also reported that being in a group with others, having a class text to read and logging their meditations were helpful components of the intervention. Some participants commented that being in a class with others coping with MCI was specifically helpful ("…Meeting everyone else (who are dealing with similar problems) has helped me to tame my anger"). Two participants commented that taking the class with their partner and meditating together was helpful.

Caregivers generally wrote more than MCI Patients did across both the Feedback Forms and Meditations Logs. That said, Caregivers appeared to report Positive

Perceptions of Meditation/Mindfulness slightly more frequently than MCI Patients did (48% of total references in Caregivers vs. 43% in MCI Patients), with one Caregiver also suggesting that Caregivers may benefit more from the intervention than MCI Patients. MCI Patients' positive perceptions of meditation/mindfulness also tended to focus more on meditation as a helpful way to feel better in the moment (e.g. "It feels good, helps me relax"), rather than a more conceptual extension of mindfulness skills to daily life or coping with MCI. Proportionally, MCI Patients also commented more frequently on positive perceptions of the intervention format (e.g. discussions, group setting) than Caregivers did (36% of total references in MCI Patients vs. 27% for Caregivers).

While positive perceptions of the intervention were far more frequent than difficulties with the intervention, some participants did experience challenges, and many offered suggestions for how the intervention might be improved. In Week 1 an MCI Patient, who also struggled to verbalize her experience on questionnaires and logs, found Belly Breathing upsetting and did not want to do it anymore. She and her spouse were advised to try different practices, which she continued to try without incident for the rest of the intervention. One Caregiver found that Chair Yoga exacerbated his pain and caused worry about meningitis. After expressing this in class he was similarly advised to focus on practices that did not increase his musculoskeletal pain, which had remitted by class time. One Caregiver found the class too "slow/beginning" and also noted that her "personal issues" with lovingkindness meditation were a barrier to participating in it. Another participant expressed that meditation was not decreasing his anxiety as he had hoped, although he did find it relaxing. Of note, this participant's reflections (e.g. "…more relaxed but still anxious.") were double coded under "Challenges in Meditation"

practice following discussion between the coders. Mindfulness training emphasizes shifting one's relationship with aversive mind states, like anxiety, rather than trying to change them, making this reflection indicative of normal aversion people experience when learning to meditate. That said, we also coded it under "Meditation not Helpful" to reflect a limitation of meditation practice, from this participant's perspective. This patient-centered approach reflects a broader movement within mindfulness research to acknowledge transient distress and limitations of meditation training, from practitioners' perspectives, while acknowledging these experiences as normative parts of mindfulness training (Britton et al., 2021; Lambert et al., 2021). The balance between acknowledging and normalizing difficulties in meditation practice is explored further in the Discussion section of this document.

Taken together, negative perceptions of meditation were very low frequency and were specific to the individual, rather than generalized across multiple participants. In contrast, many participants offered similar suggestions for improving the intervention. The most frequent suggestion by far was that the timing of the class (late afternoon or early evening in late fall or early winter) was too late, and the commute was unpleasant or inconvenient. One MCI Patient commented that it was difficult for him to verbalize his thoughts on the Meditation Log, and this was also noted by his spouse. This barrier to engagement was likely more common than it appears in this dataset, because participants had to write their feedback down in order to officially communicate it to the study team. Overall, participants clearly indicated that the time of day/year and location are important considerations for an in-person group intervention with older adults, and there was some

indication that written Meditation Logs may be a poor means of supporting adherence to practice for some MCI Patients.

Taken together, qualitative data on acceptability indicate that both MCI Patients and Caregivers found the intervention appropriate, helpful, and enjoyable. Meditation and mindfulness were very well-received components of the intervention, with some participants finding meditation practice most helpful and others valuing mindfulness skills in daily life. Caregivers may have found meditation and mindfulness even more valuable than MCI Patients did, but this could also be a result of Caregivers simply writing more on their Feedback Forms and Meditation Logs. The class format (group discussion, facilitation, guided meditations, book, etc.) was seen very positively, exempting the timing of the class later in the day and at a cold/dark time of year. These results are consistent with the strong acceptability seen on the Client Satisfaction Questionnaire and quantitative portions of the Feedback Form.

Effectiveness

Quantitative

Reliability and Validity. Several patients with MCI either stated they had difficulty or appeared to have difficulty completing self-report measures of Psychological Distress, Perceived Health, and Mindfulness. We therefore assessed reliability for each measure and subscale at every timepoint using Cronbach's alpha as a measure of internal consistency, then analyzed convergent and discriminant validity between measures. This analysis is reported in detail in Appendix C. In sum, measures with an $\alpha < 0.60$ were omitted from further analysis. In general, measures that were not reliable also appeared to be invalid and were confirmed for omission from further analysis. This amounted to 18

(out of 52) measures for MCI patients and 2 for Caregivers. These are highlighted gray in Tables 10 and 11. Of note, HR, SBP, and DBP data for 3-month follow-up were omitted following consultation with the Principal Investigator. These data were collected by study staff, rather than NJISA medical assistants (who were unavailable) using a different blood pressure cuff. It was decided that this measurement confound invalidated planned analyses of HR, SBP, and DBP at follow-up, and therefore these data were not analyzed.

Descriptive Statistics. Descriptive statistics for all outcome variables are reported in Tables 13 and 14. At baseline, 8 MCI patients demonstrated impaired performance (≥ 1 SD below age-matched norms) on three or more of the five cognitive domains tested. The remaining four participants demonstrated impaired performance on two domains. Delayed Memory was the most severely impaired domain. Depression fell into the "mild" range for MCI patients. All other retained measures of Psychological Distress and Perceived Health fell into the average range (T-score = 45-55) using a nationally normed adult reference sample. Caregivers reported caregiver burden in the mild to moderate range.

Mean baseline trait mindfulness in MCI Patients (4.8 ± 0.8) was approximately 1 SD higher than previously reported means in a mostly meditation-naïve adult sample, whereas trait mindfulness for Caregivers fell within the expected range (MacKillop & Anderson, 2007). Of note, reliability and validity for the MAAS was strong in MCI Patients. In contrast, the first measurement of MCI Patients' total AMPS at Week 2 (35.2 ± 5.4) was approximately 1 SD higher than Caregivers' (29.9 ± 12.5), but on par with previously collected AMPS data in mostly meditation-naïve patients with dementia (38.0 ± 11.9; Innis et al., 2021). This could reflect reliability and validity concerns with this

measure (see Appendix C), particularly in the Decentering subscale. Alternatively, and given that caregivers in Innis et al. (2021) also had an AMPS score of 38.9 ± 11.5, the difference could indicate low baseline application of mindfulness skills in Caregivers relative to MCI patients.

Heart rate was not elevated at baseline. Both groups had elevated blood pressure, defined as systolic blood pressure (SBP) greater than 120 and diastolic blood pressure (DBP) less than 80 (Whelton Paul et al., 2018). Body mass index (BMI) fell within the "overweight" and "obese" ranges for MCI Patients and Caregivers, respectively.

Table 13

Descriptive Statistics: MCI

	T1 (n=12)	**W2** (n=9)	**W4** (n=8)	**W6** (n=9)	**T2** (n=9)	**B1** (n=7)	**B2** (n=7)	**B3** (n=6)
Cognitive Functioning (Repeatable Battery for the Assessment of Neuropsychological Status Update, RBANS)								
Total	68.2 (11.3)	--	--	--	71.1 (17.0)	--	--	--
Immediate Memory	63.7 (12.1)	--	--	--	67.9 (15.6)	--	--	--
Visuospatial	89.3 (20.0)	--	--	--	93.7 (16.6)	--	--	--
Language	82.9 (14.0)	--	--	--	81.7 (14.1)	--	--	--
Attention	84.4 (15.6)	--	--	--	86.4 (22.2)	--	--	--
Delayed Memory	53.3 (10.1)	--	--	--	55.1 (15.5)	--	--	--
Psychological Distress (NIH Promis-29)								
Depression	56.0 (8.6)	--	--	--	53.6 (6.2)	52.6 (8.1)	51.7 (7.7)	51.1 (8.3)
Anxiety	54.9 (6.5)	--	--	--	56.0 (8.2)	50.2 (8.9)	53.5 (5.3)	52.9 (8.1)
Perceived Health (NIH Promis-29)								
Fatigue	49.8 (5.9)	--	--	--	46.7 (6.3)	45.8 (74)	47.2 (6.3)	48.6 (4.4)
Pain Interference	52.3 (10.0)	--	--	--	49.4 (6.0)	50.8 (9.7)	48.7 (7.0)	47.6 (6.8)
Physical Function	49.7 (8.9)	--	--	--	50.5 (6.6)	51.8 (6.5)	51.2 (7.5)	48.5 (4.5)
Sleep Disturbance	45.5 (11.3)	--	--	--	42.1 (8.6)	39.7 (6.1)	40.7 (5.1)	40.5 (8.4)
Social Functioning	50.8 (6.9)	--	--	--	56.9 (7.4)	53.2 (6.2)	54.0 (6.2)	54.9 (6.0)
Mindfulness								
MAAS	4.8 (0.8)	--	--	--	4.6 (0.7)	4.7 (0.5)	4.6 (0.9)	4.8 (0.7)
AMPS Total	--	35.2 (5.4)	34.4 (4.2)	34.6 (10.7)	--	--	--	--
AMPS Decentering	--	11.2 (1.6)	10.4 (2.0)	10.3 (4.4)	--	--	--	--
AMPS Positive ER	--	12.7 (3.0)	12.1 (3.8)	13.2 (3.0)	--	--	--	--
AMPS Negative ER	--	11.3 (2.1)	11.9 (1.5)	11.0 (4.2)	--	--	--	--
Vascular Risk								
Resting HR	76.3 (12.4)	--	--	--	75.7 (14.2)	--	--	--
SBP	127.4 (11)	--	--	--	130.7 (13)	--	--	--
DBP	75.7 (6.1)	--	--	--	75.8 (7.2)	--	--	--
BMI	28.8 (4.9)	--	--	--	26.8 (6.2)	--	--	27.4 (1.9)

Note: MAAS = Mindful Attention Awareness Scale; AMPS = Applied Mindfulness Process Scale; HR = Heart Rate; SBP/DBP = Systolic/Diastolic Blood Pressure; BMI = Body Mass Index; T1 = Pre-Intervention; W2, 4, & 6 = Weeks 2, 4, & 6; T2 = Post-Intervention; B1, 2, & 3 = Booster Sessions 1, 2, & 3. Scales omitted from further analyses are shaded in grey.

Table 14

Descriptive Statistics: Caregivers

	T1 (n=12)	**W2** (n=9)	**W4** (n=8)	**W6** (n=9)	**T2** (n=9)	**B1** (n=7)	**B2** (n=7)	**B3** (n=6)
Psychological Distress (NIH Promis-29 & ZBI-12)								
Depression	52.9 (9.1)	--	--	--	52.8 (10.8)	50.6 (7.7)	51.0 (8.2)	49.7 (8.4)
Anxiety	54.5 (10.1)	--	--	--	58.4 (13.2)	53.3 (10.3)	52.7 (9.7)	52.0 (12.4)
Caregiver Burden	16.1 (7.7)	--	--	--	15.7 (6.9)	--	--	--
Perceived Health (NIH Promis-29)								
Fatigue	50.5 (10.0)	--	--	--	53.7 (7.9)	50.7 (6.4)	50.8 (8.7)	50.2 (14.0)
Pain Interference	51.9 (9.8)	--	--	--	55.0 (10.6)	49.0 (7.4)	52.7 (8.8)	49.4 (8.7)
Physical Function	47.2 (10.0)	--	--	--	49.0 (10.9)	51.3 (7.2)	52.3 (5.9)	52.6 (6.8)
Sleep Disturbance	49.1 (6.1)	--	--	--	50.0 (10.8)	46.0 (8.4)	43.9 (8.6)	42.3 (8.9)
Social Functioning	52.3 (8.5)	--	--	--	50.8 (9.7)	54.0 (7.8)	56.6 (7.5)	54.8 (7.0)
Mindfulness								
MAAS	4.3 (1.1)	--	--	--	4.2 (0.8)	4.6 (0.8)	4.6 (0.8)	4.7 (1.1)
AMPS Total	--	29.9 (12.5)	35.9 (11.1)	36.4 (9.8)	--	--	--	--
AMPS Decentering	--	8.9 (4.5)	11.4 (3.5)	11.7 (2.6)	--	--	--	--
AMPS Positive ER	--	10.9 (5.0)	12.5 (3.8)	12.7 (4.3)	--	--	--	--
AMPS Negative ER	--	10.1 (3.9)	12.0 (4.5)	12.1 (3.3)	--	--	--	--
Vascular Risk								
Resting HR	67.1 (12.6)	--	--	--	74.5 (10.0)	--	--	--
SBP	127.0 (13)	--	--	--	121.5 (10)	--	--	--
DBP	77.1 (6.3)	--	--	--	77.3 (5.2)	--	--	--
BMI	31.9 (6.9)	--	--	--	32.6 (11.3)	--	--	32.1 (8.9)

Note: ZBI-12 = Short Form Zarit Burden Interview; MAAS = Mindful Attention Awareness Scale; AMPS = Applied Mindfulness Process Scale; HR = Heart Rate; BP = Blood Pressure (systolic & diastolic); BMI = Body Mass Index; T1 = Pre-Intervention; W2, 4, & 6 = Weeks 2, 4, & 6; T2 = Post-Intervention; B1, 2, & 3 = Booster Sessions 1, 2, & 3. Scales omitted from further analyses are shaded in grey.

Effect of the 6-Week Intervention. Multilevel linear models (MLMs) were used to analyze within-subject change over time (pre- vs. post-intervention) for measures of Cognitive Functioning, Psychological Distress, Perceived Health, Mindfulness, and Vascular Risk. In accordance with Field (2012), five nested linear multilevel linear models were built, each adding one parameter. The third model adds the fixed effect of the intervention (time). These models are then compared simultaneously using the log-likelihood test. A statistically significant change in the log-likelihood ratio indicates the fit of the model has improved relative to the previous model. In this case, we have hypothesized a significant improvement in model fit after adding Intervention (time). The regression parameter for the effect of the intervention is then calculated and reported in text to indicate effect size and direction.[1] The results of models 4 and 5 are not reported unless allowing the slopes to vary randomly (model 4) or adding an autoregressive covariance structure (model 5) significantly improved fit.

Cognitive Functioning. An age-normed neuropsychological measure of cognitive functioning (Repeatable Battery for the Assessment for Neuropsychological Status [RBANS]) was collected 1-2 weeks pre-intervention and again 1-2 weeks post-intervention in MCI Patients only. The two timepoints were separated by 8-10 weeks.

Multilevel linear models (MLMs) were used to analyze within-subject change over time for the RBANS Total score and 5 subscale scores. There was significant

[1] Of note, the p-values for the log-likelihood ratio and t-statistic are typically similar but not identical. This is because the two tests ask two different questions about the null hypothesis, both of which are meaningful in this context. The log-likelihood test asks whether the observed ratio (the probability of the data under the random intercepts model over the probability of the data under the random intercepts + fixed slopes model) is very probable under the null hypothesis ($\alpha = 0.05$). The t-statistic asks whether the magnitude of the slope is very probable under the null hypothesis ($\alpha = 0.05$). In other words, the first is a model comparison question whereas the second is about the magnitude of the intervention effect (Kruschke, 2014). The former is reported only if statistically significant, and the latter is reported for all models because it is associated with our measure of effect size.

variability in baseline scores for all measures of cognitive functioning, exempting Visuospatial and Delayed Memory (all p's <0.01), which justified using the random intercepts parameter. The log likelihood test trended toward significance for the model adding a fixed effect of time on Immediate Memory (χ^2 (4) = 2.96, p = 0.086), suggesting an increase in Immediate Memory scores post-intervention (ß = 5.18, t(8) = 1.79, p = 0.111; see Figure 4). However, the magnitude of this increase (5.18) is less than ½ of a standard deviation for this measure, which is not considered clinically meaningful (Phillips et al., 2015). That said, 3 out of 9 participants did show a clinically meaningful increase (≥ 10 points; Phillips et al., 2015) in Immediate Memory of 20, 15, and 15 points, respectively. The remaining 6 participants showed equal to or less than 4-point change (0.27 SDs) in either direction, suggesting that one third of the sample experienced a clinically meaningful improvement in Immediate Memory, whereas the remainder were stable (see Figure 4).[2] More generally, all parameters for the effect of the intervention on cognitive functioning were positive exempting Language, indicating stable or slightly higher cognitive functioning post-intervention.

In summary, Immediate Memory may have improved after the 6-week mindfulness course. There were no other statistically or clinically significant improvements or deteriorations in cognitive functioning (see Table 15).

[2] Although the effect of the intervention appears to vary somewhat across individuals, the degree of variability was not statistically significant. Allowing slopes to vary randomly did *not* significantly improve model fit (χ^2 (6) = 1.08, p = 0.583).

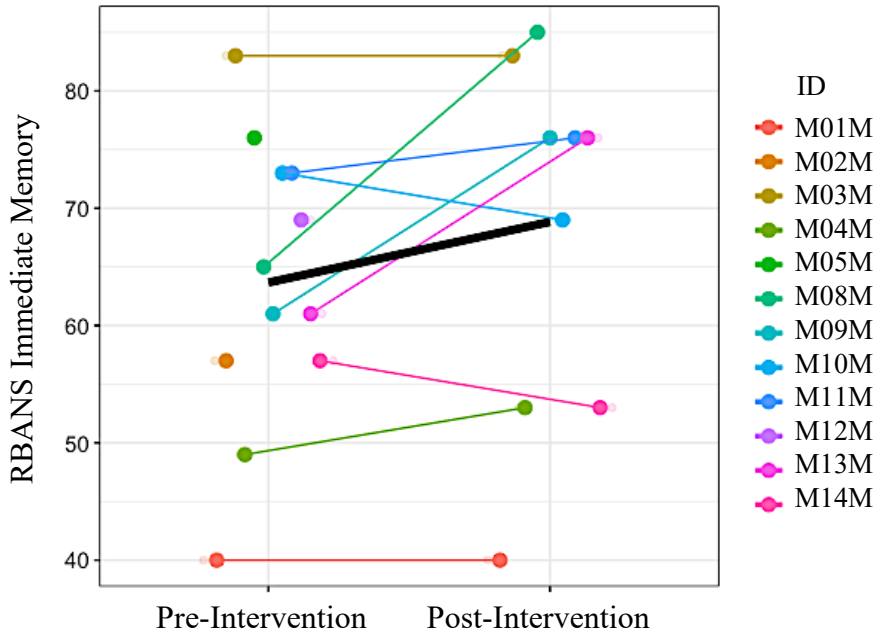
Table 15

Effects of 6-Week Mindfulness Training on Cognitive Functioning

RBANS	ß	*SE* ß	95% CI	t-value	p-value
Total	2.74	2.59	-3.0, 8.4	1.05	0.323
Immediate Memory	5.18	2.89	-1.2, 11.5	1.79	0.111
Visuospatial	2.97	6.70	-11.7, 17.7	0.44	0.669
Language	-0.46	3.04	-7.1, 6.2	-0.15	0.883
Attention	1.12	2.94	-5.3, 7.6	0.38	0.712
Delayed Memory	2.14	5.17	-9.2, 13.5	0.41	0.689

Figure 4

Immediate Memory Before and After Mindfulness Training



Note. The grand slope (ß = 5.18, t(8) = 1.79, p = 0.111) is shown in black. There was significant variability in baseline functioning, and 3 of 9 older adults with MCI showed clinically significant improvement (M08, M09, M13). Most other participants remained stable.

Psychological Distress. Depression, Anxiety, and Caregiver Burden (Caregivers only) were measured pre- and post-intervention. Caregiver's Depression, Anxiety, and

Burden scores were significantly variable at baseline (all p's < 0.01), whereas those of MCI Patients were not. There were no statistically significant effects of the 6-week mindfulness intervention on any measure of Psychological Distress for either MCI Patients or Caregivers (see Tables 16 & 17). However, Caregivers experienced a nearly 4-point increase in Anxiety. This degree of change is within or exceeds several previously published ranges for "minimally important difference" for this measure (Lee et al., 2017; Swanholm et al., 2014; Yost et al., 2011). Caregiver's mean Anxiety post-intervention (M = 58.4 (13.2)) also rose to the "Mild Anxiety" range, suggesting Caregivers may have experienced a clinically meaningful increase in anxiety after mindfulness training.

Table 16

Effects of 6-Week Mindfulness Training on Psychological Distress: MCI

	ß	***SE* ß**	**95% CI**	**t-value**	**p-value**
Depression	-1.437	2.389	-6.68, 3.80	-0.601	0.564
Anxiety	1.161	3.191	-3.43, 4.27	0.364	0.725

Table 17

Effects of 6-Week Mindfulness Training on Psychological Distress: Caregivers

	ß	***SE* ß**	**95% CI**	**t-value**	**p-value**
Depression	-0.043	2.166	-4.79, 4.71	-0.020	0.985
Anxiety	3.893	2.395	-1.34, 9.15	1.626	0.143
Caregiver Burden	0.34	1.68	-3.3, 4.0	0.20	0.847

***Perceived Health*.** Fatigue, Pain Interference, Physical Function, Sleep Disturbance, and Social Functioning were measured pre- and post-intervention. Pain

Interference and Physical Functioning were not analyzed in MCI Patients due to poor reliability and validity (see Appendix C).

MCI patient's Sleep Disturbance scores were significantly variable at baseline (χ^2 (3) = 6.853, p < .01). The same was true of Caregiver's Fatigue, Physical Function, and Social Functioning scores (all p's < .01). There was a significant improvement in model fit after adding a fixed effect of the intervention on Social Functioning in MCI Patients (χ^2 (4) = 5.876, p < .05). This means MCI Patients reported significantly better Social Functioning after the intervention (ß = 5.293, t(8) = 2.557, p < .05; see Figure 4), at clinically significant effect size for this PROMIS-29 measure (change of 1-2 points; Katz et al., 2020).[3] Of note, MCI Patient's Social Functioning was not impaired at baseline (M= 50.8 (6.9)) and increased to an above average level of Social Functioning after the intervention (M = 56.9 (7.4)). There were no intervention effects for any other measure of Perceived Health (see Tables 18 & 19).

Table 18

Effects of 6-Week Mindfulness Training on Perceived Health: MCI

	ß	***SE* ß**	**95% CI**	**t-value**	**p-value**
Fatigue	-3.167	1.978	-7.51, 1.17	-1.601	0.148
Sleep Disturbance	-1.984	2.169	-6.74, 2.77	-0.915	0.387
Social Functioning	5.293	2.070	0.75, 9.83	2.557	0.034*

*p < 0.05

[3] Change in Social Functioning did not vary significantly across participants (χ^2 (6) = 0.02, p = 0.990).

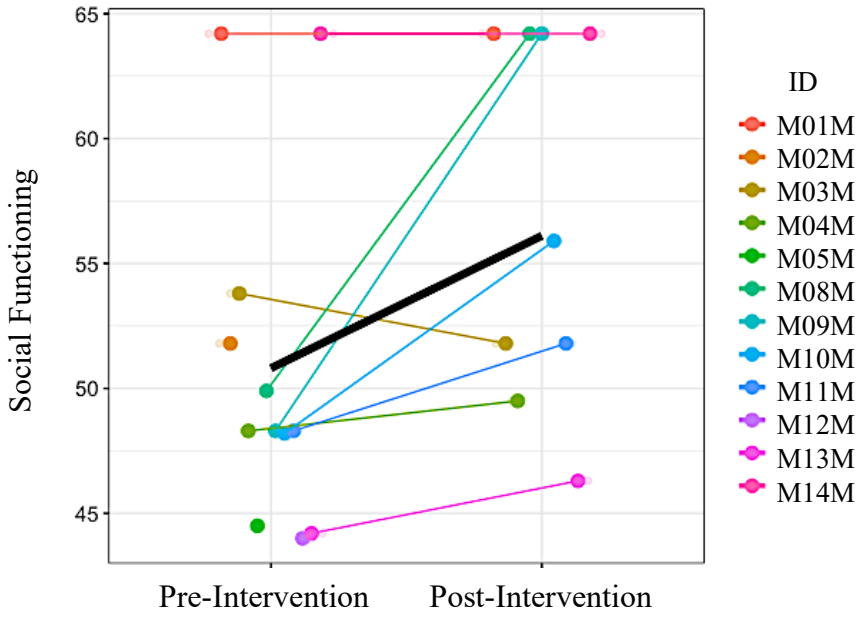
Table 19

Effects of 6-Week Mindfulness Training on Perceived Health: Caregivers

	ß	*SE* ß	95% CI	t-value	p-value
Fatigue	2.091	1.985	-2.26, 6.45	1.053	0.323
Pain Interference	2.464	3.147	-4.44, 9.37	0.783	0.456
Physical Function	1.494	1.141	-1.01, 4.00	1.309	0.227
Sleep Disturbance	0.983	2.946	-5.48, 7.44	0.334	0.747
Social Functioning	-1.539	1.930	-5.77, 2.70	-0.797	0.448

Figure 5

MCI Patients' Social Functioning Before and After Mindfulness Training



Mindfulness. Trait mindfulness was measured pre- and post-intervention using the Mindful Attention Awareness Scale (MAAS). Application of mindfulness skills in daily life was measured during the intervention at Weeks 2, 4, & 6 using the Applied Mindfulness Process Scale (AMPS). In MCI Patients, the Decentering subscale of the AMPS was omitted in its entirety due to poor reliability and validity. One timepoint

(Week 4) of the AMPS Total Score and the AMPS Negative Emotion Regulation Score was omitted in MCI Patients for the same reason (see Appendix C).

There was significant variability in baseline values across MCI Patients for the AMPS Positive Emotion Regulation, and for all outcome variables in Caregivers (all p's < .05). There was no effect of 6-week mindfulness training on trait mindfulness for either MCI Patients or Caregivers, and no effect of the intervention on MCI Patients' applied mindfulness in daily life. In Caregivers, applied mindfulness skills increased over time for the AMPS Total Score (χ^2 (4) = 7.442, p < 0.01; ß = 3.278, t(16) = 2.934, p < .01), AMPS Decentering (χ^2 (4) = 6.495, p < 0.05; ß = 1.389, t(16) = 2.700, p < .05), and AMPS Negative Emotion Regulation (χ^2 (4) = 5.061, p < 0.05; ß = 1.000, t(16) = 0.429, p < .05). For AMPS Positive Emotion Regulation the fixed effect of the intervention trended toward significance (χ^2 (4) = 3.637, p < 0.057), indicating increased mindfulness of positive emotions over time (ß = 0.889, t(16) = 1.934, p = 0.071). All intervention effects are reported in Tables 20 and 21 and Caregiver's applied mindfulness over time is shown in Figure 6.

