Feasibility and Efficacy of a Newly Adapted Multimodal Cognitive Intervention for the Elderly with Mild Cognitive Impairment

Mani Abdul Karim[1], Jonnadula Venkatachalam[1]

1 Periyar University

Funding: No specific funding was received for this work.

Potential competing interests: No potential competing interests to declare.

Abstract

Objectives: To evaluate the feasibility and efficacy of a newly adapted IAME-CCT-MCI cognitive intervention for the elderly with Mild Cognitive Impairment (MCI).

Methods: The first phase involved rehabilitation experts (N=7) for content evaluation. Followed by twelve elderly participants with MCI (N=12) were selected for rating the intervention. In phase two, Thirty-two (32) elderly participants were utilized to conduct a randomized pilot study using Single-group pretest-posttest design.

Results: Experts agreed that each module was relevant to the intended target (3.87), effective in modifying the target (3.84), and appropriate for the elderly with MCI (3.87). The elderly participants stated that the intervention modules were useful (4), easy to use (3.36), and acceptable (4.08). Analysis of the paired t-test analysis revealed that the intervention program enhanced the cognitive and memory functions of the elderly.

Conclusions: The findings suggest that the intervention was feasible, acceptable, and user-friendly to the elderly and provided preliminary support for the efficacy of the IAME-CCT-MCI cognitive intervention.

Karim, M.A.[1*] & **Venkatachalam, J.**[2]

[1] *Corresponding Author: Research Scholar, Department of Psychology, Periyar University, Salem-636011, Tamil Nadu. E-Mail: prfi2012@gmail.com Phone: (+91) 97873 37879.*

[2] *Professor, Department of Psychology, Periyar University, Salem-636011, Tamil Nadu. E-Mail:chalam66@yahoo.com*

Keywords: feasibility, efficacy, IAME-CCT-MCI intervention, elderly, mild cognitive impairment.

Introduction

Mild cognitive impairment (MCI) is a diagnostic entity used to differentiate the elderly population from normal aging to dementia (Li et al., 2013; Petersen et al., 1999, 2014). Individuals with MCI are ten times more likely to develop dementia than cognitively healthy elders (Petersen, 2004; Rubin et al., 1998). The prevalence of MCI in recent studies showed between 3% and 42% worldwide (Ward et al., 2012), whereas, in India, it's between 15% and 36% (Das et al., 2007; Karim & Venkatachalam, 2021b; Mohan et al., 2019; Sosa et al., 2012). In addition, studies have shown that various comorbidities contribute to cognitive impairment in the elderly, especially depression, hypertension, diabetes, and obesity. Thus, a need exists for preventive interventions to improve cognitive functions and reduce other psychological comorbidities.

The practice area of cognitive intervention for improving the cognitive abilities of the elderly has evolved continuously using new technologies and strategies. There are different types of nonpharmacological interventions used to decrease various dysfunctional cognitive symptoms of Traumatic Brain Injury (TBI), psychiatric disorders, and memory disorders such as Alzheimer's disease, dementia and other related disorders. In the field of cognitive intervention, different approaches such as cognitive training, cognitive rehabilitation, cognitive stimulation, and combined form of training or rehabilitation or stimulation, has been utilized to decrease the cognitive impairment (Clare & Woods, 2004; Li et al., 2011; Simons et al., 2016). Primarily, cognitive training involves guided practice of tasks to increase or sustain cognitive functions. Whereas, cognitive rehabilitation refers to the remediating or compensating program which involves the practice of some tasks that mostly targets personal goals to improve specific impairments in everyday life rather than improving performances on cognitive tasks. By contrast, cognitive stimulation promotes the involvement in activities that are aimed at a general enhancement of cognitive and social functioning (Simon et al., 2012; Woods et al., 2012). Although each approach partakes different strategies to the cognitive enhancement, all the cognitive interventional program have an impact on reducing, delaying/slow down the occurrence of neurodegenerative diseases with the elderly population (Ball et al., 2002; Willis et al., 2006).

A recent bibliometric study stated that numerous non-pharmacological interventions were developed and implemented to deal with cognitive-related disorders in the past two decades, specifically, in recent five years (Karim & Venkatachalam, 2021a). For example, Zhang et al. (2018) reported that 24 weeks of computerized combined training (executive function and memory) sessions significantly enhanced the subjective cognitive and non-cognitive function. Another study stated that video game training enhanced cognitive control in older adults (Anguera et al., 2013). Barban et al. (2016) conducted a study to assess the efficacy of process-based cognitive training (pb-CT) combined with reminiscence therapy (RT) among patients with mild Alzheimer's disease, mild cognitive impairment, and healthy elderly subjects. The findings stated that significant effect on memory training in delayed recall and executive functions. In another study, Wong et al. (2017) stated that mindfulness-based intervention improved cognitive and functional aspects for older adults with MCI. Although each study focused on specific cognitive skill enhancement through various approaches, there is a lack of evidence that a multidomain integrated interventional modal combined with mindfulness exercises and compensatory cognitive training related to mild cognitive impairment to reduce cognitive dysfunction.

Huckans and others developed a unique multi-model intervention called Motivationally Enhanced Compensatory Cognitive

Training for MCI (ME-CCT-MCI; Huckans et al., 2018). ME-CCT-MCI is a multi-modal compensatory cognitive intervention integrating restorative and compensatory strategies in prospective memory, attention, learning and memory, and executive functioning. Furthermore, integration with mindfulness based exercises such as the raisin exercises, mindful breathing exercise, and mindful body scan exercise (Kabat-Zinn, 2005). This module has been developed based on Cognitive Symptom Management and Rehabilitation Therapy (CogSMART), used to treat Traumatic Brain Injury (Kannan et al., 2017; Twamley et al., 2014, 2015) and Compensatory Cognitive Training (CCT) for psychosis and schizophrenia-spectrum disorders (Mendella et al., 2015; Twamley et al., 2008, 2011, 2012). There is no study conducted with the elderly using the ME-CCT-MCI intervention in India. Also, not adapted to the Indian context. Hence, it is needed to validate the content, feasibility, and participant feedback about the intervention module is inevitable before proceeding a randomized control trial with the study population. Evaluating user satisfaction and acceptability provides opportunities to know the end user's satisfaction with the intervention. Thus the present study answered that what adaptation is needed to enhance the intervention's acceptability to the elderly population with mild cognitive impairment. Further, the study evaluated the feasibility and user satisfaction of the Indian adapted ME-CCT-MCI with the elderly population.

