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Original Article

Effects of activities of daily living-based dual-task training on upper extremity function, cognitive function, and quality of life in stroke patients

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ABSTRACT

Objectives: The aim of this study was to investigate the effect of daily living dual-task training focused on improving attention and executive function of the upper extremities, cognitive function, and quality of life in stroke patients.
Methods: We included 30 stroke patients who were hospitalized between July 2020 and October 2020. They were divided into experimental and control groups through randomization. The experimental group performed 20 minutes of dual-task training and received 10 minutes of conventional occupational therapy, while the control group performed 20 minutes of single-task training and received 10 minutes of conventional occupational therapy. Both groups underwent their respective rehabilitation for 30 minutes per session, 5 times per week for 5 weeks.
Results: Both groups showed significant improvements in upper extremity function, cognitive function, and quality of life; the experimental group showed higher results for all items. A significant between-group difference was observed in the magnitude of the changes.
Conclusion: In stroke patients, dual-task training that combined attention and executive function with daily living activities was found to be meaningful, as it encouraged active participation and motivation. This study is expected to be used as a foundation for future interventions for stroke patients.

Keywords: Cognitive function; Dual-task; Quality of life; Stroke; Upper extremity function

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Introduction

Stroke is a cerebrovascular disease in which a blood vessel supplying the brain is ruptured or blocked, resulting in complex dysfunction and neurological function impairment following brain damage [1,2]. The type and level of the disorder are determined based on the area and extent of brain damage [2]. Common major dysfunctions after stroke include motor disorders, upper extremity dysfunction, cognitive disorders, emotional disorders, and speech disorders [3,4]. In particular, upper extremity dysfunction and cognitive impairment cause many difficulties in achieving successful rehabilitation [5].

In the field of occupational therapy, improving the function of the injured upper extremities has been regarded as one of the most important goals, as impaired upper extremity function limits independent performance in daily life [6–8]. Among stroke patients, 16% to 30% show deficits in cognitive functions such as orientation, attention, memory, language ability, executive function, and spatiotemporal cognition within 1 year [9]. Stroke patients with cognitive impairment experience difficulties in processing meaningful stimuli from the environment, making it difficult for them to self-structure and organize their environment [10]. Specifically, impaired attention and executive function have been reported as factors that negatively affect the patient's return to society, in addition to resulting in serious deterioration of the ability to perform daily activities, such as academic tasks and leisure activities [11].

Attention is the ability to elicit an efficient behavioral response by accepting and selecting external stimuli from the surrounding environment [12,13]. Attention constitutes the first step of the brain's information processing process; thus, problems in maintaining proper attention result in difficulty in the execution of other cognitive functions [14,15]. Executive function is a comprehensive concept that integrates processes related to purposeful and goal-directed behavior, and it involves initiation, planning, sequencing, control and suppression of impulses, thinking flexibility, problem-solving, abstract thinking, organization, and social judgment [16–18]. The frontal lobe of the brain is responsible for executive function. In particular, neural networks in the prefrontal cortex are involved in learning, which plays an essential role in recovery and rehabilitation after brain injury. These networks are, therefore, the main target for effective rehabilitation [19,20]. If executive function is impaired, the ability to perform complex daily life activities decreases, negatively affecting social communication and thereby reducing social participation [21,22].

The objective of rehabilitation treatment is to allow stroke patients to live independent daily lives by recovering maximum residual function after injury [23]. Thus, if rehabilitation programs for stroke patients include training focused on attention and executive function, more efficient improvement in performing daily life activities can be expected [24]. A variety of effective training methods for stroke patients have been suggested. In particular, dual-task training involving the simultaneous execution of cognitive tasks and motor tasks in relation to the recovery of motor control in patients with neurological impairment (e.g., stroke) has been implemented in clinical settings [25]. In dual-task training, the patient performs 2 or more complex tasks of different characteristics that frequently occur in everyday life [26,27]. The objective of dual-task training is to improve the subject's ability to process information by performing 2 different tasks simultaneously [28]. Most daily life movements involve performing 2 motor tasks simultaneously, and performing various daily life activities involves the concurrent execution of high-level cognitive function and motor tasks [29,30]. However, despite the high frequency of dual tasks in daily life, rehabilitation of stroke patients is mainly performed under single-task conditions [31]. Because a training method that focuses on a single task does not reflect the complex activities of daily life, it has been reported that recovering fragmentary functions such as upper extremity function and balance alone does not significantly change the level at which individuals perform daily life activities [32]. Therefore, it is necessary to actively utilize dual-task training in which 2 or more different tasks are simultaneously handled in order to improve stroke patients' performance of daily activities [28].