Table 20

Effects of 6-Week Mindfulness Training on Mindfulness: MCI

	ß	***SE* ß**	**95% CI**	**t-value**	**p-value**
MAAS	-0.245	0.202	-0.69, 0.20	-1.214	0.295
AMPS Total	-.333	1.543	-3.69, 3.02	-0.216	0.834
AMPS Positive ER	0.278	0.449	-0.64, 1.19	0.619	0.545
AMPS Negative ER	-0.167	0.722	-1.74, 1.40	-0.231	0.823

Table 21

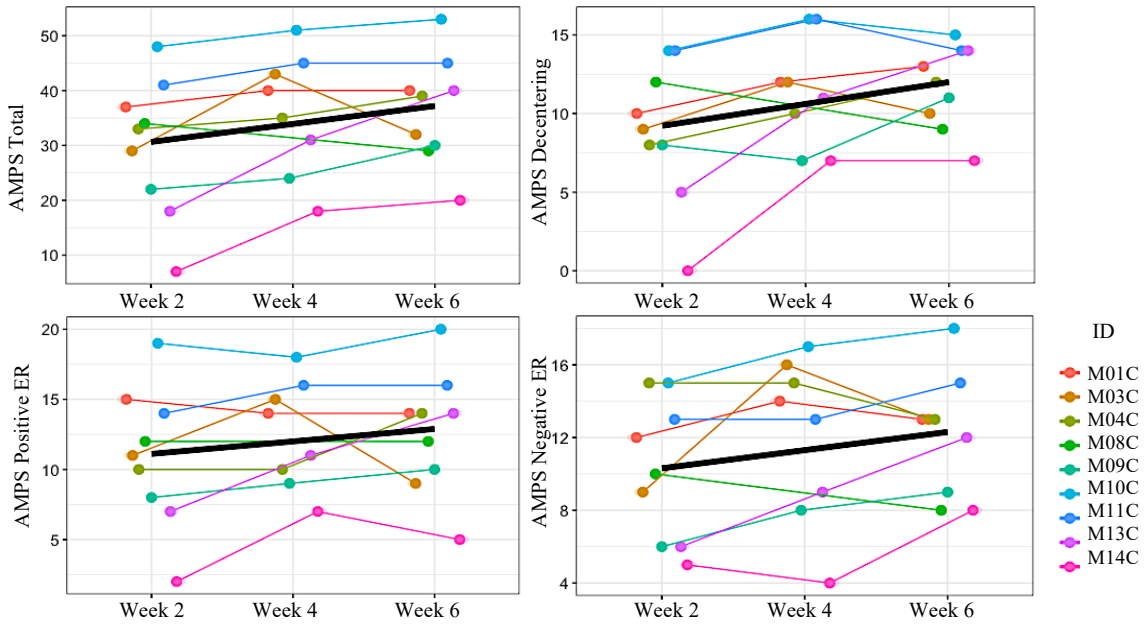
Effects of 6-Week Mindfulness on Mindfulness: Caregivers

	ß	*SE* ß	95% CI	t-value	p-value
MAAS	-0.038	0.217	-0.51, 0.44	-0.176	0.864
AMPS Total	3.278	1.117	1.00, 5.55	2.934	0.008*
AMPS Decentering	1.389	0.514	0.34, 2.44	2.700	0.016*
AMPS Positive ER	0.889	0.460	-0.05, 1.82	1.934	0.071
AMPS Negative ER	1.000	0.429	0.13, 1.87	2.332	0.033*

*p < 0.05

Figure 6

Application of Mindfulness Skills in Daily Life (AMPS) Weeks 2-6



Note. There was significant variability in daily application of mindfulness skills the first time it was assessed, at Week 2 of the intervention. Nearly all caregivers showed an improvement during the 6-wk course, over time.

Vascular Risk. Resting heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and body mass index (BMI) were collected 1-2 weeks prior to the

intervention and 1-2 weeks after the intervention. Timepoints were therefore separated by 8-10 weeks.

There was significant variance in baseline values across participants for HR in MCI patients and SBP and BMI in Caregivers (all p's < 0.01). The effect of the intervention on Caregiver's BMI also varied significantly across participants (χ^2 (6) = 8.778, p < 0.05). However, there were no fixed effects of the intervention on any outcome variable (see Tables 22 & 23).

Table 22

Effects of 6-Week Mindfulness Training on Vascular Risk: MCI

	ß	***SE* ß**	**95% CI**	**t-value**	**p-value**
HR	-1.057	3.270	-8.23, 6.11	-0.323	0.755
SBP	3.509	4.192	-5.69, 12.70	0.837	0.427
DBP	-0.378	2.416	-5.68, 4.92	-0.157	0.879
BMI	-2.237	1.699	-5.96, 1.49	-1.317	0.225

Table 23

Fixed Effects of Time on Vascular Risk: Caregivers

	ß	***SE* ß**	**95% CI**	**t-value**	**p-value**
HR	5.420	3.969	-3.29, 14.13	1.366	0.209
SBP	-2.401	2.329	-7.63, 2.82	-1.031	0.337
DBP	-0.464	1.796	-4.49, 3.56	-0.258	0.804
BMI	-0.669	1.557	-4.08, 2.75	-0.430	0.679

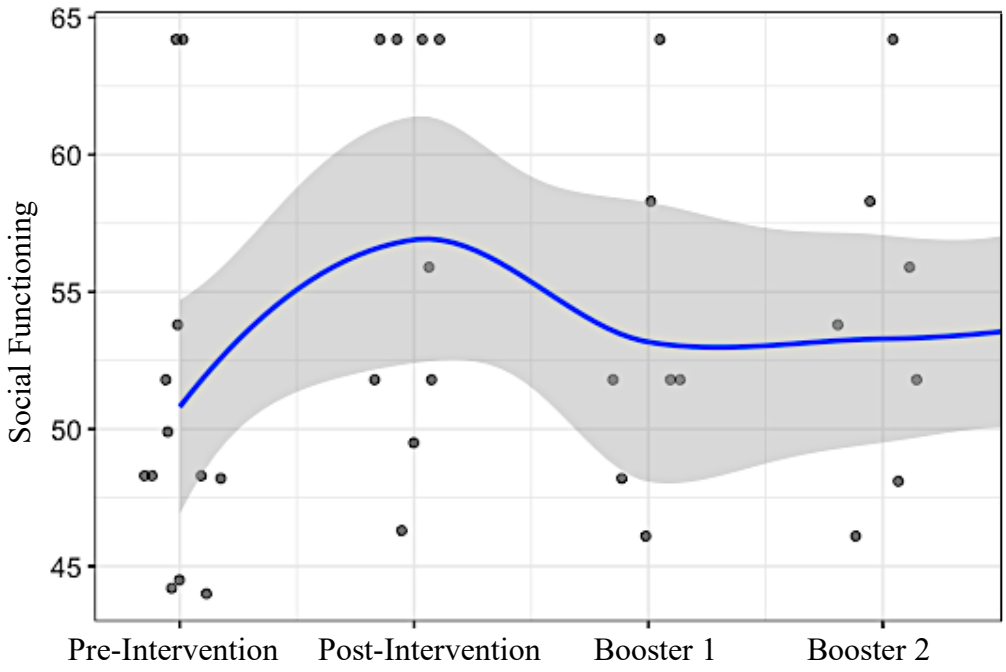
Durability. Measures of Psychological Distress, Perceived Health, and Mindfulness were collected at Booster Sessions occurring 1, 2, and 3 months after the 6-week intervention. BMI was collected 3 months after the intervention. MLMs were

conducted to analyze change in each outcome variable after the intervention (timepoints 2-5). In MCI Patients, timepoints 3-5 for Sleep Disturbance and timepoint 5 for Social Functioning were not analyzed due to poor reliability and validity (see Appendix C).

There were no changes in Anxiety or Depression through the follow-up timepoints. MCI Patients' Social Functioning dropped at follow-up, but not significantly so (ß = -0.595, t(13) = -0.760, p = 0.460; see Figure 6). The magnitude of this drop (3.7 points) would be considered clinically significant by some standards (1-2 points; Katz et al., 2020) but not others (5 points; Norman et al., 2003). At Booster Session 2, MCI Patients remained 3.2 points above their baseline average (50.8 T) level of Social Functioning. There were no further changes in MCI Patients' Perceived Health or Mindfulness. For Caregivers, there was a trend toward less Sleep Disturbance over the follow-up period (χ^2 (4) = 3.636, p = 0.057) wherein Sleep Disturbance dropped at Booster Session 1 then remained constant through the final follow-up point (ß = -1.613, t(20) = -1.903, p = 0.071; see Figure 7). Finally, Caregivers showed an increase in trait mindfulness (MAAS) at follow-up that was not apparent post-intervention (χ^2 (4) = 4.585, p < .05; ß = -1.613, t(20) = -1.903, p = 0.071; see Figure 8). BMI was constant through follow-up for all participants.

Figure 7

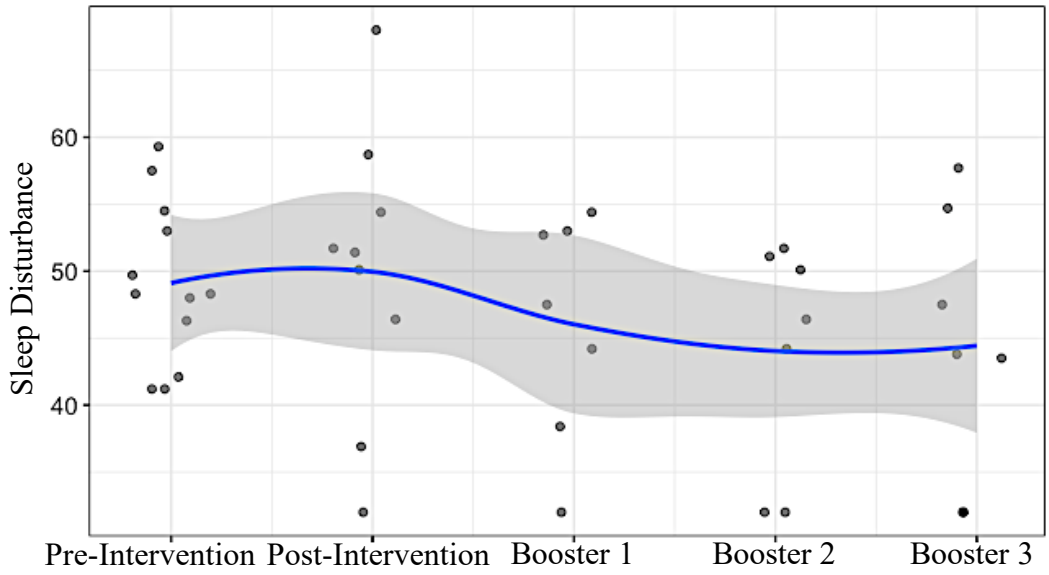
MCI Patients' Social Functioning



Note. MCI Patients' Social Functioning increased post-intervention and decreased marginally, but not significantly, through Booster Sessions 1 & 2.

Figure 8

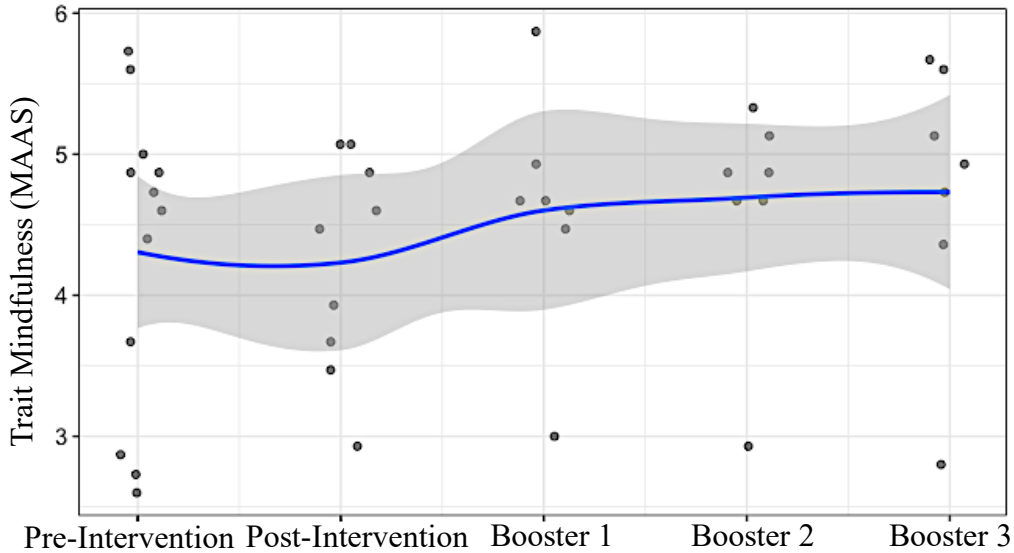
Caregivers' Sleep Disturbance



Note. Caregivers trended toward decreased Sleep Disturbance following the intervention.

Figure 9

Caregiver's Trait Mindfulness (MAAS)



Note. Caregiver's trait mindfulness (MAAS) increased after the intervention.

Qualitative

Post-intervention Feedback Forms and Meditation Logs were analyzed for content related to whether participants felt they benefitted from the intervention and, if so, how. Two themes relevant to effectiveness emerged: (1) *Development of Mindfulness Skills* and (2) *Enhanced Well-Being.* The themes and codes used for analyses related to effectiveness are detailed in Table 24.

Table 24

Themes and Codes used for Effectiveness Analysis

Theme	Sub-theme	Code	Description	Inclusion Guideline	Exclusion Guideline
3. Development of Mindfulness Skills	*3.1 Awareness*	3.1.1 Awareness of Sense Objects	Participant records awareness of body, breath, sound, thought, or emotion	Body sensations, breath, sound, thought, or emotion during or immediately following meditation	Awareness of sense objects outside formal meditation practice; awareness of relaxation, distraction, or aversion
		3.1.2 Awareness of Distraction	Participant records awareness of distraction	Wandering mind, difficulty focusing, distracted by internal or external stimuli	Awareness of distraction outside formal meditation practice
		3.1.3 Presence & Directed Attention	Participant records sustained attention or re-directing their attention back to practice after becoming distracted	Periods of focus, presence, or concentration; coming back to the anchor	Recording differences in focus between practices
	3.2 Establishing Meditation Practice	3.2.1 Experimenting with Practice	Participants records experimenting with meditation practice	Identifying favorite practices; comparing practices; comparing meditation to mindfulness in daily life; feeling challenged by a new technique; experimenting with position, location, or time of day	Adverse effects of meditation
		3.2.2 Perceived Improvement	Participant records their practice improving and/or commits to continue practicing	Better awareness or nonjudgment either within or between practices; recognizing importance of practice; more able to relax	Recording that the intervention, as a whole, made them more mindful

Theme	Sub-theme	Code	Description	Inclusion Guideline	Exclusion Guideline
3. Development of Mindfulness Skills (continued)	*3.3*	3.3 Acceptance	Participant records nonjudgment of their experience in meditation	Re-directing attention without judgment; acceptance or self-compassion during meditation	Recording that the intervention, as a whole, made them more accepting
	3.4	3.4 Mindfulness of Others	Participant reflects on a relationship as part of meditation practice or mindfulness in daily life	Sending lovingkindness; spending time with others as a mindful activity; awareness of others	Recording that the intervention, as a whole, improved their relationships
	3.5	3.5 Relaxation	Participant records feeling calm, relaxed, and/or peaceful	Relaxed, calm, tranquil, peaceful; desired sleepiness; noticing gradual relaxation; practicing relaxing during stress and/or mindful activities	Recording sleepiness as a barrier to practice; recording that the intervention, as a whole, made them more relaxed
	3.6	3.6 Mindfulness in Daily Life	Participant records mindfulness activity practice	Present for chores, meals, social activities, etc.; using mindfulness skills during a stressful experience; enjoying positives; applying mindfulness skills to daily life	Reflecting on differences between meditation and mindfulness in daily life

Theme	Sub-theme	Code	Description	Inclusion Guideline	Exclusion Guideline
3. Development of Mindfulness Skills (continued)	*3.7 Challenges in Meditation Practice*	3.7.1 Sleepiness	Participant records undesired or neutral sleepiness during practice	Sleep interrupting meditation; fighting off sleep; dozing off	Using meditation as a sleep aide or being happy to have slept during practice.
		3.7.2 Attachment & Aversion	Participant records unpleasant and/or unwanted distraction, emotion, or sensation	Frustrated by trouble focusing, unpleasant emotions, pain; dissatisfied with session; trouble relaxing; rushing through	Giving a neutral account of an unpleasant experience; strong desire to stop meditating
		3.7.3 Questioning the Practice	Participant records confusion about mindfulness and/or meditation	Wondering if I'm "doing it right"; misunderstanding the practice; questioning aspects of specific practices	Implicit confusion
4. Enhanced Well-Being	*4.1*	4.1 Enhanced Physical Well-Being	Participant records relief from physical discomfort and/or positive physical sensations	Pain relief; better sleep; enjoying stretching; in tune with body	Neutral body or breath awareness

Theme	Sub-theme	Code	Description	Inclusion Guideline	Exclusion Guideline
4. Enhanced Well-Being (continued)	*4.2 Enhanced Psychological Well-Being*	4.2.1 Feeling Good	Participant records positive feeling(s) attributed to meditation and/or the intervention	Feeling good; less stressed/anxious; less reactive; more relaxed; gratitude; positive affect; pleasant thoughts; enjoying the positives; taking a break from stressful environments	Better sleep
		4.2.2 More Present & Aware	Participant records increased presence and/or awareness, either related to a meditation practice, mindful activity, or the intervention as a whole	"Yes" I am more mindful now; sustained attention; focusing on the now; self-awareness; meditation helped me focus; increased presence in daily life	Awareness of sense objects in meditation logs
		4.2.3 More Accepting	Participant records increased acceptance of difficulty, either related to a meditation practice, mindful activity, or the intervention as a whole	Shift in perspective on MCI (patient or caregiver); acceptance of things we can't control; nonjudgment during meditation; more patient; more flexible	
	4.3	4.3 Enhanced Interpersonal Well-Being	Participant records improved mindfulness of others or satisfaction in relationships	Shift in perspective on others; more aware of others; appreciation for others including partner	Neutral reports of others during mindful activities
	4.4	4.4 Enhanced Spiritual Well-Being	Participant records prayer, spiritual, or religious experiences related to mindfulness practice	Mindful prayer; unity of body, mind & spirit; connection with God; nondual experience	Reporting religious activities unconnected with the intervention

Development of Mindfulness Skills. This theme refers to the practice of mindfulness skills throughout the intervention. It does not refer to benefits of the intervention, meaning that this theme covers positive, neutral, or challenging practice of mindfulness skills. As such, all sample quotations under this theme are drawn from Meditation Logs, in which participants are mainly reflecting on daily meditation practice. The definition of this theme and its subthemes was informed by the "Developing Profiency" and "Development of Mindfulness Skills" themes in Isbel et al. (2020) and Wells et al. (2019), respectively. Codes within the theme of *Development of Mindfulness Skills* were organized into seven sub-themes: (1) *Awareness,* (2) *Establishing a Meditation Practice,* (3) *Acceptance,* (4) *Mindfulness of Others,* (5) *Relaxation,* (6) *Mindfulness in Daily Life,* and (7) *Challenges in Meditation Practice*. The sub-theme *Awareness* was divided, in turn, into three codes: (1) *Awareness of Sense Objects,* (2) *Awareness of Distraction,* and (3) *Presence & Directed Attention*. Similarly, the sub-theme *Establishing a Meditation* Practice was divided into two codes: (1) *Experimenting with Practice* and (2) *Perceived Improvement.* This theme was informed by the "Experimenting with Practice" and "Developing Proficiency" themes from Isbel et al. (2020). Finally, the sub-theme *Challenges in Meditation Practice* was divided into three codes: (1) *Sleepiness,* (2) *Attachment & Aversion,* and (3) *Questioning the Practice.* This sub-theme parallels Isbel et al.'s (2020) "Difficulties with Practice" theme. The frequency of thematic content and sample quotations for each theme are reported in Table 24 for MCI Patients and Table 25 for Caregivers.

Enhanced Well-Being. This theme refers to participants' perceived benefits from the intervention as a whole. It does not refer to neutral or challenging accounts of

mindfulness skill development. This theme was informed by Wells et al. (2019) and is a rough amalgamation of their "Enhanced Well-Being," "Shift in Perspective About MCI," "Decreased Stress Reactivity and Improved Relaxation," and "Improvement in Interpersonal Skills" themes. It also parallels Isbel and colleague's (2020) "Benefits of Mindfulness" theme. Sample quotations under this theme are drawn from both Feedback Forms and Meditation Logs. Codes within the theme of *Enhanced Well-Being* were organized into four subthemes: (1) *Enhanced Physical Well-Being,* (2) *Enhanced Psychological Well-Being,* (3) *Enhanced Interpersonal Well-Being,* and (4) *Enhanced Spiritual Well-Being.* The subtheme *Enhanced Psychological Well-Being* was divided, in turn, into three codes: (1) *Feeling Good*, (2) *More Present & Aware,* and (3) *More Accepting*. The frequency of thematic content and sample quotations for each theme are reported in Table 25 for MCI Patients and Table 26 for Caregivers.

All sample quotations in the following tables are from Meditation Logs, unless otherwise specified. Participants often logged which type of practice they did, in which case this is included in brackets before the sample quotation. Sample quotations from Feedback Forms are preceded by the question, in bold, from the form the quotation is addressing.

Table 25

Effectiveness in MCI Patients

Code	Frequency	Sample Quotations
3.1.1 Awareness of Sense Objects	25	• "…Felt my stomach go up and down." • "Watching breath." • "Focusing on parts of my body while I breathed…" • "Feet flat on floor. Paid attention to each part as it was described." • "…could hear myself breathing." • "Feeling slight pain in the left knee."
3.1.2 Awareness of Distraction	5	• "…Traveling thoughts…" • "…I was distracted somewhat." • "Easy to relax, but hard to focus. Racing thoughts…" • "Hard to focus tonight, kept getting distracted."
3.1.3 Presence & Directed Attention	14	• "Paid attention to my breathing." • "…feeling in the now." • "Relaxed, focused." • "(Body Scan) …relaxation as I concentrated on each part. Feel it coming up my legs, concentrating on what he says." • "(Chair Yoga) Was able to concentrate." • "(Open Awareness) Trying to focus on things going on around me."
3.2.1 Experimenting with Practice	26	• "Sat in my recliner. I felt more air coming in and going out than laying on the floor." • "Concentrating on different parts. Easier during the morning." • "(Mindful Breathing) So practical – this is my favorite meditation." • "(Belly Breathing) This time I took deeper breaths and it felt very good." • "(Meditation Poem) Calming, smiling – love this technique! (Poem helps ground me)" • "(Meditation Poem) Smiling while breathing actually made me feel happy."

Code	Frequency	Sample Quotations
3.2.2 Perceived Improvement	16	• "Racing thoughts but easy to come back to center." • "Relaxing, easy to concentrate." • "Felt better than the last time I did this exercise." • "(Mindful Breathing) Relaxed – able to participate better." • "(Mindful Breathing) The more I do it the better I feel." • "(Belly Breathing) This is becoming very natural to me…" • "(Belly Breathing) It seems the more I do the exercise the better I feel." • "(Chair Yoga) I am getting acquainted with the system now even more and am valuing the session."
3.3 Acceptance	3	• "(Body Scan)…focusing on various body parts brings an appreciation of all of them." • "(Body Scan) Feeling slight pain in the left knee. I went on with the awareness experience." • "(Lovingkindness) Thought of kindness to myself and others."
3.4 Mindfulness of Others	13	• "Petting my cat; feeling the vibrations of her purring as I run my hands through her soft fur." • "Thinking of a loved one during this exercise was very enjoyable." • "I pictured my pet dog and how gentle and kind she is." • "(Lovingkindness) Thought of my cats who love me unconditionally." • "(Lovingkindness) I asked Jack his feelings while listening to the CD. He said he felt peace. He is unable to write because of tremors; he said he thought of our kids and grandkids." • "(Lovingkindness) Happy, healthy, free from pain, and safety for all."
3.5 Relaxation	60	• "…wonderful 30 minutes to wind down and sleep with happy thoughts." • (Mindful Breathing) It was relaxing." • (Mindful Breathing) Was totally relaxed – deeper I went more I lost contact with surroundings. Great feeling." • "(Belly Breathing) Deep sleeping. Very relaxed and wanted more." • "(Body Scan) Feeling edgy and antsy. The body scan calmed me down." • "(Body Scan) Relaxed, comfortable, no tension." • "(Meditation Poem) Felt totally at ease and relaxed." • "(Open Awareness) The most peaceful and relaxing experience."

Code	Frequency	Sample Quotations
3.6 Mindfulness in Daily Life	24	• "Cutting shrubs and tree branches. Noticing areas that need trimming, cutting through the branches, piling up and trimming them. Dragging them out front, body is sweaty branches are rough. Sounds of the rake on the ground. I enjoy working hard. I feel invigorated when I am working. Grandsons helping. Laughing and running around." • "Watching the ocean, walking the beach; observing the ocean, listening to the wind on the beach." • "Eating a meal; Hard to do without TV on or conversation, but I noticed more about it." • "Tore down a huge tree branch and cut down another; one tree branch fell. Cut off leaves and small branches. Son cut other one with a chain saw. Sounds of the saw cutting through the wood. Snap of small branches, crunch of dead leaves." • "Daily nice hot showers…calms me down and picks up my spirits and self-confidence."
3.7.1 Sleepiness	17	• "(Belly Breathing) Fell asleep." • "(Belly Breathing) I almost fell asleep, I guess I was really relaxed." • [same participant, following day] "(Belly Breathing) I did fall asleep this time…" • "(Body Scan) I was very relaxed and tended to dose." • "(Body Scan) Very relaxing – almost fell asleep again." • "(Meditation Poem) Calming, smiling – nearly fell asleep (again!)" • "(Open Awareness) Put to sleep, got startled by cat eating dog food"
3.7.2 Attachment & Aversion	20	• "…My neck really hurt when I was laying on the floor. It was really stiff – moved it right to left to stretch it." • "Listened to cassette; more relaxed but still anxious." • "(Body Scan) No pain: just couldn't get into it today though." • "(Belly Breathing) Do not like focusing on the movement of belly." • "(Meditation Poem) Relaxed but not thrilled with session." • "(Class) Hard to relax in the group."
3.7.3 Questioning the Practice	4	• "How hard to completely relax, especially on command." • "(Belly Breathing) I had to concentrate in order to keep this going, ok?"