Methods and Material

Participants

During the first phase, 10 rehabilitation experts were approached to participate in the study. Out of them, seven (7) have accepted and rated the content of the intervention using a structured instrument (Content Survey Form). The participants are either doctorate psychologists cum assistant/associate professors (N=4) or certified clinical psychologists (N=3) working in hospital settings. Twelve (12) elderly participants were also recruited from an institutionalized home and community-dwelling elderly in Coimbatore District, Tamil Nadu, India. The elderly participants who have 60 years and above and scored ≤ 24 points on the screening of cognitive function using the Tamil version of Montreal Cognitive Assessment (T-MoCA; Karim & Venkatachalam, 2022; Nasreddine et al., 2005) were selected for knowing the feasibility and user satisfaction.

In the second phase, 39 community-dwelling participants were identified based on the cut-off of 23 or low in the Tamil version of the Montreal Cognitive Assessment (Coonghe et al., 2020; Karim & Venkatachalam, 2022; Nasreddine et al., 2005). Also, participants were not on undergoing any drug therapy for memory-related issues. The exclusion criteria were the presence of brain atrophy or having treatment with any psychiatric illness. After applying the exclusion and inclusion criteria, 36 participants were accepted for the intervention. Meanwhile, four participants were voluntarily left in between the study. Hence, the final total of the study participants was thirty-two (32). Figure 1 shows in detail the methods of the present study.

Ethical consideration

This study is part of the doctoral study of the principal author and permission to conduct the study was sought from the

doctoral committee of the research institution (PU/Ph.D/RD1/UDS-PSY-12/2019). The researcher explained the aims and procedures of the study to the experts, participants, and the participants provided the consent to be part of the present study.

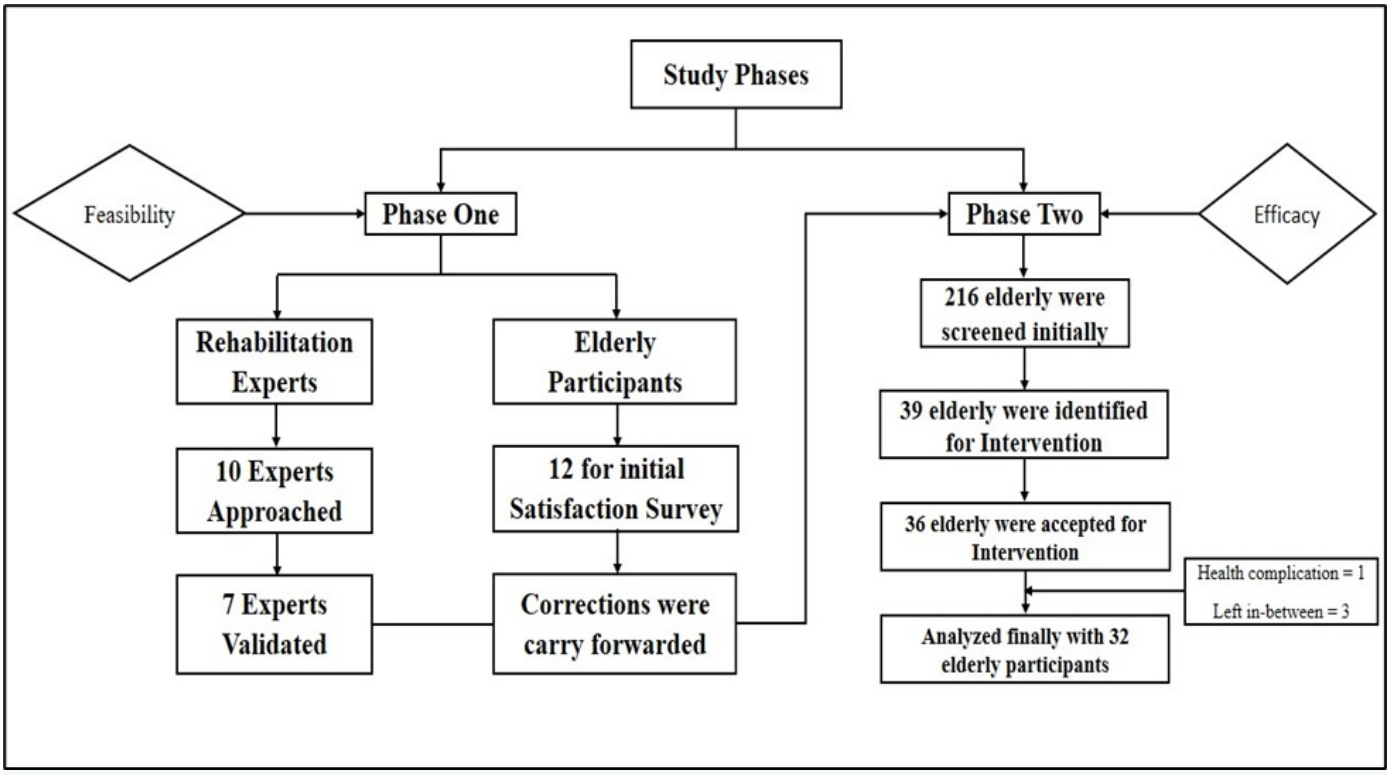

Figure 1. A PRISMA flow chart demonstrating the overall process of the sample selection and methods of the study

Procedures

The present study included two distinct phases such as intervention adaptation, feasibility, acceptability testing, and efficacy of the newly adapted intervention. In the first phase, the researcher engaged to identify a list of rehabilitation experts to get feedback about the adapted intervention content is relevant to the target population. During this phase, the researcher adopted the feasibility form that had circulated through electronic mail. Once completed, it was asked to return to the principal researcher within a month. Based on the experts' feedback, revisions were made by the researchers. Furthermore, the revised intervention document was circulated to the experts with revised activities and modified content that had been added for the target population. On the other side, the adapted intervention was further used to implement with the recruited elderly participants in-person. At the end of the session, the elderly participants were asked to complete the Satisfaction Scale. In the second phase, the intervention was implemented with the pilot group.