Most existing studies conducted with stroke patients have involved the simultaneous performance of balance or gait training with upper extremity training or cognitive tasks, and many cases demonstrated positive effects of training [33–35]. Only a handful of studies on dual-task training have applied daily life activities and upper extremity movements together with cognitive tasks for stroke patients. Therefore, this study aimed to examine the effects of repeated dual-task training coupling daily life activities with attention and executive function on upper extremity function, cognitive function, and quality of life in stroke patients.

Materials and Methods

Participants

This study was conducted among 30 subjects who met the selection criteria among patients who were hospitalized after being diagnosed with stroke based on magnetic resonance imaging or computed tomography scans taken at the H hospital in Cheongju between July 2020 and October 2020. The specific inclusion criteria were as follows: (1) those with disease onset within the past 6 months, (2) those who scored at least 20 points on the Korean version of the Mini-Mental State Examination (K-MMSE) and were able to follow the researcher's instructions, (3) those in Brunnstrom Recovery Stage (BRS) 3 or higher, and (4) those who had no issues in communication or problems with vision or hearing and could follow instructions.

Protocol

The study period was from July 2020 to October 2020. The 30 subjects who met the inclusion criteria were randomized into experimental and control groups. The experimental group performed dual tasks for 20 minutes in the treatment room and received 10 minutes of conventional occupational therapy for a total of 30 minutes per session, 5 times a week for 5 weeks. The control group performed a single task for 20 minutes and received 10 minutes of conventional occupational therapy, for a total of 30 minutes per session, 5 times a week for 5 weeks. The dual tasks combined attention or executive function with daily life activities, whereas the single tasks consisted of sensory stimulation training on the paralyzed side, upper extremity muscle strength training, cognitive and perceptual training, and fine hand movement using tools. Occupational therapists with more than 4 years of experience conducted the evaluation (pre-assessment, intervention, and post-assessment, in sequential order). The design of this study is presented in Figure 1.

Outcome Measurements

Manual Function Test

The Manual Function Test (MFT) is widely used for the measurement of upper extremity function and motor ability in the early-stage rehabilitation of stroke patients [36]. Measurements are made on both the paralyzed and the non-paralyzed sides, with a total of 8 items in the areas of upper extremity movement (4 items), grip strength (2 items), and finger manipulation (2 items). For each sub-test that can be performed, a score of 1 is assigned up to a total of 32 points, and 0 is assigned for sub-tests that could not be performed. The MFT score is calculated by converting the initial score out of 32 points to a score out of 100 by multiplying it by 3.125. The test-retest concordance was 0.99 for the paralyzed side and 0.83 for the non-paralyzed side [37,38].

The Digit Span Test

The Digit Span Test (DST) consists of the DST-Forward and DST-Backward. The DST-Forward starts with 3 digits to repeat with 1 additional digit to memorize at each stage, for a total of 9 digits to memorize and repeat at the last stage. A higher number of digits indicates a higher level of attention. In the DST-Backward, the test is conducted in the same manner for scoring, and a higher number of digits indicates better working memory. The reliability was found to be 0.72 for the DST-Forward and 0.57 for the DST-Backward [39].

Executive Function Performance Test Korean version

Executive Function Performance Test Korean version (EFPT-K) evaluates executive function and instrumental daily life performance by measuring the degree of impairment of executive function, individual competence in independent function, and the level of assistance to complete tasks. For each task, points are given for elements of executive function such as initiation, preparation, ordering, judgment and safety, and termination, and each element is given a minimum of 0 points and a maximum of 5 points. The total score is scored from 0 to 100 points, and a lower score indicates a higher level of independence. The inter-tester reliability was 0.91 and the internal consistency was found to be high (0.94) [40].