Code	Frequency	Sample Quotations
4.1 Enhanced Physical Well-Being	11	• "(Body Scan) Less pain in troublesome spots than I experience usually." • "(Meditation Poem) …Totally relaxing. Did try to loosen neck which had been tight. It felt better." • "(Chair Yoga) Felt good to stretch and loosen up. No PAIN." • "(Open Awareness) I nearly fell asleep – not a bad thing at all!"
4.2.1 Feeling Good	86	• "(Mindful Breathing) …Feels peaceful and calming." • "(Mindful Breathing) Really felt good to get back to this." • "(Belly Breathing) Very relaxed and restful – able to really rest." • "(Body Scan) It feels good. Helps me relax." • "(Body Scan) More relaxed and upbeat." • "(Meditation Poem) I enjoyed listening to it – it feels good and relaxing." • "(Meditation Poem) Good session – good feeling." • "(Chair Yoga) I enjoy the stretching. Feels good" • "(Lovingkindness) Picturing a good friend helped me feel good." • "(Open Awareness) Very soothing."
4.2.2 More Present & Aware	17	**Do you feel more mindful now, compared to before the course? If so, how?** • "Yes, I now look at routine and routine happenings in a more intuitive manner." • "Yes, more focused on the now and being in the moment." • "Yes. I stop and think about keeping calm." **Do you feel you got something of lasting value from the course? What was most meaningful to you?** • "The course was of lasting value as it brought out many thoughts which were dormant in my mind." **From Meditation Logs:** • "(Meditation Poem) Relaxed but not removed from present happenings." • "(Mindful Breathing) Easy to relax, but hard to focus. Racing thoughts but easy to come back to center."

Code	Frequency	Sample Quotations
4.2.3 More Accepting	5	**What did you find most helpful about the course?** • "Acceptance of situations out of my control." • "Not worrying so much." **Do you feel you got something of lasting value from the course? What was most meaningful to you?** • "Yes, learning how to live better and be more grateful for what I can do rather than fret over what I can't do." **Do you feel more mindful now, compared to before the course? If so, how?** • "Yes – I'm more aware of my limitations and how to work with them rather than fret that I can't do things the way I used to."
4.3 Enhanced Interpersonal Well-Being	13	**Other comments?** • "…I'm grateful my husband got to see/hear some of my issues and how to better work with me rather than get mad or lose patience with me." **From Meditation Logs:** • "(Lovingkindness) Thought of my mother, pleasant memories. Like thinking nice thoughts of others and myself." • "(Lovingkindness) Thinking about the great wife I am taking this class with made me feel thankful." • [Mindful activity] "I was worried about remembering the names of people we were visiting. I rehearsed them on the drive to help me recall them. As weekend went on I relaxed and enjoyed it."
4.4 Enhanced Spiritual Well-Being	0	--

Table 26

Effectiveness in Caregivers

Code	Frequency	Sample Quotations
3.1.1 Awareness of Sense Objects	62	• "Body sensations mixed. Thoughts are positive." • "(Belly Breathing) Skyward – fingers of my hands sliding out and in." • "(Body Scan) …Felt breathing, stomach churning, pain in a swollen lymph node." • "(Body Scan) …Flexing parts of body being scanned to focus concentration feeling breathing ache in neck." • "(Mindful Breathing) Feeling my breathing and hearing the oven cooking our dinner." • "(Open Awareness) Aware of breath, body, and quiet." • "(Open Awareness) …breathing – throat cool – relax, calming, smiling, body – feel relaxed, sound – trash truck outside gobbling trash."
3.1.2 Awareness of Distraction	33	• "(Belly Breathing) Mind wandered to a variety of thoughts." • "(Belly Breathing) Breathing, straighten legs, more mind wandering." • "(Meditation Poem) …A bit noisy outside, harder to stay focused." • "(Meditation Poem) Phone interruption, more distracted today." • "(Chair Yoga) …thoughts kind of drifted to the quiet room till the phone rang." • "(Meditation Poem) Still wandering."
3.1.3 Presence & Directed Attention	48	• "(Mindful Breathing) …Sometimes thoughts strayed but pulled back to the breathing." • "(Belly Breathing) Interrupted by phone but was able to get back into concentration." • "(Meditation Poem) …concentrated on the words. Feeling very focused." • "(Meditation Poem) Used gatha with and without words – sometimes so steady in breathing words were forgotten." • "(Meditation Poem) Only nap interruption and usual distraction then back to words." • "(Open Awareness) Interesting to pay attention to the sounds and thoughts instead of pulling mind back to breath."
3.2.1 Experimenting with Practice	49	• "I had a minor car accident. I had a lot of trouble sleeping. I tried to do belly breathing to calm down." • "(Lovingkindness) Lay down. Mind wanders more than when I sit." • "(Belly Breathing) …Sometimes feel trying to breathe a certain way causes tension." • "(Belly Breathing) Hard 2-3, soft 2-3, helps less mind wander – still a lot." • "(Body Scan) Morning, sitting on floor, legs folded under me, easier to concentrate with eyes closed." • "(Meditation Poem) Becoming the favorite."

Code	Frequency	Sample Quotations
3.2.2 Perceived Improvement	39	• "More comfortable with the exercises through repetition. Body feels more in tune with my mind." • "Distractions disappear immediately, calm…Mind focusing, body responding, can quickly get in tune with each other. Getting easier and more productive." • "(Belly Breathing) Easier to go back to mindful breathing after mind wanders." • "(Meditation Poem) Easier time today staying focused." • "(Mindful Breathing) Very relaxing and easier now to stay focused."
3.3 Acceptance	5	• "…mind flights – came back, all good" • "(Mindful Breathing) Relaxed – feeling my breathing, distractions and back all ok." • "(Belly Breathing) In out, inhale-relax, expand-relax, 'practice for where we are now.'" • "(Body Scan) chest expanding and contracting – distractions all good." • "(Open Awareness) Throat sore – relaxed, even smiled."
3.4 Mindfulness of Others	19	• [Mindful activity] Weeding with my grandson Isaac…Chatting with Isaac. Realizing how fast he is growing and how mature he's gotten. Noticing how blond his hair has gotten over the summer – probably due to so much pool time…Finding a bulb and explaining it to Isaac. Love my grandmom time." • "…In tune with body and Oreo my cat." • "(Lovingkindness) …Thoughts on father, husband. Hard to think of an acquaintance at first." • "(Lovingkindness) Wishing my husband less anxiety and more acceptance of his MCI." • "Listening to the CD I felt very relaxed…I thought of our 20-year-old grandson who took his own life two years ago over a girl. I wished him peace."
3.5 Relaxation	73	• "Another busy day. Was looking forward to relaxing. CD was soothing – breathing and exercises put me at ease. Tight and tired to calm and relaxed." • "Feel detached from the stresses of the world! Focusing on tranquility." • "(Mindful Breathing) …so relaxed arms fell off arms of the chair." • "(Body Scan) lying down – just calmness and relaxation." • "(Body Scan) Hard to focus at first, once I 'got there' it was so deep and relaxing. I felt more relaxed than I have in days." • "(Chair Yoga) My body and mind seemed to totally relax and remove me from the stress of the usual."

Code	Frequency	Sample Quotations
3.6 Mindfulness in Daily Life	40	• "I relaxed when I got mad at the traffic." • "Eating lentil soup; observing the different flavors, textures, and temperature." • "Sitting on my porch in a rocker enjoying the morning and birdwatching; watching the birds at the feeder. Seeing them hop around on the grass. Sparrows and finches dangle on the feeder perched. Turtle doves coo as they forage on the grass. The squirrel hangs upside down stealing seeds from the feeder." • "Wood working tonight before meditation. Emotions feeling gratified doing things I love to do." • "4 mile walk boardwalk; fluttering of flag, wind cool on face, breathing in and out, see reflections and shadows on boardwalk, deep breaths, rhythm/pace of walking." • "Used during golf; very hard to focus throughout the game."
3.7.1 Sleepiness	7	• "(Body Scan) Fell asleep." • "(Body Scan) Very tired when I started – was able to concentrate at first but fell sound asleep halfway through." • "(Body Scan) 12 min nap." • "(Meditation Poem) Fell asleep – immediately!"
3.7.1 Attachment & Aversion	18	• "(Belly Breathing) Find belly breathing more difficult and less relaxing. Takes much more effort and don't feel like I'm accomplishing it." • "(Listened to CD) It wasn't that helpful. I lost interest quickly." • "(Body Scan) Became aware of body pains that were normally ignored." • "(Body Scan) Not a fan of belly breathing in general hard to focus. Kept wandering and fidgeting." • "(Meditation Poem) Couldn't seem to get into mode – couldn't relax." • "(Open Awareness) Got started and half-assed attempt at least. Bad day and not interested in relaxing." • "(Lovingkindness) Rushed to get through."
3.7.2 Questioning the Practice	6	• "Having difficulty understanding concept of 'mindful activity' and mindfulness. Seems to be contradictory." • [Mindful activity] "Tried on numerous activities; Having difficulty determining if I am being mindful." • "(Lovingkindness) Curious why people would have difficulty wishing themselves the same kind thoughts they wish others." • "(Lovingkindness) Strange to wish feeling good to strangers and people you do not like." • "(Lovingkindness) I feel there are too many characters to wish well. Probably better to limit number."

Code	Frequency	Sample Quotations
4.1 Enhanced Physical Well-Being	28	• "…feeling lighter and focused. Normal body pain eases up and feel cool and comfortable." • "Yoga was toughest part due to soreness from Friday activities. Tired and soreness bodywise – thoughts of relaxing and relieving those effects…Tension and soreness seems to be easing up – feeling better." • "Body responds to breathing faster and better having my technique, feeling great. Can scan and relax parts and functions of my body that need the most attention." • "(Meditation Poem) Using it frequently at night to sleep better." • "(Chair Yoga) Felt good to stretch – some neck pain, more aware of body in different poses."
4.2.1 Feeling Good	93	**Do you feel you got something of lasting value from the course? What was most meaningful to you?** • "Very peaceful feelings." • "Yes, I know that if I'm stressed, I can meditate to calm me down." **From Meditation Logs:** • "Feeling positive – relaxed, confident emotions high reflecting on the day." • "Seems to work excellent for me. Having the experience and effects. More secure in my procedure in relaxing faster and feeling good! More in control of my thoughts and body, more responses emerging!" • "(Mindful Breathing) …This felt good." • "(Belly Breathing) Enjoyable." • "(Chair Yoga) Very much enjoyed this meditation. By participating (bodywise) my mind really stayed focused. Good experience." • "(Lovingkindness) Definitely a feel-good meditation. Nice to wish kindness and care."
4.2.2 More Present & Aware	39	**Do you feel more mindful now, compared to before the course? If so, how?** • **"**Yes, I think I am making more of an effort to be present in the moment and enjoy the things I am doing." • "I do feel more mindful, especially my breathing." **Do you feel you got something of lasting value from the course? What was most meaningful to you?** • "Being more aware of myself, my partner, and the people and events around me." **What did you find most helpful about the course?** • "To remember to be in the moment." **From Meditation Logs:** • "(Mindful Breathing) Calming, relaxing getting in tune. Mind and body: aware of what is going on in each!" • "(Open Awareness) Breathing – body…raindrops on windows, calming – relaxing, less distraction."

Code	Frequency	Sample Quotations
4.2.3 More Accepting	15	**What did you find most helpful about the course?** • "Most helpful in finding a way to reduce stress and accepting problems. Have learned how to be more helpful at home." **Do you feel you got something of lasting value from the course? What was most meaningful to you?** • "…Becoming aware that I can accept things as they are and I do not have to attempt to change things." • "Habit of being more mindful, focus on what we can control, not accentuating the wrong – we have more right than wrong." **Other comments?** • "…I find myself more understanding and patient and my husband more accepting and less anxious." **From Meditation Logs:** • [Mindful Activity] "We were spending the weekend with old friends. Concerned when [my partner] had trouble remembering a story he had started or when he repeated the story over again; Realized our friends are true friends and they understood and loved us anyway."
4.3 Enhanced Interpersonal Well-Being	28	**Do you feel more mindful now, compared to before the course? If so, how?** • "Definitely more mindful in my personal relationships and how I react to events and issues as they arise." • "Yes, more aware of feelings of others, especially my life partner (wife)." **Do you feel you got something of lasting value from the course? What was most meaningful to you?** • ""Yes – take that deep breath – slowing down "engage mind before putting mouth in gear" rational and wise before emotional." **From Meditation Logs:** • "Working on craft gifts for family, relaxing with my cat…helping [my spouse]; More focused on staying positive! More times thinking before reacting! Catching myself more on my thought control! Feeling better about myself totally."
4.4 Enhanced Spiritual Well-Being	16	• "Feel the relaxation taking effect as I'm breathing. Feel lighter than air, like floating, so many pleasant thoughts, also feels like I'm inside myself, feels illuminating." • "Peace – Strength – awareness – relaxed. Body – mind and spirit – very relaxed. Sense of myself experiencing oneness with myself and God." • "Mind focusing, body responding, can quickly get in tune with each other. Getting easier and more productive. Prayerful meditation great exercise for the body, mind, and soul."

Broadly, this analysis shows participants engaging in the skills taught in the intervention (awareness, acceptance, mindfulness of others, relaxation, and mindfulness in daily life) and encountering the expected challenges associated with learning meditation (e.g. sleepiness, distraction, attachment & aversion, confusion). Most participants (n=12) made at least one comment that reflected awareness practice, whether it was of the breath, body, sounds, thoughts, or emotions. Similarly, many (n=10) wrote about noticing distraction and redirecting their attention back to meditation. Participants also logged trying out new positions, times of day, meditation practices, and locations for meditation practice (n=12) and wrote about using mindfulness skills in daily life (n=12). "Mindfulness of Others" became its own sub-theme, since participants practiced formal lovingkindness meditation (e.g. "I pictured my pet dog and how gentle and kind she is.") and several included others in their "mindful activities" (e.g. "Weeding with my grandson…"). However, this mindfulness skill was slightly less frequent (32 references, n=8) than the others, perhaps because lovingkindness was taught near the end of the intervention, so participants had less time to integrate it into their practice. The majority of participants (n=12) also noticed themselves improving over time, but the improvement they logged was mainly about getting better at directed attention (e.g. "Easier time today staying focused") or generating positive, relaxing feelings (e.g. "The more I do it the better I feel"), rather than becoming more accepting of difficult experiences or more mindful of others.

Relatedly, all but one participant (n=17) reflected on feeling relaxed after meditating and, with 133 total references, this was by far the most frequent code in the "Development of Mindfulness Skills" theme for both MCI Patients and Caregivers. This

may suggest that using meditation training to develop the ability to relax is particularly accessible or important for this population. This is consistent with Wells et. (2019), which also found an "Improved Ability to Relax" sub-theme, although they did not report its frequency. The high frequency of this code is also interesting in the context of the facilitator's teaching, which did not emphasize meditation as a relaxation practice, exempting practices like Belly Breathing and Meditation Poem which are explicitly focused on calming the body and mind. This could suggest that becoming relaxed was an important and well-received part of meditation training for this sample, or that it was easier to remark on feeling relaxed after meditation than to comment on other mindfulness skills (e.g. paying attention, non-judgment).

In contrast, acceptance practice was logged less frequently than expected, given the emphasis on this concept in both the guided meditations and the facilitators' instruction. Only 4 participants logged non-judgment, acceptance, or self-compassion practice, and the coded text included less obvious examples of this sub-theme than sample quotations for other mindfulness skills. This could indicate that acceptance was not emphasized in a way that resonated with this sample, that awareness or relaxation practice was more valued, that acceptance requires more time to develop (Lindsay & Creswell, 2017), or that participants found acceptance practice hard to write about. Of note, this skill is also absent from Wells et al.'s (2019) "Development of Mindfulness Skills" theme, which includes MCI patients taking a mindfulness-based intervention (MBSR) which similarly emphasizes acceptance and non-judgment.

Finally, participants recorded challenges in their meditation practice, including falling asleep, getting attached to feeling good while meditating, not wanting to feel

uncomfortable sensations or emotions, or getting confused about mindfulness. Most participants (n=11) encountered attachment to meditation going well (e.g. “Relaxed but not thrilled with session.”) or aversion to difficult experiences (e.g. “Bad day and not interested in relaxing.”), but these codes were infrequent (38 total references) compared to the other mindfulness skills. Sleepiness was also a common challenge in practice (n=8), but comparatively few participants (n=4) expressed confusion about mindfulness as a barrier to practice. The latter remained its own code because “Questioning the Practice” did not fit easily into any other code, and to reflect the presence of this same sub-theme in Isbel et al. (2020).

The next theme, “Enhanced Well-Being,” suggests that participants benefitted from the intervention in ways that reflect their development of mindfulness skills – increased awareness, acceptance, and positive affect – and their application to participants’ unique needs – better physical well-being and improved relationships. As with the “Relaxation” sub-theme, “Feeling Good” was by far the most frequently coded sub-theme under “Enhanced Well-Being,” with 179 unique references across 17 participants. This theme reflects both the frequency with which participants recorded “feeling good” as an outcome of a single meditation practice (e.g. “This felt good.”) and “feeling good” as an outcome of the intervention as a whole (e.g. [Do you feel you got something of lasting value from the course? What was most meaningful to you?] “Very peaceful feelings.”). An increase in positive affect, including feeling calm and relaxed, appears to be an important outcome of mindfulness training in this sample.

Relatedly, some participants (n=8) reported relief from physical discomfort and/or improved sleep as a benefit of the intervention. This is interesting insofar as applying

mindfulness to physical pain and/or sleep was not a major focus of the intervention, and this theme did not emerge in Wells et al.'s (2019) thematic analysis of MCI patients following MBSR. In this sample, several participants coping with physical pain appeared to use meditation for pain relief (e.g. "Can scan and relax parts and functions of my body that need the most attention.") or as a sleep aide (e.g. "[Meditation Poem] Using it frequently at night to sleep better."). Given the high prevalence of chronic pain and sleep disruption in older adults (Larsson et al., 2017, Patel et al., 2018), and the possibility that both contribute to disease progression and/or functional impairment in MCI (Lipton et al., 2020; Hamdy et al., 2018), the 39 unique references to enhanced physical well-being found in this sample may support meditation training as an integrative, multi-target intervention for this population.

As expected, participants reported feeling more present and aware following the intervention. 15 participants reported feeling "more mindful now, compared to before the course," and the majority connected their perceived increased in mindfulness to being more aware (e.g. "Yes, more focused on the now and being in the moment."). Some participants also reported greater awareness of themselves (e.g. "The course was of lasting value as it brought out many thoughts which were dormant in my mind.") or connected their increase in awareness to daily life (e.g. "Being more aware of my myself, my partner, and the people and events around me."). Although reports of better presence and awareness were frequent (56 total references), it is worth noting that only one referred directly to MCI ("I'm more aware of my limitations…"). This contrasts with Wells et al. (2019), who found that some participants felt more aware of their MCI after the intervention, and some noticed a benefit to their memory.

Despite the low frequency of acceptance practice in participants' meditation logs, feeling more accepting came through clearly as a positive outcome of the intervention. 8 participants commented, in 20 unique references, on feeling more accepting of "situations out of my control" and less inclined to "fret over what I can't do." Participants' reflections on this theme were also the most clearly linked to MCI out of all the "Enhanced Well-Being" sub-themes. Several MCI Patients felt more accepting of their condition (e.g. "…be more grateful for what I can do…") and some Caregivers felt more accepting of their partner's MCI (e.g. "…I find myself more understanding and patient…"). Text coded under this sub-theme was frequently also coded under "Enhanced Interpersonal Well-Being," in which participants connected feeling more accepting to better relationships. In this sub-theme, across 41 unique references, participants discussed how the intervention helped them become more aware of others (e.g. "…more aware of feelings of others, especially my life partner (wife)."), less reactive toward them ("…slowing down 'engage mind before putting mouth in gear…'"), more appreciative of them ("Thinking about the great wife I am taking this class with made me feel thankful"), and more accepting of difficulty (e.g. [Regarding husband's MCI] "[I] Realized our friends are true friends and they understood and loved us anyway."). As in Wells et al. (2019), improvement in interpersonal skills appeared to be a key outcome of group-based mindfulness training in this sample, perhaps even more so due to the intervention's inclusion of both patients and caregivers.

Finally, one unexpected sub-theme emerged under "Enhanced Well-Being": "Enhanced Spiritual Well-Being." Despite this sub-theme's 16 unique references, only one participant, a Caregiver, contributed text to this sub-theme. This participant often

logged more than one hour of daily meditation practice (e.g. listening an entire course CD) and found it meaningful to connect his meditation practice with his Christian faith. His reflections reference spiritual well-being (e.g. “Keeping aware of body, mind, and spiritual experiences.”), connection with the divine (e.g. “Sense of myself experiencing oneness with myself and God.”), and prayer (“Course exercise helped me focus and led me to prayer.”). This same participant also logged some of the most striking improvements in psychological well-being (e.g. “More focused on staying positive! More times thinking before reacting! Catching myself more on my thought control! Feeling better about myself totally.”) Although the intervention was taught from an explicitly secular perspective, this may reflect the previously studied positive connection between spiritual experiences in mindfulness training and mental health outcomes (Greeson et al., 2011), and indicates that some older adults may benefit from connecting their mindfulness training with pre-existing religious practices.

Regarding differences between MCI Patients and Caregivers, Caregivers provided far more text for analysis, as they did for the two previously discussed acceptability themes. Out of 977 total references coded, 618 were from Caregivers. Proportionally, MCI Patients commented more frequently on Relaxation and Feeling Good than Caregivers did (41% of coded text for MCI Patients vs. 27% for Caregivers). This may indicate that feeling calm, restful, and positive was a more accessible or important skill to practice and outcome of the intervention for MCI Patients than it was for Caregivers. Alternatively, and given the difficulty some MCI Patients had with logging their meditations, it is possible that writing “relaxed” or “feels good” is simply easier than commenting on other aspects of mindfulness, even if they practiced these skills while

meditating. MCI Patients also coded "Challenges in Meditation Practice" more frequently than Caregivers did (11% vs. 5% of coded text, respectively). Given the nature of MCI, it makes sense that MCI Patients became more frustrated with difficulty focusing and encountered sleepiness more often. Similarly, Caregivers coded Awareness more frequently than MCI Patients did (23% vs. 12% of coded text, respectively). Due to their relative lack of cognitive impairment, Caregivers may have had an easier time logging their awareness of sense objects, noticing distraction, and re-directing their attention than MCI Patients did.

Taken together, qualitative data on effectiveness indicate that both MCI Patients and Caregivers were able to develop mindfulness skills and experience positive change following the intervention. Relaxing and feeling good were particularly frequent sub-themes in this sample, especially for MCI Patients. In contrast, practicing acceptance was less frequent than expected but did emerge as a perceived benefit of the intervention. Participants connected mindfulness skill acquisition with MCI slightly less often than expected but, when they did, improved acceptance of difficulty and interpersonal well-being appeared most important to shifts in perspective on MCI. These results, which suggest increased mindfulness, application of mindfulness skills to daily life, decreased psychological distress, and increased well-being, contrast with the quantitative data presented earlier. This discrepancy will be reviewed throughout the Discussion.

Trajectories. Due to the similarity between several of the above themes and sub-themes and Isbel and colleague's (2020) thematic analysis of the development of mindfulness skills via meditation logs, we completed an exploratory, descriptive analysis of the frequency of themes (3) and (4) across time. This analysis was combined across

MCI Patients and Caregivers to better illustrate any patterns in the data, acknowledging the small sample size. This analysis is summarized in Tables 27 & 28.

Table 27

Instances of "Development of Mindfulness Skills" Over Each Week of Training

Sub-theme	Code	n	W1	W2	W3	W4	W5
3.1 Awareness	3.1.1 Awareness of Sense Objects	12 (87)	26	24	12	11	14
	3.1.2 Awareness of Distraction	10 (38)	11	10	11	3	3
	3.1.3 Presence & Directed Attention	14 (62)	15	13	13	15	6
3.2 Establishing a Meditation Practice	3.2.1 Experimenting with Practice	12 (73)	17	22	15	15	4
	3.2.2 Perceived Improvement	12 (52)	8	11	15	12	6
	3.3 Acceptance	4 (8)	2	4	0	1	1
	3.4 Mindfulness of Others	8 (32)	6	1	4	3	18
	3.5 Relaxation	17 (132)	26	38	27	19	22
	3.6 Mindfulness in Daily Life	12 (47)	16	16	5	6	4
3.7 Challenges in Meditation Practice	3.7.1 Sleepiness	8 (24)	5	9	7	2	1
	3.7.2 Attachment & Aversion	11 (38)	12	10	7	5	4
	3.7.3 Questioning the Practice	4 (10)	3	0	1	0	6

Note. "n" refers to the number of participants out of 18 reporting each code during the intervention, with the number of unique references in brackets. The heat map codes 0-5 references "white" and 35+ references "dark green."

