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CHANGES IN MEMORY FUNCTION FOLLOWING COGNITIVE STIMULATION PROGRAMS AMONG OLDER ADULTS

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ABSTRACT

This study aimed to examine changes in memory function among older adults following cognitive stimulation, in response to the increasing risk of cognitive decline associated with ageing. A quasi-experimental pre–post design without a control group was employed, involving 90 older adults aged ≥60 years recruited from three community health centers. Participants received cognitive stimulation interventions in the form of puzzles, crossword puzzles, or dakon, administered over six sessions. Memory function was assessed using the Mini Mental State Examination (MMSE). The results demonstrated statistically significant improvements in memory scores across all intervention groups, with the greatest mean increase observed in the crossword puzzle group ($p < 0.001$), followed by the puzzle group ($p = 0.002$) and the dakon group ($p < 0.001$). One-way ANOVA revealed significant differences in post-intervention memory scores among the three types of cognitive stimulation ($p < 0.05$). Although the study design does not allow for causal inference, the findings indicate that structured cognitive stimulation is associated with improved memory function in older adults. These results support the potential integration of cognitive stimulation activities as practical non-pharmacological approaches within community-based elderly health programs.

Keywords: *cognitive stimulation, memory function, elderly, MMSE, non-pharmacological interventions*

ABSTRAK

Penelitian ini bertujuan untuk menganalisis perubahan fungsi memori lansia setelah pemberian stimulasi kognitif, mengingat meningkatnya risiko penurunan kognitif seiring proses penuaan. Penelitian menggunakan desain kuasi-eksperimen pre–post tanpa kelompok kontrol, melibatkan 90 lansia berusia ≥60 tahun yang direkrut dari tiga puskesmas. Responden menerima intervensi stimulasi kognitif berupa puzzle, teka-teki silang (TTS), atau dakon yang diberikan selama enam sesi. Fungsi memori diukur menggunakan Mini Mental State Examination (MMSE). Hasil analisis menunjukkan peningkatan skor memori yang bermakna secara statistik pada seluruh kelompok intervensi, dengan peningkatan rerata tertinggi pada kelompok TTS ($p < 0,001$), diikuti oleh puzzle ($p = 0,002$) dan dakon ($p < 0,001$). Uji ANOVA menunjukkan adanya perbedaan rerata skor memori antar jenis stimulasi kognitif ($p < 0,05$). Meskipun desain penelitian tidak memungkinkan penarikan kesimpulan kausal, hasil penelitian ini menunjukkan bahwa stimulasi kognitif terstruktur berasosiasi dengan peningkatan fungsi memori pada lansia. Temuan ini mendukung pemanfaatan stimulasi kognitif sebagai intervensi nonfarmakologis yang aplikatif dalam program kesehatan lansia berbasis komunitas.

Kata kunci: stimulasi kognitif, fungsi memori, lansia, MMSE, intervensi nonfarmakologis

INTRODUCTION

Population ageing is a natural demographic process and represents a major challenge for global health systems. As life expectancy continues to increase, the number of older adults is growing worldwide (Marent et al., 2025). According to the *World Health Organizatio*, (2023) the global population aged 60 years and above is projected to nearly double from 1 billion in 2020 to approximately 2.1 billion by 2050. This demographic transition toward an ageing society has substantial implications for public health, particularly with regard to brain health and cognitive functioning.

Advancing age is associated with structural and functional changes in the brain, including reduced hippocampal volume, decreased synaptic plasticity, and slower neural transmission. These age-related changes contribute to a gradual decline in cognitive function, especially in memory, attention, and problem-solving abilities (Turrini et al., 2023). Memory impairment is among the most common cognitive complaints in older adults and is often an early indicator of neurodegenerative conditions, such as Mild Cognitive Impairment (MCI) and dementia. This decline may interfere with daily activities, social engagement, and overall quality of life (Cappa et al., 2024).

Epidemiological studies indicate that memory disorders are highly prevalent among older populations across countries. In (Li et al., 2022) reported that 22.24% of older adults experienced memory impairment. In the United States, the Centers for Disease Control and Prevention reported that approximately 20.4% of older adults with chronic diseases experienced a decline in subjective cognitive function (Centers for Disease Control and Prevention, 2020). In Indonesia, data from the 2023 Indonesian Health Survey (SKI) showed that approximately 5–7% of adults aged 65 years experienced cognitive decline, with prevalence increasing to more than 20% among those aged 85 years and above (Kementerian Kesehatan Republik Indonesia, 2023). These findings indicate that

population ageing in Indonesia is accompanied by an increasing burden of cognitive impairment among older adults.