Indian Adapted ME-CCT-MCI (IAME-CCT-MCI)

Two steps were taken to adapt the existing cognitive intervention for the elderly with MCI. First, the literature surrounding the cognitive training promoted for reducing cognitive impairment was reviewed and the intervention to meet the identified

cognitive issues. The new ME-CCT-MCI intervention is unique in nature and incorporates mindfulness-based exercises along with cognitive training, both retrospective and compensatory strategies which is more relevant to the MCI population.

The Indian adapted ME-CCT-MCI intervention is a four-week short version module with an hour daily session with the elderly who have MCI. The intervention is carefully tailored and adapted all the activities from the original version developed by Huckans and colleagues (Huckans et al., 2018) considering the common cognitive deficits found in the elderly with MCI. The activities are broadly under seven categories, such as basic education related to MCI, mindfulness exercises (Raisin exercises, Body scan, Breathing exercises), cognitive training for attention and concentration, organization and prioritization, visual searching skills, memory training (auditory and visual), working memory training, cognitive flexibility training, decision-making and problem-solving, and planning oriented exercises, which are all integrated with the IAME-CCT-MCI intervention.

In the original manual of ME-CCT-MCI, more activities were based on compensatory nature and only links or other website sources were given to train working memory and other cognitive related skills. Whereas, this culturally adapted version concentrated equally both restorative and compensatory activities by using the strategies which were given in the original version of the ME-CCT-MCI intervention. Also, cognitive-related activities were newly created by the principal author and integrated to enhance attention and concentration (Letter cancelation task, Visual searching task), organization and prioritization, memory training, working memory training, cognitive flexibility, problem-solving, and decision-making skills. While creating the training activities, various factors were considered such as target groups' age, the language known in the local community, and their vision and perceptual capabilities. Finally, the training activities in each module were grouped into three categories, such as easy, moderate, and difficult.

Measures

To get feedback from the rehabilitation experts, the investigator-designed form was adapted from the work of Kassam-Adams and colleagues (Kassam-adams et al., 2015). Each expert was asked to rate the degree to which the content in each module or activity addressed the level of relevance to intended intervention targets (Irrelevant to essential), level of likely effectiveness in modifying intended target (Not likely to very likely), and appropriateness for the elderly population with MCI (Inappropriate to appropriate). The researcher also welcomed open comments for each module.

To assess the feasibility and user satisfaction with the Indian adapted ME-CCT-MCI intervention, the adapted form based on work by Bakas and colleagues (Bakas et al., 2009), was embedded by using at the end of the intervention. The elderly participants were instructed to complete the Satisfaction Scale immediately after the intervention. Permission was obtained from the developer (Bakas et al., 2009) to use and adapt the Short Satisfaction Survey (Bakas et al., 2009) (SSS). The overall ME-CCT-MCI intervention was rated using a 5-point Likert-type response scale ranging from 1-Strongly disagree to 5-Strongly agree. This scale consists of 9 items, comprising 4 items in the usefulness subscale, 3 items in the easy-of-use subscale, and 2 items in the acceptability subscale. Average scores were calculated with each subscale as well as total score.

For the second phase of the efficacy study, a comprehensive neuropsychological assessment was used to assess multiple cognitive domains for each participant at the study entry and post-intervention. All the assessments were carried out by the primary author, who was qualified and trained to assess the neuropsychological assessments. The primary outcome was measured using the Tamil version of Montreal Cognitive Assessment (T-MoCA) used to measure cognitive impairment, followed by the PGI Battery for Assessment of Mental Efficiency in the Elderly (PGI-BAMEE; Kohli et al., 1996) and PGI Memory Scale (PGI-MS; Pershad & Wig, 1977) was used to measure the secondary outcome. The T-MoCA consists of visuospatial/executive function, attention, concentration and working memory, language, abstract reasoning, memory, and orientation. The PGI-BAMEE consists of four subtests to assess mental efficiency, general information, orientation towards time and place, memory, perceptuo-motor functions, and depressive symptomology of the elderly. Further, the PGI-MS consists of a detailed assessment of ten types of memory, like remote memory, recent memory, attention-concentration, delayed recall, immediate recall, verbal retention for similar pairs, verbal retention for dissimilar pairs, visual retention, and recognition.

Analysis

After receiving the completed feedback form from the experts and the elderly participants, data were entered in an Excel sheet. Simple descriptive analyzes were conducted to summarize the data. Content analysis was performed on all open-ended questions/comments and suggestions was made by the rehabilitation experts. Further, the second phase of the study results was analyzed using the Jamovi Software package (The Jamovi Project, 2021).

Results

Phase-I: Experts' feedback on Content Adaptation

As shown in Table 1, the mean rehabilitation expert ratings evidence of content relevance, appropriateness, and effectiveness of the IAME-CCT-MCI intervention in all areas and all modules were > 3.57 out of 4, indicating that the experts strongly agreed all components were acceptable. The average overall experts rating was 3.87 in relevance, 3.84 in effectiveness, and 3.87 in appropriateness. Some valuable recommendations were received from the experts viz., the inclusion of all Tamil alphabets in attention and concentration activity, positive quotes in daily planner sheet, avoiding as one-hour full session, recommended split up the session and providing two to three intervals, providing mindfulness exercises in-middle of the session, and increase the font size in the visual searching task.