Table 28

Instances of "Enhanced Well-Being" Over Each Week of Training

Sub-theme	Code	n	W1	W2	W3	W4	W5
4.2 Enhanced Psychological Well-Being	4.1 Enhanced Physical Well-Being	8 (39)	6	6	7	13	7
	4.2.1 Feeling Good	17 (179)	28	42	33	30	34
	4.2.2 More Present & Aware	15 (56)	7	2	5	12	13
	4.2.3 More Accepting	8 (20)	2	2	3	1	3
	4.3 Enhanced Interpersonal Well-Being	11 (41)	6	1	5	2	18
	4.4 Enhanced Spiritual Well-Being	1 (16)	4	3	1	4	4

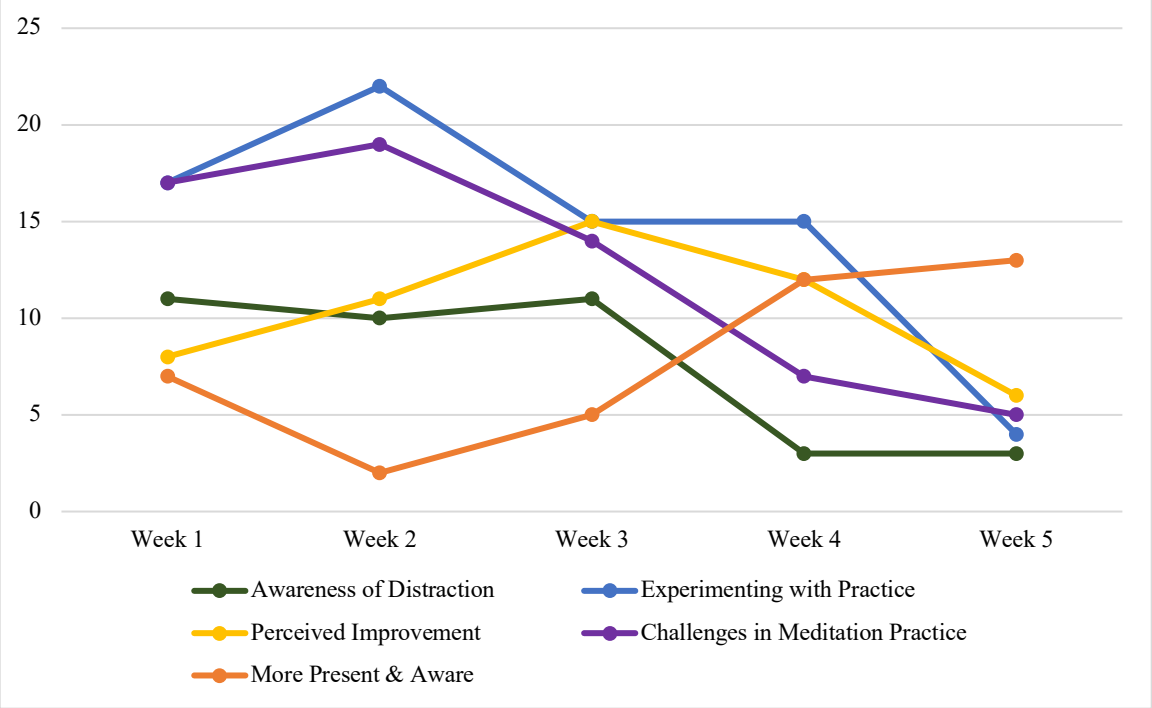
Note. "n" refers to the number of participants out of 18 reporting each code during the intervention, with the number of unique references in brackets. The heat map codes 0-5 references "white" and 35+ references "dark green."

While each participant's experience was unique, some commonalities were observed in Meditation Logs over the course of the 6-week intervention. "Awareness of Distraction," "Experimenting with Practice," and "Challenges in Meditation Practice" (omitting "Questioning the Practice," which is confounded by participant's questions about Lovingkindness) all clearly decrease over the 5-week intervention. "More Present & Aware" increases, and "Perceived Improvement" increases until Week 3, then returns to baseline. These are graphed in Figure 9.

Several other changes are attributable to the order of practices taught in the intervention and are therefore unlikely to reflect genuine developmental trajectories. These include the increase in "Mindfulness of Others" and "Enhanced Interpersonal Well-Being" in Week 5; lovingkindness meditation was taught in Week 4 and participants were assigned to practice it for homework. The decrease in "Directed Attention & Presence" in Week 5 is likely also attributable to participants practicing Lovingkindness instead of awareness practices. Similarly, the decrease in "Awareness of Sense Objects" reflects the shift from single-pointed focus practice in the beginning of the class (Belly Breathing, Breath Awareness, Body Scan) to themed practices like Meditation Poem and Lovingkindness that do not stress awareness of a sensory "anchor" to the same extent. "Relaxation" and "Feeling Good" are likely more frequent in the early weeks for this same reason. Finally, the increase in "Enhanced Physical Well-Being" in Week 4 reflects the introduction of Chair Yoga in Week 3 and the increase in "Questioning the Practice" at Week 5 is due to several participants having questions about lovingkindness practice specifically.

Figure 10

Frequency of Codes by Week of the Intervention



As in Isbel et al. (2020), participants logged more challenges in practice – getting distracted, sleepy, and frustrated – in the first two weeks of the program, after which the instance of these codes falls sharply. In this sample participants also appear to experiment with their practice – location, time of day, position, type of practice – for 2-3 weeks before "settling in" toward the end of the intervention. In contrast, participants' sense that they are becoming more present and able to focus, whether in meditation or daily life, increases over the course of the intervention. As in Isbel et al. (2020), It is only after the midpoint of the intervention that "Perceived Improvement" becomes more frequent than "Challenges in Meditation Practice," and the former remains higher than the latter through the rest of the intervention. "Perceived Improvement" does drop again, however,

perhaps due to the introduction of Chair Yoga and Lovingkindness practice, which some participants found different and/or challenging. In general, the developmental trajectories seen here seem to replicate Isbel et al. (2020) insofar as codes which reflect proficiency in mindfulness practice take 3-4 weeks to overcome the inherent difficulties associated with establishing a mindfulness practice.

Chapter 4

Discussion

This multimethod, single-arm pilot study trialed a lightly adapted, 6-week, group-based mindfulness intervention for MCI patients and their caregivers. Quantitative data were collected on the intervention's feasibility, acceptability, and effectiveness for improving cognitive functioning (MCI Patients[4] only), psychological distress, caregiver burden, perceived health, mindfulness, and vascular risk. Written qualitative data were collected and analyzed for themes related to acceptability ("Was the intervention perceived as appropriate, helpful, and enjoyable to patients and caregivers?") and effectiveness ("Did patients and caregivers feel they benefitted from the intervention and if so, how?"). Results suggest strong feasibility and acceptability, with some areas for improvement. Whereas many quantitative measures did not improve as expected, the qualitative thematic analysis *did* suggest improvements in mindfulness skills and overall well-being. This data will now be discussed in the context of prior studies, and suggestions for future research will be provided.

Feasibility of MBIs for Older Adults with MCI and their Caregivers

To the author's knowledge, this is the first study to trial a mindfulness-based intervention (MBI) specifically for MCI patients *and* their caregivers, rather than patients with dementia or patients across the cognitive impairment spectrum. We found that 57% of eligible patient-caregiver dyads decided to enroll in the study, and that an 18-week recruitment period allowed us to enroll 24 participants, 86% of our accrual goal of 28 participants. Reasons for non-enrollment included scheduling conflicts and lack of

[4] "MCI Patients" and "Caregivers" are capitalized when referring to this specific sample. They are left lowercase when referring to "MCI patients" and "caregivers" as a population.

interest in mindfulness training. The low percentage of eligible patients who enrolled is consistent with prior MBI trials with this population, which found that 26% (Marciniak et al., 2020), 30% (Larouche et al., 2019), and 64% (Klainin-Yobas et al., 2019) of eligible patients enrolled, respectively. It may also reflect previously documented difficulties recruiting older adults to clinical trials (Knechel, 2013), as well as additional difficulties MCI patients and their caregivers face when considering a behavioral intervention (e.g. aversion to medical settings, denial of illness, worry about functional impairment in group settings; difficulty remembering to follow-up; Sanders et al., 2018). This being the case, future trials may benefit from allowing a longer enrollment period, and strong collaboration between study personnel and referring care providers, to account for barriers to participation for many eligible participants.

Retention (75% at post-intervention and 3-month follow-up) was slightly lower than previous MBI trials with MCI patients (78%-96%). Reasons for attrition included conflict between patients and caregivers about whether to continue participation (n = 4) and worsening of MCI symptoms (n=2). The former reason is likely the major difference between this trial and those which included only MCI patients; dyads had to agree to participate in the intervention *and* to participate together, which patients or caregivers in isolation do not have to do. Patients and caregivers were also required to drop out as a dyad (i.e. one person could not stay while another dropped out), meaning every instance of attrition resulted in a loss of two participants, rather than one. To the author's knowledge there is only one other study, Paller et al. (2014), that has included both caregivers and patients with age-related cognitive decline in the same intervention. In that trial, 6 out of 37 participants dropped out, suggesting 84% adherence. However, this

study team also allowed multiple caregivers to participate with one patient and for patients to participate individually, which may have impacted attrition (detailed data on reasons for drop-out are not reported). Slightly increased attrition may also be expected whenever the intervention includes patients; in a meta-analysis of MBIs for patients and caregivers of people with age-related cognitive impairment, Shim et al. (2020) found several caregiver-only trials had 0% attrition, in contrast to 5.3-21.4% attrition for patient-only trials. Future trials wishing to include both patients and caregivers may consider adopting a more flexible model to decrease attrition, perhaps by allowing multiple caregivers per patient and for caregivers and patients to participate by themselves if desired.

Thematic analysis also indicated that several dyads disliked the evening class time and found the commute burdensome, particularly in the winter. Daytime classes may increase attendance and telehealth delivery may improve retention if transportation is a barrier. Group-based telehealth interventions for older adults are currently under increased study due to the Covid-19 pandemic (Zubatsky et al., 2020) and appear feasible. For example, one previous trial comparing a telehealth CBT group for older adults to its in-person equivalent found comparable attrition between the groups (Khatri et al. 2014). Online mindfulness-based interventions for a wide variety of presenting problems are also under increased study and also appear feasible for chronically ill adults (Liu et al., 2022). As access to and familiarity with videoconferencing technology increases, the benefits of online MBIs for older adults (ease of access, no transportation cost) may begin to outweigh the barriers (lack of familiarity with or access to videoconferencing).

Finally, it should be noted that of the 6 participants (3 dyads) who dropped out, 4 did so after the pre-intervention visit but before the first class. Of those who attended Class 1, 90% completed the study in full. This may indicate that (1) participants are likely to stay in the intervention once they start and (2) additional support between enrollment and Class 1 may help motivate participants to start the intervention as planned. Future studies may consider integrating informal motivational interviewing into the enrollment process, perhaps by identifying and problem-solving likely barriers to participation (e.g. disagreement between partners, transportation), and checking in with participants by phone between enrollment and Class 1.

Class attendance in this trial was comparable with the two prior studies that have reported on it, with an average of 5 classes (83%) and 2.33 booster sessions (78%) attended. Reasons for non-attendance included MCI-related illness, scheduling conflicts, and transportation barriers. Both Wells, Kerr et al. (2013) and Klainin-Yobas et al. (2019) report 88% of classes were attended, out of 8 and 12 total classes, respectively. They do not report on reasons for missing class. Again, it is likely that class attendance is slightly lower in this sample because participants were enrolled as dyads, so any non-attendance was a loss of two participants for that class, rather than one. Participants' reasons for missing class were also consistent with prior literature on older adults' attendance at group programs. A literature synthesis of factors impacting attendance and adherence to group exercise programs for older adults found that accessible program settings (familiar location, accessible transportation) were key to attendance (de Lacy Vawdon et al., 2018). Similarly, our thematic analysis strongly suggests attendance would have improved further with daytime classes and/or class held in Spring/Summer.

Participants practiced for a median of 5 days per week (IQR = 2.0-6.0). Marciniak et al. (2020), the only prior study on MCI patients to report on adherence to home practice, also reported a central tendency of 5.1 days/week (SD = 1.4), although they did not report whether this data was negatively skewed, as it was in this sample. Both the present study and Marciniak et al. (2020) recommended 6 days of home practice per week. Of note, several participants practiced 7 days per week, meaning they logged home meditation practice on class days. The thematic analysis showed strong positive perceptions of meditation practice, and that establishing a daily practice was the most important or helpful part of the intervention for many participants. Some participants specifically remarked that practicing with their partner daily was a helpful aspect of the course and the vast majority of dyads practiced the same meditations together, each week. Although we did not have participants log the amount of time they meditated for (all guided meditations were 10-15 minutes long), two caregivers regularly logged more than 15 minutes of practice per day. One reported using Gatha meditation at night before bed and other practices in the morning. Another, the same participant who reported enhanced spiritual well-being, routinely listened to an entire CD of guided meditation (approx. 1.5 hours) per day. Taken together, these data support prior literature reviews showing higher than usual adherence rates to MBIs in older adults, perhaps due to the extra time retirement provides, increased interest in nonpharmacological treatments, or responsiveness to interventions focused on coping with conditions outside of our control (e.g. chronic illness; Felsted, 2020). There is insufficient prior literature to comment on whether taking the intervention with a partner increased adherence to home practice, but

it is possible that social support within dyads made daily meditation practice more feasible for some participants.

Data from this study further confirm that MBIs for older adults with MCI and their caregivers are broadly feasible and extends this finding to an integrated care setting. To optimize retention, attendance, and adherence, future trials may consider extending the recruitment period, allowing patients and caregivers to participate together or alone, holding daytime classes, offering the intervention via videoconferencing software, and providing additional support after enrollment but before the start of the intervention. Once participants begin the intervention, adherence to home meditation practice appears to be excellent.

Acceptability of MBIs for Older Adults with MCI and their Caregivers

This study provides novel and detailed data on the acceptability of MBIs for MCI patients and caregivers. Quantitatively, all participants fell into the "mostly satisfied" or "very satisfied" ranges on the Client Satisfaction Questionnaire, 100% of participants would recommend the intervention to others, all median course structure ratings were in the "good" to "excellent" range (≥ 4), and median satisfaction with all meditation exercises was in the "very helpful" or "extremely helpful" range (≥ 4). Our thematic analysis supported expanded upon this data. Two themes – Positive Perception of the Intervention & Difficulties with the Intervention – were identified, with codes for the former reported far more frequently than for the latter. Both MCI Patients and Caregivers found mindfulness and meditation appropriate, enjoyable, and helpful, with some emphasizing how much they appreciated daily meditation practice and others finding mindfulness in daily life most useful.

Only two prior studies of MBIs for MCI patients have reported on acceptability. Marciniak et al. (2020) also found exclusively positive or neutral responses to a quantitative feedback questionnaire (n=14), and Wells et al. (2019; n=9) used thematic analysis to identify patients' positive perceptions of the class, enjoyment of the group experience, and perceived ability to develop mindfulness skills. Participants in Marciniak et al. (2020) also emphasized that non-mindfulness elements of the course structure (e.g. meeting the facilitator, meeting every week) were particularly helpful, just as MCI Patients in the present study did. In Wells et al. (2019), a positive attitude toward the group experience (e.g. feeling comradery, hearing about others' meditation practice) was reported consistently enough that it emerged as its own theme. Outside of mindfulness research, another thematic analysis of a "group memory intervention for older adults" has similarly identified that social support facilitated engagement with the intervention by enhancing participants' experience of normalcy and universality (Matthews et al., 2020). Together, this may suggest that common factors, present in all behavioral group interventions, may be important to older adults experiencing cognitive impairment.

Our analysis also emphasizes that participants with and without MCI found meditation practice an appropriate, helpful, and enjoyable skill to learn. Many participants remarked that "learning how to meditate and be mindful" was the most helpful aspect of the course for them, and several indicated they had nothing to change about the intervention (e.g. "Everything perfect – don't change anything"). While we did not rate participants' understanding of mindfulness skills as Wells et al. (2019) did via semi-structured interviews, we did find that Caregivers wrote more about positive perceptions of meditation or mindfulness than MCI Patients did. Interestingly, MCI

Patients' positive perceptions of meditation/mindfulness seemed to highlight meditation as a useful way to feel better in the moment (e.g. relaxation and positive affect), whereas Caregivers' included more conceptual comments on mindfulness skills in daily life (e.g. awareness of self and others, acceptance of difficulty). This raises the question of whether MBIs serve slightly different purposes for patients and caregivers. Wells and colleagues' (2019) analysis showed that MCI patients *were* able to develop a basic understanding of the key tenets of mindfulness, and that qualitative ratings of their understanding were *not* correlated with baseline cognition. This suggests that MCI patients can foster a basic understanding of mindfulness, despite cognitive impairment. MCI patients in this sample certainly demonstrate an understanding of mindfulness (discussed in the following section), but also seem to strongly value meditation as a way to relax and feel good, rather than a way to shift one's relationship to difficult experiences or become more aware of self, others, and the environment. The benefits of relaxation and stress reduction for MCI, which may partially explain patients' emphasis on feeling good, will be discussed in the following section.

Despite strongly positive quantitative and qualitative acceptability data, participants also offered some suggestions for improvement. First, and as in other MBIs with older adults (Wells et al., 2019), some participants had difficulty with moving meditation. Our Chair Yoga sequence was designed in consultation with one of the intervention facilitators, who is also a yoga instructor, as a gentle, chair-based version of the yoga sequence typical of MBSR. However, several participants still found it inaccessible due to pain or worries about illness. As older adults are likely to have physical health concerns and mobility constraints, it is unlikely there is a movement

practice that will be accessible to 100% of participants. That said, exercise is a potentially important adjunct to integrated care for MCI (Zheng et al., 2016) and developing awareness and acceptance of the body in motion is a key aspect of mindfulness training (Kabat-Zinn, 1990). In addition, several other participants rated Chair Yoga as "excellent," indicated it was one of their favorite practices ("Very much enjoyed this meditation. By participating bodywise my mind really stayed focused") or found it helpful with pain ("Felt good to stretch and loosen up. No pain"). Moving meditation, therefore, is a cornerstone of any mindfulness-based intervention but must also be adapted to suit the population. Although Chair Yoga was broadly acceptable in this study, other movement practices may also be appropriate for this group. Tai Chi, a gentle, flowing mindful movement practice of Taoist origin, has been extensively studied in older adults, found to be consistently feasible and acceptable, and may even enhance cognitive function (Wayne et al., 2014; Lv et al., 2022). When possible, future MBIs for older adults may consider teaching a Tai Chi sequence, either instead of or in addition to the sequence of yoga poses characteristic of MBSR.

The most frequent suggestion for improvement was that the time of day was too late and that transportation to and from class was difficult in the evening/Winter. This data clearly indicates that future studies would be well-advised to host classes during the day, and perhaps during the warmer months if the clinic is in an area where winter weather can make travel difficult. Other difficulties with the intervention were limited in scope and specific to the individual. For example, one participant found belly breathing upsetting, another disliked lovingkindness on principle and found the course too "beginner level," and a third was disappointed meditation did not reduce his anxiety and

wanted the intervention to have fewer classes. These parallel Wells et al. (2019) insofar as they found barriers to participation that were specific to one individual, such as feeling like a "misfit" in the group. That said, mindfulness research has historically been biased toward recording positive perceptions of mindfulness practice, to the neglect of potential adverse effects or limitations of mindfulness practice (van Dam et al., 2018). Furthermore, researchers have suggested qualitative research methods as a means of investigating potential harm, adverse effects, and limitations of meditation training, from participants' own perspectives (Davidson & Kaszniak, 2014; Hanley et al., 2016; van Dam et al., 2018). It is therefore worth noting that the 2 adverse effects of meditation (upset by Belly Beathing and increased pain after Chair Yoga) and the 3 reflections on limitations of the meditation instruction (too slow, disliking Lovingkindness, not helpful for anxiety), would not have been identified without qualitative data. In fact, qualitative methods are increasingly being used to explore infrequent and/or under-reported experiences in contemplative practice, particularly those described as challenging, distressing, functionally impairing, or requiring further support (Lindahl et al., 2017; Frank & Marken, 2022). This research has found that unwanted, distressing, or harmful psychophysiological experiences during meditation practice are infrequent but normative, and that these are sometimes discredited due to the emphasis on acceptance of discomfort present in mindfulness training (Lambert et al., 2021; Lindahl et al., 2017). Reporting of these events must therefore balance the spirit of mindfulness training, in which all experiences belong regardless of their valence, and the subjective experiences participants bring to their practice. Future studies may therefore benefit from retaining opportunities, whether via written meditation logs or semi-structured interviews, to

collect qualitative data on difficulties with meditation practice, while acknowledging the highly positive experiences with meditation practice that tend to be dominant.

Finally, two participants remarked that filling out the meditation logs was difficult for them or their spouse because of MCI. Indeed, Caregivers provided almost double the amount of text for analysis than MCI Patients did, suggesting that this barrier to engagement was more common than it appears, not least because participants would have to write the feedback (that they were struggling to write things down) to communicate it. Many MCI patients have subtle difficulties with more complex activities of daily living, such as playing a game, planning a social event, or writing a journal (De Vriendt et al., 2012). Logging reflections on a meditation practice or mindful activity would theoretically require both metacognition, which may be affected even in the early stages of cognitive decline (Pennington et al., 2021) and delayed memory, which was the most severely impaired cognitive domain in this sample. In contrast, some MCI Patients remarked that the Meditation Logs were "a good idea," "good to watch progress," and "helpful in that it made me express myself." In fact, writing notes to oneself is one of the most common support strategies for MCI (Nygard et al., 2022), making it likely some patients were used to writing about their days and found it helpful to extend this strategy to meditation practice. Ultimately, Meditation Logs were likely a helpful means of supporting adherence to practice for some MCI Patients, but not others. Because of this discrepancy, future studies wishing to collect qualitative data on adherence and mindfulness skill development in MCI may consider having multiple options for data collection. Semi-structured interviews and/or daily voice recordings could be a useful

alternative to written reflections for some patients and using a meditation app to track adherence could replace writing down the date and type of meditation on a paper log.

In summary, mixed methods data from this study supports a 6-week mindfulness group with three monthly booster sessions for MCI patients and their caregivers as highly acceptable. Participants enjoyed both the mindfulness-based (guided meditations, mindfulness instruction) and non-specific (group cohesion, facilitator attention) aspects of the intervention. MCI patients may particularly appreciate the latter, in addition to learning meditation as a way of calming down and generating positive affect. Difficulties with the intervention were far less frequent than positive perceptions of it; difficulties included trouble with Chair Yoga, the timing of classes, and logging meditations (MCI Patients only). Future studies are advised to (1) retain mixed methods data collection to capture both anticipated benefits as well as potential adverse effects and limitations of MBIs in this population, (2) trial alternate mindful movement practices, such as Tai Chi, (3) hold classes during the day, and (4) consider non-written methods of tracking home meditation practice.

Cognitive Functioning

This study used an age-normed neuropsychological measure (Repeatable Battery for the Assessment for Neuropsychological Status [RBANS]) to assess cognitive functioning in MCI Patients before (n=12) and after (n=9) the mindfulness-based intervention (MBI). No specific questions on perceived cognitive functioning were included on the qualitative Feedback Form, nor did we collect self- or informant-reports of cognitive impairment. We found a trend toward improved Immediate Memory (IM) after the intervention and no change in any other domain of cognitive functioning

(RBANS Total Score; Visuospatial; Language; Attention; Delayed Memory). For context, the IM score on the RBANS is derived from two subtests: List Learning and Story Memory. In the former, participants repeat back a list of unconnected words after they are spoken out loud by the examiner, and in the latter participants repeat back a two-sentence "story" as accurately as possible, right after the examiner says it out loud.

The aggregate increase in Immediate Memory seen here (5.18 points or 1/3 SD) is not considered clinically meaningful (Phillips et al., 2015). However, the aggregate increase may not reflect the dataset well, since 3 participants showed a clinically meaningful increase (≥ 10 points; Phillips et al., 2015) whereas the remaining 6 did not change (≤ 4-point change). Immediate Memory was the second most impaired domain of cognitive functioning in this sample, after Delayed Memory, with a baseline mean of 63.7 (SD = 12.1) and a post-intervention mean of 67.9 (SD = 15.6). Both these scores are in the "Extremely Low" range (Kimbell, 2013). The three participants whose improvements in Immediate Memory were clinically meaningful all began in the "Extremely Low" range. Two increased to the "Borderline" range (70-79 points) and one increased to the "Low Average" range (80-89 points). Of those who remained stable, 3 were in the "Extremely Low" range, 2 were "Borderline," and 1 was "Low Average." There was no deterioration in any other domain of cognitive functioning, and all effect sizes were positive (in the direction of improved functioning), exempting Language.

Of course, this study is not sufficiently powered to detect even large effects of mindfulness training on cognitive functioning. However, our results are informative in the context of prior research. In the Introduction of this document, our review of 8 clinical trials of MBIs for MCI showed surprisingly varied evidence for improvements in

cognitive functioning, despite a strong theoretical rationale (Wells, Kerr et al., 2013; Ng et al., 2016; Klainin-Yobas et al., 2019; Yu et al., 2021; Larouche et al., 2016; Wong et al., 2017; Larouche et al., 2019; Fam et al., 2020; Marciniak et al., 2020; Khinne et al., 2020). Across 10 papers, these 8 clinical trials have tested a total of 29 neuropsychological measures of cognitive functioning (see Table 3). 8 out of 29 measures (27%) improved following the MBI. Of these, 4 were within the IM domain: two unspecified "recognition" tests (Ng et al., 2016; Khine et al., 2020), a verbal free recall test (Larouche et al., 2016), and the Recognition subtest of the Rey Auditory Verbal Learning Test (RAVLT; Fam et al., 2020). There are 3 remaining tests of IM that did not improve: an "immediate recall" test (Yu et al., 2021), a free recall word list (Larouche et al., 2019), and the Cogstate One Back test (Marciniak et al., 2020). This means IM has improved the majority (57%) of times it has been tested in this population, more frequently than any other domain of cognitive functioning. Coupled with the trend toward better immediate memory in the present study, this may indicate that mindfulness training can facilitate recall of recently presented information in some older adults with MCI.

While we expect mindfulness training to broadly impact cognitive processes underlying attention and memory (Klimecki et al., 2019), there is some reason to believe immediate memory may be particularly responsive to mindfulness training. One study found the largest difference between non-depressed and depressed MCI patients was on the RBANS Immediate Memory scale, such that depressed patients reported almost 1 SD more impaired Immediate Memory than non-depressed patients (Johnson et al., 2013). If depressed mood is closely tied to IM in MCI, perhaps interventions targeting depressed

mood and positive affect, as MBIs do, will prompt change in this domain over others. Similarly, an RCT of MBSR or health education control (HEC) for depressed and/or anxious older adults with subjective memory complaints (n=103) found significantly greater improvement in immediate memory (verbal recall) in the mindfulness group, as compared to the HEC group, but no changes in any other domain of cognitive functioning (Wetherell et al., 2017). The authors suggest that improvements in psychological distress, which were more prominent in the MBSR group, may have driven improvements in immediate memory. This has been tested slightly more directly, and quite recently, by Doshi et al. (2021). In an RCT trialing an 8-week MBI for MCI patients against cognitive rehabilitation training (CRT) and treatment-as-usual (TAU; n=76), the authors found that improvements in global cognition were correlated with decreases in depression in the mindfulness group *only* (specific domains of cognitive functioning were not tested), suggesting a possible mediating effect of mindfulness training on global cognition via lowered depression. Extending this line of thought to future research, we may hypothesize a specific effect of mindfulness training on immediate memory in MCI and may also begin to address change in psychological distress as a potential mechanism of this improvement.

