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Effects of Computerized Cognitive Training Program Using Artificial Intelligence Motion Capture on Cognitive Function, Depression, and Quality of Life in Older Adults With Mild Cognitive Impairment During COVID-19: Pilot Study

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Abstract

Objective : We investigated the efficacy of an artificial intelligence computerized cognitive training program using motion capture to identify changes in cognition, depression, and quality of life in older adults with mild cognitive impairment.

Methods : A total of seven older adults (experimental group = 4, control group = 3) participated in this study. During the COVID-19 period from October to December 2021, we used a program, “MOOVE Brain”, that we had developed. The experimental group performed the program 30 minutes 3×/week for 1 month. We analyzed patients scores from the Korean version of the Mini-Mental State Examination-2, the Consortium to Establish a Registry for Alzheimer's Disease Assessment Packet for Daily Life Evaluation, the short form Geriatric Depression Scale, and Geriatric Quality of Life Scale.

Results : We observed positive changes in the mean scores of the Stroop Color Test (attention), Stroop Color/Word Test (executive function), SGDS-K (depression), and GQOL (QoL). However, these changes did not reach statistical significance for each variable.

Conclusion : The study results from "MOOVE Brain" can help address cognitive and psychosocial issues in isolated patients with MCI during the COVID-19 pandemic or those unable to access in-person medical services.

Keywords : Aged, Cognitive dysfunction, Computer-assisted therapy, COVID-19, Motion perception

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Ⅰ. Introduction

Mild cognitive impairment (MCI) refers to a syndrome in which an individual has a relatively lower cognitive ability as compared with other individuals of the same age or educational level (Gauthier et al., 2006). MCI is a transitional state between normal aging and dementia, which later is expected to progress rapidly into Alzheimer's disease (Traykov et al., 2007). Failure to provide adequate intervention for patients with MCI is dangerous, because untreated MCI can fast the transition time to dementia. In a study by Chertkow et al. (2008), 40%~80% of patients were diagnosed with dementia within 5 years when no MCI intervention was provided. In another community-based study, the annual conversion rate of MCI to dementia was 10%~15% (Lyketsos et al., 2002).

To prevent and slow the progression from MCI to dementia, clinical trials have been conducted over the past decades (Bachurin et al., 2018; Teixeira et al., 2012). Interventions known to delay dementia include cognitive training (CT) such as memory, organization, planning and attention training and physical exercises such as gymnastics, slow walking, joint exercise, bending and moving fingers (Hong, 2020). These have a positive effect on behavioral and psychological symptoms as well as cognitive function (Hong, 2020). Continuous cognitive and physical activity helps reduce the progression of dementia according to neuroplasticity (Hong, 2020). Karssemeijer et al. (2017) demonstrated that combined cognitive and physical excise training has a positive effect on improving the cognitive function of MCI.

Compared to cognitive rehabilitation (CR) and cognitive stimulation, which are focused on dementia patients, CT is known as an appropriate intervention for MCI. It aims to improve cognitive function through repetitive practice (Zhang et al., 2019). Recently, computerized cognitive training (CCT) using computers instead of conventional CT using paper and pens has been performed on MCI. CCT reports better adherence and satisfaction compared to CT, and has a stronger effect size (Gates et al., 2011; Hill et al., 2017). In addition, it is cost-effective and can provide systematic rehabilitation because it can provide progressive challenge on various cognitive domains (Finn & McDonald, 2011; Zhang et al., 2019).

The importance of training combined with cognitive and physical exercise is being emphasized to prevent the transition to dementia (Hong, 2020; Karssemeijer et al., 2017), Intervention that combined CCT and physical activity has not yet been studied. This study makes an effort to intervene with MCI using artificial intelligence (AI) motion capture technologies in order to realize this. AI motion capture can recognize a subject's body using a camera on a computer screen and record the movement in digital form (Cohen & Borsoi, 1996). In this study, a program that moves hands and bodies through these technologies to carry out cognitive tasks in various areas (frontal execution, calculation, language, attention, visual-spatial) was designed. The purpose of this study is to investigate the effects of intervention combined with CCT and physical activity on MCI.