Declining memory function not only affects cognitive performance but also compromises independence in daily living. Older adults may experience difficulties in recognizing food, remembering eating processes, sequencing daily activities, and even chewing and swallowing (Pragholapati et al., 2021). Such limitations increase dependence on family members and healthcare services, contributing to greater long-term care needs and higher healthcare costs (Livingston et al., 2020). Several factors, including advanced age, hypertension, diabetes mellitus, obesity, depression, smoking, social isolation, and physical inactivity, further exacerbate cognitive decline and increase the risk of dementia (World Health Organization, 2021).

In response to these challenges, non-pharmacological interventions aimed at maintaining brain function have gained increasing attention. One such intervention is the Cognitive Stimulation Program, which consists of structured activities designed to engage multiple cognitive domains, including memory, language, attention, and executive function. Previous studies have demonstrated that cognitive stimulation can slow cognitive decline and improve memory performance in older adults (Prahasasgita & Lestari, 2023).

Evidence from international studies supports these findings. Cognitive stimulation has been shown to have a positive impact on global cognitive function in older adults with mild dementia (Peralta-marrupe et al., 2023). Meta-analytic evidence indicates that memory training consistently improves episodic and working memory performance (Paradela et al., 2025), while multidomain interventions incorporating co gnitive training significantly enhance memory and executive function in older adults at risk of dementia (Barbera et al., 2025).

Recent studies further confirm the effectiveness of cognitive stimulation interventions. Group-based cognitive stimulation programs have been shown to improve Mini-Mental State Examination (MMSE) scores and short-term memory in healthy older adults (Rieker et al., 2022). Computer-based cognitive exercises have demonstrated improvements in working memory and selective attention among older adults with mild cognitive impairment (Xiang & Zhang, 2024), while community-based cognitive activities enhance memory function and social interaction (Simon et al., 2025). In addition, caregiver-assisted cognitive stimulation has been associated with improved emotional interaction and psychological well-being among older adults (Sanjuán et al., 2023). These findings align with the World Health Organization's concept of healthy ageing, which emphasizes maintaining functional ability, independence, and quality of life in later life (World Health Organization, 2020).

Despite the growing body of evidence supporting cognitive stimulation, comparative studies examining simple and culturally relevant cognitive activities remain limited, particularly in the Indonesian context. Activities such as puzzles, crossword puzzles, and traditional games are practical, low-cost, and easily implemented in community and primary healthcare settings; however, their relative effectiveness has not been sufficiently explored. Therefore, this study aims to compare the effectiveness of puzzle, crossword puzzle, and dakon as cognitive stimulation interventions on memory function in older adults.

METHOD

Participant characteristics and research design

This study used a quantitative approach with a quasi-experimental design employing a pre-test and post-test model without a control group. The design was intended to assess the effect of cognitive

stimulation programs on the memory function of older adults by comparing MMSE scores before and after the intervention in each group. Participants were older adults aged ≥60 years living in the working areas of the Tanjungsari, Natar, and Hajimena Health Centers in South Lampung Regency. Each group received a different type of cognitive stimulation: puzzles for the first group, crossword puzzles for the second group, and dakon (congklak) for the third group. Dakon (congklak) is a traditional Indonesian game played using a wooden board with small holes and a set of seeds. The game is played by taking all the seeds from one hole on the player's side and dropping them one by one into the following holes in sequence. The player with the most seeds collected in their storage house at the end of the game wins. This game stimulates working memory, concentration, counting ability, and strategic planning. The intervention was conducted over three weeks with six sessions (twice per week, 15-20 minutes per session). This study focused on comparing the effectiveness of these cognitive stimulation methods in improving memory function among older adults.

Sampling procedures

This study uses a quota sampling technique, with each of the three health centers providing 30 respondents, so that the total sample is 90 elderly people. This method was chosen because the elderly population in each region has relatively similar characteristics and is quite large, making it representative for community research. Data collection was carried out at the integrated health service post. Elderly or the meeting room of the health center with the assistance of local health workers. Before implementation, respondents were given an explanation of the objectives, benefits, and procedures of the research, and signed an informed consent as a form of voluntary participation consent.

