

# Research about the Relation Between Cognitive Function, Language Skills, and Constructional Functions in Elderly with Cognitive Disorders through CERAD-K

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## Abstract

**Background/Objectives:** This study used the CERAD-K to investigate the relationships among the cognitive, verbal, and constructional functions in elderly patients with cognitive impairments. **Methods/Statistical Analysis:** The subjects in this study were 155 community-dwelling elderly who were registered at the community clinic in the C region. These subjects consisted of 108 with mild cognitive impairments and 47 with Alzheimer's disease. We used the Korean Version of the Consortium to Establish a Registry of Alzheimer's Disease (CERAD-K). The data that were collected in this study were analyzed with SPSS 21.1. **Findings:** In both elderly patients with mild cognitive impairment and patients with Alzheimer's disease, cognitive function correlated significantly with all verbal and constructional functions, and the verbal and constructional functions decreased as cognitive function decreased. For the elderly patients with mild cognitive impairments, Verbal Fluency ( $\beta = 0.218$ ,  $p = 0.005$ ) and Word List Recognition ( $\beta = 0.223$ ,  $p = 0.011$ ) were the factors with significant influence, and they had a 65.7% explanatory power for cognitive function. In the elderly patients with Alzheimer's disease, Praxis Delayed Recall was a factor with significant influence, and it had a 69.2% explanatory power for cognitive function. **Application/Improvements:** The cognitive rehabilitation treatment of elderly patients with mild cognitive impairments requires a multidisciplinary approach that includes treating the verbal and constructional functions.

**Keywords:** CERAD-K, Cognitive Function, Constructional Function, Elderly, Verbal Function

## 1. Introduction

### 1.1 The necessity for Research

Due to improvements in living standards such as improved eating habits and development of medicine, the average lifespan in Korea is continually increasing<sup>1</sup>. At the same time birthrates decreased and the ratio of elderly population over the age of 65 is 12.9% which means that already is on the brink of aging society and it is predicted that the ratio will reach 25% in 2026 to reach a super aged society<sup>2</sup>.

The increase of elderly population can cause various problems spanning the whole society over the dimension

of simple population increase of single age range. The most serious problem among problems that result from the aging process is the decrease of cognitive function. This causes maladaptation to life and problematic behavior and due to this, independent living skills markedly decrease and it requires nursing or care from the surroundings<sup>2,3</sup>. Dementia is an age related disease associated with loss of cognitive functions<sup>4</sup>. Although prevalence of dementia which is the representative disease of cognitive dysfunction differs by type and region, it affected 8.7% of elderly over the age of 65 in 2010, 9.7% in 2015, and it is predicted that in 2050 it will increase to 15%<sup>3</sup>. Due to the increase of the duration of illness the

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seriousness of dementia is increasing as time passes but the reality is that mostly approaches are being done in the aspect of management rather than treatment of causes.

Mild cognitive impairment which is being emphasized for its importance due to it being a preclinical symptom of dementia is a state where decrease of cognitive function and memory are observed but is not accompanied by decrease of activities of daily living. It is distinguished from normal aging and it is known as a preclinical stage that transitions into dementia<sup>5,6</sup>. Because for some mild cognitive impairment it is related to damages to the medial temporal lobe it appears that language cognitive function is more specifically damaged than visuospatial cognitive function, but for Alzheimer's dementia, damage to the visuospatial cognitive function is more emphasized than the damage to the language cognitive function<sup>7,8</sup>.

Morris<sup>8</sup> used number memorization and word span on normal seniors and Alzheimer's dementia seniors to compare performance ability of visuospatial working memory and language working memory, and although visuospatial working memory had significant differences, language memory did not show differences between groups. Based on this result, the researcher emphasized that for Alzheimer's dementia it is a problem in the process of converting short-term language memory into long-term language memory and that relatively visuospatial memory loss was a characteristic memory loss of Alzheimer's dementia. Johnson, Storant, Morris &, Galvin<sup>9</sup> reported a study result stating that prodromal symptoms of Alzheimer's dementia decrease in the order of visuospatial skill, overall cognitive level, language memory, and working memory and reported that visuospatial skill was three years and that language memory and working memory were both each 1 year.

Like above it can be seen that according to the state of cognitive function there can be significant differences between language function and spatial function among cognitive functions, and there is need to reflect the characteristics of these cognitive functions in treatment and nursing.

For this the study tries to figure out the relation between cognitive function, language skills, and constructional functions in elderly with mild cognitive impairment and elderly with dementia.

Maintaining independent activities to maintain successful aging and quality-of-life is very important and can be said that preventing and managing decrease

of cognitive function is essential. This study that tries to figure out the relation between cognitive function, language skills, and constructional functions according to the state of cognitive function will be able to increase the understanding of elderly with cognitive disorders as well as provide basic data for development of an appropriate nursing intervention program.