Ⅱ. Methods

1. Study design

A total of seven participants with MCI were recruited from the community of Wonju, South

Korea. An intervention group and a control group were established, and interventions were conducted 3×/week for a total of 4 weeks for 30 min/session. Pre-post evaluation was conducted. A control group was a wait list group. All participants gave written informed consent, and the research was approved by the Yonsei University Mirae Campus Institutional Review Board as a project supported by the Korea Research Foundation (approval no.: 1041849-202108-BM-131-01).

2. Participants

Participant inclusion criteria were as follows: 1) age ≥ 65 years; 2) subjective memory decline, with a Memory Age-associated Complaint Questionnaire (MAC-Q) score of 〉25 points; 3) a Korean version of the Mini-Mental State Examination-2 (K-MMSE-2) cut-off score of 23~27 points; 4) a Clinical Dementia Rating Scale (CDR) score of .5; and 5) no limitations in communication, hearing, vision, and motion (Crook et al., 1992; Lee et al., 2023; Reisberg et al., 2008). Exclusion criteria were as follows: 1) brain tumors or encephalitis, 2) mental illness or severe depression, 3) alcohol or drug addiction, and 4) existing dementia such as Alzheimer's disease or vascular dementia.

3. Markerless motion capture for developing program

Our program, "MOOVE Brain," is designed to extract coordinate values of a patient's palm, face, and body through landmark detection. The program is based on software provided by YoungAnd and utilizes a "MediaPipe" module that leverages "BlazeNet" AI, which is integrated with a webcam mounted on the device. MediaPipe offers customizable and cross-platform machine learning solutions for live and streaming media, including face detection, hands tracking, object detection, and box tracking. We used four solutions from among these: "Hands," "Pose," "Face Mesh," and "Holistic." These solutions provide landmarks of the face, hands, and body composed of coordinates (x, y) representing different positions on the screen. "MOOVE Brain" uses these coordinates as pose information of users while game playing to judge whether a user is displaying the correct pose for the quests required by the training content. A detailed explanation of these solutions follows.

First, MediaPipe's Hands, a high-fidelity hand- and finger-tracking solution, uses machine learning to infer 21 three-dimensional (3-D) landmarks of the hand from only a single frame. Whereas current state-of-the-art approaches rely primarily on powerful desktop environments, this method achieves real-time performance on a mobile smart phone and even scales to multiple hands. Second, MediaPipe's Pose, a solution for high-fidelity body pose tracking, detects 33 3-D landmarks and background segmentation masks on the whole body from RGB video frames utilizing our BlazePose research. Current state-of-the-art approaches rely primarily on powerful desktop environments for inference, whereas this method achieves real-time performance on most mobile smart phones, desktops or laptops, in Python software, and even on the Internet.

Next, MediaPipe's Face Mesh, a face geometry solution that estimates 468 3-D face landmarks in real-time, even on mobile devices, infers the 3-D surface geometry by requiring only a single camera

Figure 1. Landmarks on the Screen

input without the need for a dedicated depth sensor. Face Mesh is based on BlazeFace, a lightweight and well-performing face detector tailored for mobile graphics processing unit (GPU) inference. Finally, MediaPipe's Holistic pipeline integrates separate models for pose, face, and hand components, each of which is optimized for its particular domain (Zhang et al., 2020). In our research, 543 landmarks, 3-D shape coordinates such as (0, 28, 37), (1, 32, 49), and (2, 44, 57), were extracted from the RGB vectors of the screen image through the web cam. The first part of the coordinates is the unique number of landmarks and the other parts are (*x*, *y*) 2-D coordinates representing the position of the screen (Figure 1).

4. Study protocol

During the COVID-19 pandemic period of October to December 2021, CCT equipped with AI motion capture technology was used to improve overall cognitive functions of memory, frontal execution, language, visual-spatial skills, and attention. To prevent mass infections when conducting the program, a therapist who had completed a second COVID-19 vaccination went to the patients' homes to conduct the training. Participants wore lip-reading masks with meltblown filters and transparent films attached to their mouths to match problems with facial expressions. In addition, the CCT could be used without wearable devices such as gloves or sensors, items previously required for motion recognition. Because it was necessary to solve the problem by moving the whole body, the CCT provided various physical stimuli than better than did conventional digital cognitive programs that rely on simply pressing buttons.

