

Original Article

Effects of combined fine motor skill and cognitive therapy to cognition, degree of dementia, depression, and activities of daily living in the elderly with Alzheimer's disease

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Abstract. [Purpose] This study evaluated the effects of combined fine motor skill and cognitive therapies on cognition, depression, and activities of daily living in elderly patients with Alzheimer's disease (AD). [Subjects and Methods] Twenty-six participants comprised 2 groups. The experimental group (n=13) received combined fine motor skill and cognitive therapy, and the control group (n=13) received only general medical care. [Results] The experimental group showed improvements in cognition, degree of dementia, depression, and activities of daily living compared to the control group. However, there were no significant differences between the two groups. [Conclusion] These results suggest that combined fine motor skill and cognitive therapy improves cognition, degree of dementia, depression, and daily living in elderly patients with AD. These therapies would therefore be effective as general medical care strategies.

Key words: Alzheimer's disease, Cognition, Depression

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INTRODUCTION

Dementia is characterized by impairment of cognitive function, which continually degenerates. It is a complex clinical syndrome that involves memory impairment, behavioral disorders, and personality changes¹⁾. The main features of dementia are reduced cognitive ability, neurological and psychiatric symptoms, and functional disability²⁾.

Alzheimer's disease (AD) has a similar clinical presentation to vascular dementia, but they differ because the onset of AD typically occurs in old age. Typical symptoms include memory loss and functional language deficits. In addition, AD symptoms are irregular and fluctuating³⁾, which includes frontal lobe symptoms such as impairments in executive cognitive functions such as attention, planning, and cognitive processing speed⁴⁾. As a result, people with AD experience severe behavioral changes such as depression, behavioral delay, psychomotor slowness, and anxiety⁵⁾. AD is associated with damage to the hippocampus and entorhinal cortex⁶⁾, which progresses to the prefrontal, right parietal posterior, occipital, and temporal lobes of the cerebral cortex, as well

as to the nigrostriatal cells⁷⁾.

As elderly patients with dementia age, they show reductions in abilities such as sight, balance control, vestibular function, and proprioceptive sensation. These reductions contribute to physical inactivity, cognitive impairment⁸⁾, increased muscle stiffness, and functional limitations, which result in reduced activities of daily living, weight gain, and muscle loss. Physical weakness therefore increases⁹⁾. The emotional disorders that occur in 40–50% of elderly patients with dementia decrease quality of life, negatively impact other health conditions, and impair cognitive function^{10, 11)}. The complicated characteristics of elderly patients with dementia are interrelated and contribute to progressive impairment. Therefore, an integrated approach is necessary in order to improve health and preserve functional ability and quality of life and for elderly patients with dementia¹²⁾.

The present study investigated the effects of combined cognitive and fine motor activity therapies on the degree of dementia, depression, and activities of daily living in elderly patients with the AD.

SUBJECTS AND METHODS

Participants were 26 patients with AD who were at least 65 years old, and who attended the Gyeonggi S Senior Center. Inclusion criteria were as follows: no exercise habits, CDR 0.5–5 points, a diagnosis of AD, no regular cognitive rehabilitation treatment after onset of dementia, and ability to understand simple verbal instructions. Participants were

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excluded if they had vascular dementia by stroke, diagnosis of other dementia, fracture or musculoskeletal disorder¹³, or brain surgery. The present study was approved by Sahmyook University Institutional Review Board (SYUIRB2014-027) and each subject was able to follow instructions and gave informed consent by signing an approved consent form; thus, the rights of human subjects were protected.

Characteristics of the combined fine motor skill and cognitive therapy group were: 3 males and 10 females, mean age of 80.15 ± 5.21 years, mean height of 156.15 ± 10.38 cm, mean weight of 54.08 ± 9.32 kg, and duration after AD onset of 5.46 ± 3.71 years. Characteristics of participants in the control group were: 2 men and 11 women, mean age of 80.00 ± 6.90 years, mean height of 151.46 ± 6.94 cm, mean weight of 53.46 ± 12.24 kg, and duration after AD onset of 5.77 ± 3.41 years. There were no significant differences in participant characteristics between the groups.

Thirty-nine participants were divided into either the cognitive intervention group with fine motor activities ($n = 20$) or the control group ($n = 19$). Four of 29 participants in the experimental group had limited participation, and 3 participants in the experimental group abandoned the study. In the control group, 6 of 19 participants were excluded due to deteriorating health. Both groups were treated with 5 mg donepezil just prior to sleep, once daily for 12 weeks. Participants in the experimental group engaged in fine motor activities for 60 min, thrice a week for 12 weeks.

Cognitive therapy with fine motor activities consisted of coloring, singing¹⁴, matching picture cards, playing instruments, physically interactive games (ball toss, bowling, and ring toss), doing puzzles¹⁵, chopsticks games, janggi football, and a fishing game. Therapy was conducted using a chair or a wheelchair with armrests and back, a desk, and small tools. First, a physical therapy program occurred for 5 min in order to release shoulder and neck tension by stretching and clapping. Next, fine motor activities occurred for 50 min. Finally, cool down exercises were performed for 5 min.

