ORIGINAL ARTICLE

Effects of Cognitively Stimulating Activities on the Cognitive Functioning of Older People with Mild Cognitive Impairment: A Meta-analysis

Raymund F. Mamayson, PhD, RN and Mary Grace C. Lacanaria, PhD, RN

Saint Louis University, Baguio City, Benguet, Philippines

ABSTRACT

Background. The number of individuals with mild cognitive impairment (MCI), or those people without dementia who are experiencing age-related cognitive decline, has increased in recent years. Conveniently, several interventions to delay cognitive decline exist, where cognitively stimulating activities (CSA) have been receiving too much attention. However, its beneficial effects have not been well established among older people with MCI due to conflicting findings.

Objectives. This study aimed to assess and summarize the available evidence on the effects of CSA on the overall cognitive functioning of older people with MCI. Specifically, it sought to answer the PICO question, "In older people with MCI, does engagement in cognitively stimulating activities improve cognitive function?"

Methods. A systematic review and meta-analysis of randomized controlled trials examining the effects of CSA on older people with MCI were conducted. Three studies met the inclusion criteria from the 1,328 records from BioMed Central, CINAHL, Cochrane Library, Health Source: Nursing/Academic Edition, MEDLINE, and PubMed databases and 156 articles from WorldCat, DSpace Saint Louis University, and Google Scholar databases and catalogs. Effect size values were inspected using the random-effects model. Data were summarized as standardized mean difference (SMD) with corresponding 95% confidence intervals in the forest plot.

Results. This meta-analysis which compared studies that employed similar methodologies, found that CSA has a significant, large effect in improving cognitive functioning among older people with MCI, evidenced by an SMD of 0.798 (95% CI = 0.510-1.085, p = 0.001). While its superiority over other interventions that improve cognitive function was not observed in this study, it was still found that using CSA was helpful in terms of its cost-effectiveness. Also, heterogeneity across studies was non-significant (Cochran's Q = 0.151, df = 2, p = 0.927, I^2 = 0.00%). These results mean that clinical heterogeneity was absent even though a diverse range of CSA was employed. Additionally, methodological diversity was not present since there were no variations in the study design and minimal variability in the risk of bias assessment.

Conclusion. Overall, it is acknowledged that CSA are effective and practical, inexpensive, non-pharmacologic cognitive training approaches to delay cognitive decline among older people with MCI. However, interpreting this study's significant, large effect, and non-significant heterogeneity warrants caution.

Keywords: cognitively-stimulating activities, cognitive function, older people, mild cognitive impairment, meta-analysis

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Corresponding author: Raymund F. Mamayson, PhD, RN
Saint Louis University
Baguio City, Benguet, Philippines
Email: rfmamayson@slu.edu.ph
ORCiD: https://orcid.org/0009-0007-9910-5759

INTRODUCTION

Background of the Study

The feats of improved health care are reflected today as a global process known as demographic aging. Due to the declining fertility rate and increasing longevity,[1] demographic aging is happening rapidly. This situation led to an increase in the proportion of older people worldwide, which, according to the Alzheimer's Society,[2] are the same individuals who are usually affected by mild cognitive impairment (MCI).

MCI often precedes dementia and is characterized by a largely intact everyday function despite objective evidence of cognitive decline.[3] MCI presents as mild problems that are not severe to interfere significantly with activities of daily living. Regardless, it still affects cognitive functioning, a broad term that refers to mental processes involved in acquiring knowledge, manipulating information, and reasoning.[4]

In recent years, the number of people living with MCI has increased. It was stated in a systematic review of population studies from the Americas, Europe, and Australia that MCI incidence per 1000 person-years was 22.5 for ages 75-79, 40.9 for ages 80-84, and 60.1 for ages 85 and older.[5] In the Philippines, only data from a population-based study among Filipino older adults is available, which yielded a dementia prevalence of 10.6%.[6] In the same study, approximately a quarter (23.2%) were identified to have MCI.

These figures show that many older people are experiencing problems in their golden years and are finding it challenging to age successfully, especially because one of the goals of successful aging is the prevention of loss of information processing capacity and cognitive reserve. Since many older people today have problems with thinking, reasoning, and remembering, healthcare professionals must help and support older people. Specifically, nurses should focus on improving cognitive function since cognitive decline has long been considered a leading cause of social isolation.[7]

To date, several interventions have been continuously employed to manage or delay neurodegeneration, promote physical well-being, and keep older people engaged in life. Extant literature reveals, for instance, that the Mediterranean diet, nutritional support, and calorie-controlled diets can protect against cognitive decline and Alzheimer's disease.[8] Moreover, physical exercises, which include resistance and aerobic training, are among the best-known methods of slowing down neurodegeneration and can modulate the potential risk factors of dementia.[9] Furthermore, cognitively stimulating activities (CSA) using video games[10,11] and brain games[12] have been used to improve cognitive function, which can eventually facilitate improvements in functional ability. Lastly, combined mental and physical exercise training has shown small to medium positive effects on cognitive function, moderate to significant positive impact on daily living activities, and small to medium positive outcomes for the mood of older people with MCI or dementia.[13]

Indeed, nurses and other health care professionals have varied choices of interventions for the promotion of older people's cognitive wellness. However, it is essential to note that CSA has recently received much attention. Several researchers have used CSA in their studies to address the threats to functional independence from the cognitive effects of aging, and the results are conflicting. For instance, one study found an inverse relationship between hobby participation and cognitive decline among elderly Japanese community-dwelling individuals, suggesting that engaging in a later-life hobby can preserve cognitive function.[14]

Additionally, it was found that engaging in mentally-stimulating leisure activity was significantly associated with later-life cognition, better memory, speed of processing, and executive functioning, and less deterioration in overall cognition and language use.[15] Finally, it was found that long-term cognitive leisure activity programs involving dance or playing musical instruments improved memory and general cognitive function compared with a health education program in older adults with MCI.[16]