1) Rock-Paper-Scissors: frontal execution ability

Rock-Paper-Scissors requires patients to show one of three shapes with their hands to win against the shape shown on the screen (Figure 2A). As the game progresses, patients use both hands simultaneously to win against two shapes. More complicated rules are in development. This task can help increase cognitive flexibility.

2) Finger Math: calculation ability

In Finger Math, patients solve randomly generated mathematical problem with one- or two-digit numbers (Figure 2B). Patients use their fingers on both hands to form the number that answers the question and are awarded more points if they use an unusual pattern of fingers to represent the number. This task can help improve calculation speed.

3) Word Quiz: language ability

In Word Quiz, patients use their hands to drag various phonemes (imprinted on the images of various fruits) from the middle of the screen to an image of a blender to make up a word that answers the riddle in the questions (Figure 2C). This task can help improve spelling and vocabulary.

4) Gesture Posing: attention ability

In Gesture Posing, which shows patients various gesture and facial expression images to mirror, patients follow the given image in the time limit (Figure 2D). In this process, patients immediately need to focus on the suggested gestures. This task can help increase attention span.

5) Motion Following: visual-spatial ability

In Motion Following, patients follow the motion of a pictogram on the screen; higher precision in following the image gives a higher score for accuracy (Figure 2E). Dance movements can help increase visual-spatial area skills.

6) Overall ability

Ability levels increase when a patient shows >80% accuracy and decreases with <50% accuracy. Memory programs that include medical education, stories, and memory strategies can help support more efficient memorization.

5. Outcomes measurement

We measured intervention outcomes using the K-MMSE-2, the CDR, the Korean version of the Consortium to Establish a Registry for Alzheimer's Disease Assessment Packet for Daily Life Evaluation (CERAD-K) (Lee et al,. 2002). We conducted an evaluation of depression using the Korean version of the short form Geriatric Depression Scale (SGDS-K) and evaluated quality of life (QoL) with the Geriatric Quality of Life Scale (GQOL) (Lee et al., 2004; Lee et al., 2013).

6. Statistical analysis

We performed all statistical analyses using SPSS ver. 26.0 statistical software (IBM Corp.). Because the number of participants was small, we used the Mann-Whitney *U*-test for continuous variables to compare data at pre- and postevaluation and changes between groups. We used the Wilcoxon signed-rank test to compare the differences between pre- and