While improvements in other domains of cognitive functioning via lowered psychological distress are certainly possible, particularly those closely related to IM (Attention and Delayed Memory), the dominance of null findings in this study is still consistent with prior research. In fact, 21 out of 29 (73%) of neuropsychological measures failed to improve in the 8 studies reviewed above, and several trials showed no improvement across all included measures (Marciniak et al., 2020; Klainin-Yobas et al.,

2019; Yu et al., 2021). Others found improvement at small effect size and equivalent to HEC or cognitive training (Wells, Kerr et al., 2013; Ng et al., 2016), calling into question the usefulness of mindfulness training over any other active, group-based behavioral intervention. Fortunately, several researchers have published formal meta-analyses of this research in the past year. Including studies of MBIs for both MCI and full dementia, Han (2021) pooled the group by time effects of MBIs on delayed recall across 3 RCTs with MCI patients and 2 with dementia patients (n=236). He found a small effect on delayed memory favoring active control groups over mindfulness training (SMD = -0.26, 95% CI [-0.52, -0.00]). For the 5 RCTs testing the effect of MBIs vs. active controls on overall cognitive functioning (Mini Mental Status Exam [MMSE], n=207), he found no effect of either intervention. This review and another inconclusive meta-analysis of MBIs for MCI and dementia (Nagaoka et al., 2021) both note that improvement in methodological quality is needed to clarify heterogenous findings and reduce the risk of bias in this literature. They suggest intent-to-treat (ITT) analyses, blinding psychometricians to group allocation, treatment-as-usual conditions to highlight the effect of common factors and/or deterioration of cognitive functioning, and using statistical methods which appropriately handle missing data (e.g. multilevel linear modelling rather than repeated measures ANOVA). In sum, while higher quality research is needed, several prior studies have also found no effect of mindfulness training on cognitive functioning, and the small effects that have been found may be common across active, group-based behavioral interventions.

The mainly null neuropsychological results of the present study suggest, as do prior literature and recent meta-analyses, that we may not expect stark improvements in

many objective measures of cognitive functioning following mindfulness training, with immediate memory as a possible exception. These results partly contrast with the theoretical rationale for mindfulness training in MCI. Mindfulness training is thought to impact attention, executive function, and fluid intelligence by promoting broad preservation of grey matter structures, brain glucose metabolism, and functional connectivity in older adults (Klimecki et al., 2019). We would therefore expect any changes in one domain (e.g. IM) to appear in related domains too, given broad improvement in attention and executive function. In the RBANS we might expect this to include the Digit Span and Coding subtests at least, which also rely on attentional brain processes thought to be impacted by meditation (Petersen & Posner, 2012). In the context of the mostly null research reviewed above, we might also expect mindfulness training to leverage intact capacities for procedural learning in MCI (Fleischman, 2007) thereby building or maintaining cognitive reserve *more* effectively than health education controls (Malinowski & Shalamanova, 2017), but this does not appear to be the case. Null neuropsychological test results following MBIs also contrast with promising neurobiological findings showing increased global and medial temporal lobe efficiency in an MBI group, compared to a psychoeducation control group (Fam et al., 2020) and better cortical thickness in MCI patients following a 3-month MBI (Yu et al., 2021). The most straightforward explanation for this discrepancy is that a larger sample size is required to capture what may be small, diffuse effects over other domains of cognitive functioning. Similarly, a higher "dose" of mindfulness training may be required before these effects are apparent. Finally, MCI is a progressive illness, and both mindfulness training and active control interventions (cognitive training, health education) may

meaningfully slow, but not reverse, disease progression. Future research is needed to (1) identify the minimum necessary amount of mindfulness training (and home practice adherence) required to achieve clinically meaningful *improvement* across domains of cognitive functioning and (2) compare active interventions to treatment-as-usual (TAU) conditions in order to isolate preservation effects.

Fortunately, one RCT including both an active control and TAU group was published in late 2021 and contains a useful caution for future research. As recommended above, Doshi et al. (2021) trialed an 8-week MBI against cognitive rehabilitation training (CRT) *and* TAU (n=76). Both active groups improved on the Montreal Cognitive Assessment (MoCA), the MMSE, and the Delayed Memory subscale of the RBANS, and there was a larger improvement on the latter in the MBI group, relative to CRT. Surprisingly, none of these improvements were superior to TAU, as all cognitive functioning scores in the TAU group improved, showing a formidable degree of spontaneous remission. It appears participants in the study were diagnosed under Peterson/Winblad criteria ("at least one impairment across the domains tested for neurocognitive functioning...have a Clinical Dementia Rating Score (CDR) = 0.5 and…have a Mini Mental State Examination (MMSE) score of >20). The high false positive rate associated with this diagnostic method (Bondi & Smith, 2014) may account for the high remission rate and potentially masks possible preservation effects in the MBI/CRT groups. To ensure an accurately diagnosed study sample and avoid the confound of a high false-positive rate, future RCTs, particularly those with a TAU group, are strongly advised to recruit patients diagnosed under Jak/Bondi criteria.

It should also be noted that no MCI Patients or Caregivers commented on subjective cognitive functioning in either their Meditation Logs or Feedback Forms. Neither group was asked directly about perceived cognitive functioning, nor was it addressed via self-report questionnaire. This may indicate that participants did not notice changes in cognitive functioning following the intervention but could also mean subjective cognitive functioning was not adequately assessed. Because many MCI patients remain subjectively aware of their cognitive impairment, future research should consider including validated self-report measures of cognitive functioning in older adults, such as the Ascertain Dementia-8 Questionnaire (AD8; Galvin et al., 2007) or the Self-Administered Gerocognitive Examination (SAGE; Scharre et al., 2010). Of course, subjective measures of cognitive impairment are confounded by the disease itself; cognitive complaints are overestimated among more cognitively intact patients and underestimated among patients with amnesic MCI, ostensibly because of the lack of awareness characteristic of memory impairments (Edmonds et al., 2014). These measures should therefore be used in conjunction with neuropsychological testing and possibly caregiver reports of cognitive impairment, such as the Informant Questionnaire on Cognitive Decline in the Elderly (Jorm & Jacomb, 1989). Given a large enough sample size, statistical analyses of change in subjective cognitive impairment could then use both measures as covariates to control for the impact of disease severity on patient report.

We also did not assess functional impairment, a potential outcome variable closely tied to conversion to dementia (Triebel et al., 2009). The Functional Activities Questionnaire (FAQ; Weintraub et al., 2009), a commonly used measure in the Jak/Bondi approach to diagnosing MCI, may fill this gap in future research. This measure can be

completed by the caregiver as well as the patient (Hackett et al., 2020), and may highlight clinically meaningful improvements in instrumental activities of daily living (IADLs) that neuropsychological testing in isolation will not capture. More nuanced qualitative data collection may also address functional impairment in MCI following mindfulness training. One participant with MCI commented that mindfulness training made her "more aware of my limitations and how to work with them rather than fret I can't do things the way I used to," suggesting the intervention helped her functionally adjust for her MCI, rather than resisting her limitations ineffectively. Future research may use a semi-structured interview format to ask both patients and caregivers directly how meditation practice does or does not help them address MCI-related barriers to IADLs.

In summary, this study found some indication that MCI patients' Immediate Memory (IM) improved following mindfulness training. This effect was driven by clinically meaningful improvement in 3 participants, whereas the remaining 6 were stable. Prior research suggests this domain of cognitive functioning may be particularly responsive to mindfulness training, perhaps due to changes in psychological distress associated with both mindfulness and IM. All other measures of cognitive functioning remained stable, also in line with prior research showing null or infrequent effects of MBIs on cognitive impairment in MCI. Future research is needed to (1) replicate improvement in IM following mindfulness training, (2) address how much mindfulness training/home practice is required to see improvements in cognitive functioning, (3) assess whether mindfulness training and other active control interventions protect against deterioration in cognition functioning, and (4) investigate whether subjective or

informant reports of cognitive and functional impairment are responsive to mindfulness training.

Psychological Distress, Perceived Health, & Mindfulness

This study used validated self-report measures to assess depression, anxiety, fatigue, pain interference, physical functioning, sleep disturbance, social functioning, caregiver burden (caregivers only), trait mindfulness, and application of mindfulness skills in daily life. In addition, we analyzed participants' Meditation Logs and Feedback Forms for themes related to mindfulness skill acquisition and perceived benefits of the intervention. In MCI Patients, we found that several measures of perceived health and applied mindfulness lacked internal consistency and convergent/divergent validity, and we omitted these from further analysis. Of the remaining measures, we found that only depression was elevated at baseline. Analysis of intervention effects showed that MCI Patients' social functioning improved, but all other measures were constant through to follow-up. In contrast, our thematic analysis suggested MCI Patients were able to learn basic mindfulness skills and experienced enhanced well-being following the intervention. In Caregivers, burden was in the mild-moderate range, but no other measures of psychological distress or perceived health were elevated at baseline. As expected, Caregivers' application of mindfulness skills increased over the 6-week intervention. Trait mindfulness also increased as expected, but not until the first follow-up timepoint (1-month post-intervention). There were no changes in Caregivers' psychological distress, caregiver burden, or perceived health. Thematic analysis showed clear evidence of mindfulness skill acquisition and application in this group, consistent with our quantitative results. However, this analysis also suggested enhanced well-being in

caregivers following the intervention, which contrasts with the null quantitative findings for psychological distress and perceived health. These results will be discussed for each group, with an emphasis on the apparent contradictions between quantitative and qualitative findings.

MCI Patients

18 out of 52 total self-report measures lacked internal consistency and convergent/divergent validity in MCI Patients, versus only 2 measures for Caregivers. This lack of reliability and validity had a clear pattern: Pain Interference, Physical Function, Sleep Disturbance, and Application of Mindfulness Skills in daily Life (AMPS) were impacted at most timepoints, whereas Depression, Anxiety, Fatigue, Social Functioning, and trait mindfulness (MAAS) were largely reliable and valid at all timepoints.[5] Since all measures exempting the AMPS were completed at the same time, it is worth exploring why some measures may have been more difficult for MCI Patients to complete than others.

In MCI, using patient self-report measures is challenging given the loss of insight characteristic of cognitive impairment (Vogel et al., 2004). MCI-related disruptions to memory and metacognition may significantly impair patients' ability to fill out a questionnaire accurately. In clinical settings this leads to increased reliance on informant report and clinical interviewing, but the former can be confounded by caregiver burden or lack of awareness (Arguelles et al., 2001) and the latter by clinician errors, biases, and faulty assumptions (Bondi & Smith, 2014). In the context of behavioral health research,

[5] Outcome variables (e.g. "Depression was elevated at baseline.") are capitalized when referring to the measure itself and left lowercase when referring to the construct (e.g. "Caregivers were not experiencing depression.").

where subjective psychological distress and health are key outcome variables, researchers must find a way to access the most comprehensive and accurate account of patient well-being. This is particularly difficult in the early stages of cognitive impairment, when patients have a variable degree of preserved insight. For example, some research has found MCI patients' symptom reports are concordant with informants', suggesting self-report in MCI may be a valid measure of disease severity and functioning after all (Farias et al., 2005). However, there is also a systematic review showing MCI patients' awareness of memory functioning *does* vary significantly (Roberts & Woods, 2009). In addition, data from one small study suggests patients' level of insight into their illness impacts the reliability and validity of self-rated quality of life (Berwig et al., 2009) and another shows MCI patients, as compared to cognitively-normal controls, are likely to overestimate their abilities in some functional domains (e.g. financial; Okonkwo et al., 2009). Importantly, the authors of the above review suggest that insight in MCI, and its impact on the reliability and validity of patient self-report, likely varies both within and between patients. For example, patients may be aware of general cognitive deficits but not specific memory impairments, or of specific memory impairments but not their impact on IADLs (Roberts & Woods, 2009). That said, there is a relative lack of data on the impact of patient insight on self-report measures in MCI specifically (rather than in dementia or across the dementia continuum; Frank et al., 2011). Furthermore, there is little data definitively validating the use of either generic adult neuropsychiatric measures or AD-specific neuropsychiatric measures in MCI (Frank et al., 2011).

In this study, MCI Patients were able to provide consistent and valid (insofar as these measures correlated as expected with other measures) ratings of their depression,

anxiety, fatigue, social functioning, and trait mindfulness. Relative to the less reliable and valid questionnaires, these measures had shorter, simpler questions. For example, the PROMIS-29 measures of depression and anxiety ask questions like: "In the past 7 days…I felt hopeless" or "I felt fearful," and respondents fill out a Likert scale from "Never" to "Always." In contrast, the PROMIS-29 measures for Physical Function and Pain Interference ask: "Are you able to go for a walk of at least 15 minutes?" and "In the past 7 days how much did pain interfere with your ability to participate in social activities?" The Likert scales in these cases range from "Without any difficulty" to "Unable to do" and from "Not at all" to "Very Much," respectively. In this case, it is possible that reliability and validity on the latter measures was poor simply because the cognitive load for these questions (remembering walks from the week and how long they took, remembering social activities and pain during them) was higher. This may have taxed patients' memory and/or executive functioning ability to varying degrees. To our knowledge, this is one of the first studies to assess patient's perceived health across several domains via self-report, and previous reliability and validity concerns with these measures in this population have not been reported. Although we were unable to analyze much of our collected data on perceived health in MCI, future research may consider using health-related quality of life measures adapted for AD, as no MCI-specific measures of health-related quality of life yet exist (Frank et al., 2011). The AD Disease Related Quality of Life instrument (Kasper et al., 2009), which includes subscales for social interaction, awareness of self, feelings and mood, enjoyment of activities, and response to surroundings, may be a useful alternative for future studies.

Moving on to mindfulness, we noted a discrepancy between the strong reliability of our measure of trait mindfulness (MAAS) and the weaker reliability of our measure of applied mindfulness (AMPS). The MAAS was designed to assess trait mindfulness in individuals who may not have any meditation experience, and therefore all the questions concern "mindlessness" rather than mindfulness (Brown & Ryan, 2003). Questions ask, for example, whether respondents "find it difficult to stay focused on what's happening in the present," "forget a person's name almost as soon as I've been told it for the first time," "drive places on automatic pilot then wonder why I went there," or "snack without being aware that I'm eating." Some of these questions clearly address activities that would be impacted not only by lack of mindfulness, but also by cognitive impairment. In fact, MCI Patients' mean baseline trait mindfulness on the MAAS (4.8 ± 0.8) was approximately 1 SD *higher* than previously reported means in a mostly meditation-naïve adult sample (MacKillop & Anderson, 2007), whereas trait mindfulness for Caregivers fell well within the expected range. There is some research showing that MCI patients underestimate the impact of their cognitive impairment on their functional abilities and performance on neuropsychiatric tests (Okonkwo et al., 2008; Fragkiadaki et al., 2016), a tendency that may also impact some measures of mindfulness due to their overlap with cognitive ability. This overestimation of ability may have resulted in inflated baseline trait mindfulness in this sample, given the measure's emphasis on mind*less*ness in daily life. That said, the MAAS had strong internal consistency in MCI Patients *and* correlated as expected with other measures. Perhaps this is to be expected if MCI Patients completed it as a rough measure of cognitive impairment; they may still be expected to respond consistently across time (with overestimation of ability) and the measured

construct – perhaps perceived mind*less*ness related to cognitive impairment – may still be expected to correlate with psychological distress. Nonetheless, the measure could be invalid insofar as it is too confounded by cognitive impairment to actually be measuring trait mindfulness in isolation. Only one prior study has given the MAAS to MCI patients (Wells, Kerr, et al., 2013), and also found it did not change following the intervention as expected (although participants did not have inflated baseline scores). Unfortunately, the authors do not report the measure's internal consistency for their sample, but their qualitative data also contradicts the MAAS's lack of change. Using semi-structured interviews with the same participants, this team found moderate researcher-rated understanding of basic mindfulness constructs (Wells et al., 2019). This dovetails nicely with the present study's thematic analysis, which contains several examples of MCI patients writing about mindfulness, although with slightly less frequency, clarity, and consistency than caregivers did (e.g. "Racing thoughts but easy to come back to center," "…focusing on various body parts brings an appreciation of all of them," "…more focused on the now and being in the moment."). It is possible, therefore, that adults with MCI *are* capable of learning and benefitting from mindfulness skills, but traditional measures of trait mindfulness like the MAAS, which reliably improve following mindfulness training in cognitively unimpaired samples (Brown & Ryan, 2003), may be too confounded by cognitive impairment to capture trait mindfulness accurately in this population.

This argument may be strengthened by the relative lack of reliability and convergent/discriminant validity in our other measure of mindfulness: the Applied Mindfulness Process Scale (AMPS). 4 out of 12 subscales were omitted for this measure

due to low internal consistency in MCI Patients only. The scales that were retained showed that MCI Patients' total AMPS at Week 2 (35.2 ± 5.4) was approximately 1 SD higher than Caregivers' (29.9 ± 12.5). This score is almost on par with that of meditation practitioners (39.86 ± 8.66; Li et al., 2016) and, interestingly, also on par with previously collected AMPS data in meditation-naïve patients with dementia (38.0 ± 11.9; Innis et al., 2021). Unlike the MAAS, the AMPS is designed for individuals engaged in meditation practice. It therefore asks directly about how respondents are using mindfulness skills in daily life, for example to "observe my thoughts in a detached manner," "calm my emotions when I am upset," or "realize that I can grow stronger from difficult circumstances." A total score and three subscale scores – Decentering, Positive Emotion Regulation, and Negative Emotion Regulation – are calculated, none of which changed significantly in MCI Patients over the course of our intervention. It is possible that the degree of metacognition required for this questionnaire was too cognitively taxing for some MCI Patients, resulting in poor reliability and validity for some subscales. It does, after all, take some time and effort for anyone to remember specific times in the past 7 days where one has used mindfulness skills to "stop reacting to my negative impulses" or to "be aware of and appreciate pleasant events." Furthermore, MCI Patients may have overestimated their application of mindfulness skills at baseline, perhaps because, as in the MAAS, certain questions seem to address cognitive impairment, which MCI patients may underreport as the disease progresses.

Ultimately, the AMPS also failed to change as expected in MCI Patients. In contrast, our thematic analysis suggests many instances of applied mindfulness, most vividly in patients' accounts of mindful activities (e.g. "Eating a meal. Hard to do

without TV on or conversation, but I noticed more about it," "I was worried about remembering the names of people we were visiting. I rehearsed them on the drive to help me recall them. As weekend went on I relaxed and enjoyed it.") and mindfulness of others (e.g. "Thinking about the great wife I am taking this class with made me feel thankful."). However, relative to Caregivers MCI Patients *did* report fewer instances of mindfulness in daily life and mindfulness of others. They also recounted fewer direct applications of meditation to a difficulty in daily life, such as sleeplessness, emotional reactivity, or pain, all of which were addressed many times by Caregivers. Instead, MCI Patients seemed to apply mindfulness skills most often to generating positive affect and relaxing (e.g. "It feels good. Helps me relax," "More relaxed and upbeat" [after Body Scan]). It is interesting to note that the AMPS Positive Emotion Regulation subscale, the one which most closely parallels using mindfulness to feel good, was the only subscale of the AMPS retained in its entirety due to stronger internal consistency. It was also the only subscale to improve over the intervention in MCI Patients (M_{W2} = 12.7 (3.0); M_{W6} = 13.2 (3.0)), although the improvement was not statistically significant. One possible interpretation of this is that MCI Patients found it most impactful to apply mindfulness skills to positive emotion regulation and, therefore, had an easier time reporting on this aspect of mindfulness skill development. Taken together, this suggests (1) that validity of the MAAS, and possibly the AMPS, may be confounded by some items' similarity to questions about cognitive ability, (2) that MCI patients may overestimate their baseline trait mindfulness and application of mindfulness skills due to this similarity, (3) that MCI patients may have difficulty completing the AMPS due to higher cognitive load on this measure, resulting in poor internal consistency for some subscales,, and (4) that

positive emotion regulation may be both the most accessible locus of mindfulness skill application for MCI patients, *and* the easiest to report on quantitative and qualitative measures.

This was the first study to give the AMPS to MCI patients during a mindfulness-based intervention, and only 3 trials of MBIs for MCI have measured change in mindfulness to date (Wells, Kerr et al., 2013; Wong et al., 2017; Larouche et al., 2019). All three gave different scales, with the MAAS (Wells, Kerr et al., 2013) and the Five Facet Mindfulness Questionnaire (FFMQ; Larouche et al., 2019) showing no change and the Freiberg Mindfulness Inventory (FMI) improving as expected (Wong et al., 2017). The latter measure contains relatively short and simple question stems (e.g. "I accept unpleasant experiences," "I sense my body, whether eating, cooking, cleaning, or talking;" Walach et al., 2006). Most questions ask about mindfulness (rather than mind*less*ness) and may therefore be less easily confused with questions about cognitive impairment. It also contains several items which simply and directly measure acceptance of difficulty (e.g. "I accept unpleasant experiences," "I am impatient with myself and others."). This construct is deemphasized in the MAAS and less directly addressed in the AMPS (e.g. "I used mindfulness practice to let go of unpleasant thoughts and feelings."). Because acceptance of difficulty came through strongly as an outcome of mindfulness training for MCI Patients (e.g. [What was most helpful?] "…acceptance of situations out of my control," "...learning how to live better and be more grateful for what I can do rather than fret over what I can't do."), a trait mindfulness measure which simply and directly asks about acceptance of difficulty may more accurately reflect the skills MCI Patients build through mindfulness training. In sum, future studies are advised to retain

qualitative opportunities to measure mindfulness skills in MCI patients, as this seems to capture valuable evidence of mindfulness skill acquisition in this population. Researchers may also consider the FMI as a quantitative measure of mindfulness since it may be more appropriate for individuals with cognitive impairment and is the only such measure to reflect MCI patients' development of mindfulness skills thus far.

Of the remaining reliable and valid measures, only Social Functioning improved after the intervention, whereas Depression, Anxiety, and Fatigue stayed constant. We will address Depression first. Depression was the only measure elevated at baseline, falling in the "mild" range for this scale. Mean Depression dropped throughout the intervention timeline, from the "mild" range at baseline (M_{T1}=56.0 (8.6)) to the "normal" (M_{B3}=51.1 (8.3)) range at the final booster session, but not significantly so (ß = -0.574, p = .290). Missing data from participants who dropped out (all three of whom had depression scores greater than 60T), a variable direction of change (2 participants' Depression *increased* from near the floor of the measure to "mild" at T2) and this study's small sample size likely rendered the overall drop in Depression statistically insignificant. In context, depression has been measured via self-report questionnaire before and after mindfulness training in 6 previous trials of an MBI for MCI patients (Wells, Kerr et al., 2013; Klainin-Yobas et al., 2019; Larouche et al., 2016; Wong et al., 2017; Larouche et al., 2019; Marciniak et al., 2020). It improved in 3 of these (Larouche et al., 2016; Larouche et al., 2019; Marciniak et al., 2020), all of which used the Geriatric Depression Scale (GDS) and found mild depression in their sample at baseline. In the remaining 3 studies participants did not have elevated depression scores at baseline. It follows that we may only expect depression to improve if/when participants

are struggling with symptoms of depression pre-intervention. In this sample participants *were* mildly depressed, but without the 3 participants who dropped out mean Depression for those who actually completed the intervention drops to the "normal" range (M_{T1}=54.18 (9.3)). Of course, the thematic analysis of the intervention's benefits for MCI patients clearly indicates increased positive affect. In fact, "Feeling Good" was by far the most frequently coded outcome of mindfulness training for MCI Patients, and they wrote about it far more frequently in proportion to other outcomes (41% of coded text) than Caregivers did (27%). This is interesting insofar as increased positive affect via meditation practice has been strongly linked to decreased biomarkers related to chronic stress and inflammation in several clinical populations (Bottaccioli et al., 2019). In MCI, stress-related physiological dysregulation has been linked to disease progression, in turn (Barnes et al, 2009). It follows that MCI Patients' emphasis on relaxation and feeling good may also reflect what they require from the intervention: a means of down-regulating stress and increasing positive states. Our PROMIS-29 measure of depression may not have captured this, however. It asks only about negative affect (e.g. "In the past seven days…I felt hopeless."), and therefore may not reflect the increase in positive affect seen in patients' Meditation Logs and Feedback Forms. Interestingly, the GDS includes both negatively valenced ("Do you feel that your life is empty?") and positively valenced ("Do you feel happy most of the time?") questions (Sheikh & Yesavage, 1986). Given the positive findings from prior literature in mildly depressed samples and our sample's emphasis on increased *positive* mood states, perhaps this measure may more effectively capture enhanced mood following mindfulness training in MCI patients.

The remaining measures - Social Functioning, Anxiety, and Fatigue – can be more simply discussed. Neither Anxiety nor Fatigue were elevated at baseline, suggesting MCI Patients were not struggling with these. Only three MCI Patients mentioned anxiety or worry in their qualitative feedback, one to say that meditation was relaxing but not helping with his anxiety as he had hoped, and two to say that mindfulness helped them worry less about MCI. Similarly, only 1 prior study has found improved anxiety following mindfulness training in MCI patients, as measured by the Geriatric Anxiety Inventory (GAI; Larouche et al., 2019). In the 3 other studies that have measured anxiety, two found it was not elevated at baseline (Klainin-Yobas et al., 2019; Wong et al., 2017) and one found it was mildly elevated but did not improve (Marciniak et al. 2020). Future research may consider adapting their MBI to help participants directly apply mindfulness skills to worry about MCI, given its importance to some participants in this study, and may also hypothesize improvement *only* in samples with elevated anxiety at baseline. Regarding Fatigue, sleepiness was a common barrier to practice for MCI Patients and many enjoyed deep relaxation in their practice, but no one wrote about mindfulness training as a means of feeling less "run-down," which is the construct centered in our PROMIS-29 measure of fatigue. Measures which capture "getting enough rest" or relaxing, such as the recently published Relaxation State Questionnaire (Steghaus & Poth, 2021) may more effectively address change in this domain in future research.

Finally, MCI Patients reported average Social Functioning at baseline, which significantly improved to an above average level post-intervention and dropped slightly through the 1st and 2nd Booster Sessions. To our knowledge, this is the first time social

functioning has been directly measured in MCI patients as a potential outcome of group-based mindfulness training, and suggests patients' may feel more connected and confident in social relationships following an MBI. This outcome was also reflected in our thematic analysis, which showed patients practicing mindfulness of others, pets very much included ("Thinking of a loved one during this exercise was very enjoyable," "I pictured my pet dog and how gentle and kind she is"), and noticing positive shifts in their relationships ("…I'm grateful my husband got to see/hear some of my issues and how to better work with me rather than get mad or lose patience with me."). Similarly, patients commented frequently that "listening to others," "meeting everyone else" and "class discussions" were among the most positive aspects of the intervention for them. These findings build nicely on Wells and colleague's (2019) analysis of semi-structured interviews with MCI patients following MBSR; "Importance of the Group Experience" was discussed frequently enough in this sample that it became its own theme, with patients frequently commenting on how helpful it was to learn mindfulness with a group of other older adults with MCI. The present study's inclusion of both patients and caregivers may have intensified this effect for some patients, like the woman above who valued her husband having a chance to learn more about how to help her, rather than becoming upset. These findings are also important insofar as social engagement is a means of maintaining cognitive reserve (Stern, 2012), with some specific indication that interventions which include regular social engagement preserve cognitive functioning (Ertel et al., 2008). However, our data also show that continued social contact is likely required to maintain intervention effects, although the drop in Social Functioning through follow-up was not statistically significant. While monthly Booster Sessions were

enough to maintain slightly improved social functioning in MCI Patients, clinics considering implementing mindfulness-based programming may consider offering weekly "drop-in meditation groups" for those interested in staying connected with each other and continuing their meditation practice. Future studies are advised to (1) continue measuring social functioning directly, as it is both clinically important and responsive to mindfulness training, and (2) continue investigating how long intervention effects can be expected to persist following a weekly group intervention.