Dementia was assessed using the Korean Convenience Mental State Examination (Korean-Mini Mental State Examination, K-MMSE). K-MMSE primarily assesses cognitive ability, is highly reliable (Cronbach's $\alpha = 0.98$), and consists of scales to assess disorientation, memory, visual ability, concentration, calculation, verbal language, writing, reading, and configuration abilities¹⁶.

The degree of dementia in elderly patients with AD was assessed using the Clinical Dementia Scale (Clinical Dementia Rating, CDR). The CDR assesses both Alzheimer's dementia and the severity of different types of dementia. It consists of 6 subscales, including memory, orientation, judgment and problem-solving, social activities, family life and hobbies, and personal hygiene. CDR data are analyzed with a complex algorithm and yield scores from 0–5 points, with higher numbers indicating more severe dementia (Cronbach's $\alpha = 0.90$)¹⁷.

Overall degeneration associated with dementia was assessed with the Global Deterioration Scale (GDS). The GDS is most widely used as the basis for determining drug therapy for patients with dementia. It evaluates declining cognition and social functioning, and consists of subscales

for memory, orientation, judgment and problem-solving skills, social activities, family life and hobbies, and hygiene or grooming (Cronbach's $\alpha = 0.93$)¹⁸. The Korean form of the Geriatric Depression Scale (KGDS) was used to assess depression. The KGDS is useful for administration to elderly people who are healthy, ill, or have impaired cognition, and consists of 30 scale items. Depression is classified as mild (14–18 points), moderate (19–21 points), or severe (22 points or more) (Cronbach's $\alpha = 0.94$)¹⁹. Caregivers of the study participants completed the KGDS.

Daily living skills were assessed using the Modified Barthel Index (MBI). The MBI consists of the following 10 subcategories: personal hygiene, bathing, eating, toileting, climbing stairs, dressing, adjustable stool use, urine control, walking or wheelchair use, and transferring to chair or bed, which are scored to a maximum total of 100 points (Cronbach's $\alpha = 0.90$)²⁰.

Data were analyzed with SPSS version 19.0. The Shapiro-Wilk test was conducted as a test of normality. Descriptive statistics were used to describe participant characteristics, and independent sample t-tests and χ^2 tests assessed homogeneity between groups. Paired t-tests were used to evaluate changes before and after the K-MMSE, CDR, GDS, KGDS, and MBI. Independent t-tests were used to test differences in demographic characteristics between groups. Values of $p < 0.05$ were considered significant.

RESULTS

K-MMSE, CDR, GDS, KGDS, and MBI scores improved in the experimental group but only KGDS scores improved for participants in the control group. However, there were no significant differences between the groups for any of the variables ($p < 0.05$) (Table 1).

DISCUSSION

The purpose of this study was to investigate the effects of cognitive therapy with fine motor activities on cognition, degree of dementia, depression, and activities of daily living in elderly patients with AD. Physical activity affects cognitive function of elderly patients with dementia as they age²¹.

K-MMSE scores significantly increased following cognitive therapy with fine motor activities. Scores were significantly decreased between the experimental and control groups. CDR scores and GDS scores were significantly decreased in the experimental group compared to the control group ($p < 0.05$). In a previous study, Spector²² administered a cognitive stimulation program that included using money, a ball game, and a word game, which was realistic training for patients with dementia. The training was conducted for 45 min twice per week for 7 weeks. Patients were assigned to either the experimental group ($n = 115$) or the control group ($n = 86$). The experimental group participated in the cognitive stimulation program and the control group received only general medical intervention. There were significant increases in the experimental group MMSE scores compared to the control group ($p < 0.05$).

Yamanaka¹⁵ assessed a cognitive stimulation program for patients with dementia, which also occurred for 45 min

Table 1. Comparison of outcome measures with groups and between groups (N=26)

Parameters	Values				Change values	
	Cognitive therapy group (n=13)		Control group (n=13)		Cognitive therapy group (n=13)	Control group (n=13)
	Pre	Post	Pre	Post	Post-Pre	Post-Pre
Cognitive parameters						
K-MMSE (score)	18.62 (2.46) ^a	22.08 (2.62) ^{***}	15.08 (3.54)	14.54 (4.40)	3.46 (1.85)	-0.54 (4.87)
Degree of dementia						
CDR (score)	2.38 (0.87)	1.73 (0.78) ^{**}	2.23 (0.83)	2.50 (1.38)	-0.65 (0.62)	0.26 (0.78)
GDS (score)	5.15 (0.89)	4.46 (1.12) ^{**}	4.85 (1.46)	5.08 (1.32)	-0.69 (0.63)	0.23 (0.92)
Depression parameters						
KGDS (score)	15.08 (6.47)	11.46 (6.03) [*]	10.38 (9.96)	9.38 (10.27)	-3.62 (3.66)	-0.92 (3.37)
ADL parameters						
MBI (score)	55.54 (15.30)	60.92 (12.95) [*]	56.77 (19.55)	55.23 (21.73)	5.38 (6.19)	-1.38 (8.48)

^a Values are mean (SD), K-MMSE: Korea-Mini Mental State Examination, CDR: Clinical Dementia Rating, GDS: Global Deterioration Scale, KGDS: Korea Geriatric Depression Scale, MBI: Modified Barthel Index. * p<0.05, **p<0.01, ***p<0.001

twice per a week for 7 weeks. The experimental group (n=26) participated in a cognitive stimulation program that included word puzzles, word games, physically interactive games, puzzles, using tools, number card games, and using money. The control group (n=30) was observed only. MMSE scores were significantly increased in the experimental group compared to the control group (p<0.05).