On the contrary, one study found a deterioration in the overall cognitive function of older individuals with mild to moderate dementia living at home and attending adult day care twice a week after undergoing a 12-week cognitive training program. Follow-up after three months revealed that changes were 0.8 for the intervention group and 1.7 for the control group on the Alzheimer's Disease Assessment Scale-Cognitive subscale (ADAS-Cog), making them conclude that systematic cognitive training had no effect on overall cognitive function in community-living persons with mild to moderate dementia.[17] Additionally, some authors found no evidence that cognitive training influences neural activity during decision-making, nor did they find cognitive training effects on delay discounting or risk sensitivity measures.[18] Moreover, it was found that the gamified cognitive training implemented in one study have not improved the cognitive performance of the respondents greatly.[19]

While cognitive training has received much attention, its beneficial effects have not been well-established due to conflicting findings. Today, questions if CSA holds any real benefit exists. Hence, conducting this study is a great leap forward in synthesizing the results of randomized controlled trials (RCT) conducted over the past years. This study also has great potential to influence current and future professional nursing practice. In an era where the nursing discipline is moving towards evidence-based practice, this study provides results that may guide clinical decision-making among nurses. Lastly, this study is a good learning reference in nursing undergraduate and graduate programs to enhance older person care knowledge.

This study aimed to ascertain the effects of CSA on the cognitive functioning of older people with MCI. In particular, this study aimed to quantitatively pool data from individual studies that demonstrated the effects of CSA and reanalyze the data using established statistical methods.

METHODS

Design

A systematic review and a meta-analysis were conducted to establish the effects of CSA on the cognitive functioning of older people with MCI. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement,[20] guided the search process and the meta-analysis.

Study Eligibility

This review focused on (i) published, peer-reviewed, and non-published RCTs investigating the effects of CSA on the cognitive functioning of people 60 years old and above with MCI; (ii) CSA administered manually or through a computer, console, or smartphone versus passive or waitlist controls; and (iii) studies which used neuropsychological testing tools to report overall cognitive function measures. The publication date was not limited, but only studies published in English were included.

Observational studies and studies with less than five participants in each study arm, with non-impaired older people or those with probable dementia unless separate data for participants with MCI were provided, and studies that used active controls were not included. Moreover, studies with inadequate information or data from which effect sizes could not be computed were excluded.

Search Strategy

From September to December 2021, a comprehensive search of BioMed Central, CINAHL, Cochrane Library, Health Source: Nursing/Academic Edition, MEDLINE, and PubMed databases was conducted. Additionally, to minimize publication bias, a search in the WorldCat, DSpace Saint Louis University, and Google Scholar databases and catalogs for unpublished yet relevant studies was conducted. The keywords *"leisure activities"* and *"cognition"* were used when specifying a Medical Subject Heading (MeSH). Moreover, the keywords *"cognitively-stimulating activities," "cognitive intervention," "brain games," "older people," "elderly,"* and *"mild cognitive impairment"* were used to confirm the comprehensive search. The Boolean operators AND, OR, and NOT were used to limit, widen, or define the search. Lastly, restrictions were placed such that only RCTs published in English were taken.

Study Selection and Quality Assessment

All potentially eligible articles were screened by title and abstract, followed by a comprehensive review of the full texts. Before the screened studies were officially included in the analysis, the researcher and two expert external reviewers assessed their methodological quality simultaneously and independently.

The checklist for RCTs developed by the Joanna Briggs Institute[21] was used to establish the methodological quality of the included studies. Disagreements were addressed through arbitration. Also, Cohen's Weighted Kappa, a robust statistic broadly used in cross-classification to measure agreement between two observed raters, was computed.

Data Extraction

Data from the included studies were extracted using a predesigned form. In particular, the first author's family name, publication year, study design, sample size, intervention and duration, outcome measures, results, and general conclusions were abstracted from each study.

Outcome Measure

Before assessing effectiveness, this study looked into overall cognitive function, which consists of specific functions, including attention, perception, comprehension, memory, language, processing speed, orientation, reasoning, executive function, and calculation.[22] Hence, scores in the Mini-Mental State Examination (MMSE)[23] and Montreal Cognitive Assessment (MoCA),[24] which measured overall cognitive function, were taken to compute the effect sizes. In particular, mean scores were used to compute the standardized mean differences (SMD).

Data Synthesis

MedCalc® Statistical Software version 20.027[25] was used to perform all statistical analyses. The sample sizes, mean values, and standard deviations were manually entered into the program to compute effect sizes, presented as SMD with a 95% confidence interval (CI). All effect size values in this study were inspected using the random-effects model (DerSimonian-Laird method) as it accommodated the possibility that the underlying effect differed across studies. It was also more conservative and had a wider 95% CI than a fixed-effect model.

The interpretation of SMD suggested in the Cochrane Handbook for Systematic Reviews of Interventions version 6.2 was used as a basis where an effect size of SMD < 0.40 represented a small effect, SMD between 0.40 to 0.70 a moderate effect, and SMD> 0.70 a large effect.[26] Heterogeneity was quantitatively assessed using Cochran's Q and I^2 indices. To quantify the proportion of actual variance (variance from the true effect size rather than due to sampling error) from the total observed variance, the I^2 index with 95% CI was used. Taking each quartile as an interval, an I^2 of 0% indicates no heterogeneity, 50% indicates moderate heterogeneity, and a value over 75% indicates a high degree of heterogeneity.[27]

The planned subgroup analysis and meta-regression were not employed because of the small number of studies included in the meta-analysis. The estimates of T^2 within subgroups are likely to be imprecise if only a few studies are within subgroups, and meta-regression, especially with multiple covariates, is not recommended when limited studies are included.[28] Furthermore, subgroup analysis and meta-regression are recommended if there is significant heterogeneity and the studies are more than ten, respectively.[29]

Publication Bias

The potential for publication bias was initially explored through a visual inspection of Begg's funnel plot asymmetry. Further investigation was done using the Egger regression test, Begg and Mazumdar rank correlation test, and the trim and fill method.

Ethical Approval and Considerations

All procedures were approved by the Saint Louis University-Research Ethics Committee (protocol number SLU-REC 2021-036). Data from the included studies were carefully and accurately managed and presented. Lastly, the included studies were cited appropriately, and authorship credits were aptly given.