In summary, patients with MCI appear capable of engaging in and benefitting from mindfulness training. However, they may have difficulty reporting on mindfulness skill acquisition via questionnaire, with the possible exception of mindful regulation of positive emotions. During and after mindfulness training, MCI patients may experience enhanced social functioning and increased positive affect. Some may also benefit from increased acceptance of their condition. Additional research is needed to confirm that MBIs are effective in reducing psychological distress in depressed and/or anxious samples, which this sample was not. Our results also suggest that some more cognitively taxing self-report measures can be confounded by cognitive impairment in this population, to the point they are no longer reliable or valid. Future researchers are advised to include straightforward measures and/or measures designed for cognitively impaired respondents as available, and to retain a mixed methods approach as a key means of capturing change in this population.

Caregivers

Caregiver burden, which fell in the mild to moderate range on the Zarit Burden Interview (ZBI), was the only measure of psychological distress or perceived health

elevated at baseline in this group. It did not improve following the intervention, nor did Caregivers' Depression, Anxiety, Fatigue, Pain Interference, Physical Function, Sleep Disturbance, or Social Functioning scores. In fact, Caregivers' Anxiety rose to the "mild" range post-intervention, although this change was not statistically significant and Anxiety dropped back down to normal levels at Booster Sessions 1-3. As expected, application of mindfulness skills in daily life (AMPS) increased in Caregivers over the 6-week intervention. Trait mindfulness (MAAS) also increased as expected, but not until Booster Session 1. Similarly, Caregivers' Sleep Disturbance decreased and remained low through follow-up, but did not drop until the first Booster Session. Our thematic analysis reflects these findings insofar as Caregivers clearly demonstrated mindfulness skill acquisition and application. In addition, Caregivers reported an increase in positive affect, acceptance of difficulty, and interpersonal well-being that was not apparent in quantitative measures. This section will contextualize these findings within prior MBI research on caregivers of patients with MCI or dementia and will suggest directions for future research.

Caregiver's expected increase in application of mindfulness skills in daily life was also reflected in their qualitative data, which indicated meaningful shifts in coping for several Caregivers. One Caregiver found herself "more understanding and patient" with her husband, another found "a way to reduce stress and accept problems" and "learned how to be more helpful at home," and a third felt "more aware of the feelings of others, especially my life partner (wife)." These and similar reflections were coded under "Enhanced Interpersonal Well-Being" and "More Accepting," and were more frequent for Caregivers than MCI Patients, relative to the other "Enhanced Well-Being" codes.

This text demonstrates clear understanding of mindfulness skills (e.g. "…Becoming aware that I can accept things as they are and I do not have to attempt to change things.") and their application to daily life (e.g. [Regarding husband forgetting a story with friends] "Realized our friends are true friends and they understood and loved us anyway.").

While this is the first qualitative exploration of this specific population's experience of MBIs, a growing body of research suggests a mixed methods approach provides valuable insight into caregivers' experiences. In trials of MBIs for caregivers of people with dementia, thematic analyses have shown increased self-compassion, a sense of shared suffering, and reduced stress in some caregivers (Douglas et al., 2021), as well as increased acceptance (Hoppes et al., 2011) and increased connection with their relative (Berk et al., 2019). In Berk et al. (2019), the only mixed methods example of this work thus far, the study team saw positive change in their semi-structured interview data but *no* improvements in quantitative measures of psychological distress, worry, or caregiver burden. However, these were not elevated at baseline. Interestingly, and as in the present study, they *did* find a large increase in trait mindfulness in caregivers. Taken together, we might expect MBIs to increase trait mindfulness as expected, and for this increase to translate to positive change in caregivers' experience of themselves and their loved ones. However, future research with more distressed samples is required to confirm that MBIs can treat elevated depression, stress, pain interference, or fatigue in this population.

Indeed, the only measure of psychological distress or perceived health to improve in Caregivers was Sleep Disturbance, beginning at Booster Session 1. Several Caregivers

also reported using meditation as a sleep aide in our qualitative data. In fact, more than one Caregiver commented that a specific practice, Gatha meditation, helped them sleep (e.g. "Started using this [Gatha] at night to go back to sleep. Very effective." "Using it frequently at night to sleep better."). Gatha is a type of mantra meditation that trains practitioners to link the lines of a short poem to their breathing, thereby calming a wandering mind. It was included in the intervention to give MCI Patients additional supports for mindful attention, but it is not typically taught in either MBSR or MBCT. To the author's knowledge, only one trial of MBCT for caregivers of persons with dementia has measured sleep disturbance as an outcome, and found no change (Oken et al., 2010). It is difficult to say whether the inclusion of Gatha meditation contributed directly to Caregivers' decrease in sleep disturbance, but future studies are advised to retain this outcome measure and consider framing any mantra practices included in the intervention as a potential sleep aide.

Caregivers' slight increase in Anxiety was driven by four participants whose score increased by 6 points or more on a T-score scale, while the remaining participants remained stable or decreased. Two out of the four participants whose anxiety increased had "moderate" anxiety at baseline ($60 < T < 70$) and "severe" anxiety post-intervention ($T > 70$). The other two were within normal limits ($T < 55$) at both timepoints, but still experienced clinically meaningful increases (change > 2-6; Lee et al., 2017). No Caregivers reported feeling more worried, anxious, or fearful after the intervention in Meditation Logs or Feedback forms. These results are surprising, given that meta-analyses of MBIs for adult anxiety suggest these interventions have a reliable moderate effect in *reducing* anxiety (Fumero et al., 2020; Hofmann & Gomez, 2017). This effect

seems to extend to older adults, with a recent review finding Mindfulness-Based Cognitive Therapy particularly effective in reducing geriatric anxiety in the absence of comorbid depression (Hazlett-Stevens et al., 2017). However, the effect of MBIs on anxiety in caregivers of patients with MCI or dementia may not be so reliable. Data is somewhat limited; in a review of 9 studies trailing an MBI for this population, only 2 measured anxiety (Leach et al., 2015; Whitebird et al. 2013). Of these, only one, a Transcendental Meditation trial, recorded improvement (Leach et al., 2015). Caregivers in this trial were moderately anxious at baseline. It is difficult to draw conclusions here, both because the present study was uncontrolled and underpowered, and because it appears to be only the third time self-reported anxiety has been included as an outcome variable in MBI trials for this population. Future RCTs with larger sample sizes are needed to discern whether longitudinal increases in anxiety in this population are common in the absence of any intervention, and whether MBIs can reliably improve anxiety symptoms in caregiver samples who do *not* show elevated anxiety at baseline. Future studies may also note that caregiver burden, which was mildly elevated in this sample, is associated with increased anxiety (Anderson et al., 1995). Because caregiver burden may change throughout the intervention timeline due to extraneous events occurring concurrently with treatment *or* due to the treatment itself, researchers may wish to test whether change in caregiver burden mediates any positive or negative effects of mindfulness training on anxiety.

Relatedly, although caregiver burden was elevated in this sample, it did not improve post-intervention. There was also limited text directly addressing caregiver burden in Caregivers' Meditation Logs and Feedback Forms. Caregiver burden impacts

caregivers' emotional, social financial, and physical functioning (Hudson et al., 2020) and creates increased risk of adverse health outcomes in both caregiver and patient (Navaie et al., 2002), making it a key outcome of behavioral intervention studies with this population. However, a recent review of MBIs for caregivers of MCI or dementia patients found that only 1 out of 3 studies assessing caregiver burden found lower burden post-MBI (Shim et al., 2020). In this one study, the improvement in caregiver burden following MBSR did not persist to 6-month follow-up (Brown et al., 2016). Our results are consistent with prior research insofar as they suggest MBIs may *not* decrease caregiver burden in this population, as hypothesized. This is surprising, as cross-sectional research has shown links between lower caregiver burden and higher self-compassion, higher emotion-focused coping strategies, reduced dysfunctional coping, and higher trait mindfulness (Lloyd et al., 2019; Innis et al., 2020), all of which are targeted in MBIs. However, although there seems to be an association between mindfulness-based coping and caregiver burden in this population, a 6-8 week MBI may not be sufficient to create meaningful and sustainable change. After all, caregiver burden is influenced by a multitude of factors that are not frequently addressed in MBIs. These include, but are not limited to, facilitating activities of daily living, managing care coordination, explaining patients' limitations to others, tracking symptoms, and coping with ambiguous loss (Hudson et al., 2020). Interventions which include direct instruction, discussion, and support for these challenges may be required to "move the needle" on caregiver burden in this population. For example, one study trialed a "coping strategies intervention" versus TAU (care management phone call every two weeks; Chen et al., 2015). The intervention group received a series of five interventions

focusing on problem solving skills, knowledge of dementia, social resources, and emotional support. The intervention group saw significant improvement, relative to TAU, on self-report measures of problem-focused coping, social support coping, and caregiver burden. Similarly, the "Tailored-Activity Program" (TAP), led by an occupational therapist, appears to decrease burden in caregivers of patients with dementia (de Oliveira et al., 2019). TAP is an 8-session personalized behavioral intervention delivered to one caregiver-patient dyad at a time. It focuses on psychoeducation about dementia, implementing 3 personalized activities for increased cognitive engagement, and generalizing new coping strategies to ADLs. In sum, this research suggests MBIs may not be specific enough to the problems caregivers face to significantly impact caregiver burden, and that interventions which target coping strategies specific to this burden may be more effective. That said, because this MBI was so well-received by Caregivers, future research may also consider integrating mindfulness training into such interventions.

Larger randomized and controlled trials adapted to the specific needs of the target population (Loucks et al., 2022) are required to understand the nature and scope of benefits caregivers may derive from mindfulness training. In the context of previous research, the results of the present study suggest caregivers respond to mindfulness training with increases in trait mindfulness and application of mindfulness skills in daily life, as expected, and that this growth is reflected in both quantitative and qualitative measures. However, mindfulness training may not be sufficiently targeted to meaningfully address caregiver burden and is unlikely to impact psychological distress or perceived health in samples that are not experiencing distress in these domains.

Qualitative methods are useful for capturing more nuanced effects of mindfulness training on caregiver burden and for describing positive change in the absence of pre-existing distress. Future studies are advised to (1) consider integrating psychoeducation and problem-focused coping, while retaining mindfulness training, into behavioral interventions for this population and (2) to retain a mixed methods approach to assessing effectiveness in this population.

Vascular Health

Neither MCI Patients' nor Caregivers' resting heart rate, blood pressure, or BMI changed following the intervention or at 3-month follow-up (BMI only). Only BMI was elevated at baseline. Prior research suggests very small and unreliable improvements in BMI following mindfulness training in individuals who are overweight or obese, and previous trials showing this effect have been notably confounded by poor methodology (Rogers et al., 2017; Conversano et al., 2021). Similarly, there is some indication that reductions in clinic blood pressure can be expected following mindfulness training, but this change is likely specific to participants with elevated blood pressure at baseline (Lopez, 2018). This study did not have enough participants to limit planned analyses to only those with elevated blood pressure, and the majority (n=14) of participants in this study were also taking antihypertensives, confounding the potential impact of mindfulness training on otherwise high blood pressure.

That said, this was the first study to assess vascular risk factors as potential correlates of lower stress following mindfulness training. High vascular risk is thought to contribute to disease progression in MCI and may therefore be a clinically relevant and objective measure of treatment response in this population. However, the high incidence

of antihypertensive use in this population, lack of prior research suggesting BMI is responsive to mindfulness training, and small sample size made the data difficult to interpret in the context of a pilot study. In hindsight, a lab-based stress-testing protocol may have more effectively captured stress-related change in heart rate and blood pressure while controlling for antihypertensive use. There is a growing body of research showing more efficient cardiovascular reactivity to and recovery from emotional stress following mindfulness training (for review see Morton et al., 2020). Fortunately, antihypertensive drugs do not seem to impact the typical hemodynamic response to emotional stress (Ruddel et al., 1988), meaning psychophysiological measures of stress reactivity can provide valid measures of cardiovascular health, even in those taking antihypertensives. However, no studies have yet investigated these variables in a sample of older adults, much less older adults with MCI. This area is ripe for future research, as prior studies have shown an association between high blood pressure reactivity to stress and worse performance on neuropsychological measures of immediate memory, delayed memory, and executive function (Waldstein & Katzel, 2005). These protocols, in which subjects are presented with a previously validated stressor while heart rate and blood pressure are continuously recorded, may also give researchers a valuable objective alternative to self-report measures of psychological distress and application of mindfulness skills. As discussed, reliability and validity concerns complicated our interpretation of these measures in MCI, but coping with psychological distress is a major target of mindfulness training. Lab-based stress testing may complement self-report and qualitative measures by providing a measure of reactivity to emotional stress that is not reliant on patients' metacognition.

Chapter 5

Conclusion

The prevalence of mild cognitive impairment (MCI) is rising as the population of older adults in the United States continues to grow (Stawski et al., 2019). In response, non-pharmacologic interventions for behavioral and psychological health are increasingly studied as a means of improving patients' psychological well-being, reducing functional impairment, and potentially buffering the risk of disease progression. This dissertation investigated one such intervention – mindfulness-based interventions (MBIs) – as a potential adjunct to integrated care for this growing population of patients and their caregivers.

This multimethod pilot study funded by the New Jersey Health Foundation attempted to add to the growing literature on MBIs for MCI by trialing a lightly adapted, 6-week, group-based mindfulness intervention for both MCI patients and their caregivers. We used repeated measures analyses of quantitative data and thematic analysis of written qualitative data to address the intervention's feasibility, acceptability, and effectiveness over 5 domains: cognitive functioning, psychological distress, perceived health, mindfulness, and vascular risk. Our data further confirm that MBIs for older adults with MCI and their caregivers are broadly feasible, with excellent adherence to home meditation practice. Similarly, mixed methods analyses indicated that participants enjoy both the mindfulness-based (guided meditation, mindfulness instruction) and non-specific (group cohesion, facilitator attention) aspects of the intervention, with MCI Patients emphasizing meditation as a helpful way to relax and feel better in the moment. Regarding effectiveness, we found a trend toward better immediate memory post-

intervention in MCI Patients, as well as improved social functioning. However, many self-report measures in MCI Patients lacked internal consistency and convergent/divergent validity, which limited our interpretation of other measures. Qualitative data from patients' Meditation Logs helped fill this gap, showing that patients were able to acquire basic mindfulness skills, and that many noticed better relationships, more relaxation and positive affect, and increased acceptance as a result. For Caregivers, our data suggests Caregivers respond to mindfulness training with the expected increases in trait mindfulness and application of mindfulness skills in daily life, but some measures which improved, namely the MAAS and Sleep Disturbance, did not do so until the first follow-up timepoint. In addition, caregiver burden was not responsive to mindfulness training, suggesting the intervention may not be targeted enough to significantly address the many facets of burden in this population.

This study was limited by its small sample size, lack of either waitlist or active control groups, and mostly non-elevated levels of psychological distress in our sample. While our sample size was sufficient to provide rich qualitative data, this study was not formally powered to detect even large effects of mindfulness training on cognitive functioning, psychological distress, perceived health, or vascular risk. An intention to treat approach and multilevel linear modelling were therefore used to preserve sample size, reduce the likelihood of Type 1 error, and provide effect size estimates of within-subjects change over time. This analysis revealed several potential treatment effects, but due to the lack of control group we cannot conclude that the recorded changes in immediate memory, social functioning, or mindfulness are due to mindfulness training rather than common factors, maturation effects, or demand characteristics. Furthermore,

it is possible that mindfulness training protected against decline in cognitive functioning in MCI Patients, since there was no deterioration in any domain therein, but this conclusion requires further research with waitlist control groups. Finally, clinically significant symptoms of depression and anxiety are common in both MCI patients and their caregivers, but these measures were not elevated in our sample. Conclusions about the usefulness of MBIs for treating comorbid clinical depression or anxiety in these populations are there difficult to draw, particularly in the absence of a control group to measure regression to the mean, maturation, or common factors effects. Although future randomized controlled trials (RCTs) are required to address these limitations, this study was strengthened by its novel focus on treating *both* MCI patients and their caregivers simultaneously and collecting qualitative data on acceptability and effectiveness. We are also the first MBI trial with this population to collect data on perceived health and vascular risk, although the former was not reliable or valid in MCI patients and the latter was likely confounded by antihypertensive use. These contributions, particularly our focus on both patients and caregivers and the inclusion of qualitative Meditation Log data, demonstrate that MBIs are feasible and acceptable when delivered to these populations simultaneously and that we can track patients' and caregivers acquisition and application of mindfulness skills, while also supporting adherence to home meditation practice.

With these strengths and limitations in mind, we can make several informed recommendations for future research. While feasibility is strong, future trials may optimize retention, attendance, and adherence by extending the recruitment period, allowing patients and caregivers to participate together or alone, holding daytime classes,

considering a telehealth format when weather is a barrier to transportation, and providing additional support between enrollment and the start of the intervention. Participants may also appreciate alternate mindful movement practices, such as Tai Chi, to accommodate mobility impairments. Qualitative data collection is highly recommended as a valuable means of collecting data on infrequent adverse effects and limitations of MBIs in this population, as well as benefits of the intervention that do not emerge on self-report measures. These may include, but are not limited to, enhanced interpersonal well-being, positive affect, acceptance of MCI, relaxation, spiritual well-being, and reduced caregiver burden in some domains. That said, some MCI patients had difficulty expressing themselves in writing, and may benefit from non-written methods of providing qualitative data and tracking their mindfulness skill development. These could include meditation apps, voice recordings, and/or semi-structured interviews. Relatedly, future trials should consider the possibility that some more cognitively taxing self-report measures, including measures of mindfulness, can be confounded by MCI patients' cognitive impairment to the point they are no longer reliable or valid. Measures of mindfulness should be examined for questions that are easily confounded by memory impairment, and researchers may consider including both self-report and informant measures specifically designed for this population. More suitable measures may include the Freiburg Mindfulness Inventory (FMI; Walach et al., 2006), the Self-Administered Gerocognitive Examination (SAGE; Scharre et al., 2010), the Informant Questionnaire on Cognitive Decline in the Elderly (Jorm & Jacomb, 1989), the Functional Activities Questionnaire (Weintraub et al., 2009), the AD Disease Related Quality of Life instrument (Kasper et al., 2009), and the Geriatric Depression Scale (GDS; Sheikh & Yesavage, 1986).

Researchers may also wish to add positively valanced mood measures and/or measures of relaxation, to capture these important benefits of mindfulness training in MCI patients. Finally, future trials may hypothesize a specific effect of mindfulness training on immediate memory in MCI patients and may use active control and treatment as usual (TAU) groups to isolate both mindfulness-specific treatment effects and potential preservation effects of any active behavioral intervention on cognitive functioning. Continued use of long-term follow-up timepoints is also required to address when intervention effects emerge and how long they can be expected to persist.

In conclusion, mindfulness training may be a well-received, helpful, and low-cost adjunct to integrated care for both patients with MCI and their caregivers. However, such interventions are not panaceas, and future research is needed to isolate the specific and reliable effects of mindfulness training on well-being and disease progression in this population. In so doing, we may hope to create a class of behavioral interventions which improve quality of life and possibly slow disease progression in this growing population of patients and their families.

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Appendix A

Intervention Materials

Course Syllabus

Mindfulness and Healthy Aging
Course Outline

Welcome to NJISA's *Mindfulness and Healthy Aging*! During this class you and your partner will be introduced to the practice of mindfulness. You will learn several ways to practice mindfulness, including meditation, which may help you manage stress and feel happier.

Mindfulness is about paying full attention to all the moments in your life. This means that we spend less time wishing things were different, worrying about the future, or longing for the past. A "mindful" attitude is non-judgmental, curious, attentive, and accepting. When we practice seeing the world this way, we also feel less overwhelmed by the challenges of life.

This course is meant to be an introduction to mindfulness. Just like any new skill, it takes practice. This course is an opportunity for you and your partner to commit to learning something new together. We invite you to stay curious about what you experience here and to practice kindly and patiently every day.

Some Notes on Class Structure

- Please let us know if you and/or your partner will not be coming to class. You can reach Emma, the co-instructor and study coordinator, at XXX-XXX-XXXX or XXXX@students.rowan.edu
- Please turn off your cellphone during class.
- Please arrive on time.

Class Homework

It is vital that you practice mindfulness at home in order to benefit from this course. For the next 6 weeks we are asking you to:

- Practice meditation for 10-15 minutes every day
- Log your meditation on the paper meditation log we will give you
- Read the assigned chapters in the book.

You will receive a CD with guided meditations to listen to for homework. If you prefer, you can also listen to each meditation by following this link: XXX

Reading

The reading in this course is optional. The text, *Wherever You Go There You Are* by Jon Kabat-Zinn, can be a helpful complement to our in-class activities. If you choose to read the text, please read the following chapters each week:

Class 1: Introduction & Chapters 1-10
Class 2: Chapters 11-22
Class 3: Chapters 23-33
Class 4: Chapters 34-44
Class 5: Chapters 45-56
Class 6: Chapters 57-70

Note: You can also listen to this book on YouTube via the following link: https://www.youtube.com/watch?v=7Ap_-F9D5Gw

The Classes and Homework

Each week you and your partner will learn ways to meditate and practice mindfulness, and will discuss your experience with the instructors and your classmates. In the week after class you will practice any of the skills you have learned so far at home. You may find that you prefer some skills over others, and this is OK. The goal is for you to find one or two ways of practicing meditation that work for you.

Class Schedule

Each class will begin with an opening meditation followed by class discussion and learning one or two meditation skills.

Class One

Orientation & Introductions
Breath Awareness: In this meditation you will learn the basic technique of finding and returning to your breath.
Belly Breathing/Diaphragmatic Breathing: This is a calming skill that can be used to help relax yourself when you are feeling upset or to help

you fall asleep. You will be taught to breathe deeply into your belly, using your diaphragm rather than the muscles of your chest and lungs.
Mindfulness of Daily Life: In this exercise you will choose an activity that is already part of your routine, such as washing the dishes or taking a shower. As part of your homework you will commit to doing this activity with full mindfulness.

Class Two

Body Scan Meditation: In this meditation you will learn to use body sensations as an anchor to the present moment, rather than your breath.

Class Three

Meditation Poem: In this meditation you will learn to use a short poem, called a gatha, to help focus your mind during meditation. Students often find the gatha useful when they have trouble concentrating or remembering to come back to the breath.

Class Four

Chair Yoga: You will be guided through a series of simple and accessible yoga postures aimed at cultivated awareness of the body. Like the body scan, your anchor to the present moment during yoga are the sensations in your body as it moves.

Class Five

Lovingkindness Meditation: In this meditation you will practice silently wishing yourself and others well-being and happiness. Students often find this to be a powerful way of connecting with themselves and those they love.

Class Six

Open Awareness Meditation: In this final meditation practice you will practice using whatever arises as your anchor to the present moment: breathing, sound, emotions, thoughts, sensations, etc.

Booster Sessions

There will be three booster sessions following this course. **These will be held on _____, _____, and _____ from _____ in the same location.** They will be aimed at helping you and your partner keep up your mindfulness practice. Booster sessions will be 1.5 hours long and will involve meditation practice and group discussion.

Facilitator Manual: Class One

Introduction to Mindfulness

Orientation & Introductions (5:00-5:45):

- Who we are, course objectives, rationale.
    - We ALL have the *natural* ability to be mindful!
    - Learning mindfulness has been shown to help some people feel less worried, more accepting, and happier, even when going through illness. Mindfulness can help "reduce the negatives" AND "enhance the positives" in life.
    - Instructor goal of sharing these skills with the group. Seeing together whether mindfulness can be helpful for people with MCI and those who love them.
- Group structure & "rules to abide by."
    - Start/end on time. Confidentiality. Speak from *own experience*; mindful listening. Be open to new experiences and information and quiet any expectations. Silent phones. Contact us if need be.
- Discussion: "What brings you here?"
- Tie course objective and rationale to patients' stories, values, and motivations for enrolling (together). Themes:
    - **Uncertainty/lack of control:**
        - How do we cope with the things we can't control? Aging, new roles (caregiving), illness, uncertainty, worrying, changing bodies/minds
        - Being here is one way to begin learning how to cope - how to enjoy life even when we're challenged/not in control. (contentment, "happy for no reason")
    - **Frustration:**
        - Possible frustration - doctors do their best but we may feel as though we're just supposed to learn how to "live with it." How? It's really hard to learn how to live with MCI (or new suffering in general)
        - Symptoms of MCI sometimes get worse when we become frustrated/stressed out. Can get better as we learn to calm down and be kind to ourselves. This is one way to do that.
    - **Caregiving:**
        - Sometimes we're more able to care for others when we take time to care for ourselves
    - **Curiosity:**
        - Attitude of togetherness and curiosity. These strategies might help, in fact there's some good indication that they help people experiencing illness feel happier, less stressed. BUT, we've never done this with this group of people! Invitation to keep an open mind. ("come and see" mentality)

Mindful Movement (5:45-5:50):

Sit quietly in a chair with the feet hip-distance apart and knees directly in front of the hips. Let your palms rest on your thighs. Lift the rib cage away from the hips, lift the chest towards the ceiling and pull the crown of the head upwards. Bring your awareness to your breath and begin to deepen each inhalation and exhalation (pause instruction for ~30 seconds). Inhale as you lift your chest towards the ceiling and arch your back, exhale as you curl your chest in and round your back. Inhale to come back to center and raise your arms overhead, exhale as you sidebend over to the right. Inhale as you come back to center, exhale to sidebend over to the left. Inhale as you come back to center, exhale your palms back down onto your lap. Inhale to cat, etc. (repeat from beginning).

Mindful Breathing (5:50-5:55): Example script below.

Today we will practice a breath awareness meditation. First, finding your meditation position. Adjusting your posture so that you are sitting comfortably and upright. If you are in a chair, place your feet flat on the floor and allow your hands to rest comfortably in your lap. Allow your eyes to close if that feels comfortable for you. If not, simply gazing towards the floor a few feet ahead of you with your gaze soft and unfocused.