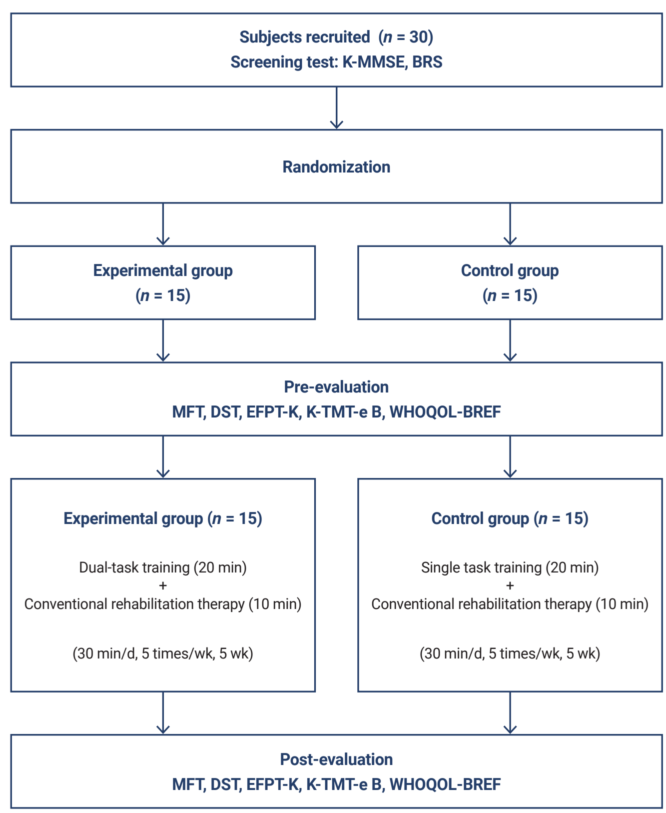

Figure 1. Flow chart of the study.
K-MMSE, Korean version of the Mini-Mental State Examination; BRS, Brunnstrom Recovery Stage; MFT, Manual Function Test; DST, Digit Span Test; EFPT-K, Executive Function Performance Test Korean version; K-TMT-e B, Korean version of the Trail Making Test for the Elderly B; WHOQOL-BREF, World Health Organization Quality of Life-BREF.

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Korean version of the Trail Making Test for the Elderly B

To measure the improvement in the speed of cognitive processing, the Korean version of the Trail Making Test for the Elderly B (K-TMT-e B) was conducted. Cognitive processing and executive function are measured through visual concept tracking and visual movement tracking. There are 2 types of the test (type A and B); however, only type B, which reflects attention movement and retrograde suppression, was used to determine cognitive processing speed. The instructions for the test are to connect items composed of numbers and alphabetical letters in alternating order. The frequency and type of errors are not separately recorded, but the instructions state that the test should be stopped if it takes more than 5 minutes [26,27]. The test-retest reliability of the K-TMT-e B was found to be relatively high (0.89) [41].

World Health Organization Quality of Life-BREF

Quality of life was measured using the World Health Organization Quality of Life-BREF (WHOQOL-BREF). The WHOQOL-BREF is divided into 4 subscales (physical health, psychology, social relations, and environment) and consists of a total of 26 items. It is measured on a 5-point scale (1 to 5 points), and higher scores indicate higher quality of life. The test-retest reliability ranged from 0.43 to 0.73, and the value of Cronbach's alpha, which indicates the degree of internal consistency, was found to be 0.89 [42].

Intervention

The dual-task training used in this study was designed based on previous studies [43,44] that examined training for attention and daily life activities for stroke patients, as well as the study by Park et al. [45], which conducted interventions for executive function in stroke patients. Attention training consisted of continuous subtraction, simple addition or subtraction, counting the numbers 1 to 20 forward or backward in order, reading words backwards, and a simple word game of coming up with a word that starts with the last letter of the previous word. Daily living-based activities included climbing the stairs, making tea or coffee, folding tops or bottoms, buttoning and unbuttoning, and moving beans. The activities for executive function consisted of presenting a virtual situation, explaining the order of wearing clothes, describing a daily routine, making a shopping list, and talking about categorization types. The activities of executive function were composed of items related to daily life activities. Because executive function is a high-level cognitive domain, it can cause confusion in patients with brain damage when performing the dual task of applying items that require higher-order thinking and daily life activities together. Therefore, for example, when "buttoning and unbuttoning" is performed as a daily activity, the corresponding item of the executive function would be "explaining the order of wearing clothes." Dual-task training was conducted by combining the aforementioned executive function and daily life activities (Table 1, Table S1).