## 1.2 Purpose of Study

Purpose of this study was to figure out the relation between cognitive function, language skills, and constructional functions of elderly with mild cognitive impairment and elderly with Alzheimer's provide useful data that helps in cognitive rehabilitation of elderly with mild cognitive impairment and elderly with Alzheimer's, and the detailed purposes are as follows.

- Figure out the general characteristics of the subjects.
- Figure out the correlation between the subjects' cognitive function, language skills, and constructional functions.
- Figure out the level of influence of language skills and constructional functions of the subjects on their cognitive function.

## 2. Study Method

### 2.1 Study Design

The study is a descriptive correlational research study to figure out the relation between cognitive function, language skills, and constructional functions and level of influence of language skills and constructional function on cognitive function in elderly with mild cognitive impairment and elderly with Alzheimer's.

### 2.2 Study Subject

The subjects of this study were 155 elderly people in the local community composed of 108 elderly with mild cognitive impairment and 47 elderly with Alzheimer's registered at a public health center in C region. The diagnosis for mild cognitive impairment and Alzheimer's were done by psychiatric specialists. After explaining to the subjects and guardians about the purpose, anonymity, non-risk, that the participation in the study is done voluntarily, that they can always draw when they want to, that responses are confidential, and that the responses will be only used for the purpose of study, the survey was

conducted when they agreed to the participation in the study. The survey was done in a way where the research assistant reads the survey and the subject responds. For subjects that completed the survey, a specified gratuity was provided.

### 2.3 Study Tools

CERAD-K (The Korean Version of Consortium to Establish a Registry of Alzheimer's disease) - The study used a neuropsychological assessment tool developed by Morris, Heyman, Mohs, Hughes, Van Belle, & Fillenbaum et. al.<sup>10</sup> for dementia diagnosis which was standardized in Korean by Lee, Lee, Lee, Kim, Jhoo & Lee et. al.<sup>11</sup>

CERAD-K is composed of nine subtests verbal fluency test, Boston Naming Test, Mini mental status examination (MMSE-KC), word list memory, constructional praxis, word list delayed recall, word list recognition, praxis delayed recall, and Trail Making Test A, B and the study used eight subtests excluding the Trail Making Test.

Among the eight subtests of CERAD-K, cognitive function was defined by MMSE-KC, language skills was defined by verbal fluency, Boston Naming Test, word list recall, word list delayed recall, and word list recognition, and constructional function was defined by constructional praxis and praxis delayed recall.

The reliability during test-retest of CERAD-K was found to be 0.63-0.87<sup>12</sup>.

### 2.4 Analysis Method

The data collected in this study was analyzed using SPSS 21.1.

- Descriptive statistics were used for general characteristics of subjects.
- Pearson's correlation coefficient was used for relation between cognitive function, language skills, and constructional function of subjects
- Hierarchical multiple regression was used for the level of influence on cognitive function by language skills and constructional function of subjects.

## 3. Study Results

### 3.1 General Characteristics of Subjects

The average age of elderly with mild cognitive impairment was 73.7 and there were more women with 79 (73.1%) people. 64 (59.3%) were married. 94 (87.0%) which was the majority had under six years of education and the average was 3.8 years. The average age of elderly with moderate to severe cognitive impairment was 80.5 and there were more women with 27 (57.4%) people. 24 (51.0%) were married and 37 (70.7%) which was the majority had under six years of education (Table 1).

### 3.2 Level of Cognitive Function, Language Skills, and Constructional Functions

MMSE-KC was 19.9 (4.29), Verbal Fluency was 8.5 (2.77), Boston Naming Test was 6.8 (3.01), Word List Recall was 8.5 (3.89), Word List Delayed Recall was 2.5 (1.68), Word list Recognition was 5.8(3.23), Constructional Praxis was 6.6(1.68), and Praxis Delayed Recall was 3.4 (2.54) for elderly with mild cognitive impairment and it was higher than 14.7 (6.07), 5.3 (2.60), 4.9 (2.47), 3.1 (3.43), 1.23

**Table 1.** General Characteristics of Subjects

Variables	Category	N(%)		M(SD)	
		Elderly with Mild Cognitive Impairment(N=108)	Elderly with Alzheimer's Disease (N=47)	Elderly with Mild Cognitive Impairment (N=108)	Elderly with Alzheimer's Disease (N=47)
Age(year)	≤70	30(27.8)	3(6.4)	73.4(6.21)	80.5(6.19)
	71-80	67(62.0)	17(36.2)		
	81≤	11(10.2)	27(57.4)		
Sex	Male	29(26.9)	20(42.6)		
	Female	79(73.1)	27(57.4)		
Marital Status	Married	64(59.3)	24(51.0)		
	Single	44(40.7)	23(49.0)		
Education (year)	≤6	94(87.0)	37(78.7)	3.8(3.88)	4.1(4.53)
	7-9	6(5.5)	9(19.2)		
	10≤	8(7.4)	1(2.1)		

(1.61), 5.2 (3.88), 5.6 (3.13), and 1.2 (1.88) of elderly with Alzheimer's (Table 2).

