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Effects of Cognitive Enhancement Program based on Workbook for Sustained Attention and Working Memory in The Elderly with Mild Cognitive Impairment

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Abstract

Background/Objectives: This study was to investigate how general cognitive program and workbook cognitive programs were applied to the elderly with mild cognitive impairment, respectively, to find out how they help the subject's sustained attention and working memory.

Methods/Statistical analysis: To investigate the effect of program for 13 elderly of mild cognitive impairment, this study was classified into two group which in experime ntal and control group. The evaluation tool were such as digit span forward test, digit span backward test, digit substitution symbol test and attention questionnaire scale was used.

Findings: As a result of the study, there was a statistical difference in sustained attention and working memory after intervention within two groups ($p<0.05$), but there was no significant difference in sustained attention and working memory after intervention between two groups ($p>0.05$).

Improvements/Applications: Based on these results, the workbook cognitive program and general cognitive program can be utilized in consideration of the local community environment of the elderly of mild cognitive impairment and the characteristics on the individual of mild cognitive impairment, and through this, the cognitive function of the elderly can be improved.

***Keywords*:** Mild cognitive impairment, Elderly, Workbook cognitive program, Sustained attention, Working memory

1. Introduction

The development of medical technology is increasing the elderly population. The rapid increment in the elderly population caused by this negatively affects the functional activity of the aged population by increasing the decline in cognitive function caused by degenerative diseases of central nerve system such as Alzheimer's disease as well as the decline in physical function[1]. Dementia in the elderly affects not only memory but also the overall cognitive abilities of humans such as attention span, language, spatiotemporal ability, and judgment[2]. Treatment of dementia through drugs has limitations in improving of the cognition in elderly with dementia, so it is important to prevent dementia, early detection, and to suppress cognitive deterioration through active intervention following the initial diagnosis[3]. Mild cognitive impairment (MCI), a disease associated with dementia, is a high risk with a high rate of developing into dementia in the future, with reduced attention and memory compared to the same elder age group. To prevent dementia, various programs that detect MCI for early and prevent it from developing into dementia are required. Attention can be explained as one of the basic cognitive functions required for normal task performance[4]. Attention is classified into sustained attention, selective attention, divided attention. Among them, sustained attention explain that ability to maintain

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concentration activity for a certain period of time, and is an important process for learning or remembering new knowledge. In a comparative study between MCI and normal person through a computerized neurocognitive function test, it was confirmed that there was a difference in sustained attention and selective attention. In addition, MCI appears as a major feature of memory decline[5]. In particular, it is characterized by impairment of working memory, which stores and manipulates information for a short period of time[6]. This impairment of working memory plays an important role in daily life as it is difficult to find objects in the house or to perform complex daily activities[7]. The importance of prevention of dementia and intervention of MCI due to the increase of the elderly population is increasing. In addition, in order to prevent dementia and improve MCI, development of a program that can be easily applied to cognitive rehabilitation with minimal help is required. And one of the programs applied to patients with dementia and MCI is the workbook cognitive program. Compared to other programs, it is easy to purchase, easy to use, and can be useful at home. The workbook cognitive program can be used for the purpose of improving memory and attention span through the use of objects, tasks for waiting for names, and organized problems. In previous studies, it was reported that it is helpful in improving the subject's attention span, but has limitations in improving memory[8]. And while the workbook cognitive program focuses on improving complex cognitive functions, it has limitations in improving the activities of daily living in the subject through workbooks cognitive program[9,10, 17-26]. Therefore, this study aimed to find out how it can help improve cognitive functions such as sustained attention and working memory by using workbooks cognitive program by level. Through this program, I would like to present a basis for an effective workbook approach for MCI level and characteristics of MCI.

2. Materials and Methods

2.1. *Subjects*

This study was conducted for the 13 elderly with MCI over 65 years old. First, Korean version mini-mental state examination (K-MMSE) was used to select subjects and to proceed with a workbook cognitive program, and selected subjects who agreed to the study.

2.2. *Methods*

To investigate the effect of the workbook cognition program, it was classified into two group which in experimental (n=7) and control group (n=6). A workbook cognitive program was conducted, and control group applied general cognitive programs. Digit span test (DST) digit substitution symbol test (DSST), and attention questionnaire scale (AQS) were used to investigate changes in work memory and attention span of study in subjects. The digit span test (DST) can measure working memory and consists of a digit span forward test (DSFT) and a digit span backward test (DSBT) [11]. DSFT is a test that memorizes the numbers presented aurally according to the order presented, starting with a new number, and DSBT is a test that memorizes the numbers presented aurally in reverse, starting with two numbers. DSST is an assessment that can distinguish between the elderly with MCI and the elderly with Alzheimer's dementia. It measures executive function, working memory, temporal spatial processing skills, and sustained attention[12]. AQS is a questionnaire that provides information on the subject's sustained attention by categorizing the types of attention. This study was conducted in the form of self-report. In both groups, a cognitive program was conducted 3 times a week, 12 sessions for a total of 4 weeks, and 50 minutes per session, and evaluations were conducted before and after the intervention.