Sample size, power, and precision

The number of samples in this study is 90 elderly respondents, which was determined through power analysis using G*Power 3.1. With a significance level of $\alpha = 0.05$, a test power of 0.80, and a moderate effect size (0.5), a minimum of 84 respondents were obtained, then increased to 90 to anticipate possible dropouts. All participants who completed the pre-test and post-test were included in the final analysis. No interim analysis or stopping rule was conducted, and the analysis was carried out using an intention-to-treat approach, where all participants were analyzed according to their intervention group.

Measures and covariates

The main instrument of this study was the Mini Mental State Examination (MMSE) by Folstein et al. (1975), which assessed orientation, attention, language, and short-term memory with a score of 0–30 (24–30 normal, 18–23 mild, <18 severe). The Indonesian version of MMSE has a reliability of $\alpha = 0.83$ (Tombaugh & McIntyre, 1992). Cognitive stimulation interventions include puzzles, crossword puzzles, and dakon (congklak) to train various cognitive aspects. Before the intervention, data collection training and trials were carried out on five respondents to ensure clarity and consistency. Dependent variables are the memory function of the elderly, independent of the type of cognitive stimulation, with covariates of age, education, and health status.

Data analysis

Data were analyzed using IBM SPSS Statistics version 25. Before the analysis is carried out, the data is checked for completeness and tested for normality with the Kolmogorov-Smirnov Test. The analysis consisted of two stages, namely univariate analysis to describe respondent characteristics and MMSE scores before and after the intervention, and bivariate analysis using a paired t-test to see differences in MMSE scores within each group and One-way ANOVA to compare effectiveness between groups. If there is a significant difference, a Post Hoc Tukey test is performed. The significance level was set at $p < 0.05$, and the results were presented in the form of a table and a descriptive narrative.

RESULTS AND DISCUSSION

Results

The results of this study present the characteristics of the respondents, the average age and demographic profile of the elderly, the type of cognitive stimulation intervention given, the average score of the MMSE score before and after the intervention, the level of improvement in memory function, and the comparison of the results of cognitive function in the three groups (puzzle, crossword puzzle, and dakon). In addition, the results also illustrate the relationship between the type of cognitive stimulation and the improvement of memory ability in the elderly.

Characteristics of the Participants

Table 1 shows that the age of respondents in the three community health center is relatively similar, with a minimum age of 60–62 years and a maximum age of 72–77 years. The highest average age was found at the Natar Health Center (68.10 ± 4.06), followed by Tanjungsari (66.27 ± 2.85) and Hajimena (65.70 ± 1.42). Overall, the average age of respondents was 66.69 ± 3.94 years, indicating that the majority were in the early elderly category (60–69 years).

Table 1 Characteristics of Respondents by Age

Community Health Center	N	Minimun	Maximum	Mean	SD
Tanjungsari	30	61	72	66.27	2.852
Natar	30	62	77	68.10	4.063
Hajimena	30	60	74	65.70	1.416
Total	90	60	77	66.69	3.937

The results of table 2, the majority of respondents were in the age group of 60-65 years with a percentage of 45.6%. Based on gender, female respondents are the largest group, which is 77.8%. At the education level, the group with low education dominated with a percentage of 53.3%. Meanwhile, based on medical history, respondents who did not have the disease were the largest group, with a percentage of 51.1%.

Table 2 Characteristics of Respondents Based on Age, Gender, Education and Health History

Respondent Characteristics	Tanjungsari	%	Natar	%	Hajimena	%	Total	%
Age								
>70 year	5	16.7	10	33.3	10	33.3	25	27.8
66 – 70 year	13	43.3	9	30.0	2	6.7	24	26.7
60 – 65 year	12	40.0	11	36.7	18	60.0	41	45.6
Total	**30**	100	30	100	30	100	**90**	**100**
Gender								
Man	4	13.3	7	23.3	9	30.0	20	22.2
Woman	26	86.7	23	76.7	21	70.0	70	77.8
Total	**30**	**100**	**30**	**100**	**30**	**100**	**90**	**100**
Education								
No schooling	3	10.0	0	0.0	4	13.3	7	7.8
Low education level	16	53.3	17	56.7	15	50.0	48	53.3
Intermediate education level	9	30.0	11	36.7	11	36.7	31	34.4
High education level	2	6.7	2	6.7	0	0.0	4	4.4
Total	**30**	**100**	**30**	**100**	**30**	**100**	**90**	**100**

Medical History								
Hypertension	7	23.3	25	83.3	7	23.3	39	43.3
DM (Diabetes Mellitus)	1	3.3	3	10.0	1	3.3	5	5.6
No disease	22	73.3	2	6.7	22	73.3	46	51.1
Total	**30**	**100**	**30**	**100**	**30**	**100**	**90**	**100**

Univariate Analysis

The results of table 3 of the descriptive analysis, the average score in the three community health center showed relatively balanced results, namely 24.37 in Tanjungsari, 24.27 in Natar, and 24.17 in Hajimena, with an overall average of 24.27. The range of values ranged from 21 to 27, indicating little variation between respondents. A low standard deviation (1.285–1.416) indicates that the data is fairly homogeneous and consistent. Overall, there are no striking differences between health centers, which means that the level of assessment or performance in all three is relatively the same.