Statistical Analysis

The statistical analysis was conducted using IBM SPSS ver. 24.0 (IBM Corp., Armonk, NY, USA). The normality of the distribution of data across the study subjects was determined using the Shapiro-Wilk test, and if normality could not be established, a nonparametric analysis was conducted. Among general characteristics, sex, stroke type, and the paralyzed side were analyzed using the chi-square and Mann-Whitney U-tests to test the homogeneity of the subjects before the intervention. Changes after the intervention within the experimental and the control groups were analyzed using the Wilcoxon signed rank test, whereas between-group differences before and after the intervention were analyzed using the Mann-Whitney U-test. The statistical significance level for all data was set to 0.05.

Results

General Characteristics of Research Subjects

The general characteristics of the subjects who participated in the study are presented in Table 2. There were 8 male (53.3%) and 7 female patients (46.7%) in the experimental group, and 7 male (46.7%) and 8 female patients (53.3%) in the control group. The mean age was 65.20 ± 12.17 years in the experimental group and 65.27 ± 12.73 years in the control group. The right and left sides were paralyzed in 6 (40.0%) and 9 patients (60.0%), respectively, in the experimental group, and the right side was paralyzed in 7 patients (46.7%) and the left side was paralyzed in 8 (53.3%) in the control group. The mean duration of disease was 4.07 ± 0.88 months in the experimental group and 4.20 ± 0.77 months in the control group. There were no significant differences in sex, age, the paralyzed side, disease duration, K-MMSE scores, and BRS between the 2 groups ($p > 0.05$).

Comparison of the MFT Results Before and After the Intervention

Table 3 shows the post-intervention changes in upper extremity function in the experimental and the control groups. MFT measures both the affected and unaffected sides, but in this study, only the affected side was measured and reflected in the results. In the experimental group,

Table 1. Dual-task training that combined attention and executive function tasks with daily activities

Daily living activity-based task	Attention task	Executive function task
Climbing stairs	Continuous subtraction e.g., 20−3−3−3	Presenting a virtual situation e.g., You're in a taxi but do not have your wallet.
Making tea/coffee	Simple addition/subtraction e.g., 5+4, 9−6	Explaining the order of wearing clothes e.g., Dress, skirt, pants, shirts, tie
Folding tops/bottoms	Counting numbers forward/backward in order e.g., Counting from 1 to 20 forwards/backwards in order	Talking about daily routine e.g., Describe your daily routine for today.
Buttoning/unbuttoning	Reading words backwards e.g., Hat, pencil, soap, ballpoint pen	Making a shopping list e.g., Make a shopping list for grocery shopping, pharmacy, bookstore.
Moving beans	Simple word game of coming up with a word that starts with the last letter of the previous word e.g., Standing-train-garage	Categorization e.g., Types of land animals, types of drinks, colors

Perform attention tasks while performing daily living activity, or perform executive function task while performing daily living activity.

Table 2. General characteristics of the research subjects

Characteristic	Experimental group (n = 15)	Control group (n = 15)	p
Mean age (y)	65.20 ± 12.17	65.27 ± 12.73	0.868
Sex			0.715
Male	8 (53.3)	7 (46.7)	
Female	7 (46.7)	8 (53.3)	
Stroke type			0.464
Infarction	8 (53.3)	6 (40.0)	
Hemorrhage	7 (46.7)	9 (60.0)	
Paralyzed side			0.713
Right	6 (40.0)	7 (46.7)	
Left	9 (60.0)	8 (53.3)	
Disease duration (mo)	4.07 ± 0.88	4.20 ± 0.77	0.691
K-MMSE (score)	24.00 ± 2.00	24.00 ± 1.96	0.916
BRS (phase)	5.33 ± 0.61	5.00 ± 0.65	0.161

Data are presented as mean ± standard deviation or n (%).
K-MMSE, Korean version of the Mini-Mental State Examination; BRS, Brunnstrom Recovery Stage.

all of the MFT items showed statistically significant improvements after the intervention ($p < 0.05$, $p < 0.01$). Similarly, the control group showed statistically significant improvements in all items after the intervention ($p < 0.05$, $p < 0.01$). Significant differences between the 2 groups were found in the changes in upper extremity function for all items, excluding the item for upper extremity movement ($p < 0.05$).