2.3. *Statistical analysis*

Analysis was performed SPSS 21.0 Window version. Among the general characteristics of the study subjects, age, K-MMSE, DSFT, DSBT, DSST, and AQS mean values and standard deviation were used for descriptive statistics and gender and education were used for frequency analysis. All analyzes used a nonparametric test. The comparison of sustained attention and working memory on pretest and posttest within two groups uses the Wilcoxon signed rank test of the nonparametric test, and the comparison on the difference of working memory and sustained attention between two groups is Mann-Whitney U test of the nonparametric test. The statistical significance level is $\alpha = 0.05$.

3. Results and Discussion

3.1. *Results*

3.1.1. General characteristics of subjects

As shown in Table 1, the gender of all subjects in this study was 5 males, 6 females and the average age was 77.92. The K-MMSE as screening test for cognitive function was 21.08±1.38. In the experimental group, the gender was 3 males, 4 females, and the average age was 78.00. And K-MMSE was 21.43±1.27. Finally, the gender of the control group was 2 males, 4 females, and the average age was 77.83. K-MMSE was 20.67±1.50 [Table 1].

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Table 1 General characteristics of participants

Variable		TG (n=13)	EG (n=7)	CG (n=6)
Age (point)		77.92±4.01	78.00±3.32	77.83±5.03
Gender	Male	5(33.3)	3(42.9)	2(42.9)
	Female	8(66.7)	4(57.1)	4(57.1)
K-MMSE (point)		21.08±1.38	21.43±1.27	20.67±1.50

M ± SD: mean ± standard deviation, TG: total group, EG; experimental group, CG; control group, K-MMSE; korean version mini mental state examination

3.1.2. Difference of sustained attention and working memory within two groups

3.1.2.1. Difference of sustained attention and working memory in EG

As shown in Table 2, DSFT and DSBT, a detailed item of DST examined to examine the working memory of experimental group, was 3.71 ± 1.50 after 2.00 ± 0.58 before intervention, and 1.86 ± 1.21 before intervention and 3.57 ± 1.13 after intervention. In the DSST, which was examined to investigate attention span, there was a statistically significant difference in all items($p<0.05$), even 44.35 ± 6.02 before intervention, 51.32 ± 5.42 after intervention, and 18.14 ± 1.17 before intervention and 22.71 ± 3.87 before intervention in AQS ($p<0.05$) [Table 2].

Table 2. Comparison of the sustained attention and working memory in EG

Variable		EG (n=7)		Z	p
		pre-test	post-test		
DST	DSFT	2.00±0.58	3.71±1.50	-2.226	0.03*
	DSBT	1.86±1.21	3.57±1.13	-2.264	0.02*
DSST		44.35±6.02	51.32±5.42	-2.366	0.02*
AQS		18.14±1.17	22.71±3.87	-2.414	0.02*

$p^* < 0.05$, M ± SD = mean ± standard deviation, EG; experimental group, CG; control group, DST; digit span test, DSFT; digit span forward test, DSBT; digit span backward test, DSST; digit symbol substitution test, AQS; attention questionnaire scale

3.1.2.2. Difference between working memory and attention span in CG

As shown in Table 3, Among the detailed items of DST examined to examine the working memory of the control group, DSFT was 2.67±0.16 before intervention, 5.33 ± 0.82 after intervention, and DSBT was 2.00±0.63 before intervention and 3.50±1.22 after intervention, and both DSFT and DSBT were statistically significant difference. There was no difference ($p>0.05$). In the DSST examined for persistence, there was no statistically significant difference between 41.26±4.85 before intervention and 48.65±2.76 after intervention, and statistically significant difference from AQS to 14.83±1.17 before intervention and 17.83± 3.66 after intervention. there was statistically significant difference ($p <0.05$) [Table 3].