Table 3 Distribution of Elderly Memory Ability Scores Before Giving Cognitive Stimulation

Community Health Center	N	Minimun	Maximum	Mean	SD
Tanjungsari	30	22	27	24.37	1.351
Natar	30	22	26	24.27	1.285
Hajimena	30	21	27	24.17	1.416
Total	90	21	27	24.27	1.339

The results of Table 4 show that after receiving cognitive stimulation, older adults across all community health centers demonstrated relatively good memory scores, with an overall mean of 25.71 ± 1.70. The highest mean memory score was observed in Natar (26.57 ± 1.14), followed by Tanjungsari (25.70 ± 1.60), while Hajimena showed the lowest mean score (24.87 ± 1.87). These findings indicate that cognitive stimulation was associated with improved memory performance across all groups, although variations in mean scores were observed among health centers.

Table 4 Distribution of Elderly Memory Ability Scores after being given Cognitive Stimulation

Community Health Center	N	Minimum	Maximum	Mean	Std
Tanjungsari	30	23	30	25.70	1.601
Natar	30	24	29	26.57	1.135
Hajimena	30	21	28	24.87	1.871
Total	90	21	30	25.71	1.698

Bivariate Analysis

The results of Table 5 show that memory ability scores increased after cognitive stimulation across all intervention groups. In the puzzle group (Tanjungsari), the mean memory score increased from 24.37 ± 1.35 before intervention to 25.70 ± 1.60 after intervention, with a statistically significant difference ($p = 0.002$). In the crossword puzzle group (Natar), the mean score increased from 24.27 ± 1.28 to 26.57 ± 1.13, showing a highly significant improvement ($p < 0.001$). Meanwhile, the dakon group (Hajimena) showed an increase from 24.17 ± 1.41 to 24.87 ± 1.87, which was also statistically significant ($p < 0.001$). These findings indicate that all forms of cognitive stimulation were effective in improving memory function among older adults, with the greatest improvement observed in the crossword puzzle group.

Table 5 Distribution of Respondents Based on Memory Ability Before and After Being Given Cognitive Stimulation with Various

Variabel Memory ability score	Mean	SD	SE	P Value	n
Puzzle (Tanjungsari)					
Before	24.37	1.351	0.247	0.002	30
After	25.70	1.601	0.292		
TTS (Natar)					
Before	24.27	1.285	0.235	0.000	30
After	26.57	1.135	0.206		
Dakon (Hajimena)					
Before	24.17	1.416	0.259	0.000	30
After	24.87	1.871	0.342		
Total					90

The results of Table 6 show that there were significant differences in memory ability scores among older adults who received different types of cognitive stimulation. The ANOVA analysis indicated a statistically significant difference in post-intervention memory scores across the three groups ($p = 0.0005$). The highest mean memory score was observed in the dakon group (26.57 ± 1.35), followed by the crossword puzzle group (25.70 ± 1.60), while the puzzle group showed the lowest mean score (24.87 ± 1.87). These findings suggest that the type of cognitive stimulation provided significantly influenced memory performance among older adults.

Table 6 Anova's Analysis Results on the Memory Ability of the Elderly After Being Given Cognitive Stimulation with Puzzle Cognitive Stimulation, Crossword Puzzles and Dakon

Variabel Stimulation	N	Mean	SD	95%	P Value
Puzzle (Tanjungsari)	30	24.87	1.871	24.17-25.57	0.0005
Crossword Puzzle (Natar)	30	25.70	1.601	25.10-26.30	
Dakon (Hajimena)	30	26.57	1.135	26.14-26.99	
Total	90	25.71	1.698	25.36-26.07	