Table 1. Mean Content Validity Expert Ratings for IAME-CCT-MCI intervention modules (N=7)

ME-CCT-MCI Modules	Relevance	Effectiveness	Appropriateness
Mindfulness exercises	3.85	3.71	3.85
Attention and Concentration	3.85	3.85	3.71
Daily Planner	3.85	3.85	3.85
Home Based Exercises	3.71	3.85	3.85
Organizing and priorities	3.85	3.57	3.85
Visual Searching	3.85	3.85	3.85
Memory Training	3.85	3.85	3.85
Working Memory training	4.00	4.00	4.00
Cognitive Flexibility	3.85	3.85	3.85
Decision-making and Problem-solving	3.85	4.00	3.85
Planning oriented exercises	4.00	3.85	4.00
Average	**3.87**	**3.84**	**3.87**

User Satisfaction

In the aspect of user satisfaction with Indian adapted ME-CCT-MCI intervention, the average of 12 elderly participants in the usefulness subscale scored 4.00 out of 5, the easy-of-use subscale was 3.36, and acceptability was 4.08, which shows the range from agreeing to strongly agree (Table -2). The Mean overall user satisfaction score was 34.25 and the average completion of interventional activities in the easy category was 20 minutes per module. Although the easy-of-use subscale is low as compared to other subscales in the moderate and difficult category, the acceptability and usefulness of the content are high enough.

Table 2. User Satisfaction of the overall IAME-CCT-MCI intervention modules (N=12)

Scale Item	Usefulness	Easy of Use	Acceptability
Item-1	3.83	-	-
Item-2	-	2.83	-
Item-3	4.25	-	-
Item-4	-	-	4.41
Item-5	4.16	-	-
Item-6	-	3.41	-
Item-7	3.75	-	-
Item-8	-	-	3.75
Item-9	-	3.83	-
Average	**4.00**	**3.36**	**4.08**

Phase-II: Efficacy of the Intervention

Characteristics of the participants are provided in Tables 3 and 4. Participants were 67.4 years of age, on average (SD = 5.46). Out of 32 participants, 18 were male (56.25%) and 14 were female (43.75). Over half of the participants were married and lived with both partners (16; 50%) and 13 participants were widowed (40.63%) and lived separately. Further, three (3) participants were living as single and not yet married (9.37%). Based on occupation, 15 participants come under self-employed (46.87%), whereas, 17 participants worked under government machinery in various categories (53.13%).

Table 3. Phase-II participants characteristics (N=32)

	n	%
Gender		
Male	18	56.25
Female	14	43.75
Education		
< 12 Years	19	59.37
> 12 Years	13	40.63
Marital Status		
Single	3	9.37
Married	16	50.00
Widowed	13	40.63
Occupation		
Self-employed	15	46.87
Govt-employed	17	53.13

Table 4 shows that participants' mean scores on the tools such as the Tamil version of the Montreal Cognitive Assessment (T-MoCA), PGI Battery for Assessment of Mental Efficiency in the Elderly (PGI-BAMEE), and PGI Memory Scale (PGI-MS) were used during screenings. The mean pre-test T-MoCA score based on gender for the male was 21.2 (Standard deviation, SD=1.86), and the female mean score was 21.6 (SD=1.15). On education-based classification, the mean score for less than 12 years of education participants was 20.9 (SD=5.47), whereas the mean score for greater than 12 years of educated participants was 22.0 (SD=1.15). Based on marital status, there is no greater difference between single, married living with a partner, and widowed participants. Also, the same results were obtained in the occupation category (self-employed mean score= 21.0, SD=1.51; Govt-employed mean score= 21.7, SD=1.61).

PGI-BAMEE tool consists of four subscales, such as the set test, the standard test, Nahar & Benson test, and the Geriatric depression scale and it covered mental efficiency, motivation and alertness, general orientation to time and place, memory, concentration, depth perception, muscular coordination and depressive symptomatology and mood associated with old age. The mean score of the set test based on gender (male 24.8, SD=2.62; female 24.0, SD=3.88), marital status (single 23.3, SD=3.79; married 24.4, SD=2.42; widowed 24.8, SD=4.04), and occupation (self-employed 24.2, SD=2.51; government employed 24.7, SD=3.77) is not much difference in the mean scores, however, differs based on educational category (< 12 years education 25.1, SD=3.35; > 12 years education 23.5, SD=2.85). The standard test mean scores are differed in gender (male 6.28, SD=1.41; female 5.79, SD=1.12), education (< 12 years education 5.68, SD=0.88; > 12 years education 6.62, SD=1.61), and occupation category (self-employed 5.93, SD=0.96; govt-employed 6.18, SD=1.55). On the marital status, married participants' mean score (6.25, SD=1.48) is higher than the single (6.00, SD=1.00) and widowed elderly participants (5.85, SD=1.14).

Table 4. Participants baseline score on screening cognitive functions and other domains

	n	T-MoCA (SD)	SET-Test (SD)	STAN-Test (SD)	NB-Test (SD)	Depression Scale (SD)	PGI-MS (SD)
Gender							
Male	18	21.2(1.86)	24.8(2.62)	6.28(1.41)	4.89(1.13)	9.33(2.68)	18.7(3.46)
Female	14	21.6(1.15)	24.0(3.88)	5.79(1.12)	4.86(1.03)	9.93(2.27)	18.8(3.89)
Education							
< 12 Years	19	20.9(5.47)	25.1(3.35)	5.68(0.88)	4.63(1.01)	8.95(2.55)	19.4(3.50)
> 12 Years	13	22.0(1.15)	23.5(2.85)	6.62(1.61)	5.23(1.09)	10.5(2.15)	17.8(3.65)
Marital Status							
Single	3	21.7(0.57)	23.3(3.79)	6.00(1.00)	4.67(0.57)	9.67(3.51)	20.7(2.31)
Married	16	21.3(1.95)	24.4(2.42)	6.25(1.48)	5.06(1.06)	9.38(2.45)	17.9(3.26)
Widowed	13	21.5(1.27)	24.8(4.04)	5.85(1.14)	4.69(1.18)	9.85(2.51)	19.3(4.11)
Occupation							
Self-employed	15	21.0(1.51)	24.2(2.51)	5.93(0.96)	5.07(1.10)	9.87(2.77)	18.3(3.35)
Govt-employed	17	21.7(1.61)	24.7(3.77)	6.18(1.55)	4.71(1.05)	9.35(2.26)	19.1(3.85)