Mindfulness is the practice of coming back, again and again, to what is happening in this moment. Today, we will practice mindfulness of breathing. You will notice that your mind wanders away from breathing every so often, and this is completely natural. When this happens we simply guide our mind back to the breath, again and again, taking the opportunity to arrive again in the present moment.

Beginning now by just becoming aware of your body sitting. Feeling your feet touching the floor, your hands in your lap. Noticing the places your body contacts the chair or cushion. Feeling the body here, right now, supported by the chair or cushion.

Now, becoming aware of the body breathing. Noticing the place in your body where it is easiest to feel your breath. You may feel the breath moving in and out of the nostrils, or perhaps the back of the throat. You may feel the rise and fall of the chest or of the belly. There is no "right" or "wrong" place to feel your breathing. Everyone has a different body and feels the breath differently. Simply allowing your attention to settle on the place in your body where the breath is easiest to feel...How does it feel to breathe naturally?...Observing the breath moving in and out...There is no need to change the breath in any way. We are simply placing our attention on the natural movement of the breath, as it happens. Resting the attention here, feeling the rise and fall...

...At some point you will notice that your attention has left the breath. Perhaps you've been distracted by a sensation in the body, a sound outside, or thoughts in your mind. This is not a problem. It is normal and natural for your mind to wander. When you notice this, you have a wonderful opportunity to build your mindfulness muscle by coming back to the breathing without judging yourself for having wandered away. With an attitude of kindness, as though you are gently settling a child, bringing your attention back to the body breathing. What sensations do you notice as you breathe? Noticing the temperature of the inhale…the exhale…The pace at which your body naturally breathes…Allowing the breath to be the focus of your attention…

...There is no need to control the breath in any way. Simply observing the breath as it naturally rises and falls...Reminding yourself that the body knows how to breathe. It has been breathing your whole life. We can allow the body to breathe itself…Watching the natural inhale and exhale…

...Noticing where your mind is now. If it has wandered, reminding yourself that this is not a problem to be solved but simply the normal activity of the mind. Each time your mind wanders you are invited to take a completely fresh start. Letting go of what has passed, letting go of judgment, and noticing the breathing again as though for the first time. Resting here, now, with the feeling of the body breathing.

...Returning to the breath as an anchor to this moment. Becoming fully present for this breath...this one...the next...

There is no need to go looking for the breath, the body is always breathing...Noticing the quality of the breath - shallow or deep, slow or faster...Noticing the entire inhale...the entire exhale…

...Reminding yourself that there is no need to try to stop your thoughts. Instead, we are just learning to notice when we are thinking and return to the sensations of the present moment...Feeling the here and now sensations of breath entering and leaving the body…

...Noticing where the mind is now. Practicing an attitude of non-judgment and kindness, gently return to the sensations of breathing. Relaxing back into in the inflow and outflow of the breath…

...As this meditation comes to a close, experimenting with relaxing just a bit more. Letting go of controlling the breath…Resting here, trusting the body's ability to breathe itself.

In this moment there is nothing to do...Simply receiving the sensations of breathing as they arise on their own...

…This meditation will conclude with the sound of a bell. When you hear the bell, taking a moment to thank yourself for this time you've taken to care for your mind and body. Knowing that each time you practice you are increasing your ability to be calm and present in your life.

[Bell]

Didactic (5:55-6:05): **What is Mindfulness?**

- Discussion: "What did you notice?" (Difficult/easy? Quality of breath? Thinking?)
- What is mindfulness?
    - Paying attention in a particular way - on purpose, non-judgmentally.
        - Seeing whatever is here right now - feelings, thoughts, pain, pleasure, bodies, sounds - without trying to make some things stay longer and other things go away.
    - **River metaphor** - not trying to stop the river of thought, just sitting on the bank and watching things go by. (non-judging, non-striving, acceptance, letting go)
    - **Mindfulness muscle** - a skill like any other, takes practice and grows with time. No one will be good at it right away. But, we all have the ability to be mindful, just like we all have muscles! It's available to all of us, right now (patience, beginner's mind, trust)
- (List on WHITE BOARD; see hand-out) 7 Attitudinal Foundations (from Kabat-Zinn)
    1. Non-Judging
    2. Patience
    3. Beginner's Mind
    4. Trust
    5. Non-Striving
    6. Acceptance
    7. Letting Go

Belly Breathing/Diaphragmatic Breathing (6:05-6:20): 5-7-min guide; 5-min debrief. Example script below.

In this meditation we will practice a way of breathing that many people find calming and relaxing. For this practice you may wish to lie back in your chair a bit, or to lie down on the floor. Taking some time now to adjust your body so that you are comfortable. For this exercise, placing both hands gently on your belly and allowing your eyes to close.

As the body settles, beginning to become aware of the breath, moving in and out of the body. You may notice that the hands you have placed on the belly rise and fall with the breath, or you may not notice much movement in the belly at all. Both are okay. Different bodies have different ways of breathing naturally. Taking a

few normal breaths now and just notice, without judgment, whether you feel your hands rise and fall as you breathe naturally.

In this meditation we will practice a specific way of breathing in which we consciously breathe into and out of our bellies. This way of breathing takes practice to learn, and you are always welcome to return to your natural breath if you need a break. For now, beginning to practice breathing with your belly. As you breathe in, as best you can, pushing your belly out so that your hands rise up. As you breathe out, letting your hands fall as your belly sinks back down. Inhaling, allow air to fill your belly, breathing into your hands. Exhaling, releasing air from your belly. Feeling your hands moving up and down as you breathe…Continuing to breathe in this way, practicing filling the belly on the inhale and emptying it on the exhale.

...As you practice, placing your attention on the rise and fall of the belly...In this moment, noticing the movement of the hands up...and down... inhaling... exhaling... Continuing to breathe in this way, allowing the attention to settle on the rise and fall of the belly.

...You might find it helpful to imagine there is a balloon in your belly. As you inhale, the balloon inflates and fills with air…as you exhale, the air in the balloon is gently pushed out and the belly relaxes. Each time you inhale, blowing up the balloon. Each time you exhale, allowing the balloon to deflate. Using your hands to notice the balloon growing and shrinking.

...If breathing into your belly is a new skill for you breathing this way might feel difficult at first. This is completely normal. If at any time you need to stop simply take a few natural breaths at your own rhythm, and return to belly breathing when you are ready. Remember, belly breathing is a skill like any other and takes practice to learn. Part of mindfulness is practicing being kind and patient with ourselves, allowing the body to learn to breathe in this new way at its own pace…

...Inhaling into the hands...exhaling letting air leave the belly...Inhaling hands rise...Exhaling hands fall...

...At some point you may notice that your mind has wandered. This is not a problem - that's just what minds do. When you notice that you have been lost in thought simply return to breathing into and out of your belly. Inhaling and filling the balloon, exhaling letting the air go and the belly fall…Inhaling expand...exhale release...

...You might try deepening the breath by counting to 3 as the belly expands and relaxes. Inhale...2...3, exhale...2...3…. Expand...2...3, relax...2...3. Continuing on your own, gently resting the attention on the movement of air in and out of the belly…

...Noticing where the mind is, and if it has wandered reminding yourself that this is completely natural. Once you have noticed that the mind has wandered all that remains is to relax back into the rise and fall of the breath at the belly…

...Coming back to this breath...Practicing inhaling deep into the torso...exhaling softening the belly down to the spine...continuing to practice gently, without judgement.

...Allowing the body to relax into this breath. Receiving this next inhale in a soft, expanding belly...exhaling feeling the belly button drop down toward the spine...

...Filling the belly with breath...releasing as you exhale…

...In these last few moments, taking some time to thank yourself for taking the time to practice this calming breath. Whatever you are doing next, setting an intention to bring this sense of restfulness and ease into the rest of your day.

[Bell]

- Discussion: "What did you notice?"
    - **Themes:** sleepiness, calm, relaxing, difficulty learning to breathe in a new way

Mindfulness of Daily Life (6:20-6:25): Choose an activity

- Discussion: Go around and say activity out loud
- **Themes**: mindfulness doesn't only happen in meditation (metaphor: mindfulness is the muscle and meditation is going to the gym, but you can be strong any time)
- Instructor examples of mindlessness - we miss things in our lives and when we're lost in thought - it's harder to feel happy, be kind, feel calm, etc.

Logistics and Homework Assignment (6:25-6:30):

- CDs - Mindful Breathing AND Belly Breathing (try BOTH, alternate days)
- Mindfulness of Daily Life
- Introduce meditation log - log practice and daily activity
- Reading - as much as you'd like, when you'd like. Write down your favorite quotes to bring to class
- IF TIME: What might make it hard to do this? What might help?
- Email/call if you will miss class (contact info on syllabus)

Appendix B

Qualitative Measures

Mindfulness and Healthy Aging (MaHA)
Feedback Form

Please answer the questions below as honestly as you can. Your feedback will help us improve this course for future participants. Thank you!

1. **Do you feel you got something of *lasting value* from the course? What was most meaningful to you?**

   _____
   _____
   _____

2. **Do you feel *more mindful* now, compared to before the course? If so, how?**

   _____
   _____
   _____

3. **What did you find *most helpful* about the course?**

   _____
   _____
   _____

4. **What was *least valuable*? What would you have changed?**

   _____
   _____
   _____

5. Please rate the following aspects of this class: (circle answers)

	Poor ----------> *Excellent*					
Class Length (90-min.)	1	2	3	4	5	
Course Duration (6-weeks)	1	2	3	4	5	
Class Discussion	1	2	3	4	5	
Guided Meditations		1	2	3	4	5
Teaching Quality/Didactics	1	2	3	4	5	
Feeling Support from Others	1	2	3	4	5	

6. Please share any additional thoughts and feedback regarding:

- Class Format (meditations, class discussion, teaching, timing):

  _____
  _____

- Guided Meditation Exercises (recordings for practice at home):

  _____
  _____

- Meditation Logs:

  _____
  _____

- Textbook (*Wherever You Go, There You Are*):

  _____
  _____

7. How helpful were each of these guided meditation exercises?

	Not at All Helpful------>Extremely Helpful				
Breath Awareness Meditation	1	2	3	4	5
Belly Breathing	1	2	3	4	5
Body Scan	1	2	3	4	5
Meditation Poem	1	2	3	4	5
Chair Yoga	1	2	3	4	5
Lovingkindness Meditation	1	2	3	4	5
Open Awareness Meditation	1	2	3	4	5

8. **Would you recommend this class to other individuals with MCI and their caregivers?**
   - ❑ Yes
   - ❑ No
9. **What could the facilitators have done more (or less) of to enhance your experience?**

   _____
   _____
   _____
10. **Other comments?**

    _____
    _____
    _____
    _____
    _____
    _____
    _____
    _____
    _____
    _____

THANK YOU!

Mindfulness Weekly Log

Do any of the guided meditations we have covered so far at least six times this week. Don't expect to feel anything in particular from this practice. In fact, give up all expectations about it! Just let your experience be your experience.

Record each time you practice on this form. In the "Meditation Practice" box, fill in the type of guided meditation you did. In the "Comments" box, write a few words about what you noticed during the meditation: body sensations, thoughts, emotions, insights, etc. ***Make sure to write down your comments right away so that it's easy to remember!***

In the "Mindful Daily Activity" box at the bottom, please note a daily activity you did during mindfully this week (e.g. washing the dishes, brushing your teeth).

Date	**Meditation Practice** (e.g., mindful breathing, body scan, yoga)	**Comments** (e.g., body sensations, thoughts, emotions, insights)

Date	**Meditation Practice** (e.g., mindful breathing, body scan, yoga)	**Comments** (e.g., body sensations, thoughts, emotions, insights)
	Mindful Activity of the Week	**Comments/Observations**

Appendix C

Reliability and Validity

Several patients with MCI either stated they had difficulty or appeared to have difficulty completing self-report measures of Psychological Distress, Perceived Health, and Mindfulness. We therefore assessed reliability for each measure and subscale at every timepoint using Cronbach's alpha as a measure of internal consistency. In Caregivers, Cronbach's alpha was in the "good" to "excellent" range for most measures at all timepoints ($\alpha > 0.80$), with 4 exceptions. However, 22 out of 52 scales showed suboptimal reliability in MCI patients and this pattern was also inconsistent across timepoints (e.g. some measures were reliable at one timepoint but not others). Cronbach's alpha for each measure given to MCI patients and caregivers at each timepoint is reported in Tables 10 and 11. Measures with an $\alpha < 0.60$ were omitted from further analysis. This amounted to eight measures for MCI patients and two for caregivers. These measures are highlighted dark orange in Tables 10 and 11.

Table C1

Internal Consistency (Cronbach's Alpha) for Self-Report Measures in MCI Patients

	T1	W2	W4	W6	T2	B1	B2	B3
Psychological Distress (NIH Promis-29 & ZBI-12)								
Depression	0.873	--	--	--	0.829	0.835	0.852	0.893
Anxiety	0.816	--	--	--	0.901	0.920	0.841	0.892
Perceived Health (NIH Promis-29)								
Fatigue	0.878	--	--	--	0.774	0.908	0.839	0.658
Pain Interference	0.921	--	--	--	0.624	0.979	0.839	0.711
Physical Function	0.960	--	--	--	0.605	0.419	0.675	0.242
Sleep Disturbance	0.940	--	--	--	0.892	0.614	-0.429	0.712
Social Functioning	0.612	--	--	--	0.926	0.916	0.870	0.479
Mindfulness								
MAAS	0.877	--	--	--	0.846	0.804	0.939	0.908
AMPS Total	--	0.854	0.347	0.914	--	--	--	--
AMPS Decentering	--	-0.117	0.560	0.790	--	--	--	--
AMPS Positive ER	--	0.717	0.767	0.848	--	--	--	--
AMPS Negative ER	--	0.655	0.051	0.723	--	--	--	--

Note: Excellent: $\alpha > 0.90$; Good: $0.80 < \alpha \leq 0.90$; Acceptable: $0.70 < \alpha \leq 0.80$ (light yellow); Suboptimal: $0.60 < \alpha \leq 0.70$ (yellow); Unacceptable: $\alpha < 0.60$ (orange; Cortina, 1993).

Table C2

Internal Consistency for Self-Report Measures in Caregivers

	T1	W2	W4	W6	T2	B1	B2	B3
Psychological Distress (NIH Promis-29 & ZBI-12)								
Depression	0.955	--	--	--	0.973	0.862	0.897	0.872
Anxiety	0.908	--	--	--	0.969	0.955	0.946	0.955
Perceived Health (NIH Promis-29)								
Fatigue	0.949	--	--	--	0.944	0.938	0.950	0.977
Pain Interference	0.963	--	--	--	0.988	0.818	0.958	0.928
Physical Function	0.921	--	--	--	0.964	0.656	0.491	0.407
Sleep Disturbance	0.866	--	--	--	0.939	0.897	0.882	0.913
Social Functioning	0.947	--	--	--	0.969	0.916	0.959	0.918
Mindfulness								
MAAS	0.951	--	--	--	0.856	0.958	0.927	0.968
AMPS Total	--	0.960	0.965	0.951	--	--	--	--
AMPS Decentering	--	0.921	0.890	0.714	--	--	--	--
AMPS Positive ER	--	0.933	0.938	0.937	--	--	--	--
AMPS Negative ER	--	0.862	0.935	0.903	--	--	--	--

Note: Excellent: $\alpha > 0.90$; Good: $0.80 < \alpha \leq 0.90$; Acceptable: $0.70 < \alpha \leq 0.80$ (light yellow); Suboptimal: $0.60 < \alpha \leq 0.70$ (yellow); Unacceptable: $\alpha < 0.60$ (orange; Cortina, 1993).

Due reliability concerns for several measures in MCI patients, and since reliability is necessary but not sufficient for validity, we ran bivariate correlations between measures of Psychological Distress, Perceived Health, and Mindfulness to assess convergent and discriminant validity in both MCI patients and Caregivers (Messick, 1995). These are reported in Tables 1-16. Out of 130 total correlations for MCI patients, 27 were in the opposite direction than expected at small to medium effect size ($r > |0.1|$) and 12 were unexpectedly null ($-.10 < r < .10$). In contrast, for Caregivers only 3 correlations out of 130 were in the opposite from expected direction and only 1 was unexpectedly null. In general, scales that were not reliable also appeared to be invalid and were confirmed for omission from further analysis. These were: AMPS Decentering at Weeks 2 & 4, AMPS Total at Week 4, AMPS Negative Emotion Regulation at Week 4, Physical Function at Booster 1, Sleep Disturbance at Booster 2, Physical Function at Booster 3, and Social Functioning at Booster 3. In addition, the Pain Interference scale showed 22 counterintuitive correlations with other measures across all timepoints (out of 35 correlations for this measure), only two of which were present in Caregivers. This scale was therefore excluded from further analysis in MCI patients at all timepoints. It was retained in Caregivers due to stronger internal consistency and consistent convergent and discriminant validity across the majority of bivariate correlations. After Pain Interference, Physical Function and Sleep Disturbance had the most counterintuitive correlations in MCI patients (8 and 9 counterintuitive correlations, respectively). We elected to omit Physical Function in its entirety due to suboptimal or unacceptable reliability at each timepoint exempting pre-intervention, coupled with validity concerns throughout. We retained Sleep Disturbance pre- and post-intervention due to strong

internal consistency at these timepoints but omitted the measure at Boosters 1-3 due to weaker internal consistency coupled with questionable convergent and discriminant validity. In Caregivers, all measures were retained exempting those two with unacceptable internal consistency (Physical Function at Boosters 2 & 3).

Table C3

Pre-Intervention Bivariate Correlations between Measures of Psychological Distress, Perceived Health, and Mindfulness in MCI Patients

	1	2	3	4	5	6	7	8
1. Depression	--							
2. Anxiety	.661*	--						
3. Fatigue	.571	.721	--					
4. Pain Interference	-.166	-.477	-.052	--				
5. Physical Function	-.357	-.218	-.382	-.588*	--			
6. Sleep Disturbance	.453	.185	.421	.585*	-.737**	--		
7. Social Functioning	-.622	-.305	-.478	-.296	.646	-.598	--	
8. MAAS	-.210	-.301	-.465	-.373	.274	-.256	.107	--

Note. *p < .05, **p < .01, two-tailed; n = 12. Correlations > |0.1| in the opposite from expected direction are colored orange. Unexpected lack of correlation (-0.1 < r < 0.1) is colored light orange.

Table C4

Week 2 Bivariate Correlations between AMPS Facets in MCI Patients

	1	2	3	4
1. AMPS Total	--			
2. AMPS Decentering†	.483	--		
3. AMPS Positive ER	.925**	.217	--	
4. AMPS Negative ER	.869	.156	.775*	--

Note. *p < .05, **p < .01, two-tailed; †Cronbach's alpha < 0.60; n = 9.

Table C5

Week 4 Bivariate Correlations between AMPS Facets in MCI Patients

	1	2	3	4
1. AMPS Total†	--			
2. AMPS Decentering†	.521	--		
3. AMPS Positive ER	.911**	.257	--	
4. AMPS Negative ER†	-.176	-.522	-.307	--

Note. *p < .05, **p < .01, two-tailed; †Cronbach's alpha < 0.60; n = 8. Correlations > |0.1| in the opposite from expected direction are colored orange.

Table C6

Week 6 Bivariate Correlations between AMPS Facets in MCI Patients

	1	2	3	4
1. AMPS Total	--			
2. AMPS Decentering	.949**	--		
3. AMPS Positive ER	.780*	.567	--	
4. AMPS Negative ER	.975**	.941**	.665	--

Note. *p < .05, **p < .01, two-tailed; n = 9.

Table C7

Post-Intervention Bivariate Correlations between Measures of Psychological Distress, Perceived Health, and Mindfulness in MCI Patients

	1	2	3	4	5	6	7	8
1. Depression	--							
2. Anxiety	.763*	--						
3. Fatigue	.209	-.264	--					
4. Pain Interference	-.129	-.414	.237	--				
5. Physical Function	.107	.399	-.633	-.416	--			
6. Sleep Disturbance	.383	.195	.130	.047	-.026	--		
7. Social Functioning	-.201	.110	-.726*	.200	.580	-.085	--	
8. MAAS	-.654	-.323	-.127	-.265	-.158	-.385	.431	--

Note. *p < .05, **p < .01, two-tailed; †Cronbach's alpha < 0.60; n = 9. Correlations > |0.1| in the opposite from expected direction are colored orange. Unexpected lack of correlation (-0.1 < r < 0.1) is colored light orange.

Table C8

Booster 1 Bivariate Correlations between Measures of Psychological Distress, Perceived Health, and Mindfulness in MCI Patients

	1	2	3	4	5	6	7	8
1. Depression	--							
2. Anxiety	.408	--						
3. Fatigue	.191	.452	--					
4. Pain Interference	-.279	-.486	-.244	--				
5. Physical Function†	-.051	-.226	-.666	.154	--			
6. Sleep Disturbance	.486	.044	.568	.254	-.328	--		
7. Social Functioning	-.585	-.195	-.633	-.302	.415	-.843*	--	
8. MAAS	-.639	-.445	-.589	.309	.012	-.364	.603	--

Note. *p < .05, **p < .01, two-tailed; †Cronbach's alpha < 0.60; n = 7. Correlations > |0.1| in the opposite from expected direction are colored orange. Unexpected lack of correlation (-0.1 < r < 0.1) is colored light orange.

Table C9

Booster 2 Bivariate Correlations between Measures of Psychological Distress, Perceived Health, and Mindfulness in MCI Patients

	1	2	3	4	5	6	7	8
1. Depression	--							
2. Anxiety	.863*	--						
3. Fatigue	.933**	.949**	--					
4. Pain Interference	-.088	-.234	-.299	--				
5. Physical Function	-.350	-.128	-.155	.018	--			
6. Sleep Disturbance†	.553	.131	.336	-.127	-.434	--		
7. Social Functioning	-.772*	-.768*	-.689	-.255	.241	-.090	--	
8. MAAS	-.552	-.664	-.537	-.487	-.220	.163	.800*	--

Note. *p < .05, **p < .01, two-tailed; †Cronbach's alpha < 0.60; n = 12. Correlations > |0.1| in the opposite from expected direction are colored orange. Unexpected lack of correlation (-0.1 < r < 0.1) is colored light orange.

Table C10

Booster 3 Bivariate Correlations between Measures of Psychological Distress, Perceived Health, and Mindfulness in MCI Patients

	1	2	3	4	5	6	7	8
1. Depression	--							
2. Anxiety	.836*	--						
3. Fatigue	.708	.316	--					
4. Pain Interference	.046	-.426	.382	--				
5. Physical Function†	-.825*	-.813*	-.312	.249	--			
6. Sleep Disturbance	.184	-.345	.512	.676	-.127	--		
7. Social Functioning†	-.712	-.572	-.397	.150	.920*	-.400	--	
8. MAAS	-.770*	-.729*	-.452	.034	.477	.132	.240	--

Note. *p < .05, **p < .01, two-tailed; †Cronbach's alpha < 0.60; n = 7. Correlations > |0.1| in the opposite from expected direction are colored orange. Unexpected lack of correlation (-0.1 < r < 0.1) is colored light orange.

Table C11

Pre-Intervention Bivariate Correlations between Measures of Psychological Distress, Perceived Health, and Mindfulness in Caregivers

	1	2	3	4	5	6	7	8
1. Depression	--							
2. Anxiety	.962**	--						
3. Fatigue	.510	.561	--					
4. Pain Interference	.577*	.637*	.455	--				
5. Physical Function	-.629*	-.636*	-.550	-.659	--			
6. Sleep Disturbance	.644*	.712	.516	.692*	-.680*	--		
7. Social Functioning	-.601*	-.567	-.609*	-.676*	.867**	-.473	--	
8. MAAS	-.646*	-.667*	-.449	-.663*	.471	-.661*	.642	--

Note. *p < .05, **p < .01, two-tailed; n = 12.

Table C12

Week 2 Bivariate Correlations between AMPS Facets in Caregivers

	1	2	3	4
1. AMPS Total	--			
2. AMPS Decentering	.949**	--		
3. AMPS Positive ER	.975**	.921**	--	
4. AMPS Negative ER	.893**	.737*	.811**	--

Note. *p < .05, **p < .01, two-tailed; n = 9.

Table C13

Week 4 Bivariate Correlations between AMPS Facets in Caregivers

	1	2	3	4
1. AMPS Total	--			
2. AMPS Decentering	.937**	--		
3. AMPS Positive ER	.971**	.946**	--	
4. AMPS Negative ER	.918**	.737*	.817*	--

Note. *p < .05, **p < .01, two-tailed; n = 8.

Table C14

Week 6 Bivariate Correlations between AMPS Facets in Caregivers

	1	2	3	4
1. AMPS Total	--			
2. AMPS Decentering	.953**	--		
3. AMPS Positive ER	.966**	.906**	--	
4. AMPS Negative ER	.926**	.827**	.817**	--

Note. *p < .05, **p < .01, two-tailed; n = 9.

Table C15

Post-Intervention Bivariate Correlations between Measures of Psychological Distress, Perceived Health, and Mindfulness in Caregivers

	1	2	3	4	5	6	7	8
1. Depression	--							
2. Anxiety	.868**	--						
3. Fatigue	.692*	.730*	--					
4. Pain Interference	.169	.280	.443	--				
5. Physical Function	-.569	-.596	-.703*	-.753*	--			
6. Sleep Disturbance	.117	.319	.444	.739*	-.684*	--		
7. Social Functioning	-.814**	-.796*	-.760*	-.599	.853**	-.360	--	
8. MAAS	-.773*	-.719*	-.678*	-.115	.505	-.362	.648	--

Note. *p < .05, **p < .01, two-tailed; n = 9.

Table C16

Booster 1 Bivariate Correlations between Measures of Psychological Distress, Perceived Health, and Mindfulness in Caregivers

	1	2	3	4	5	6	7	8
1. Depression	--							
2. Anxiety	.907**	--						
3. Fatigue	.558	.586	--					
4. Pain Interference	.292	.502	.747	--				
5. Physical Function	-.256	-.552	-.675	-.874*	--			
6. Sleep Disturbance	.315	.403	.598	.702	-.450	--		
7. Social Functioning	-.265	-.386	-.581	-.287	.531	.202	--	
8. MAAS	-.809*	-.780*	-.601	-.141	.208	-.237	.552	--

Note. *p < .05, **p < .01, two-tailed; n = 7. Correlations > |0.1| in the opposite from expected direction are colored orange.