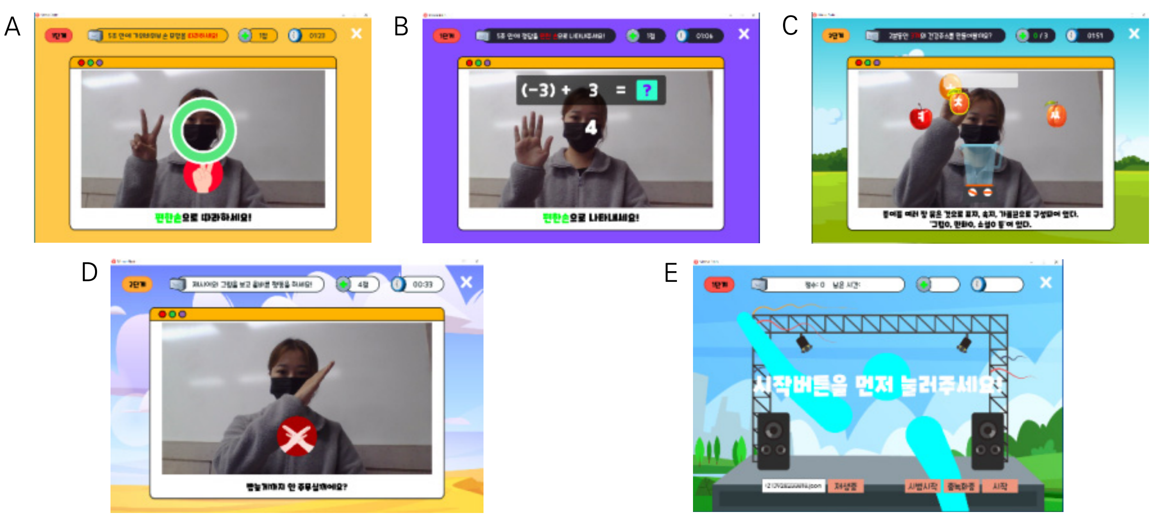

Figure 2. Integrating Multitasking and Motion

(A) Rock-Paper-Scissors, (B) Finger Math, (C) Word Quiz, (D) Gesture Posing, and (E) Motion Following.

postevaluation for each group. Before and after the intervention, we analyzed statistically the changes in overall cognitive function and task accuracy, and we confirmed average scores using the significance level of .05.

Ⅲ. Results

1. Software design

We developed program for Windows PC by applying Python in the Pycharm studio environment. We imported the OpenCV library to convert the screen images to an RGB matrix, and we imported MediaPipe to derive the vector value of the pose landmarks. We designed the program using the vector value of a player's body, hand, and face landmarks to judge whether players showed a correct or incorrect pose as required by the quests in the training content.

Through user ID registration, players can log in to this program; play the training content; and check their previous records, including content name, accuracy, and points. Patient records can be accumulated and managed by changing the form of the Excel data (Microsoft).

2. Participants demographics

We selected the seven participants using accidental sampling. Their mean age was 78.71 ± 7.97 years. No differences existed in age, sex, education, dominant hand, or screening evaluation scores between the in the intervention and the control groups (Table 1).

3. Intervention results

The results of the cognitive intervention are presented

Table 1. General Participant Characteristics (N = 7)

Characteristic		Total (n = 7)	Intervention group (n = 4)	Control group (n = 3)	p-value
Age (yr)		78.71 ± 7.97	84.50 ± 2.08	71.00 ± 5.29	.629
Female		6 (85.7)	3 (75.0)	3 (100)	.057
Education	No education	2 (28.6)	1 (25.0)	1 (33.3)	.629
	Elementary school	2 (28.6)	1 (25.0)	1 (33.3)	
	High school	1 (14.3)	-	1 (33.3)	
	≥ University	2 (28.6)	2 (50.0)	-	
Right-handedness		7 (100)	4 (100)	3 (100)	>0.99
MAC-Q		29.86 ± 4.34	31.25 ± 4.35	28.00 ± 4.36	.629
K-MMSE-2		24.71 ± 1.70	24.00 ± 2.00	25.67 ± 0.58	.400
CDR-SB		179 ± 0.91	2.38 ± 0.75	1.00 ± 0.00	.057
CDR		0.50 ± 0.00	0.50 ± 0.00	0.50 ± 0.00	>0.99
Sum of CERAD-K		68.86 ± 21.25	51.25 ± 10.44	69.00 ± 30.35	.629
GQOL		64.14 ± 14.02	62.25 ± 17.04	66.67 ± 11.72	>0.99
SGDS-K		4.43 ± 3.74	5.00 ± 4.55	3.67 ± 3.06	.857

Values are presented as *mean* ± standard deviation or *number* (%).
CDR = Clinical Dementia Rating Scale; CDR-SB = Clinical Dementia Rating Scale-Sum of Boxes; CERAD-K = Korean version of the Consortium to Establish a Registry for Alzheimer's Disease Assessment Packet for Daily Life Evaluation; GQOL = Geriatric Quality of Life Scale; K-MMSE-2 = Korean version of the Mini-Mental State Examination-2; MAC-Q = Memory Age-associated Complaint Questionnaire; SGDS-K = Korean version of the short form Geriatric Depression Scale.

in Table 2 and 3. We found no statistically significant improvements in each variable and in each group ($p > .05$). Although we were unable to reject the null hypothesis, we did find some differences in the

Table 2. Results within and between Intervention Groups (N = 7)