RESULTS

Search Results

An initial comprehensive search identified 1328 records from indexed databases and 156 articles from other databases and catalogs. Fifty (50) duplicate articles were excluded after manual checking and after using the deduplication feature of Mendeley Desktop version 1.19.8.[30] From this, 1380 articles were removed due to various reasons, including the use of pharmacologic and other non-pharmacologic interventions, not using an RCT design, presenting study protocols only, measuring outcomes beyond the scope of this study, inappropriate participant characteristics, using active controls, and no English translations. Fifty-four titles were then sought for retrieval. However, 12 articles could not be located. The full-text screening was conducted for the 42 articles, where only three met the eligibility criteria. Figure 1 shows the flow chart of the study selection process.

Study Characteristics and Risk of Bias Assessment

A total of three articles met the inclusion criteria for meta-analyses. The study characteristics are shown in Table 1.

Two studies (Peng 2019;[31] Poptsi 2019[32]) included participants aged 60 and above, while the other study (Kwok 2011[33]) included participants aged 70 and above. All studies included participants regardless of sex. Two studies[31,32] were published in 2019, while one study[33] was published in 2011. The total number of participants was 199, where 98 were from the experimental groups (mean group size=33), and 101 were from the control groups (mean group size=34). Samples were drawn from Hong Kong, Greece, and China. Two studies[31,33] compared CSA to a passive control, and the other study[32] to a waitlist control.

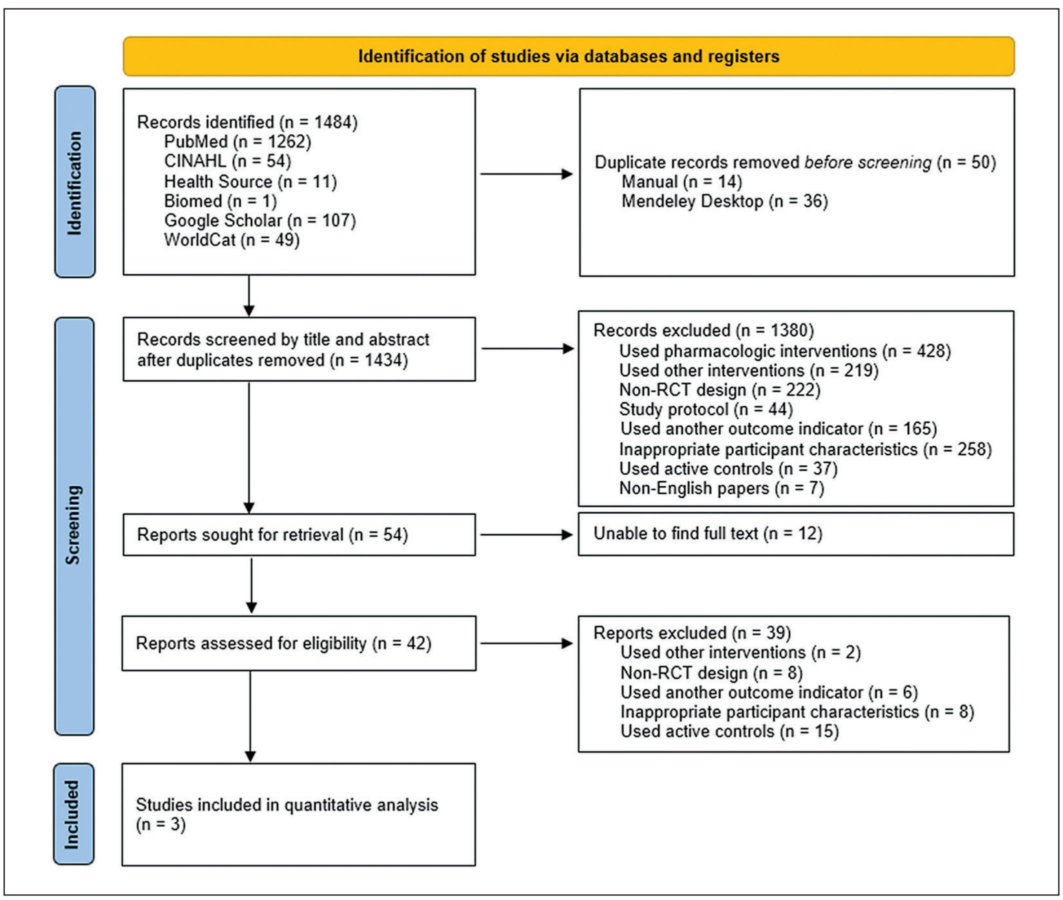


Figure 1. Flow chart of the study selection process.

Table 1. Synthesis Table on the Effects of Cognitively-stimulating Activities on the Cognitive Function of Older People with Mild Cognitive Impairment

No.	Author	Study Design	Sample size	Intervention	Duration	Outcome Measures	Results	General Conclusions	Percent Agreement and Cohen's Kappa
1.	Kwok 2011	RCT, passive control	n = 31 Tx: 14 Con: 17	Group-based, intensive calligraphy training versus passive control.	Each session of calligraphic writing lasted about 30 minutes, with one session per day, five times per week, for eight consecutive weeks.	Overall cognitive function was assessed using the Chinese version of the Mini-Mental State Exam (MMSE).	The calligraphy group was found to have a noticeable increase in CMMSE overall score after two months (M = 2.36, P < 0.01). In contrast, their counterparts in the control group experienced a decline in the CMMSE score (M = −0.41, P < 0.05).	Calligraphy therapy was effective in enhancing cognitive function in older people with mild cognitive impairment (MCI) and should be incorporated as part of routine programs in both community and residential care settings.	92.31% k = 0.806 Almost perfect agreement
2.	Peng 2019	RCT, passive control	n = 140 Tx: 70 Con: 70	Group-based, cognitive training versus the passive control group.	The participants in the intervention group all gathered in a classroom and were provided cognitive training consisting of memory training, attention training, and calculation training every two weeks for six months; each training session lasted approximately 90 minutes.	Overall cognitive function was assessed using the Montreal Cognitive Assessment (MoCA).	The total MoCA score of the intervention group increased from 19.77 ± 2.24 points to 21.09 ± 2.20 points after six months of cognitive training, but the score of the control group decreased from 20.41 ± 2.10 points to 19.17 ± 2.57 points. The two-way repeated-measures ANOVA revealed a significant effect of the interaction between time and cognitive training on the total MoCA score.	The cognitive training intervention is effective and may help to decrease the deterioration of cognitive function in patients with MCI, and the interaction between intervention time and cognitive training significantly improves cognitive function.	76.92% k = 0.451 Moderate agreement
3.	Poptsi 2019	RCT, waitlist control	n = 28 Tx: 14 Con: 14	Language intervention program carried out via individual, computer-based cognitive training, paper-and-pencil, and oral versus an active control receiving unstructured sessions and a waitlist control group.	The experimental group attended 48 sessions of language training for six months.	Overall cognitive function was assessed using the MMSE.	Mixed measures analysis of variance at the follow-up showed significant improvement in cognitive abilities among the experimental (MMSE 28.92, 28.33, and 26.70) versus control groups (MMSE 27.40 and 26.92). At the end of the language training, the experimental groups presented improved cognitive abilities and daily function, while the control group remained at the same performance level.	The cognitive language training methods were significantly effective.	84.62% k = 0.435 Moderate agreement