Table C17

Booster 2 Bivariate Correlations between Measures of Psychological Distress, Perceived Health, and Mindfulness in Caregivers

	1	2	3	4	5	6	7	8
1. Depression	--							
2. Anxiety	.867*	--						
3. Fatigue	.550	.682	--					
4. Pain Interference	-.130	.075	.512	--				
5. Physical Function†	-.130	-.478	-.796*	-.664	--			
6. Sleep Disturbance	.363	.360	.714	.777*		--		
7. Social Functioning	-.365	-.689	-.622	-.308	.843*	-.207	--	
8. MAAS	-.687	-.772*	-.731	.146	.481	-.251	.549	--

Note. *p < .05, **p < .01, two-tailed; †Cronbach's alpha < 0.60; n = 12. Correlations > |0.1| in the opposite from expected direction are colored orange. Unexpected lack of correlation (-0.1 < r < 0.1) is colored light orange.

Table C18

Booster 3 Bivariate Correlations between Measures of Psychological Distress, Perceived Health, and Mindfulness in Caregivers

	1	2	3	4	5	6	7	8
1. Depression	--							
2. Anxiety	.813*	--						
3. Fatigue	.613	.795*	--					
4. Pain Interference	.144	.467	.651	--				
5. Physical Function†	-.309	-.451	-.814*	-.793	--			
6. Sleep Disturbance	.540	.446	.620	.645	-.718	--		
7. Social Functioning	-.553	-.858*	-.838*	-.484	.622	-.247	--	
8. MAAS	-.605	-.751	-.764*	-.132	.298	-.272	.699	--

Note. *p < .05, **p < .01, two-tailed; †Cronbach's alpha < 0.60; n = 7.

Appendix D

Multilevel Linear Modelling Syntax

The dataset used in the following syntax is available upon reasonable request. Required packages to run the following syntax in R Studio are: nlme, lme4, flexplot, tidyverse

```
#Effect of the 6-Week Intervention

d = read.csv("/Volumes/GoogleDrive/My Drive/MINDFULNESS LAB 2.0/Lab Members/Emma McBride/Dissertation/HLM_2TimePoints.csv")
head(d)

#RBANS

    #RBANS_tot

intercept <- gls(RBANS_tot ~ 1, data = d, method = "ML", na.action = na.exclude)
randomIntercept <- lme(RBANS_tot ~ 1, data = d, random = ~1|ID, method = "ML", na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRS); intervals(timeRS)

    #RBANS_IM

intercept <- gls(RBANS_IM ~ 1, data = d, method = "ML", na.action = na.exclude)
randomIntercept <- lme(RBANS_IM ~ 1, data = d, random = ~1|ID, method = "ML", na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

    #RBANS_VC

intercept <- gls(RBANS_VC ~ 1, data = d, method = "ML", na.action = na.exclude)
randomIntercept <- lme(RBANS_VC ~ 1, data = d, random = ~1|ID, method = "ML", na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
```

```
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

        #RBANS_L

intercept <- gls(RBANS_L ~ 1, data = d, method = "ML", na.action = na.exclude)
randomIntercept <- lme(RBANS_L ~ 1, data = d, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

        #RBANS_A

intercept <- gls(RBANS_A ~ 1, data = d, method = "ML", na.action = na.exclude)
randomIntercept <- lme(RBANS_A ~ 1, data = d, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID) #singular fit
ARModel<-update(timeRS, correlation = corAR1())

anova(intercept, randomIntercept, timeRI)
summary(timeRI); intervals(timeRI)

        #RBANS_DM

intercept <- gls(RBANS_DM ~ 1, data = d, method = "ML", na.action = na.exclude)
randomIntercept <- lme(RBANS_DM ~ 1, data = d, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

#Psychological Distress

d = read.csv("/Volumes/GoogleDrive/My Drive/MINDFULNESS LAB 2.0/Lab
Members/Emma McBride/Dissertation/HLM_MaHA.csv")
```

```
#subset for Group
dMCI <- subset(HLM_MaHA, Group!="Caregiver")
dCAR <- subset(HLM_MaHA, Group!="MCI")

#subset for pre- and post-intervention only
dMCI2 <- subset(dMCI, Time < 3)
dCAR2 <- subset(dCAR, Time < 3)

        #Depression

intercept <- gls(DEP ~ 1, data = dMCI2, method = "ML", na.action = na.exclude)
randomIntercept <- lme(DEP ~ 1, data = dMCI2, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

intercept <- gls(DEP ~ 1, data = dCAR2, method = "ML", na.action = na.exclude)
randomIntercept <- lme(DEP ~ 1, data = dCAR2, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

        #Anxiety

intercept <- gls(ANX ~ 1, data = dMCI2, method = "ML", na.action = na.exclude)
randomIntercept <- lme(ANX ~ 1, data = dMCI2, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

intercept <- gls(ANX ~ 1, data = dCAR2, method = "ML", na.action = na.exclude)
randomIntercept <- lme(ANX ~ 1, data = dCAR2, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
```

```
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

        #Caregiver Burden

read.csv("/Volumes/GoogleDrive/My Drive/MINDFULNESS LAB 2.0/Lab
Members/Emma McBride/Dissertation/HLM_2TimePoints.csv")
d = HLM_2TimePoints

intercept <- gls(ZBI ~ 1, data = d, method = "ML", na.action = na.exclude)
randomIntercept <- lme(ZBI ~ 1, data = d, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

#Perceived Health

d = read.csv("/Volumes/GoogleDrive/My Drive/MINDFULNESS LAB 2.0/Lab
Members/Emma McBride/Dissertation/HLM_MaHA.csv")

#Subset for Group
dMCI <- subset(HLM_MaHA, Group!="Caregiver")
dCAR <- subset(HLM_MaHA, Group!="MCI")

#Subset for pre- and post-intervention only
dMCI2 <- subset(dMCI, Time < 3)
dCAR2 <- subset(dCAR, Time < 3)

        #Fatigue

intercept <- gls(Fatigue ~ 1, data = dMCI2, method = "ML", na.action = na.exclude)
randomIntercept <- lme(Fatigue ~ 1, data = dMCI2, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)
```

```
intercept <- gls(Fatigue ~ 1, data = dCAR2, method = "ML", na.action = na.exclude)
randomIntercept <- lme(Fatigue ~ 1, data = dCAR2, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

        #Pain Interference (no MCI due to reliability/validity)

intercept <- gls(PainInt ~ 1, data = dCAR2, method = "ML", na.action = na.exclude)
randomIntercept <- lme(PainInt ~ 1, data = dCAR2, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

         #Physical Functioning (no MCI due to reliability/validity)

#Subset for reliability concern
dCARPhys <- subset(dCAR, Time < 4)

intercept <- gls(Physical ~ 1, data = dCAR2, method = "ML", na.action = na.exclude)
randomIntercept <- lme(Physical ~ 1, data = dCAR2, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

        #Sleep Disturbance

#Subset for reliability concern
dMCISleep <- subset(dMCI, Time < 3)

intercept <- gls(Sleep ~ 1, data = dMCI2, method = "ML", na.action = na.exclude)
randomIntercept <- lme(Sleep ~ 1, data = dMCI2, random = ~1|ID, method = "ML",
na.action=na.exclude)
```

```
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

intercept <- gls(Sleep ~ 1, data = dCAR2, method = "ML", na.action = na.exclude)
randomIntercept <- lme(Sleep ~ 1, data = dCAR2, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

        #Social Functioning

#Subset for reliability concern
dMCISocial <- subset(dMCI, Time < 5)

intercept <- gls(Social ~ 1, data = dMCI2, method = "ML", na.action = na.exclude)
randomIntercept <- lme(Social ~ 1, data = dMCI2, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

intercept <- gls(Social ~ 1, data = dCAR2, method = "ML", na.action = na.exclude)
randomIntercept <- lme(Social ~ 1, data = dCAR2, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

#Mindfulness

        #MAAS
```

```
intercept <- gls(MAAS ~ 1, data = dMCI2, method = "ML", na.action = na.exclude)
randomIntercept <- lme(MAAS ~ 1, data = dMCI2, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

intercept <- gls(MAAS ~ 1, data = dCAR2, method = "ML", na.action = na.exclude)
randomIntercept <- lme(MAAS ~ 1, data = dCAR2, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

        #AMPS_Total

d = read.csv("/Volumes/GoogleDrive/My Drive/MINDFULNESS LAB 2.0/Lab
Members/Emma McBride/Dissertation/HLM_3TimePoints.csv")
head(d)

#Subset for Group
dMCI <- subset(d, Group!="Caregiver")
dCAR <- subset(d, Group!="MCI")

#Subset for reliability concern
dMCIAMPSTotNeg <- subset(dMCI, Time != 2)

intercept <- gls(AMPS_Total ~ 1, data = dMCIAMPSTotNeg, method = "ML", na.action
= na.exclude)
randomIntercept <- lme(AMPS_Total ~ 1, data = dMCIAMPSTotNeg, random = ~1|ID,
method = "ML", na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID) #singluar fit
ARModel<-update(timeRS, correlation = corAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

intercept <- gls(AMPS_Total ~ 1, data = dCAR, method = "ML", na.action = na.exclude)
```

```
randomIntercept <- lme(AMPS_Total ~ 1, data = dCAR, random = ~1|ID, method =
"ML", na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

        #Decentering (noMCI due to reliability concern)

intercept <- gls(AMPS_Decentering ~ 1, data = dCAR, method = "ML", na.action =
na.exclude)
randomIntercept <- lme(AMPS_Decentering ~ 1, data = dCAR, random = ~1|ID, method
= "ML", na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

        #AMPS PosER

intercept <- gls(AMPS_PosER ~ 1, data = dMCI, method = "ML", na.action =
na.exclude)
randomIntercept <- lme(AMPS_PosER ~ 1, data = dMCI, random = ~1|ID, method =
"ML", na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID) #singular fit
ARModel<-update(timeRS, correlation = corAR1())

anova(intercept, randomIntercept, timeRI)
summary(timeRI); intervals(timeRI)

intercept <- gls(AMPS_PosER ~ 1, data = dCAR, method = "ML", na.action =
na.exclude)
randomIntercept <- lme(AMPS_PosER ~ 1, data = dCAR, random = ~1|ID, method =
"ML", na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID) #singular fit
ARModel<-update(timeRS, correlation = corAR1())

anova(intercept, randomIntercept, timeRI)
summary(timeRI); intervals(timeRI)
```

```
        #AMPS Neg ER

intercept <- gls(AMPS_NegER ~ 1, data = dMCIAMPSTotNeg, method = "ML",
na.action = na.exclude)
randomIntercept <- lme(AMPS_NegER ~ 1, data = dMCIAMPSTotNeg, random =
~1|ID, method = "ML", na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

intercept <- gls(AMPS_NegER ~ 1, data = dCAR, method = "ML", na.action =
na.exclude)
randomIntercept <- lme(AMPS_NegER ~ 1, data = dCAR, random = ~1|ID, method =
"ML", na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID) #Singular fit
ARModel<-update(timeRS, correlation = corAR1())

anova(intercept, randomIntercept, timeRI) #none
summary(timeRI); intervals(timeRI)

#Vascular Risk

#Subset for pre- and post-intervention only
dMCI2 <- subset(dMCI, Time != 3)
dCAR2 <- subset(dCAR, Time != 3)

        #HR

intercept <- gls(HR ~ 1, data = dMCI2, method = "ML", na.action = na.exclude)
randomIntercept <- lme(HR ~ 1, data = dMCI2, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

intercept <- gls(HR ~ 1, data = dCAR2, method = "ML", na.action = na.exclude)
randomIntercept <- lme(HR ~ 1, data = dCAR2, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
```

```
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

        #SBP

intercept <- gls(SBP ~ 1, data = dMCI2, method = "ML", na.action = na.exclude)
randomIntercept <- lme(SBP ~ 1, data = dMCI2, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

intercept <- gls(SBP ~ 1, data = dCAR2, method = "ML", na.action = na.exclude)
randomIntercept <- lme(SBP ~ 1, data = dCAR2, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel) #none
summary(timeRI); intervals(timeRI)

        #DBP

intercept <- gls(DBP ~ 1, data = dMCI2, method = "ML", na.action = na.exclude)
randomIntercept <- lme(DBP ~ 1, data = dMCI2, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

intercept <- gls(DBP ~ 1, data = dCAR2, method = "ML", na.action = na.exclude)
randomIntercept <- lme(DBP ~ 1, data = dCAR2, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())
```

```
anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

        #BMI

intercept <- gls(BMI ~ 1, data = dMCI2, method = "ML", na.action = na.exclude)
randomIntercept <- lme(BMI ~ 1, data = dMCI2, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

intercept <- gls(BMI ~ 1, data = dCAR2, method = "ML", na.action = na.exclude)
randomIntercept <- lme(BMI ~ 1, data = dCAR2, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

#Durability

d = read.csv("/Volumes/GoogleDrive/My Drive/MINDFULNESS LAB 2.0/Lab
Members/Emma McBride/Dissertation/HLM_MaHA.csv")

#Psychological Distress

#Subset for Group
dMCI <- subset(d, Group!="Caregiver")
dCAR <- subset(d, Group!="MCI")

#Subset for Durability
dMCIf <- subset(dMCI, Time != 1)
dCARf <- subset(dCAR, Time != 1)

        #Depression

intercept <- gls(DEP ~ 1, data = dMCIf, method = "ML", na.action = na.exclude)
randomIntercept <- lme(DEP ~ 1, data = dMCIf, random = ~1|ID, method = "ML",
na.action=na.exclude)
```

```
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

intercept <- gls(DEP ~ 1, data = dCARf, method = "ML", na.action = na.exclude)
randomIntercept <- lme(DEP ~ 1, data = dCARf, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

        #Anxiety

intercept <- gls(DEP ~ 1, data = dMCIf, method = "ML", na.action = na.exclude)
randomIntercept <- lme(DEP ~ 1, data = dMCIf, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

intercept <- gls(DEP ~ 1, data = dCARf, method = "ML", na.action = na.exclude)
randomIntercept <- lme(DEP ~ 1, data = dCARf, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

#Perceived Health

        #Fatigue

intercept <- gls(Fatigue ~ 1, data = dMCIf, method = "ML", na.action = na.exclude)
randomIntercept <- lme(Fatigue ~ 1, data = dMCIf, random = ~1|ID, method = "ML",
na.action=na.exclude)
```

```
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1()) #singular fit

anova(intercept, randomIntercept, timeRI, timeRS)
summary(timeRI); intervals(timeRI)

intercept <- gls(Fatigue ~ 1, data = dCARf, method = "ML", na.action = na.exclude)
randomIntercept <- lme(Fatigue ~ 1, data = dCARf, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1()) #singular fit

anova(intercept, randomIntercept, timeRI, timeRS) #random slopes
summary(timeRI); intervals(timeRI)

        #Pain Int (no MCI due to reliability concern)

intercept <- gls(PainInt ~ 1, data = dCARf, method = "ML", na.action = na.exclude)
randomIntercept <- lme(PainInt ~ 1, data = dCARf, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID) #singular fit
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI)
summary(timeRI); intervals(timeRI)

        #Physical Function (no MCI due to reliability concern)

#Subset for reliability concern
dCARfPhysical <- subset(dCARf, Time < 4)

intercept <- gls(Physical ~ 1, data = dCARfPhysical, method = "ML", na.action =
na.exclude)
randomIntercept <- lme(Physical ~ 1, data = dCARfPhysical, random = ~1|ID, method =
"ML", na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

        #Sleep (no MCI due to reliability concern)
```

```
intercept <- gls(Sleep ~ 1, data = dCARf, method = "ML", na.action = na.exclude)
randomIntercept <- lme(Sleep ~ 1, data = dCARf, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS)
summary(timeRI); intervals(timeRI)

        #Social

#Subset due to reliability concern
dMCIfSocial <- subset(dMCIf, Time < 5)

intercept <- gls(Social ~ 1, data = dMCIfSocial, method = "ML", na.action = na.exclude)
randomIntercept <- lme(Social ~ 1, data = dMCIfSocial, random = ~1|ID, method =
"ML", na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID) #singluar fit
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI)
summary(timeRI); intervals(timeRI)

intercept <- gls(Social ~ 1, data = dCARf, method = "ML", na.action = na.exclude)
randomIntercept <- lme(Social ~ 1, data = dCARf, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

#Mindfulness (MAAS)

intercept <- gls(MAAS ~ 1, data = dMCIf, method = "ML", na.action = na.exclude)
randomIntercept <- lme(MAAS ~ 1, data = dMCIf, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID) #singular fit
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI)
```

```
summary(timeRI); intervals(timeRI)

intercept <- gls(MAAS ~ 1, data = dCARf, method = "ML", na.action = na.exclude)
randomIntercept <- lme(MAAS ~ 1, data = dCARf, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

  #Vascular Risk

d = read.csv("/Volumes/GoogleDrive/My Drive/MINDFULNESS LAB 2.0/Lab
Members/Emma McBride/Dissertation/HLM_3TimePoints.csv")
head(d)

#Subset for Group
dMCI <- subset(d, Group!="Caregiver")
dCAR <- subset(d, Group!="MCI")

#Subset for Durability
dMCIf <- subset(dMCI, Time > 1)
dCARf <- subset(dCAR, Time > 1)

          #BMI

intercept <- gls(BMI ~ 1, data = dMCIf, method = "ML", na.action = na.exclude)
randomIntercept <- lme(BMI ~ 1, data = dMCIf, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
summary(timeRI); intervals(timeRI)

intercept <- gls(BMI ~ 1, data = dCARf, method = "ML", na.action = na.exclude)
randomIntercept <- lme(BMI ~ 1, data = dCARf, random = ~1|ID, method = "ML",
na.action=na.exclude)
timeRI <-update(randomIntercept, .~. + Time)
timeRS <- update(timeRI, random=~Time|ID)
ARModel<-update(timeRS, correlation = corCAR1())

anova(intercept, randomIntercept, timeRI, timeRS, ARModel)
```

```
summary(timeRI); intervals(timeRI)
```

Appendix E

Qualitative Analysis Log

The following are the author's verbatim analysis log, recorded in NVivo between 1/23/2022 and 3/11/2022.

1/23/2022

Coded all feedback forms and log M01C_W1

Onboarded FF and oriented her to the dataset

Separating helpful/enjoyable/appropriate - unecessary? Positive perceptions of "x"?

"Feeling good" might encompass more nodes - improved well-being theme?

Noticing initial thematic similarity to Wells et al. (2019): positive perceptions of class, development of mindfulness skills, importance of the group experience, enhanced well-being, shift in MCI perspective (maybe less of this one so far?), decreased stress reactivity and increased relaxation (do these go together in this dataset?), and improvement in interpersonal skills (ours more specific to caregivers and patients). Possible addition of feeling challenged by meditation/mindfulness?

Coded log M01M_W1 through log M01M_W2

Wondering about redundancy in nodes.

Ran word frequency query for insight on possible themes and redundancy. "relax" most frequent by far.

1/27/2022

Coded through log M13C_W2

Wondering whether to separate relaxation from sleepiness

Added positive affect node but this likely redundant with "feeling good"

1/28/2022

Nixed the "more" for several effectiveness codes?

Finished first round of coding. Saved codebook. 79 unique preliminary codes developed inductively in accordance with Saldana (2013) and Hseih and Shannon (2005)

Wondering whether to add "type of file (feedback/log)" as a case?

Wondering whether to add "week 1-5" as cases?

Potential themes:
Acceptability: positive perceptions of intervention; difficulties with intervention
Effectiveness: development of mindfulness skills; enhanced well-being/benefits of meditation; shift in perspective about MCI; difficulties with practice

Meeting between EM and FF
- Examined the data within each particular code
- Discussed possible themes and aggregated codes within each theme
- Discussed diffference between acceptability and effectiveness themes, particularly for text concerning meditation/intervention = helpful.

1/30/2022

Created cases for “type of file” and “week of meditation log”

Summarized meeting with FF into a new codebook
- Agreed on definitions or codes and how to segment text meeting criteria for a code
- Developed descriptions, inclusion guidelines and examples for each code
- Sent codebook to FF for review and requested a copy of FF's initial codebook

2/1/2022

FF approved new codebook

FF provided a copy of her initial codebook, which contains 33 unique preliminary codes developed inductively.

2/6/2022

Exported my dataset with first round codes into a new file, then deleted first round codes

Coded each file with its type (feedback form vs. log) and week (1-5) for meditation logs

Transferred codebook to NVivo

Emailed FF new dataset with codebook and randomly selected list of files for coding:
Feedback_M03C
Feedback_M10M
Feedback_M14C
Log_W1_M01C
Log_W1_M08M
Log_W2_M04M

Log_W2_M10C
Log_W3_M01M
Log_W3_M13C
Log_W4_M11M
Log_W5_M10M
Log_W5_M14M

Needed changes to the codebook:
1.1 change to "Positive perception of meditation and/or mindfulness" and include "mindfulness skills as 'most valuable'"
1.2 include "having mindfulness homework" and "taking course with partner"
1.2 change to "Participant records a overall positive attitude toward the intervention as a whole or to specific non-meditation-related aspects of the intervention."
2.1.2 include "finding a type of practice inappropriate"
3.2.1 include "feeling challenged by a new technique"
3.1.3 include "sense of presence"
4.1 inclue "feeling in tune with body"
4.2.1 include "good sleep"
4.2.2 include "awareness of MCI sx"

Finished Feedback forms and Log_W3_M01M

2/19/2022

Finished Log_W3_13C through Log_W5_M14M

Received FF's dataset coding the above

2/24/2022

Ran coding comparison query. Overall unweighted kappa: 0.56

Notes for discussion with FF:
- Code the questions in Feedback forms
- 1.1: note that this includes positive perceptions of mindfulness, positive perceptions of guided meditations. Excludes feeling more mindful now and positive perception of a specific instance of meditation - DONE
- 1.2: Includes having nothing to change; Excludes positive perceptions of guided meditations; DISCUSS M03C_Feedback DONE; M10M_Feedback DONE; M14C_Feedback DONE
- 2.1.1. Excludes meditation instruction not being challenging enough (put this in 2.2); DISCUSS M14C_Feedback "LK" (should be 2.1.2 imo) DONE; Log_W1_M01C DONE
- 2.2 Exludes being uncertain what to change
- 3.1.1 Excludes awareness in daily life DISCUSS Log_W1_M01C - does awareness of relaxation count? Does awareness of challenge count? Log_W2_M10C DONE; Log_W4_M11M DONE

- 3.1.2 DISCUSS Log_W1_M01C; L0G_W3_M13C DONE
- 3.1.3 Include periods of sustained focus/attention; DISCUSS Log_W1_M08M DONE; Log_W2_M10C DONE; Log_W3_M13C DONE
- 3.2.1 Includes noticing differences between meditation and mindfulness in daily life; DISCUSS Log_W1_M01C DONE Log_W2_M04M DONE Log_W3_M13C DONE Log_W4_M11M DONE
- 3.2.2 DISCUSS Log_W3_M13C DONE
- 3.3 Excludes recording that the intervention as a whole made them more accepting DONE
- 3.4 Incluudes mindfulness of others in daily life DISCUSS Log_W2_M10C DONE
- 3.5 Includes practicing relaxation during mindful activities DISCUSS Log_W2_M10C DONE; Log_W3_M01M
- 3.6 DISCUSS Feedback_M03C; Log_W2_M10C DONE
- 3.7 DISCUSS Log_W3_M13C; Log_W5_M10M DONE
- 4.1 Includes feeling in tune with body, better sleep DISCUSS Log_W2_M10C
- 4.2.1 Includes feelings relaxed; Excludes feeling present without explicit positive valence DISCUSS Feedback_M03C Log_W1_M01C Log_W2_M10C
- 4.2.2 Includes "yes I am more mindful now" DISCUSS Log_W1_M01C
- 4.2.3 DISCUSS Log_W3_M01M Log_W4_M11M
- 4.3 Includes appreciation for partner (e.g. Feedback_M10M); DISCUSS Log_W3_M01M
- DISCUSS FF "Feedback_M10M "learning how to live better" didn't fit neatly for me, coded it under 4.2.1"
- DISCUSS FF "Log_W1_M08M "being in the now" didn't seem to fit into "feeling more present" because I wasn't sure it was articulated an an "improvement"
- Show how to undo a code

2/25/2022

Thinking about how to report and analyze, similar to Isbel et al. (2020). Table for each theme with sub-themes and codes, n, then frequency by week. Similar table for each theme showing CAR and MCI

Met with FF and made several changes to inclusion and exclusion criteria in the Codebook. No changes to overall themes or sub-themes.
Agreed to re-code and extend to all Feedback forms.

Coded remaining Feedback forms and re-coded M03C, M10M, and M14C Feedback forms

Should we have a "less reactive" code? (Wells et al. 2019 has one, seems less frequent in this dataset but still present)
Should enjoying the group/people be coded as improvement in interpersonal skills?

3/2/2022

Received re-coded dataset with Feedback forms from FF

3/3/2022

Ran coding comparison query. Overall unweighted kappa: 0.71

Met with FF and resolved all coding discrepancies. Adjusted codebook. resolved discrepancy with how FF was coding "positive perceptions of meditation/mindfulness." Agreed she will include positive perceptions of mindfulness, in addition to meditation. Note two potential adjustments that we discussed but decided not to implement: adding a code for reduced reactivity to stress (decided this is too low frequency and can fit under 4.2.1) and adding a code for awareness of self (decided this is too low frequency and can fit under 4.2.2). May revisit these in future. Also adjusted inclusion criteria for 3.6 to capture participant reports that the intervention improved their ability to be present and/or accepting in daily life.

Agreed to code first 2 weeks of logs then meet again.

3/4/2022

Coded first 2 weeks of logs

3/6/2022

Ran coding comparison query. Overall unweighted kappa: 0.77

Met with FF and resolved all coding discrepancies. Resolved discrepancy with how we were each coding "Perceived Improvement." Agreed that improvement within the same unit of practice counts (e.g. figuuring out a way to stay focused while meditating). Continued to discuss whether reduuced reactivity to stress should be its own code and elected to wait until the whole dataset is coded and to review 4.2.1 and see whether it fits.

3/10/2022

Coded remaining logs

Received new dataset from FF

3/11/2022

Imported FF's dataset and ran coding comparison quuery. Overall unweighted kappa: 0.81

Met with FF and resolved all coding discrepancies. Vast majority were length of the coded section. Decided to leave reduced reacitivity to stress under "feeling good" or "more accepting," as appropriate, due to limited number of references. Changed coding in

master dataset until we had perfect agreement. Reviewed themes, theme definitions and final list of codes. Agreed that an "awareness of self" code is too low frequency and fits under 4.2.2

Finalized master dataset and agreed that EM will proceed with data analysis and writing.