DISCUSSION

Respondent Characteristics

The results showed that the majority of respondents were at the age of 60–65 years, which is the early phase of the elderly when a decline in cognitive function begins to appear, although not as severe as at the age of >70 years. Research (Giedre et al., 2023) states that memory degenerative processes begin to appear from the age of 60, especially in short-term memory and working memory, so cognitive stimulation interventions in this phase become more effective in preventing memory impairment. By gender, most of the respondents were female (77.8%). This is in line with (Mielke & Clinic, 2019) that women have a life expectancy 4-6 years longer than men, so they are more at risk of cognitive degeneration. Research by (Motlani et al., 2023) also confirms that a decrease in the postmenopausal hormone estrogen increases women's susceptibility to decreased memory function. This condition strengthens the urgency of cognitive stimulation in elderly women. In terms of education, the majority of respondents were low-educated (elementary-junior high) at 53.3%.

According to research (Kim et al., 2024) low education is associated with more limited cognitive reserves, thereby increasing susceptibility to memory impairment. Research (Erlianti & Trihandini, 2022) also shows that poorly educated seniors have lower memory scores compared to those with secondary and higher education, making this group a priority for cognitive interventions. Regarding health conditions, most of the respondents experienced hypertension (43.3%), which is known to be

a risk factor for memory impairment and dementia. Chronic high blood pressure can damage the vascular brain and interfere with hippocampus function. In accordance with (Badhiwala et al., 2018) found that the elderly with uncontrolled hypertension experienced memory decline 1.5 times faster than the normotensive elderly.

Overall, the characteristics of respondents' age, gender, education, and health conditions suggest that cognitive stimulation programs are highly relevant and necessary. These findings are in line with (Halma et al., 2024) who report that interventions such as brain exercise, reminiscence therapy, and brain exercises have been shown to be effective in improving memory function in the elderly with chronic risk factors.

Elderly Memory Ability Score Before Being Given Cognitive Stimulation

The results of this study show that the average memory ability score of the elderly in the working area of the Tanjungsari Health Center, Natar Health Center, and Hajimena Health Center is 24. Based on the Mini Mental State Examination (MMSE) instrument, a score of 24 is included in the normal borderline category, which is at the upper limit of mild cognitive impairment (22-24). In the MMSE category, a value of 24 can be considered reasonable, especially in the elderly with a low level of education, but it can indicate a decline in cognitive function when found in individuals with secondary or higher education.

These findings are in line with the characteristics of the study respondents who mostly have an elementary and junior high school education level. According to (Malanchini et al., 2021), intellectual and educational levels from childhood have a strong influence on cognitive abilities in old age. Individuals with low education tend to have lower MMSE scores, even in the absence of neurological pathologies. This is understood through the concept of cognitive reserve, where education plays a protective role against the decline of cognitive function. A recent study by (P. Liu et al., 2024) shows that low education increases the vulnerability of the elderly to memory impairment through weak cognitive reserves. Similarly, (Almeida, 2025) states that low formal education reduces the brain's capacity to compensate for structural changes due to aging.

Memory impairment in the elderly can be classified into two types, namely *age-associated memory impairment* and pathological memory impairment, such as dementia. Age-related memory decline is a common physiological process in the elderly and does not always lead to Alzheimer's disease. The latest literature from *Nature Aging* (2023) confirms that mild cognitive impairment (MCI) is a transitional phase that can be stable in the long term and does not always progress to dementia. However, various biological changes still occur with age, such as a decrease in the number of active neurons, decreased levels of the neurotransmitter acetylcholine, disruption in synaptic transmission, and the accumulation of beta-amyloid and tau proteins. Research by (Dahan et al., 2020) explains that early neurodegenerative processes, such as hippocampal atrophy and synaptic dysfunction, are important markers of memory decline in the elderly.

A recent journal by (He et al., 2025) also showed that these structural changes in the brain play a major role in the decline in the ability to form, store, and retrieve memory in the elderly group. In addition to education and the aging process, health conditions such as hypertension play a major role in influencing the memory scores of the elderly. In this study, most of the respondents were known to have a history of hypertension. (Dégano et al., 2017) stated that hypertension, diabetes, lack of physical activity, and low education are strong risk factors for cognitive decline. A recent study by (F. Liu & Lu, 2024) shows that hypertension contributes to memory impairment through increased serum methylmalonic acid (sMMA) levels that cause brain vascular damage and decrease cerebral perfusion.