In the subscale of the PGI-BAMEE, Nahar & Benson test, the mean score of gender (male 4.89, SD=1.13; female 4.86, SD=1.03) has not differed, however, significant difference between educational category (< 12 years education 4.63, SD=1.01; > 12 years education 5.23, SD=1.09), marital status (single 4.67, SD=0.57; married 5.06, SD=1.06; widowed 4.69, SD=1.18), and occupational categories (self-employed 5.07, SD=1.10; govt-employed 4.71, SD=1.05). Another subscale is identifying depressive symptomology through a depressive scale. The mean score of females (9.93, SD=2.27) is higher than males (9.33, SD=2.68), and greater than 12 years of education category participants have a higher mean score (10.5, SD=2.15) than less than 12 years of education (8.95, SD=2.55). Widowed participants have higher depressive symptoms (9.85, SD=2.51) than single (9.67, SD=3.51) and married participants living with a partner (9.38,

SD=2.45).

In the PGI-memory scale (PGI-MS), there is no gender difference between males (18.7, SD=3.46) and females (18.8, SD=3.89). However, the educational difference (< 12 years education 19.4, SD=3.50; > 12 years education 17.8, SD=3.65), marital status (single 20.7, SD=2.31; married 17.9, SD=3.26; widowed 19.3, SD=4.11), and occupational difference exists (self-employed 18.3, SD=3.35; govt-employed 19.1, SD=3.85).

Table-5 shows that paired t-test analysis and the effect of the IAME-CCT-MCI intervention. Through the analysis, it was found that the IAME-CCT-MCI intervention program significantly improved the T-MoCA (21.38 ± 1.58 vs. 22.00 ± 1.90, Cohen's d_z = 0.641, p<0.01) and PGI-MS (18.06 ± 3.36 vs. 18.72 ± 3.59, Cohen's d_z = 0.656, p<0.05) scores. In the PGI-BAMEE, the subtests like the set test (24.47 ± 3.20 vs. 25.47 ± 3.02, d_z = 0.215, p<0.01), the standard test (6.06 ± 1.29 vs. 7.09 ± 1.33, Cohen's d_z = 0.971, p<0.01), the Nahar and Benson test (4.88 ± 1.07 vs. 5.16 ± 1.11, Cohen's d_z = 0.386, p<0.05), and geriatric depression scale (9.59 ± 2.49 vs. 8.09 ± 2.11, Cohen's d_z = 0.827, p<0.01), were significantly improved during the immediate pretest-posttest period. The effect size is also in the range of mild to moderate. The sub-domains of T-MoCA, Attention concentration and working memory (ACWM), and Memory domain was found significantly improved and the remaining domains are not statistically significant.

Table 5. Comparison of pre-test and post-test scores of T-MoCA, PGI-BAMME, and PGI-MS

		Mean Differences	Paired-t value	Effect size
PostMoCA_TS	PreMoCA_TS	0.625	3.62*	0.641
EF_Fin_1.1	EF_Fin_1	0.250	1.86NS	0.328
VSA_1.1	VSA_1	0.125	1.28NS	0.226
ACWM_1.1	ACWM_1	0.406	4.10*	0.726
LANG_1.1	LANG_1	0.219	1.37NS	0.241
MEM_1.1	MEM_1	0.500	2.27*	0.402
ORIEN_1.1	ORIEN_1	-0.875	-3.63*	-0.642
Post_SET	Pre_SET	1.000	4.64*	0.821
Post_STAN	Pre_STAN	1.031	5.49*	0.971
Post_NB	Pre_NB	0.281	2.18*	0.386
Pre_Dep	Post_Dep	1.500	4.68*	0.827
Pre_PGI-MS	Post_PGI-MS	0.656	2.52*	0.446
PostMoCA_TS	PreMoCA_TS	0.625	3.62*	0.641

** <0.05 level of significance, NS-Not significant.*

Note: EF-Executive function, VSA-VisuoSpatial Ability, ACWM-Attention Concentration and Working Memory, LANG-Language, MEM-Memory, ORIEN-Orientation, STAN- Standard Test, NB-Nahar-Benson Test, Dep-Depression.

Discussion

Despite the extensive availability of non-pharmacological interventions serving neuro-degenerative diseases, limited attention has been provided to how to better engage the elderly population with MCI by using the integrated form of cognitive training activities with following systematic procedures for adaptation of an intervention. Therefore, this study focused on adapting the ME-CCT-MCI intervention for the elderly experiencing mild cognitive impairment. The complexity of the intervention increased its attention to determining the intervention's content appropriateness to the target population, acceptability, and feasibility could be achieved from the perspectives of the rehabilitation experts and the elderly with MCI. Thus, the present study also assessed the feasibility and user satisfaction of the intervention with the target population.

Adaptation of ME-CCT-MCI

To the best of our knowledge, the current study represents the first attempt to carry out adaptation procedures with ME-CCT-MCI intervention, which involves feedback from experts, content feasibility, appropriateness, and relevance to the MCI elderly. The current Indian adapted ME-CCT-MCI (IAME-CCT-MCI) intervention is a 4-week session of one hour daily with the MCI elderly. Several strategies from the original intervention considered as strengths of the intervention incorporated with the adapted Indian version, such as mindfulness exercises (raisin exercises, mindful breathing, mindful body scan, mindful sitting meditations), skill-building (attention and concentration, organization, problem-solving, decision making, and cognitive flexibility), and psychoeducation in regards to enhancing the understanding of mild cognitive impairment. To improve the attention and concentration of the elderly, the IAME-CCT-MCI intervention utilized the PEAS (**P**reparation, **E**nergy conservation, **A**ctive effort, and **S**elf-talk) principle strategy while completing the attentional task. Memory oriented tasks focused on both visual and auditory short term recognition by using various active and internal strategies, such as LEAP (**L**istening, **E**liminating distractions, **A**sking questions, and **P**araphrasing), RITA (**R**emember, **I**maging, **T**ime, and **A**ctive), Association, Acronyms, Chunking, and Visual Imagery. Furthermore, problem-solving and decision-making tasks utilized DBESTE (**D**efine, **B**rainstorm, **E**valuate, **S**elect, **T**ry, and **E**valuate) strategy to enhance the abilities of the elderly.