The CSA used in the individual studies were calligraphy training[33], cognitive training[31], and a language intervention program[32]. All the interventions stimulated the domains of memory, attention, and concentration. The calculation domain was stimulated in one study,[31] and the executive function domain in another.[32] The MMSE tool was used in two studies,[32,33] while the other study[31] used the MoCA instrument. Two studies[31,33] used the group format training mode, while one study[32] used computer-based programs. Treatment duration was roughly divided into either short (8 weeks or less, Kwok 2011[33]) or long (greater than eight weeks, Peng 2019;[31] Poptsi 2019[32]).

The quality of the studies included in the meta-analysis was relatively modest, with scores ranging from eight to 12 points. The lowest percent agreement was 76.92%, and the highest was 92.31%. The quality assessment results revealed that the participants were similar at baseline, the follow-up of participants was adequate, and the participants were analyzed in the groups with which they were randomized. Furthermore, the outcomes were measured the same way in the compared groups and were measured reliably. The trial designs, and the statistical analyses used were also considered appropriate.

Conversely, the quality assessment (Figure 2) revealed that the concealment of allocation and the description of blinding of the participant and those delivering treatment was generally unclear or low. Moreover, the blinding of outcome assessors was mainly unclear or inadequate.

The Cohen's Kappa statistic was calculated for each study. In particular, one study[33] had a Kappa score of 0.81, interpreted as an almost perfect agreement between raters. Meanwhile, the Kappa statistics for the other studies[31,32] were 0.45 and 0.43, interpreted as a moderate agreement between raters. The overall percent agreement was 84.62%, and the Kappa statistic was 0.58, interpreted as a moderate agreement between raters.

Analysis Results

The summary results of cognitively-stimulating interventions demonstrated a significant, large effect in improving overall cognitive functioning among older people with MCI (SMD = 0.798, 95% CI 0.510-1.085, p = 0.001). The effect sizes of the individual studies, which reflect the effects of different CSA on the response variable of interest, ranged from moderate to large. One study[33] had a moderate effect on overall cognitive function with SMD of 0.700, while two studies[31,32] had large effects on overall cognitive function with SMD of 0.798 and 0.906.

Figure 3 illustrates the forest plot of the study where the effect sizes of studies versus their precision (inverse of standard error) are described. Qualitative visual analysis revealed little between-study variability. Furthermore, it

Study		True Randomization	Allocation Concealment	Similarity at Baseline	Participant Blinding	Implementer Blinding	Assessor Blinding	Identical Treatment of Treatment Groups	Complete and Adequate Description of Follow-up	Analysis in Groups to which Participants were Randomized	Same Measurement of Outcomes	Reliable Measurement of Outcomes	Appropriate Statistical Tests	Appropriate Trial Design	Percent Agreement	Cohen's Kappa
Kwok et al. (2011)	R1	+	?	+	+	?	?	+	+	+	+	+	+	+	92.31	0.806
	R2	+	–	+	–	–	?	+	+	+	+	+	+	+		
Poptsi et al. (2019)	R1	+	?	+	+	+	+	+	+	+	+	+	+	+	84.62	0.435
	R2	+	–	+	–	–	+	+	+	+	+	+	+	+		
Peng et al. (2019)	R1	+	+	+	+	?	?	+	+	+	+	+	+	+	76.92	0.451
	R2	?	–	+	–	–	–	+	+	+	+	+	+	+		

Key

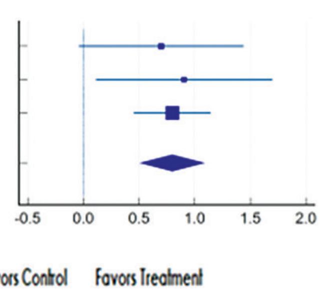
– High risk of bias (no details were reported or stated)

? Unclear risk of bias (too few details were available to make a judgement)

\+ Low risk of bias (details were clearly reported or stated)

Figure 2. Risk of bias summary.

Study	N1	N2	Total	SMD	SE	95% CI	t	P	Weight (%) Fixed	Weight (%) Random
Kwok et al., 2011	14	17	31	0.700	0.363	-0.0417 to 1.441			16.17	16.17
Poptsi et al., 2019	14	14	28	0.906	0.386	0.111 to 1.700			14.24	14.24
Peng et al., 2019	70	70	140	0.798	0.175	0.453 to 1.144			69.59	69.59
Total (random effects)	98	101	199	0.798	0.146	0.510 to 1.085	5.471	<0.001	100.00	100.00



Test for heterogeneity

Q	0.1508
DF	2
Significance level	P = 0.9274
I^2 (inconsistency)	0.00%
95% CI for I^2	0.00 to 55.51

Figure 3. Effects of cognitively stimulating activities on the cognitive functioning of older people with mild cognitive impairment.

was revealed that the individual study points estimate of the treatment effect (blue squares) have varying sizes due to the sample size of the individual studies. Moreover, it was revealed that the blue squares do not line up on a vertical axis, but all squares were on the right side of the line of no effect, hence, indicating a similar treatment effect magnitude that favored the treatment. The CI for most studies' treatment effects were also overlapping, indicating a similar estimation of the population treatment effect between studies.