**Table 2.** Cognitive Function, Verbal Function, Constructional Function of Subjects

	M(SD)	
	Elderly with Mild Cognitive Impairment (N=108)	Elderly with Alzheimer's Disease (N=47)
MMSE-KC	19.9(4.29)	14.7(6.07)
Verbal Fluency	8.5(2.77)	5.3(2.60)
Boston Naming Test	6.8(3.01)	4.9(2.47)
Word List Recall	8.5(3.89)	3.1(3.43)
Word List Delayed Recall	2.5(1.68)	1.23(1.61)
Word list Recognition	5.8(3.23)	5.2(3.88)
Constructional Praxis	6.6(1.68)	5.6(3.13)
Praxis Delayed Recall	3.4(2.54)	1.2(1.88)

### 3.3 Correlation between Cognitive Function, Language Skills, and Constructional Function

The cognitive function and all language skills and constructional functions of elderly with mild cognitive impairment showed significant correlation and it was found that with the decrease of cognitive function,

language skills and constructional function also decreased. Especially among these, it was  $r=.57(p=.000)$  with word list recognition and  $r=.52(p=.000)$  with constructional praxis.

The cognitive function and all language skills and constructional functions of elderly with Alzheimer's also showed significant correlation and it was found that with the decrease of cognitive function, language skills and constructional function also decreased. Especially among these, it was  $r=.79(p=.000)$  with word list recall and  $r=.81(p=.000)$  with praxis delayed recall.

There were no significant correlations between Boston Naming Test, word list recognition, praxis delayed recall, constructional praxis, word list delayed recall, and word list recognition in elderly with Alzheimer's (Table 3).

### 3.4 Influencing Factors of Cognitive Function

To confirm the influencing factors of cognitive function in elderly with mild cognitive impairment and elderly with Alzheimer's, simple regression analysis was conducted with cognitive function as a dependent variable. Durbin-Watson statistic that show autocorrelation of the error (independence of the residuals) were 1.9 and 1.8 which was relatively close to 2 which meant there was no problems in autocorrelation of the error term and independence of

**Table 3.** Correlation among Cognitive Function, Verbal Function, Constructional Function

		1r(p)	2r(p)	3r(p)	4r(p)	5r(p)	6r(p)	7r(p)	8r(p)
	MMSE-KC <sup>1)</sup>	1							
	Verbal Fluency <sup>2)</sup>	.50**	1						
		(<.001)							
Elderly with Mild Cognitive Impairment	Boston Naming Test <sup>3)</sup>	.44**(<.001)	.36**(<.001)	1					
	Word List Recall <sup>4)</sup>	.54**(<.001)	.45**(<.001)	.51**(<.001)	1				
	Word List Delayed Recall <sup>5)</sup>	.49**(<.001)	.37**(<.001)	.31**(.001)	.61**(<.001)	1			
	Word list Recognition <sup>6)</sup>	.57**(<.001)	.41**(<.001)	.36**(<.001)	.50**(<.001)	.56**(<.001)	1		
	Constructional Praxis <sup>7)</sup>	.52**(<.001)	.21*(.029)	.43**(<.001)	.53**(<.001)	.40**(<.001)	.42**(<.001)	1	
	Praxis Delayed Recall <sup>8)</sup>	.43**(<.001)	.24*(.011)	.39**(<.001)	.46**(<.001)	.45**(<.001)	.50**(<.001)	.48**(<.001)	1
	MMSE-KC <sup>1)</sup>	1							
	Verbal Fluency <sup>2)</sup>	.52**(<.001)	1						
	Boston Naming Test <sup>3)</sup>	.57**(<.001)	.46**(.001)	1					
Elderly with Alzheimer's Disease	Word List Recall <sup>4)</sup>	.79**(<.001)	.53**(<.001)	.61**(<.001)	1				
	Word List Delayed Recall <sup>5)</sup>	.52**(<.001)	.47**(.001)	.37*(.010)	.56**(<.001)	1			
	Word list Recognition <sup>6)</sup>	.55**(<.001)	.45**(.001)	.26(.077)	.54**(<.001)	.61**(<.001)	1		
	Constructional Praxis <sup>7)</sup>	.56**(<.001)	.30*(.036)	.46*(.001)	.58**(<.001)	.13(.358)	.24(.094)	1	
	Praxis Delayed Recall <sup>8)</sup>	.59**(<.001)	.29*(.044)	.26(.070)	.53**(<.001)	.52**(<.001)	.41*(.004)	.33*(.023)	1

\*p<.005, \*\*p<.001

the residuals was confirmed. Tolerance limits were .34-.72 and .23-.66 which was over 0.1 and variance inflation factor all did not exceed 10 with 1.37-2.93 and 1.50-4.24 and there were no problems of multicollinearity between independent variables.