Recent studies provided strong evidence that mindfulness training is associated with an increased connection in several brain regions, e.g., the bilateral frontal, left frontocentral, and temporal regions of the brain (Doborjeh et al., 2020). Also, mindfulness training increased functional connectivity between the auditory cortex and areas associated with attentional and self-referential processes (Kilpatrick et al., 2011). Interestingly, in our study, the rehabilitation experts confirmed and recognized that executive functioning-related activities such as decision-making and problem-solving exercises, planning strategic exercises, and flexibility training, are needed to help to reduce the cognitive impairment of the elderly. Most of the experts agreed that all the components in the adapted ME-CCT-MCI intervention were useful and highly relevant to the targeted population. Also, the content/activities had more effective and highly appropriate to the elderly with MCI.

From the user side (User/Participants Satisfaction), all the elderly participants were satisfied with the Indian adapted ME-CCT-MCI and agreed that each activity was useful and acceptable. Some of the elderly participants struggled to complete

some tasks in the working memory and problem-solving activities. And hence, the average of easy-of-use subscale got lesser than other subscales. A straightforward question asked in the Satisfaction Scale at item number two (Item No-2) that the interventional activities were easy to use or not, the average response of this item was 2.83 showed that neither agrees to be easy to use nor disagree. Also, item 4 asked that whether liked or not the ME-CCT-MCI intervention. The average of the 12 elderly participants was 4.41, which is the highest average as compared to the rest of the items in the satisfaction scale, which showed that agree/strongly agreed to like the Indian adapted ME-CCT-MCI intervention. Thus, the present study demonstrated that the IAME-CCT-MCI was feasible and acceptable to people with mild cognitive impairment.

In this study, the overall cognitive abilities improved with the participants, however, some specific abilities are not significantly different between the pre-test and post-test. Importantly, domains viz., executive function, visuospatial ability, and language are not significantly changed on comparing pre and post-test assessments. Though, various cognitive abilities viz., overall global cognitive function, memory, attention, concentration, and working memory, orientation, information on current social affairs, and remembering learned information, are improved through implementing the IAME-CCT-MCI integrative interventional module. Furthermore, mindfulness-based exercises help to reduce depressive symptomology. This combined approach of IAME-CCT-MCI intervention is effective in enhancing cognitive functions and reducing the symptomology of MCI and postponing the onset of progression of dementia or allied cognitive-related diseases with the elderly.

Implication

The present study provides strong evidence that the content and core components of the intervention were acceptable to the elderly with mild cognitive impairment and are promising for future exploration. In the further step, a randomized controlled trial or longitudinal study design would be more beneficial to establishing the effectiveness of the intervention. In addition to testing the specific cognitive skill development of the elderly with MCI, it appears that the IAME-CCT-MCI intervention might be most successful in enhancing the cognitive abilities of the elderly when paired with compensatory as well as cognitive training supports.

Conclusions

The Indian adapted ME-CCT-MCI (IAME-CCT-MCI) intervention is a novel client-centered individual/group-based intervention developed to improve outcomes for the elderly with MCI. This study demonstrates evidence supporting the IAME-CCT-MCI content was feasible, appropriate, and satisfying for the target population which is the initial step before testing the efficacy of an intervention. Further, the result evidenced that the IAME-CCT-MCI intervention may be a viable cognitive training program for reducing, postponing/slowing down the cognitive impairment of the elderly.

Acknowledgement

The authors thank Dr. Marilyn Huckans, Dr. Elizabeth Twamley, and the team members for permitting us to use/adapt the ME-CCT-MCI intervention for our research. Also, thanks to the rehabilitation experts and the elderly participants who readily accepted and participated in the study.

Declarations

Conflict of Interest

The authors declare that no conflict of interest exists.

Funding

This research received no external funding from any sources.

Availability of data and materials

The datasets of the current study are available on request from the corresponding author.

References

- Anguera, J. A., Boccanfuso, J., Rintoul, J. L., Al-Hashimi, O., Faraji, F., Janowich, J., Kong, E., Larraburo, Y., Rolle, C., Johnston, E., & Gazzaley, A. (2013). Video game training enhances cognitive control in older adults. *Nature*, *501*(7465), 97–101. https://doi.org/10.1038/nature12486
- Bakas, T., Farran, C. J., Austin, J. K., Given, B. A., Johnson, E. A., & Williams, L. S. (2009). Content Validity and Satisfaction With a Stroke Caregiver Intervention Program. *Journal of Nursing Scholarship*, *41*(4), 368–375. https://doi.org/10.1111/j.1547-5069.2009.01282.x
- Ball, K., Berch, D. B., Helmers, K. F., Jobe, J. B., Leveck, M. D., Marsiske, M., Morris, J. N., Rebok, G. W., Smith, D. M., Tennstedt, S. L., Unverzagt, F. W., & Willis, S. L. (2002). *Effects of Cognitive Training Interventions With Older Adults*. *288*(18), 2271–2281.
- Barban, F., Annicchiarico, R., Pantelopoulos, S., Federici, A., Perri, R., Fadda, L., Carlesimo, G. A., Ricci, C., Giuli, S., Scalici, F., Turchetta, C. S., Adriano, F., Lombardi, M. G., Zaccarelli, C., Cirillo, G., Passuti, S., Mattarelli, P., Lymperopoulou, O., Sakka, P., … Caltagirone, C. (2016). Protecting cognition from aging and Alzheimer's disease: A computerized cognitive training combined with reminiscence therapy. *International Journal of Geriatric Psychiatry*, *31*(4), 340–348. https://doi.org/10.1002/gps.4328
- Clare, L., & Woods, R. T. (2004). Cognitive training and cognitive rehabilitation for people with early-stage Alzheimer's disease: A review. *Neuropsychological Rehabilitation*, *14*(4), 385–401. https://doi.org/10.1080/09602010443000074
- Coonghe, P. A. D., Fonseka, P., Sivayokan, S., Kesavaraja, A., Malhotra, R., & Ostbye, T. (2020). Adaptation and

validation of the Tamil (Sri Lanka) version of the montreal cognitive assessment. *Kesmas*, *15*(2), 86–91. https://doi.org/10.21109/KESMAS.V15I2.3268