The blue diamond reflects the pooled result using the random-effects model (SMD = 0.798, p = 0.001), with its width demonstrating the CI length (0.510-1.085). The random-effects model enabled partial pooling where the effect estimates were based partially on the more abundant data from other studies rather than completely pooling all studies, which could mask variations and give poor estimates for low-sample studies.

These qualitative and quantitative results suggest little heterogeneity or between-study variability. In particular, heterogeneity across studies was non-significant ($p = 0.927$), evidenced by Cochran's Q of 0.151 (df = 2). Furthermore, the I^2 value was 0.00%, indicative of no heterogeneity. These results mean that clinical heterogeneity was absent even though a diverse range of CSA was employed, and two instrument types were used to measure the outcome. All the interventions were cognitively stimulating activities, and the standardized instruments still measured the same outcome. Additionally, methodological diversity was not present since there were no variations in the study design and minimal variability in the risk of bias assessment.

The aggregated effect size funnel plot appeared symmetrical, with no outlier observed. Hence, the possibility of publication bias was not considered. Further analysis of funnel plot asymmetry using Begg and Mazumdar's test for rank correlation revealed a p-value of 0.602, indicating no evidence of publication bias. Egger's test for a regression intercept revealed a p-value of 0.965. The p-value was greater than the 0.05 level of significance. Thus, publication bias does not exist. Still, since fewer than ten studies were included in the meta-analysis, it is possible that there was insufficient power for such an analysis. Lastly, the trim-and-fill procedure was used to search for studies missing in the meta-analysis. The process revealed that there were no missing studies. The adjusted combined effect size was the same as the observed values.

DISCUSSION

Principal Findings

The evidence for using cognitive interventions on older people with cognitive deficits has grown relatively fast. This situation may be due to the unconfirmed claims of researchers that engaging in cognitive activities can delay cognitive decline. Thus, to prove or disprove such claims, this study was conducted.

The current meta-analysis is one of the few studies that sought to assess and summarize the available evidence on the effects of CSA on the overall cognitive functioning of older people with MCI. Specifically, it sought to answer the PICO question, "In older people with MCI, does engagement in cognitively stimulating activities improve cognitive function?" Based on the results of this meta-analysis, where a significant and large effect was found (SMD = 0.798, 95% CI 0.510-1.085, $p = 0.001$), it is confirmed that CSA can indeed enhance overall cognitive functioning among people with MCI who are 60 years and above, regardless of sex and geographic location. The null hypothesis that engaging in CSA does not improve cognitive function among older people with MCI was rejected.

This finding augments the evidence base regarding the effects of cognitive interventions on the overall cognitive functioning of patients with MCI. In particular, the result is consistent with the findings of a study about the impact of a novel memory game on an iPad as cognitive training among patients with amnestic MCI.[34] It was found that episodic memory robustly improved after exposure to the intervention and that gamification of cognitive training may enhance the visuospatial abilities of MCI patients. Moreover, it corresponds with the findings of a study that found that group- and home-based cognitive interventions for patients with MCI are effective in improving cognitive function,[35] and with another study which found that computerized cognitive training (CCT) and virtual reality cognitive training (VRCT) for individuals with MCI were moderately effective in long-term improvement of cognition for those at high risk of cognitive decline.[36]

Additionally, the result supports the findings of a study where it was found that MCI patients can improve their cognitive and functional performance when provided with cognitive training early in the disease process.[37] Lastly, the finding primarily resonates with the results of a meta-analysis which found that in terms of subtypes of cognitive intervention, cognitive stimulation and cognitive training had positive effects on MMSE in MCI patients but cognitive rehabilitation had the lowest score.[38] It also resonates with the results of a meta-analysis which found a significant, moderate effect for multicomponent training.[39] Overall, the findings of the meta-analysis suggest that the outcome measures of cognition among individuals with MCI tend to improve after implementing multicomponent training or interventions targeting multiple domains. In particular, the authors discussed that interventions targeting single domains like memory and those targeting multiple domains of cognition are particularly helpful in improving cognitive function. However, in the same breath, multidomain methods or those interventions that intervene in at least two domains of cognition are less effective than memory-based approaches.

The large summary effect size found in this study after the older persons with MCI were exposed to CSA may be explained by poorly understood mechanisms but are discussed in extant literature. Primarily, the improvements in the cognitive functioning of older people might have resulted from stimulating the older person's core cognitive skills. According to one study, cognitive interventions such as brain games targeting focus, logic, memory, visuospatial, and language skills improve overall cognitive function.[12]

The various CSA in the individual studies included in this meta-analysis did the same action, where the majority stimulated the participant's memory, attention, and concentration. At the same time, some targeted the domains of executive function and calculation. Mainly, the CSA in the three studies were all effective cognitive stimulation techniques, strategies, and materials that improve cognitive capabilities and executive functions such as memory, attention, language, reasoning, and planning.

Second, the large summary effects observed in this meta-analysis are consistent with the impact of scaffolding enhancements. Specifically, the changes in the cognitive function of older people with MCI may be due to the benefits of CSA in individual studies that enhanced compensatory scaffolding and, ultimately, their cognitive function. According to the Scaffolding Theory of Aging and Cognition (STAC),[40] and the Life Course Model of the Scaffolding Theory of Aging and Cognition (STAC-r),[41] brain functioning is maintained despite neural challenges and functional deterioration due to the brain's constant engagement of compensatory scaffolding. In the theory, it was said that interventions such as new learning, social and intellectual engagement, exercise, meditation, and cognitive training are necessary to enhance compensatory scaffolding. These interventions, such as the CSA used in individual studies, make it easier for the brain to recruit extra circuitry, thus, supporting deteriorating structures whose functioning has become ineffective. The CSA also probably activated supplementary neural circuitry engagement, providing the additional computational support required by the participants' aging brains to preserve cognitive function in localized or global neurofunctional decline.