For elderly with mild cognitive impairment Verbal Fluency ( $\beta=.218$ ,  $p=.005$ ) and Word list Recognition ( $\beta=.223$ ,  $p=.011$ ) where significant influencing factors in these were found to have explanatory power of 65.7% on cognitive function. For elderly with Alzheimer's it was found that praxis delayed recall was a significant influencing factor and this was found to have explanatory power of 69.2% on cognitive function (Table 4).

**Table 4.** Influencing Factors of Depression

Variables		$\beta$	P	Adj.R <sup>2</sup>	F(p)
Elderly with Mild Cognitive Impairment (N=108)	Verbal Fluency	.218	.005	.657	16.21** ( $<.001$ )
	Word list Recognition	.223	.011		
Elderly with Alzheimer's Disease (N=47)	Praxis Delayed Recall	.420	.042	.692	10.40** ( $<.001$ )

\*\* $p<.001$

## 4. Conclusion

This study was attempted for the purpose of figuring out the relation between cognitive function, language skills, and constructional function of elderly with mild cognitive impairment using CERAD-K to provide basic data to help treatment and nursing of elderly with cognitive disorders.

Most studies about cognitive function of elderly are intervention studies or research studies that focus on the entire cognitive function and there are only few studies that focus on parts of cognitive function such as language or construction.

According to the study by Byeon<sup>13</sup>, drinking habits of the elderly was a significant influencing factor in language memory, it had no significant influence on visuospatial memory. This signifies that when brain function decreases with age or adverse lifestyle habits, not all of the brain function decreased together but that parts of it can decrease relatively quickly and that language memory and visuospatial memory did not decrease together and that language memory decreased further by being influenced more. The study by Johnson

et. al.<sup>9</sup> on 444 elderly showed that language cognition skill decreased in shorter time compared to visuospatial cognitive skill. Also in the study by Lee, Ahn, Oh, Kim, Lee & Oh et. al.<sup>14</sup> there were no significant differences in visuospatial perception abilities between elderly with mild cognitive impairment and elderly with dementia but there were significant differences in language skills. Also in this study language cognitive function was found to be a significant influencing factor over spatial cognitive function in cognitive function of elderly with mild cognitive impairment and spatial cognitive function was found to be a significant influencing factor over language cognitive function in cognitive function of elderly with dementia which is determined to have significant relation with this. Therefore, decrease of language cognitive function is a symptom that can occur at the primary stage of cognitive function to occur in all elderly with cognitive disorders but because spatial cognitive function decreased is a symptom that can occur at the later stage of cognitive disorder, it can be estimated that overall cognitive function decreases with decrease of spatial cognitive function.

Devanand, Folz, Gorlyn, Moeller & Stern<sup>15</sup> mentioned verbal fluency and Boston Naming Test as predictive factors that predict transitioning into dementia from suspected dementia group among language skills. In this study there were relatively large differences between elderly with mild cognitive impairment and elderly with dementia in verbal fluency, Boston Naming Test, and word list recall. Especially there was large difference in word list recall and this is similar to the study results by Filley, Heaton & Nelson<sup>16</sup> which mentioned that reading and writing among language skills is maintained until later but that understanding of written or spoken language decrease in the primary stages. Word list recall is a test of memorization of 10 printed words after presentation of the words. Is a test that requires more understanding of written and spoken language compared to verbal fluency where words randomly thought of and heard are spoken. Therefore there is need to refer to this when nursing elderly with cognitive dysfunction.

According to the study by Park & Lee<sup>17</sup>, you spatial function decreased with decrease of cognitive function. This matches the results of this study and that means that not only language skills but visuospatial functions should be importantly evaluated and adjusted in evaluation of cognitive function and intervention programs. However, because there are factors that influence cognitive function

such as level of education and age, there needs to be consideration about these<sup>18</sup>.

This study was a study of relation between language cognitive function, spatial cognitive function, and cognitive function in elderly with mild cognitive impairment and elderly with dementia. Recall program using newspapers by Lee, Kang & Sohn<sup>19</sup> influenced language comprehension in elderly with Alzheimer's dementia and through improvement in cognitive function it activated memory function and language comprehension. Also the study by Shin<sup>20</sup> suggested game contents using PC considering color and musical elements so that it would be easily approachable by the elderly and through this the predicted improvement in spatial cognitive function. As above, although there aren't many, there are a few intervention researches to improve parts of cognitive function. Results of this study will aid in preparing these cognitive function improvement programs. It is thought that in future studies there should be research that deals with relation with more parts of cognitive function, research about the influencing factors, and researches dealing with more subjects.

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