- Das, S. K., Bose, P., Biswas, A., Dutt, A., Banerjee, T. K., Hazra, A., Raut, D. K., Chaudhuri, A., & Roy, T. (2007). An epidemiologic study of mild cognitive impairment in Kolkata, India. *Neurology*, *68*(23), 2019–2026. https://doi.org/10.1212/01.wnl.0000264424.76759.e6
- Doborjeh, Z., Doborjeh, M., Crook-rumsey, M., Taylor, T., Wang, G. Y., Moreau, D., Krägeloh, C., Wrapson, W., Siegert, R. J., Kasabov, N., Searchfield, G., & Sumich, A. (2020). Interpretability of spatiotemporal dynamics of the brain processes followed by mindfulness intervention in a brain-inspired spiking neural network architecture. *Sensors (Switzerland)*, *20*(24), 1–29. https://doi.org/10.3390/s20247354
- Huckans, M., Twamley, E., Tun, S., Hutson, L., Noonan, S., Savla, G., Jak, A., Schiehser, D., & Storzbach, D. (2018). Motivationally Enhanced Compensatory Cognitive Training for Mild Cognitive Impairment (ME-CCT-MCI). In *Unpublished treatment manual. VA Portland Health care System and Oregon Health & Science University*(Issue June).
- Kabat-Zinn, J. (2005). *Full Catastophe Living* (15th Anniv). Bantam Dell.
- Kannan, S., Chandramohan, V., & Kannan, S. R. (2017). Efficacy of cognitive intervention using CogSMART in the management of cognitive problems in mild traumatic brain injury. *Indian Association of Health, Research and Welfare*, *8*(9), 1008–1011.
- Karim, M. A., & Venkatachalam, J. (2021a). Global trends on studies with cognitive training : Mapping and bibliometric analysis using CiteSpace. *Cognition, Brain, Behavior. An Interdisciplinary Journal*, *25*(4), 311–340. https://doi.org/10.24193/cbb.2021.25.16
- Karim, M. A., & Venkatachalam, J. (2021b). Prevalence of mild cognitive impairment of the elderly in Coimbatore district: A community-based study. *Research Journey*, *A* (269), 5–8. https://www.researchjourney.net/special-issues
- Karim, M. A., & Venkatachalam, J. (2022). Construct validity and psychometric properties of the Tamil (India) version of Montreal Cognitive Assessment (T-MoCA) in elderly. *International Journal of Gerontology*, *16*(4), 365–369. https://doi.org/10.6890/IJGE.202210_16(4).0010
- Kassam-adams, N., Marsac, M. L., Kohser, K. L., Kenardy, J. A., March, S., & Winston, F. K. (2015). A New Method for Assessing Content Validity in Model-Based Creation and Iteration of eHealth Interventions. *Journal of Medical Internet Research*, *17*(4), 1–8. https://doi.org/10.2196/jmir.3811
- Kilpatrick, L. A., Suyenobu, B. Y., Smith, S. R., Bueller, J. A., Goodman, T., Creswell, J. D., Tillisch, K., Mayer, E. A., & Naliboff, B. D. (2011). Impact of mindfulness-based stress reduction training on intrinsic brain connectivity. *NeuroImage*, *56*(1), 290–298. https://doi.org/10.1016/j.neuroimage.2011.02.034
- Kohli, A., Verma, S., & Pershad, D. (1996). Manual for PGI Battery for Mental Efficiency in the Elderly (PGI-AMEE). In *National Psychological Corporation, Agra* (Vol. 1).
- Li, H., Li, J., Li, N., Li, B., Wang, P., & Zhou, T. (2011). Cognitive intervention for persons with mild cognitive impairment : A meta-analysis. *Ageing Research Reviews*, *10*(2), 285–296. https://doi.org/10.1016/j.arr.2010.11.003
- Li, X., Ma, C., Zhang, J., Liang, Y., Chen, Y., Chen, K., Wang, J., Zhang, Z., & Wang, Y. (2013). Prevalence of and potential risk factors for mild cognitive impairment in community-dwelling residents of beijing. *Journal of the American*