Table 3. Comparison of the sustained attention and working memory in CG

Variable		CG (n=6)		Z	p
		pre-test	post-test		
DST	DSFT	2.67±0.16	5.33±0.82	-2.226	0.03*
	DSBT	2.00±0.63	3.50±1.22	-2.264	0.02*
DSST		41.26±4.85	48.65±2.76	-2.201	0.03*
AQS		14.83±1.17	17.83±3.66	-2.232	0.03*

$p^* < 0.05$, M ± SD = mean ± standard deviation, CG; control group, , DST; digit span test, DSFT: digit span forward test, DSBT; digit span backward test, DSST; digit symbol substitution test, AQS; attention questionnaire scale

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3.1.3. Comparison of working memory and sustained attention between two groups

3.1.3.1. Comparison of working memory between two groups

As shown in Table 4, The DSFT and DSBT of DST, which was examined to examine working memory between the two group, were 1.71 ± 1.38 and 1.71 ± 0.95 in EG, and CG was 2.67 ± 1.03 and 1.50 ± 0.84. And there was no significant difference (p>0.05) [Table 4].

Table 4. Comparison of the working memory between two groups

Variable		EG (n=7)	CG (n=6)	Z	p
DST	DSFT	1.71±1.38	2.67±1.03	-1.326	0.16
	DSBT	1.71±0.95	1.50±0.84	-0.682	0.50

M±SD: mean±standard deviation, EG: experimental group, CG: control group, DST: digit span test, DSFT: digit span forward test, DSBT: digit span backward test

3.1.3.2. Comparison of sustained attention between EG and CG

The DSST, which was examined to examine sustained attention between two groups, had a difference of 6.97 ± 3.40 before and after intervention in CG and a difference of 7.39±4.73 in EG. In AQS, difference value was 4.57±3.05 in CG, and difference value was 3.00±3.10 in EG, but the two groups showed no significant difference (p>0.05) [Table 5].

Table 5. Comparison of the sustained attention between two groups

Variable	EG (n=7)	CG (n=6)	Z	p
DSST	7.39±4.73	6.97±3.40	-O.072	0.94
AQS	3.00±3.10	4.57±3.05	-1.369	0.17

M ± SD = mean ± standard deviation, EG; experimental group, CG; control group, DSST; digit symbol substitution test, AQS; attention questionnaire scale

3.2. *Discussion*

This study was to find out how the workbook-based program applied to the elderly with MCI contributes to work memory and sustained attention. MCI is defined as a cognitive impairment that affects more advanced cognitive functions due to decrease mild memory and attention, but does not affect daily activities[13]. In diagnosing mild cognitive impairment, it is difficult to clearly define it due to differences in opinions of evaluation tools and clinicians. In particular, even if the cognitive level is in the normal category as a result of a specific test, there are many cases of complaining of restrictions in daily life activities, and the information presented by the patient's family is helpful in early detection of the dementia[14]. In addition, in improving MCI, it is helpful to improve cognitive impairment through physical and cognitive activity programs rather than drug[15]. An elderly with MCI appears to have a problem in working memory among memory related to daily life activities, and is particularly accompanied by difficulty in performing tasks based on working memory in performing tasks[6]. The cognitive rehabilitation guidelines and specific workbook cognitive programs proposed to improve cognitive function in previous studies were presented as effective intervention tools for subjects with MCI. Previous study reported that this is a textbook capable of autonomous learning activities through a workbook, and through this, the subject's learning ability was improved[16]. In this study, based on the guidelines of the corporation, the workbook cognitive program was organized with contents such as classifying figures, seasons, and pictures. In study, there was a significant difference in the AQS, which assessed sustained attention, which in particular led to sustained social interactions among the subjects, which positively helped them to improve their participation, attention and memory. However, the workbook program needs to consider the amount of time and the amount of focus that can be focused among individuals, and it is necessary to adjust the difficulty level with the level of help[10]. On the other hand, this study showed a lot of help in the program intervention process, so there was little personal voluntary participation, and a workbook cognitive program different from the subject's individual level was suggested and limited[14]. Therefore, it is considered that the workbook cognitive program carried out in this study is an important factor in selecting individual workbook items suitable for the individual's cognitive level and appropriately suggesting a difficulty level to maximize the participation of the subjects. The limitation of this study is that the number of participants and the study period are short, and it is difficult to generalize this targeting the elderly in some regions. Future study will have to proceed in the direction of

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confirming reliable effects through long-term planning including many subjects. In addition, it should be conducted to generalize the results of the study targeting the elderly in many regions.

4. Conclusion

This study was to find out how workbook cognitive program of elderly with MCI can improve working memory and attention span, and the following conclusions were drawn. First, in the workbook based cognitive program, AQS helped working memory ($P<0.05$). Second, there was no difference between the workbook based cognitive program and the general cognitive program ($P>0.05$). Therefore, the workbook cognitive program can be used as one of the cognitive enhancement programs for the elderly with MCI. In addition, it is thought that it will be able to influence work memory and attention span by promoting active participation in connection with the life perception program that fits the characteristics of the subject.

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