Comparison of the DST, EFPT-K, and K-TMT-e B Results Before and After the Intervention

The results for changes in cognitive function before and after the intervention in the experimental and control groups are presented in Table 4. The experimental group showed statistically significant improvements in both the DST-Forward and DST-Backward after the intervention ($p < 0.01$). The control group also showed significant improvements in all items after the intervention ($p < 0.05$, $p < 0.01$). Statistically significant improvements were seen for all items in the EFPT-K in both the experimental and the control groups ($p < 0.01$). For the K-TMT-e B, there was a statistically significant reduction in the time taken for completion after the intervention in both the experimental and the control groups ($p < 0.01$). On the cognitive function assessment, the experimental group showed slightly higher scores than the control group for all of the items, and there was a significant difference when the changes between the groups were compared ($p < 0.01$).

Comparison of the WHOQOL-BREF Results Before and After the Intervention

Table 5 shows the results for changes in the WHOQOL-

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Table 3. Changes in Manual Function Test scores after the intervention within groups and differences between groups ($n = 30$)

Variable	Intervention with groups				Difference between groups		
	Before (mean ± SD)	After (mean ± SD)	Z	p	Mean ± SD	Z	p
Upper extremity training							
EG	14.40 ± 1.35	15.53 ± 0.74	−2.724	0.006**	1.13 ± 1.18	−0.932	0.351
CG	14.40 ± 1.45	15.20 ± 1.01	−2.414	0.016*	0.80 ± 1.14		
Grip strength							
EG	5.33 ± 0.48	5.87 ± 0.35	−2.530	0.011*	0.67 ± 0.48	−2.159	0.031*
CG	5.47 ± 0.51	5.73 ± 0.45	−2.000	0.046*	0.27 ± 0.45		
Finger manipulation							
EG	4.60 ± 0.91	6.20 ± 1.08	−3.520	0.000**	1.60 ± 0.50	−2.361	0.018*
CG	4.60 ± 0.82	5.53 ± 0.99	−2.889	0.004**	0.93 ± 0.79		
Total score							
EG	24.53 ± 1.99	27.73 ± 1.58	−3.438	0.001**	3.20 ± 1.52	−2.430	0.015*
CG	24.47 ± 2.06	26.40 ± 1.95	−3.088	0.002**	1.93 ± 1.79		

SD, standard deviation; EG, experimental group; CG, control group.
*$p < 0.05$, **$p < 0.01$.

Table 4. Changes in the DST, EFPT-K, K-TMT-e B after the intervention within groups and differences between groups ($n = 30$)

Variable	Intervention with groups				Difference between groups		
	Before (mean ± SD)	After (mean ± SD)	Z	p	Mean ± SD	Z	p
DST-Forward							
EG	5.27 ± 0.88	6.93 ± 0.88	−3.542	0.000**	1.67 ± 0.48	−3.181	0.001**
CG	5.20 ± 1.08	6.07 ± 1.10	−3.127	0.002**	0.87 ± 0.64		
DST-Backward							
EG	2.60 ± 0.73	3.93 ± 0.45	−3.397	0.001**	1.33 ± 0.61	−3.500	0.000**
CG	3.00 ± 0.75	3.40 ± 0.73	−2.449	0.014*	0.40 ± 0.50		
EFPT-K							
EG	12.70 ± 2.51	9.96 ± 1.30	−3.413	0.001**	−2.74 ± 1.29	−4.720	0.000**
CG	12.70 ± 2.63	11.94 ± 2.58	−3.474	0.001**	−0.77 ± 0.19		
K-TMT-e B							
EG	89.13 ± 10.85	67.00 ± 12.16	−3.411	0.001**	−22.13 ± 4.86	−3.199	0.001**
CG	89.60 ± 12.33	77.00 ± 13.26	−3.412	0.001**	−12.60 ± 7.83		

DST, Digit Span Test; EFPT-K, Executive Function Performance Test Korean version; K-TMT-e B, Korean version of the Trail Making Test for the Elderly B; SD, standard deviation; EG, experimental group; CG, control group.
*$p < 0.05$, **$p < 0.01$.