Physiologically, hypertension can interfere with cognitive function through several key mechanisms. First, damage to brain blood vessels such as atherosclerosis reduces the supply of oxygen to brain tissue, causing chronic ischemia. Second, hypertension triggers inflammation and endothelial dysfunction that causes disruption of the regulation of brain blood flow. Third, hypertension increases the accumulation of beta-amyloid proteins, accelerating neurodegenerative processes associated with Alzheimer's. Fourth, hypertension causes disruption of the brain's blood flow autoregulation mechanism so that the supply of oxygen and nutrients to neurons becomes suboptimal. (Gallo et al., 2022) assert that a combination of vascular damage, inflammation, and endothelial dysfunction is the main cause of memory decline in the elderly with hypertension.

These findings are reinforced by recent research from (Hay, 2020) which states that chronic hypertension accelerates brain aging and increases the risk of mild cognitive impairment by up to threefold. Seniors with hypertension have a higher risk of decreased memory and executive function than seniors with normal blood pressure. Overall, the average MMSE score of 24 in this study reflects a combination of low education levels, physiological aging processes, and chronic health conditions such as hypertension that synergistically contribute to decreased memory function. Although this score is still in the normal borderline category, these results indicate early signs of cognitive decline that need attention, especially through cognitive stimulation interventions, hypertension management, and health education for the elderly and their families.

Memory Ability Score of the Elderly After Cognitive Stimulation

The results showed an increase in the average memory ability score of the elderly after being given cognitive stimulation using Puzzle, Crossword Puzzle (TTS), and Dakon. In the elderly at the Tanjungsari Health Center who received the Puzzle, the score increase reached 1.33 points; at the Natar Health Center with TTS of 2.3 points; and at the Hajimena Health Center with Dakon by 0.7 points. The t-dependent test showed that all of these media provided a significant improvement ($\alpha < 0.05$), indicating that both traditional and modern games are equally effective at improving memory.

ANOVA's results showed that the combination of Puzzle and Dakon provided the most significant improvement because they stimulated various cognitive domains: Puzzle on visual-spatial, attention, and problem solving, while Dakon on coordination, short-term memory, and concentration. These findings are in line with the theory of neuroplasticity, where challenging cognitive activity is able to increase synaptic connections and slow brain degeneration (Gazerani, 2025). This study is consistent with the findings (Zhang et al., 2023) that puzzles improve short- and long-term memory, as well as (Siregar et al., 2024) that demonstrate the effectiveness of Dakon in improving short- and long-term memory. International studies also support these results. (Wesnes et al., 2019) explained that problem-solving activities such as TTS and puzzles improve working memory. Research by (Nirmala et al., 2021) reported that TTS increased MMSE scores by 2.1 points, and (Wahyuningsih, 2024) found that traditional puzzles improve concentration and short-term memory. Memory improvement is also influenced by emotional and social aspects. Play activities induce a sense of pleasure and relaxation, which helps to lower stress and increase the release of dopamine, thereby strengthening memory processes (Dobbins et al., 2020).

Thus, cognitive stimulation using Puzzle, TTS, and Dakon both individually and in combination has proven to be effective as a non-pharmacological intervention that is cheap, easy to apply, and has a positive impact on the maintenance of brain health in the elderly. This activity is worthy of being used as a routine program at health centers or community health post for the elderly to slow down cognitive decline and improve the quality of life of the elderly.

LIMITATION OF THE STUDY

This study has limitations due to the small number of samples, short intervention times, and external factors such as diet and sleep that are not fully controlled. In addition, the measurement instruments used are still limited so the results cannot be generalized widely.

CONCLUSIONS AND SUGGESTIONS

This study shows that cognitive stimulation using Puzzle, Crossword Puzzle, and Dakon significantly improves memory function in the elderly. These simple, low-cost, culturally based interventions effectively support brain health and prevent cognitive decline. They are recommended to be implemented routinely in primary healthcare and community elderly programs. Further studies with larger samples and additional variables are needed to deepen the understanding of cognitive stimulation mechanisms.

Ethical Considerations

This research has obtained a Certificate of Ethical Feasibility No. 456/KEPK-TJK/VIII/2025 from the Health Research Ethics Committee of the Tanjungkarang Ministry of Health. The research was declared ethically feasible based on seven WHO ethical standards (2011), namely: (1) Social Value, (2) Scientific Validity, (3) Fairness in Burden and Benefit Sharing, (4) Risk Assessment, (5) Protection from Persuasion or Exploitation, (6) Confidentiality and Privacy, and (7) Informed Consent, in accordance with the CIOMS 2016 Guidelines.

Conflict of Interest

The authors declare that there are no conflicts of interest in this study.

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