Category		Variable	Group	Pre-intervention	Post-intervention	*p*-value	
						Within	Between
CERAD-K	Attention	TMT A	Control	108.67 ± 46.50	90.67 ± 37.90	>0.99	.400
			Intervention	88.00 ± 33.15	68.00 ± 25.34	.593	
		Stroop Word Test	Control	58.00 ± 34.04	64.00 ± 45.64	>0.99	.857
			Intervention	57.50 ± 27.04	54.25 ± 13.96	.715	
		Stroop Color Test	Control	53.33 ±21.46	62.67 ± 30.55	.285	>0.99
			Intervention	44.25 ± 16.46	57.50 ±14.66	.068	
	Memory	Word list memory	Control	13.00 ± 5.00	15.33 ± 3.06	.414	.857
			Intervention	13.50 ± 4.65	15.25 ±2.63	.465	
		Word list recall	Control	6.00 ± 2.00	4.33 ± 3.06	>0.99	.857
			Intervention	2.50 ± 1.73	3.75 ± 2.22	.257	
		Word list recognition	Control	7.00 ± 3.61	8.00 ± 2.65	.276	.400
			Intervention	4.75 ± 2.22	6.00 ± 0.82	.461	
		Constructional recall	Control	6.33 ± 2.52	6.33 ± 3.21	.180	.229
			Intervention	2.50 ± 2.38	4.00 ± 2.16	.109	
	Language	Boston naming	Control	9.67 ± 4.04	9.00 ± 3.61	>0.99	.629
			Intervention	10.50 ±3.00	10.75 ± 2.87	.705	
	Visual-spatial	Constructional praxis	Control	9.00 ± 2.00	9.00 ± 1.73	.285	.400
			Intervention	9.25 ± 0.96	10.25 ± 1.50	.102	
	Executive function	TMT B	Control	255.67 ± 76.79	236.67 ± 109.70	.655	.629
			Intervention	243.50 ± 67.89	216.25 ± 85.62	.189	
		Verbal fluency	Control	15.00 ± 4.58	15.00 ± 3.61	.109	.400
			Intervention	10.75 ± 0.96	11.75 ± 2.63	.465	
		Stroop Color and Word Test	Control	22.33 ± 2.08	22.33 ± 2.08	>0.99	.057
			Intervention	37.25 ± 13.60	43.50 ± 12.79	.197	
	Global cognition	MMSE-KC	Control	23.67 ± 4.51	22.33 ± 7.51	>0.99	.629
			Intervention	23.25 ± 3.77	24.50 ± 2.38	.414	
		Sum 1	Control	69.00 ± 30.35	70.67 ± 28.75	>0.99	.857
			Intervention	51.25 ± 10.44	64.75 ± 18.32	.144	
		Sum 2	Control	75.33 ± 32.72	77.00 ± 31.95	>0.99	.857
			Intervention	53.75 ± 12.34	68.75 ± 20.32	.144	
GQOL			Control	66.67 ± 11.72	48.67 ± 4.16	.655	.114
			Intervention	62.25 ± 17.04	71.25 ± 17.84	.144	
SGDS-K			Control	3.67 ± 3.06	8.33 ± 4.16	.109	.229
			Intervention	5.00 ± 4.55	3.75 ± 3.40	.102	
K-MMSE-2			Control	25.67 ± 0.58	24.00 ± 6.56	.102	>0.99

Values are presented as *mean* ± standard deviation.
CERAD-K = Korean version of the Consortium to Establish a Registry for Alzheimer's Disease Assessment Packet for Daily Life Evaluation; GQOL = Geriatric Quality of Life Scale; K-MMSE-2 = Korean version of the Mini-Mental State Examination-2; MMSE-KC = Mini-Mental State Examination in the Korean version of CERAD Assessment Packet; SGDS-K = Korean version of the short form Geriatric Depression Scale; TMT = Trail Making Test.

sample. Scores for the Stroop Color Test (p = .068) improved within the intervention group. Scores for the Stroop Color and Word Test (p = .057) improved between the groups. Improvement occurred in the amount of changes of the GQOL (p = .057) and SGDS-K (p = .057) scores between groups.