On another note, certain uncontrollable factors, which include the participants' chronological age, sex, level of education, and time between visits, might have affected the results. While the authors did not discuss these factors as the main reason for the improvement in the participants' overall cognitive functioning, they are still contributory. For instance, the participants' chronological age at the time of the assessment may have influenced the results, mainly because while older age is associated with cognitive decline, some cognitive abilities are resilient to age-related changes in the brain.[42] Also, most participants were females who might have outperformed men, especially in activities involving memory and processing speed.[43] Moreover, on the premise that a higher level of education is related to a higher level of cognition at baseline and that the rate of cognitive decline at average or high levels of education was slightly increased during earlier years of follow-up,[44] it could be that the participants got high scores during the follow-up assessment since their level of education was relatively average at about 12 years or below. Also, the follow-ups were conducted two and six months post-intervention.

Lastly, the large summary effect was calculated as a weighted average of the intervention effects estimated in the individual studies. The bigger the weight given to a particular study, the more it will contribute to the weighted average. Since one study (Peng 2019)[31] was given the biggest weight (69.59%), it can be presumed that it had the most significant influence on the summary effect. A scrutiny of the study revealed that the CSA was administered via the group training method and included memory, attention, and calculation training to target multiple cognitive domains. In particular, the researchers gathered the participants in a classroom and provided cognitive training every two weeks for six months, with each training session lasting approximately 90 minutes. The seven-piece board recovery training, picture-reading memory, reading aloud, and reciting phrases were part of the memory training. In contrast, the attention training included the color reaction and Schulte Grid training. The calculation training had two simple calculation questions and a straightforward application question for calculation in each intervention process.

The study of Peng[31] confirms that interventions targeting multiple cognitive domains and those with longer treatment durations may be the most promising in MCI. However, while their study proves that their approach of stimulating memory, attention, and calculation is better than focusing on one domain only, the textual analysis also revealed that the intervention involved time spent by the respondents with the designer and other respondents. This factor could have provided a social benefit or some additional confounding benefit to the respondents in the intervention group. Lastly, the analysis revealed that the therapeutic effect of the CSA may have been affected by specific and non-specific factors such as educational level, sleep and exercise time, engagement in community activities, and patient-doctor relationships.

Indeed, several studies have continuously promoted cognitive training due to its ability to slow or prevent cognitive decline. In contrast, others have informed the public of the lack of benefits from such activities. The ambiguity of conclusions in these studies that explored the effects of cognitive activities might be due to several factors, such as methodological differences. However, this meta-analysis compared studies that employed similar methodologies and found promising results. This study observed dissimilarity between the two groups. While its superiority over other interventions that improve cognitive function was not measured in this study, it was still found that using CSA is helpful in terms of its cost-effectiveness. Hence, the result of this meta-analysis is of clinical importance since this meta-analysis provides nurses and other people working with older people with new information regarding the efficacy of CSA on the overall cognitive functioning of older people with MCI. Moreover, it gives nurses an option of inexpensive, non-pharmacologic interventions that may be used to delay neurocognitive decline. Lastly, it guides nurses as they engage older people in cognitive training using CSA.

Strengths and Limitations of the Study

This meta-analysis' strengths were limiting study inclusion to RCTs measuring overall cognitive functioning with well-established standardized instruments. Also, the studies included in this meta-analysis were of good quality, as assessed by independent external reviewers in the risk of bias assessment.

Conversely, just like other similar meta-analyses, the limitations of this study were a small number of studies, relatively small sample sizes, a range of cognitive exercises employed, and the diversity of sites. However, the various types of CSA used in primary studies were of the most significant concern. Moreover, the small number of studies (<10) makes the results of Egger's regression intercept test questionable due to lack of power. Nevertheless, indexed and other databases and catalogs were extensively searched to include non-published yet relevant articles to overcome this limitation. This method, however, did not result in finding articles that can be included in the meta-analysis since the eligibility criteria were not met.

In sum, despite the strengths mentioned above, the establishment of a significant and large effect and not finding heterogeneity across studies, interpreting the current findings warrant forethought. Also, this meta-analysis' results are true today but might not be true tomorrow. Hence, researchers should also be willing to change their minds when new information or circumstances emerge.

CONCLUSION AND RECOMMENDATIONS

While individual studies suggest unfavorable effects on overall cognitive function, the data do not bear this out collectively. This meta-analysis suggests that cognitive training using CSA improves overall cognitive function among older people with MCI. It is acknowledged that CSA are effective and practical non-pharmacologic cognitive training approaches to delay cognitive decline among older people with MCI.

For clinical practice, it is recommended that nurses and other individuals working with older people, healthy or otherwise, advocate for them by keeping them engaged in CSA. Additionally, it is recommended that nurse managers and leaders consider using the results of this study as they develop programs to promote cognitive functioning among the in-patients in their respective hospitals. Furthermore, nurse leaders can communicate the results of such programs to appropriate agencies and institutions, such as the Department of Health and the Department of Social Welfare and Development, to intensify existing programs for older people.

Moreover, nurse leaders can work with the Gerontology Nurses Association of the Philippines, Inc., to herald the formation of programs that can certify nurses as Dementia and MCI Care Specialists. Lastly, nurse leaders can work with policymakers to amend Republic Act 9994 or the Expanded Senior Citizens Act of 2010. In particular, government assistance in terms of health, as stipulated in section five of RA 9994, can be amended. Instead of simply having a senior citizen's ward in every government hospital, implementing CSA can be an essential component of geriatric ward programs geared towards health promotion and disease prevention.

For nursing research, it is recommended that the research community employ larger samples in future RCTs, consider using tracking tests administered after a certain period to provide data about subsequent effectiveness, and consider conducting prospective longitudinal studies with longer follow-ups. Also, since there were studies that were not retrieved due to budget constraints, it is recommended that researchers balance the thoroughness of the search with efficiency in using funds. Likewise, since some studies were disregarded due to language restrictions, it is recommended that researchers try to work with multilingual interpreters and translators to minimize restricting the search to a specific language. Furthermore, since this study only included three studies in the meta-analysis, the Egger's test conducted to determine the presence of publication bias had low statistical power. Hence, it is recommended that more studies be included in future meta-analyses about CSA. Lastly, since the planned subgroup analysis and meta-regression were not performed due to the absence of heterogeneity and the small number of studies, it is recommended that such processes be performed in future meta-analyses to answer specific questions about particular types of CSA.