Geriatrics Society, *61*(12), 2111–2119. https://doi.org/10.1111/jgs.12552

- Mendella, P. D., Burton, C. Z., Tasca, G. A., Roy, P., St. Louis, L., & Twamley, E. W. (2015). Compensatory cognitive training for people with first-episode schizophrenia: Results from a pilot randomized controlled trial. *Schizophrenia Research*, *162*(1–3), 108–111. https://doi.org/10.1016/j.schres.2015.01.016
- Mohan, D., Iype, T., Varghese, S., Usha, A., & Mohan, M. (2019). A cross-sectional study to assess prevalence and factors associated with mild cognitive impairment among older adults in an urban area of Kerala, South India. *BMJ Open*, *9*(3). https://doi.org/10.1136/bmjopen-2018-025473
- Nasreddine, Z. S., Phillips, N. A., Bedirian, V., Charbonneau, S., Whitehead, V., Collin, I., Cummings, J. L., & Chertkow, H. (2005). The Montreal Cognitive Assessment, MoCA: A brief screening tool for mild cognitive impairment. *Journal of American Geriatric Society*, *53*, 695–699. https://doi.org/10.1177/0891988716666381
- Pershad, D., & Wig, N. N. (1977). P.G.I. Memory Scale: A normative study on elderly subjects. In*Indian Journal of Clinical Psychology* (Vol. 4, Issue 1, pp. 6–8).
- Petersen, R. (2004). Mild cognitive impairment as a diagnostic entity.*Journal of Internal Medicine*, *256*, 183–194. https://doi.org/10.1007/s11682-017-9680-4
- Petersen, R., Caracciolo, B., Brayne, C., Gauthier, S., Jelic, V., & Fratiglioni, L. (2014). Mild cognitive impairment: A concept in evolution. *Journal of Internal Medicine*, *275*(3), 214–228. https://doi.org/10.1111/joim.12190
- Petersen, R., Smith, G. E., Waring, S. C., Ivnik, R. J., Tangalos, E. G., & Kokmen, E. (1999). Mild cognitive impairment: clinical characterization and outcome. *Archives of Neurology*, *56*(3), 303–308.
- Rubin, E. H., Storandt, M., Miller, J. P., Kinscherf, D. A., Grant, E. A., Morris, J. C., & Berg, L. (1998). A prospective study of cognitive function and onset of Dementia in cognitively healthy elders. *Archives of Neurology*, *55*(3), 395–401. https://doi.org/10.1001/archneur.55.3.395
- Simon, S. S., Yokomizo, J. E., & Bottino, C. M. C. (2012). Cognitive intervention in amnestic Mild Cognitive Impairment: A systematic review. *Neuroscience and Biobehavioral Reviews*, *36*(4), 1163–1178. https://doi.org/10.1016/j.neubiorev.2012.01.007
- Simons, D. J., Boot, W. R., Charness, N., Gathercole, S. E., Chabris, C. F., Hambrick, D. Z., & Stine-morrow, E. A. L. (2016). *Do " Brain-Training " Programs Work ?*https://doi.org/10.1177/1529100616661983
- Sosa, A. L., Albanese, E., Stephan, B. C. M., Dewey, M., Acosta, D., Ferri, C. P., Guerra, M., Huang, Y., Jacob, K. S., Jiménez-Velázquez, I. Z., Rodriguez, J. J., Salas, A., Williams, J., Acosta, I., González-Viruet, M., Guerra Hernandez, M. A., Shuran, L., Prince, M. J., & Stewart, R. (2012). Prevalence, distribution, and impact of mild cognitive impairment in Latin America, China, and India: A 10/66 population-based study. *PLoS Medicine*, *9*(2). https://doi.org/10.1371/journal.pmed.1001170
- The Jamovi Project. (2021). *jamovi-1* (1.8.4). https://www.jamovi.org
- Twamley, E. W., Burton, C. Z., & Vella, L. (2011). Compensatory cognitive training for psychosis: Who benefits? who stays in treatment? *Schizophrenia Bulletin*, *37*(SUPPL. 2), 55–62. https://doi.org/10.1093/schbul/sbr059
- Twamley, E. W., Jak, A. J., Delis, D. C., Bondi, M. W., & Lohr, J. B. (2014). Cognitive Symptom Management and Rehabilitation Therapy (CogSMART) for Veterans with traumatic brain injury: Pilot randomized controlled trial. *JRRD*, *51*(1), 59–70.

- Twamley, E. W., Savla, G. N., Zurhellen, C. H., Heaton, R. K., & Jeste, D. V. (2008). Development and pilot testing of a novel compensatory cognitive training intervention for people with psychosis. *American Journal of Psychiatric Rehabilitation*, *11*(2), 144–163. https://doi.org/10.1080/15487760801963678
- Twamley, E. W., Thomas, K. R., Gregory, A. M., Jak, A. J., Bondi, M. W., Delis, D. C., & Lohr, J. B. (2015). CogSMART compensatory cognitive training for traumatic brain injury: Effects over 1 year. *Journal of Head Trauma Rehabilitation*, *30*(6), 391–401. https://doi.org/10.1097/HTR.0000000000000076
- Twamley, E. W., Vella, L., Burton, C. Z., Heaton, R. K., & Jeste, D. V. (2012). Compensatory cognitive training for Psychosis: Effects in a randomized controlled trial. *Journal of Clinical Psychiatry*, *73*(9), 1212–1219. https://doi.org/10.4088/JCP.12m07686
- Ward, A., Arrighi, H. M., Michels, S., & Cedarbaum, J. M. (2012). Mild cognitive impairment: Disparity of incidence and prevalence estimates. *Alzheimer's and Dementia*, *8*(1), 14–21. https://doi.org/10.1016/j.jalz.2011.01.002
- Willis, S. L., Tennstedt, S. L., Marsiske, M., Ball, K., Elias, J., Koepke, K. M., Morris, J. N., Rebok, G. W., Unverzagt, F. W., Stoddard, A. M., & Wright, E. (2006). Long-term effects of cognitive training on everyday functional outcomes in older adults. *Journal of the American Medical Association*, *296*(23), 2805–2814. https://doi.org/10.1001/jama.296.23.2805
- Wong, W. P., Coles, J., Chambers, R., Wu, D. B.-C., & Hassed, C. (2017). The effects of mindfulness on older adults with mild cognitive impairment. *Journal of Alzheimer's Disease Reports*, *1*(1), 181–193. https://doi.org/10.3233/adr-170031
- Woods, B., Aguirre, E., Spector, A. E., & Orrell, M. (2012). Cognitive stimulation to improve cognitive functioning in people with dementia. *Cochrane Database of Systematic Reviews*, *2*. https://doi.org/10.1002/14651858.cd005562.pub2
- Zhang, H., Wang, J., Sun, T., Wang, Z., Lyu, X., Yu, X., & Wang, H. (2018). A randomized controlled trial of combined executive function and memory training on the cognitive and noncognitive function of individuals with mild cognitive impairment: Study rationale and protocol design. *Alzheimer's and Dementia: Translational Research and Clinical Interventions*, *4*, 556–564. https://doi.org/10.1016/j.trci.2018.09.004