Table 3. Changes between Pre- and Post-Evaluation (N = 7)

Category		Variable		Change	p-value
CERAD-K	Attention	TMT A	Control	-18.00 ± 25.63	.700
			Intervention	-7.67 ± 33.61	
		Stroop Word Test	Control	6.00 ± 12.12	.629
			Intervention	-3.25 ± 15.35	
		Stroop Color Test	Control	9.33 ± 10.97	.857
			Intervention	13.25 ± 4.99	
	Memory	Word list memory	Control	2.33 ± 3.79	.857
			Intervention	1.75 ± 4.79	
		Word list recall	Control	-1.67 ± 2.31	.229
			Intervention	1.25 ± 2.06	
		Word list recognition	Control	1.00 ± 1.00	>0.99
			Intervention	1.25 ± 2.63	
		Constructional recall	Control	0.00 ± 1.00	.229
			Intervention	1.50 ± 1.29	
	Language	Boston naming	Control	-0.67 ± 2.89	.857
			Intervention	0.25 ± 1.50	
	Visual-spatial	Constructional praxis	Control	0.00 ± 1.00	.229
			Intervention	1.00 ± 0.82	
	Executive function	TMT B	Control	-19.00 ± 32.91	.857
			Intervention	-27.25 ± 22.82	
		Verbal fluency	Control	0.00 ± 2.00	.629
			Intervention	1.00 ± 2.94	
		Stroop Color and Word Test	Control	0.00 ± 3.61	.400
			Intervention	6.25 ± 9.81	
	Global cognition	MMSE-KC	Control	-1.33 ± 3.06	.400
			Intervention	1.25 ± 2.63	
		Sum 1	Control	1.67 ± 5.51	.400
			Intervention	13.50 ± 15.07	
		Sum 2	Control	1.67 ± 4.73	.400
			Intervention	15.00 ± 15.71	
GQOL			Control	-18.00 ± 12.00	.057
			Intervention	9.00 ± 12.14	
SGDS-K			Control	4.67 ± 1.15	.057
			Intervention	-1.25 ± 1.26	
K-MMSE-2			Control	-1.67 ± 6.66	.629

Values are presented as *mean* ± standard deviation.
CERAD-K = Korean version of the Consortium to Establish a Registry for Alzheimer's Disease Assessment Packet for Daily Life Evaluation; GQOL = Geriatric Quality of Life Scale; K-MMSE-2 = Korean version of the Mini-Mental State Examination-2; MMSE-KC = Mini-Mental State Examination in the Korean version of CERAD Assessment Packet; SGDS-K = Korean version of the short form Geriatric Depression Scale; TMT = Trail Making Test.

We found no significant improvement between any of the other measures between the groups: Trail Making Test (TMT) A (p = .400), TMT B (p = .629), Stroop Word Test (p = .857), word list memory (p = .857), word list recall (p = .857), word list recognition (p = .400), constructional recall (p = .229), Boston naming (p = .629), constructional praxis (p = .400), verbal fluency (p = .400), Mini-Mental State Examination in the Korean version of CERAD Assessment Packet (p = .629), K-MMSE-2 (p = >0.99), sum 1 (p = .857), and sum 2 (p = .857). However, The reults showed a significant change in the average value of the Stroop Color Test in the intervention group (Figure 3). Additionally, differences were observed between the average values of the intervention and control groups (Figure 4). The Geriatric Quality of Life Scale and the Geriatric Depression Scale evaluation also revealed significant differences between the groups (Figures 5, 6).

Ⅳ. Discussion

In this study, we used a CCT program using AI motion capture that is the first study to observe cognition, depression, and QoL of the older adults in MCI. As a result of this experiment, a positive change occurred in the mean sore of the Stroop Color Test, Stroop Color and Word Test, SGDS-K, and GQOL. The results suggest that attention, executive function, emotion, and QoL scores have changed. The meta-analysis study report that combined cognitive and physical training may beneficial in people with MCI which could improve attention, executive function and memory ability than single task (Meng et al., 2022). In other previous study, older adults with