Jean²³⁾ studied 22 patients with dementia, who had mild cognitive impairment. Eleven participants in the experimental group were participated in face-name associated training with errorless learning and spaced retrieval training, as well as memory training. Eleven participants in the control group participated in face-name associated training with errorless learning, as well as memory training. All participants completed 6 45 min sessions. CDR scores significantly decreased in both groups (p < 0.05). This study showed increased cognition, similarly to the findings of Spector²²⁾ and Yamanaka¹⁵⁾. The degree of dementia also decreased, similarly to the findings of Jean²³⁾. In order to increase cognitive functioning, aerobic exercise or strength training is thought to be fundamental. However, a recent study demonstrated that the effects of exercise are mediated via synaptic plasticity mechanisms or neuron generation^{24, 25)}. This study also considered that fine motor activities can enhance cognitive functioning. Brain areas responsible for the hand function are utilized, so fine motor activity should improve cognitive functioning due to stimulating both the premotor cortex and also the nerves of the other cortex. The degree of dementia in elderly patients with AD is thought to significantly decrease because of increasing the cognitive function.

Depression can occur at any age, and it is a mental illness with both social and personal effects. Cognitive impairment and dementia risk increase in elderly patients with depression²⁶⁾. Yoon¹⁹⁾ studied 20 patients with dementia. An experimental group (n = 11) was offered exercise programs with cognitive activities for 20 min thrice a week, for 12 weeks. A control group (n = 9) was provided only with cognitive activities for 20 min thrice a week, for 12 weeks. General physical therapy was offered to both groups for 30 min, 5

times a week, for 12 weeks. Depression in patients with dementia was assessed by GDS. Both groups had significantly decreased GDS scores (p < 0.05) but there was no difference between groups.

Kerse²⁶⁾ used the Otago program with 193 elderly people with depression, for 30 min thrice a week, for 6 months. The experimental group (n = 97) participated in upper extremity exercise programs from the Otago exercise program and the control group (n = 96) had only a social visit. As a result, GDS-15 scores significantly decreased in both groups (p < 0.001), but there was no difference between groups. In this study, KGDS was used to assess depression in elderly patients with Alzheimer's dementia. KGDS scores decreased significantly in the experimental group compared to the control group (p < 0.05). The present study found decreased depression, similarly to the results of Yoon¹⁹⁾ and Kerse²⁶⁾. Depression includes impairment in cognitive functioning and decreased ability to perform activities of daily living due to Alzheimer's dementia. However, cognitive treatment with fine muscle activity improved not only cognitive function and the ability to participate in activities of daily living, but also decreased depression.

The variation in findings between studies likely results from differences in study durations, participants, and treatment methods. Physical activity is necessary to the elderly, who are often concerned about the possibility of declining health, including social support, lack of exercise, discomfort, and falls. Decreased abilities of elderly patients with dementia to perform activities of daily living contribute to difficulties with walking or climbing stairs, which increase the probability of a fall, followed by entering a medical institution, and incurring the associated medical costs²⁷⁾.

Tsolaki²⁸⁾ investigated gait and balance in 176 elderly people with mild cognitive impairment. There were 20 sessions once a week for 12 weeks. The experimental group (n = 104) participated in cognitive training, including naming objects and numbers backwards. The control group (n = 72) was primarily observed only. Activities of daily living significantly increased in the experimental group (p < 0.001).

In the present study, the MBI measured ability of elderly patients with AD to perform daily living tasks, and found that MBI was significantly increased in the experimental group compared to the control group. There was a significant difference between groups ($p < 0.05$). Our findings demonstrating increased activities of daily living are similar to results reported by Tsolaki²⁸. Fine muscle activities with cognitive therapy improved hand manipulation for elderly patients with AD, improved sensation and function of the hand, and improved performance of activities of daily living. Although not a replacement for a walker, a cane, or other suitable balance treatments, improved hand function contributes to reducing fear to perform activities of daily living for elderly patients with Alzheimer's disease. In addition, activities of daily living were enhanced by improved cognitive functioning. Executive function in elderly patients with AD was advanced due to various activities such as coloring, using chopsticks, Jenga and block play, mosaics, puzzles, jigsaw puzzles, playing instruments, singing, and tossing a ball. MBI scores increased through these processes. MBI scores of 50–74 points indicate a moderate level of independence in daily life. Therefore, although the MBI scores increased from 5.38 points to 60.92 points for elderly patients with AD in the present study, these patients still require assistance.

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