For nursing education, it is recommended that this study's results be integrated into gerontology courses in different nursing graduate programs. By including the results of this meta-analysis in lectures and discussions, nurses can be educated on how they can meet evolving healthcare demands of older people. Furthermore, they are provided information about effective and proven solutions to improve cognitive functioning among older people, especially those with MCI.

Statement of Authorship

Both authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

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REFERENCES

1. United Nations, Ageing [Internet]. 2019 [cited 2021 Nov 8]. Available from: https://www.un.org/en/global-issues/ageing
2. Alzheimer's Society, Mild cognitive impairment (MCI) [Internet]. 2021 [cited 2021 Apr 8]. Available from: https://www.alzheimers.org.uk/about-dementia/types-dementia/mild-cognitive-impairment-mci
3. Albert MS, DeKosky ST, Dickson D, Dubois B, Feldman HH, Fox NC, et al. The diagnosis of mild cognitive impairment due to Alzheimer's disease: Recommendations from the National Institute on Aging-Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. Alzheimers Dement. 2011 May;7(3):270-9. doi: 10.1016/j.jalz.2011.03.008.
4. Kiely K. Cognitive Function. In: Michalos A, editor. Encyclopedia of Quality of Life and Well-Being Research. Dordrecht: Springer; 2014. pp. 974-978.
5. Gillis C, Mirzaei F, Potashman M, Ikram MA, Maserejian N. The incidence of mild cognitive impairment: A systematic review and data synthesis. Alzheimers Dement (Amst). 2019 Mar;11:248-56. doi: 10.1016/j.dadm.2019.01.004.
6. Dominguez J, de Guzman MF, Reandelar M, Thi Phung TK. Prevalence of dementia and associated risk factors: a population-based study in the Philippines. J Alzheimers Dis. 2018;63(3):1065-73. doi: 10.3233/JAD-180095.
7. Lara E, Caballero FF, Rico-Uribe LA, Olaya B, Haro JM, Ayuso-Mateos JL, et al. Are loneliness and social isolation associated with cognitive decline? Int J Geriatr Psychiatry. 2019 Nov;34(11):1613-22. doi: 10.1002/gps.5174.