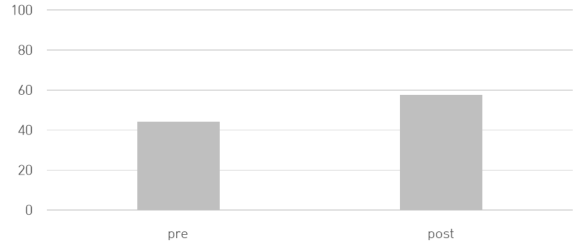

Figure 3. Mean of Stroop Color Test for Intervention Group

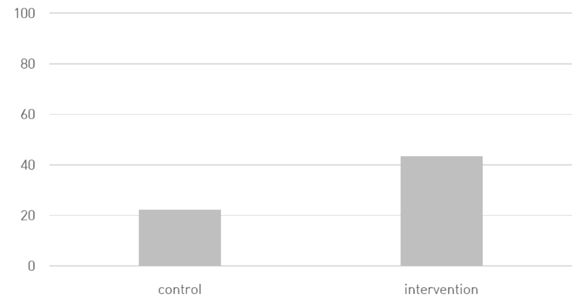

Figure 4. Mean of Stroop Color and Word Test Between Groups

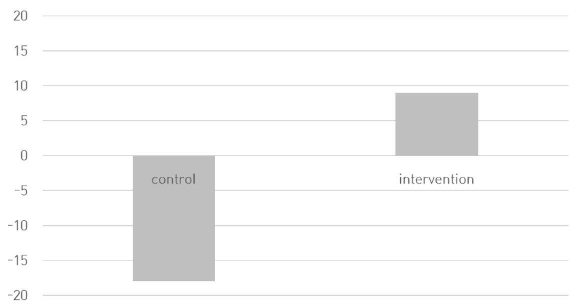

Figure 5. Amount of Geriatric Quality of Life Scale Change Between Groups

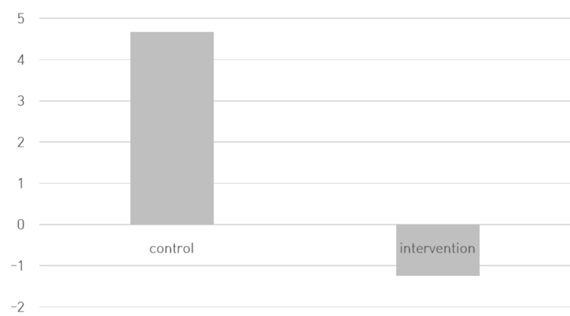

Figure 6. Amount of the Short Form Geriatric Depression Scale Change Between Groups

cognitive impairment may indicate that significant improvements in overall cognitive ability, attention, executive function and memory when using the combinition of physical and cognitive ability. Our study also sujest efficacy in the same context (Law et al., 2014).

The older adults diagnosed with MCI, are observed that mild but noticeable declines in working memory, attention, execution function (Saunders & Summers, 2011). Recent studies have shown that initial damage in each area strongly predicts progression to dementia and increases the risk of activities of daily life loss, even if they do not seem to have much trouble performing their daily lives immediately (Kirova et al., 2015). The Stroop Color Test is conducted to evaluate the subject's concentration, and when MCI subjects are tracked longitudinally, the attention was decreased first compared to other functions (Saunders & Summers, 2011). Attention is an essential prerequisite for performing daily tasks, and if attention decreases, prediction and responsiveness to changes may decrease in daily living (Kaplan & Foldi, 2009). The Stroop Color and Word Test is a test performed to identify execution functions. Execution functions is the high-level cognitive functions such as attention control, planning, concept generation, and rule discovery, and are used in tasks such as driving as important functions for controlling behavior and thinking in daily living (Junquera et al., 2020).

In addition to cognitive decline, MCI suffers from factor of deterioration in psychological well-being and QoL, but it has generally been overlooked in clinical intervention (Gates et al., 2014). MCI patients have shown psychosocial problems such as depression and anxiety that can affect QoL, so controlling mood can help prevent or delay cognitive decline (Regan & Varanelli, 2013). And our study found the possibility of improving depression and QoL, as well as cognitive function, in older adults.

In the recent review literature, applying dual task as a CR program, it represents the positive effect on both cognitive and physical function in older adults with cognitive impairment (Gallou-Guyot et al., 2020). Therefore, combining physical and CT for older adults with MCI can promote a synergistic effect (Bamidis et al., 2015; Fissler et al., 2013). Therefore, cognitive intervention, including physical activity, can help improve independent function and psychological health in patients with MCI and, thus, can promote healthy aging (Nuzum et al., 2020). The perspective of our dual task program, we can support the potential for improving cognitive function, mood and the QoL.

Another feature of our work is markerless AI motion capture, which is classified as a subtype of CCT program, but does not requiring digital accessories such as computer mice, keyboard, sensors, and auxiliary equipment. Therefore "MOOVE Brain" program has the advantage of establishing a protocol that allows therapists to perform treatment remotely. On the basis of the results of our study, our program can be used to solve cognitive and psychological problems of older adults who are isolated due to COVID-19 or who cannot receive medical care for reasons such as gait problems or living far from a medical facility.

This study has some limitations. First, the participant sample size was small. It was difficult to find participants because community facilities were closed temporarily due to the risk of COVID-19 infection. In future studies, it will be necessary to plan more levels and types of content for a noncontact (meeting participants without face-to-face, in-person contact) at-home program.

Second, the treatment time and duration were short, so designing interventions for longer intervention and evaluation times and duration is required to reduce learning effects. Third, a control group was wait list group. In the future study, control group needed to be receive intervention simultaneously. Finally, because we used body motion capture to solve problems, patients with physical difficulties (e.g., lower range of motion due to joint construction, amputation, or hemiplegia) may have shown lower performance than their actual cognitive abilities would indicate. Therefore, developing additional programs for people with limited physical abilities is necessary.

V. Conclusion

The findings of this study and our "MOOVE Brain" can be used to help MCI patients who are isolated owing to COVID-19 or who cannot obtain in-person medical care overcome their cognitive and psychological problems.

Conflicts of interest

No potential conflict of interest relevant to this article was reported.

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국문초록

인공지능 동작 인식을 활용한 전산화인지훈련이 코로나-19 기간 동안 경도 인지장애 고령자의 인지 기능, 우울, 삶의 질에 미치는 영향: 예비 연구

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목적 : 본 연구의 목적은 경도인지장애 고령자에게 인공지능 동작 인식 기술을 활용한 전산화인지훈련 프로그램을 실시하여 인지 기능, 우울감, 삶의 질을 향상시키고자 한다.

연구방법 : 연구 참여자는 총 7명(실험군 = 4명, 대조군 = 3명)이며 코로나-19 발생 기간인 2021년 10월부터 12월까지 시행되었다. 프로그램은 직접 개발한 인공지능 동작 인식 기술을 활용한 전산화 프로그램 "MOOVE Brain"을 활용했으며 실험군은 한 달 동안 주 3회 30분씩 프로그램을 진행하였고 대조군에게는 중재를 제공하지 않았다. 치료의 전후 평가는 Korean version of the Mini-Mental State Examination-2, Korean version of the Consortium to Establish a Registry for Alzheimer's Disease Assessment Packet for Daily Life Evaluation, Korean version of the short form Geriatric Depression Scale (SGDS-K), 그리고 Geriatric Quality of Life Scale (GQOL)을 이용하였다.

결과 : 치료 전후로 실험군의 주의력 지표인 Stroop Color Test에서 평균 점수가 향상되었고(p = .068), 그룹 간 비교를 했을 때는 실험군의 실행 기능 평가 지표인 Stroop Color/Word Test 평균 점수가 향상되었다(p = .057). 그룹 간의 변화량을 비교했을 때는 실험군의 삶의 질 측정 도구인 GQOL (p = .057)과 우울증 지표인 SGDS-K (p = .057)의 평균 점수가 개선되었다. 하지만 각 영역들은 통계적으로 유의미하지 않았다.

결론 : 본 연구의 결과는 코로나-19로 인해 격리되어 있거나 의료 서비스를 받기 힘든 경도인지장애 고령자의 인지 및 심리 사회적 문제를 해결하는 데 활용될 수 있을 것으로 기대된다.

주제어 : 경도인지장애, 고령자, 동작 인식, 컴퓨터보조치료, 코로나-19