8. Bianchi VE, Herrera PF, Laura R. Effect of nutrition on neurodegenerative diseases. A systematic review. Nutr Neurosci]. 2021 Oct.;24(10):810-34. doi: 10.1080/1028415X.2019.1681088.
9. Müllers P, Taubert M, Müller NG. Physical exercise as personalized medicine for dementia prevention? Front Physiol [Internet]. 2019 May;10:672. doi: 10.3389/fphys.2019.00672.
10. Palaus M, Marron EM, Viejo-Sobera R, Redolar-Ripoll D. Neural basis of video gaming: a systematic review. Front Hum Neurosci. 2017 May;11:248. doi: 10.3389/fnhum.2017.00248.
11. West GL, Zendel BR, Konishi K, Benady-Chorney J, Bohbot VD, Peretz I, et al. Playing Super Mario 64 increases hippocampal grey matter in older adults. PLoS One. 2017 Dec;12(12):e0187779. doi: 10.1371/journal.pone.0187779.
12. Mamayson RF, Caballes LG, Asiatico KNB, Acosta RAR, Chavez SDS, Deocares LB, et al. Effects of brain games on global cognition among older Filipinos. Acta Med Philipp. 2020 Apr;54(2):109-16. doi:10.47895/amp.v54i2.1540
13. Karssemeijer E, Aaronson J, Bossers W, Smits T, Olde Rikkert M, Kessels R. Positive effects of combined cognitive and physical exercise training on cognitive function in older adults with mild cognitive impairment or dementia: A meta-analysis. Ageing Res Rev. 2017 Nov;40:75-83. doi: 10.1016/j.arr.2017.09.003.
14. Iwasa H, Yoshida Y, Kai I, Suzuki T, Kim H, Yoshida H. Leisure activities and cognitive function in elderly community-dwelling individuals in Japan: A 5-year prospective cohort study. J Psychosom Res. 2012 Feb;72(2):159-64. doi: 10.1016/j.jpsychores.2011.10.002.
15. Yates LA, Ziser S, Spector A, Orrell M. Cognitive leisure activities and future risk of cognitive impairment and dementia: systematic review and meta-analysis. Int Psychogeriatr. 2016 Nov;28(11):1791-1806. doi: 10.1017/S1041610216001137.
16. Doi T, Verghese J, Makizako H, Tsutsumimoto K, Hotta R, Nakakubo S, et al. Effects of cognitive leisure activity on cognition in mild cognitive impairment: results of a randomized controlled trial. J Am Med Dir Assoc. 2017 Aug;18(8):686-91. doi: 10.1016/j.jamda.2017.02.013.
17. Kallio E, Öhman H, Hietanen M, Soini H, Strandberg TE, Kautiainen H, et al. Effects of cognitive training on cognition and quality of life of older persons with dementia. J Am Geriatr Soc [Internet]. 2018 Apr;66(4):664-70. doi: 10.1111/jgs.15196.
18. Kable JW, Caulfield MK, Falcone M, McConnell M, Bernardo L, Parthasarathi T, et al. No effect of commercial cognitive training on brain activity, choice behavior, or cognitive performance. J Neurosci. 2017 Aug;37(31):7390-402.
19. Souders DJ, Boot WR, Blocker K, Vitale T, Roque NA, Charness N. Evidence for narrow transfer after short-term cognitive training in older adults. Front Aging Neurosci. 2017 Feb;9:41.
20. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. J Clin Epidemiol. 2021 Jun;134: 178-189. doi: 10.1016/j.jclinepi.2021.03.001.
21. Joanna Briggs Institute, Critical Appraisal Tools [Internet]. 2021 [cited 2021 Sep 29]. Available from: https://jbi.global/critical-appraisal-tools
22. Bitbrain, 12 types of cognitive stimulation activities [Internet]. 2018 [cited 2022 Mar 14]. Available from: https://www.bitbrain.com/blog/cognitive-stimulation-activities
23. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state." A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res. 1975 Nov;12(3):189-198. doi: 10.1016/0022-3956(75)90026-6.
24. Nasreddine ZS, Phillips NA, Bédirian V, Charbonneau S, Whitehead V, Collin I, et al. The Montreal Cognitive Assessment, MoCA: A brief screening tool for mild cognitive impairment. J Am Geriatr Soc. 2005 Apr [c;53(4):695-9. doi: 10.1111/j.1532-5415.2005.53221.x.
25. MedCalc Software Ltd., MedCalc statistical software [Internet]. 2022 [cited 2022 Apr 19]. Available from: https://www.medcalc.org
26. Higgins J, Thomas J, Chandler J, Cumpston M, Li T, Page M, et al. Cochrane Handbook for Systematic Reviews of Interventions version 6.2 (updated February 2021) [Internet]. London: Cochrane; 2021 [cited 2021 Jun 18]. Available from: https://www.training.cochrane.org/handbook
27. Higgins JPT, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. BMJ. 2003 Sep;327(7414):557-60. doi: 10.1136/bmj.327.7414.557.
28. Borenstein M, Hedges L, Higgins J, Rothstein H. Introduction to Meta-Analysis. Chichester: John Wiley & Sons, Ltd.; 2009.
29. Deeks J, Higgins J, Altman D. Chapter 10: Analysing data and undertaking meta-analyses. In: Higgins J, Thomas J, Chandler J, Cumpston M, Li T, Page M, et al., editors. Cochrane Handbook for Systematic Reviews of Interventions version 6.2 [Internet]. London: Cochrane; 2021 [cited 2021 Jun 18]. Available from: https://training.cochrane.org/handbook/archive/v6.2/chapter-10
30. Mendeley, Mendeley Reference Manager [Internet]. 2021 [cited 2021 Oct 18]. Available from: https://www.mendeley.com/?interaction_required=true
31. Peng Z, Jiang H, Wang X, Huang K, Zuo Y, Wu X, et al. The efficacy of cognitive training for elderly Chinese individuals with mild cognitive impairment. BioMed Res Int. 2019 Nov;2019:4347281. doi: 10.1155/2019/4347281.
32. Poptsi E, Lazarou I, Markou N, Vassiloglou M, Nikolaidou E, Diamantidou A, et al. A comparative single-blind randomized controlled trial with language training in people with mild cognitive impairment. Am J Alzheimers Dis Other Demen. 2019 May;34(3): 176-87. doi: 10.1177/1533317518813554.
33. Kwok TCY, Bai X, Kao HSR, Li JCY, Ho FKY. Cognitive effects of calligraphy therapy for older people: a randomized controlled trial in Hong Kong. Clin Interv Aging [Internet]. 2011;6:269-273. doi: 10.2147/CIA.S25395.
34. Savulich G, Piercy T, Fox C, Suckling J, Rowe JB, O'Brien JT, et al. Cognitive training using a novel memory game on an iPad in patients with amnestic mild cognitive impairment (aMCI). Int J Neuropsychopharmacol. 2017 Aug];20(8):624-33. doi: 10.1093/ijnp/pyx040.
35. Jeong JH, Na HR, Choi SH, Kim J, Na DL, Seo SW, et al. Group- and home-based cognitive intervention for patients with mild cognitive impairment: a randomized controlled trial. Psychother Psychosom. 2016;85(4):198-207. doi: 10.1159/000442261.
36. Coyle H, Traynor V, Solowij N. Computerized and virtual reality cognitive training for individuals at high risk of cognitive decline: systematic review of the literature. Am J Geriatr Psychiatry. 2015 Apr;23(4):335-59. doi: 10.1016/j.jagp.2014.04.009.
37. Rojas GJ, Villar V, Iturry M, Harris P, Serrano CM, Herrera JA, et al. Efficacy of a cognitive intervention program in patients with mild cognitive impairment. Int Psychogeriatr. 2013 May;25(5):825-31.
38. Liang JH, Xu Y, Lin L, Jia RX, Zhang HB, Hang L. Comparison of multiple interventions for older adults with Alzheimer disease or mild cognitive impairment: A PRISMA-compliant network meta-analysis. Medicine. 2018 May;97(20):e10744. doi: 10.1097/MD.0000000000010744.
39. Sherman DS, Mauser J, Nuno M, Sherzai D. The efficacy of cognitive intervention in mild cognitive impairment (MCI): a meta-analysis of outcomes on neuropsychological measures. Neuropsychol Rev. 2017 Dec;27(4):440-84. doi: 10.1007/s11065-017-9363-3.
40. Park DC, Reuter-Lorenz P. The adaptive brain: aging and neurocognitive scaffolding. Annu Rev Psychol. 2009];60):173-96. doi: 10.1146/annurev.psych.59.103006.093656.
41. Reuter-Lorenz P, Park D. How does it STAC up? Revisiting the scaffolding theory of aging and cognition. Neuropsychol Rev [Internet]. 2014 Sep;24(3):355-70. doi: 10.1007/s11065-014-9270-9.
42. Harada CN, Natelson Love MC, Triebel KL. Normal cognitive aging. Clin Geriatr Med. 2013 Nov;29(4):737-52. doi: 10.1016/j.cger.2013.07.002.
43. Nooyens ACJ, Wijnhoven HAH, Schaap LS, Sialino LD, Kok AAL, Visser M, et al. Sex differences in cognitive functioning with aging in the Netherlands. Gerontology [Internet]. 2022;68(9):999-1009. doi: 10.1159/000520318.
44. Wilson RS, Hebert LE, Scherr PA, Barnes LL, Mendes de Leon CF, Evans DA. Educational attainment and cognitive decline in old age. Neurology. 2009 Feb;72(5):460-5. doi: 10.1212/01.wnl.0000341782.71418.6c.