BREF quality of life scale after the intervention for the experimental and the control groups. Statistically significant improvements were found for all items in both the experimental and the control groups after the intervention ($p < 0.01$), and there was a significant difference in the change in the quality of life between the 2 groups ($p < 0.01$).

Discussion

Dual-task training involves performing 2 or more complex tasks with different characteristics that frequently occur in daily life. The training requires performing 1 additional task while performing 1 basic task, or performing 2 or more tasks simultaneously [26,27]. To carry out functional movements in daily life, it is necessary to be able to perform multiple tasks at once [46–48]. According to previous studies on stroke, dual-task training was more effective in improving the subject's information processing ability than performing only 1 task at a time for the same amount of time [28]. However, most studies have used upper extremity functions together for balance and gait training, or have dealt with cognitive tasks for balance and gait

Table 5. Changes in WHOQOL-BREF after the intervention within groups and differences between groups ($n = 30$)

Variable	Intervention with groups				Difference between groups		
	Before (mean ± SD)	After (mean ± SD)	Z	p	Mean ± SD	Z	p
Physical health							
EG	19.47 ± 3.50	26.00 ± 2.59	−3.391	0.001**	6.53 ± 2.61	−3.158	0.002**
CG	19.93 ± 4.14	23.60 ± 4.18	−3.309	0.001**	3.67 ± 2.09		
Psychology							
EG	15.60 ± 2.44	22.33 ± 3.71	−3.423	0.001**	6.73 ± 2.86	−3.617	0.000**
CG	15.60 ± 2.92	18.47 ± 4.08	−3.196	0.001**	2.87 ± 1.88		
Social relations							
EG	8.73 ± 2.21	10.87 ± 1.99	−3.455	0.001**	2.13 ± 0.99	−3.094	0.002**
CG	8.67 ± 1.58	9.60 ± 1.76	−2.913	0.004**	0.93 ± 0.88		
Environment							
EG	23.53 ± 2.64	27.93 ± 3.15	−3.428	0.001**	4.40 ± 1.95	−3.524	0.000**
CG	23.73 ± 2.28	25.20 ± 2.65	−2.842	0.004**	1.47 ± 1.72		
Total score							
EG	68.13 ± 8.55	86.73 ± 9.52	−3.411	0.001**	18.60 ± 4.05	−3.596	0.000**
CG	66.93 ± 9.27	76.87 ± 11.74	−3.414	0.001**	9.93 ± 5.68		

WHOQOL-BREF, WHO Quality of Life-BREF; SD, standard deviation; EG, experimental group; CG, control group.
**$p < 0.01$.

training [30,31,33,34]. Therefore, in this study, we devised a dual task in which a cognitive task including attention and executive function was combined with daily living-based activities, and the effect of this activity on stroke patients was investigated. Dual-task activities were generated based on previous studies [43–45]. In each session, dual-task training appropriately integrated attention and executive function tasks with daily living activities.

The results revealed that both the experimental group, which performed daily life-based dual-task training, and the control group, which performed single-task training, showed improvements in upper extremity function after the intervention. A study by Kim et al. [49], investigated the effects of a dual task in which the experimental group moved the upper extremity of the paralyzed side while standing, and the results showed improvement in upper extremity function on the paralyzed side. In a study by Jang et al. [50], significant improvements were observed in functional movement of the upper extremity after performing tasks in dual-task and single-task groups, suggesting that upper extremity function can be improved with single-task training and conventional occupational therapy. Similarly, the improvement in upper extremity function in both groups of this study may have been due to the activities that heavily involved the upper extremity, such as sensory stimulation of the affected side and upper extremity movement using the affected side, in the daily life-based single and dual tasks.

When changes in cognitive function after the intervention in the experimental and the control groups were examined, significant improvements were observed for both groups in the DST, which assessed attention, the EFPT-K, which tested executive function, and the K-TMT-e B. However, an analysis of between-group differences showed that the change was significantly greater in the experimental group than in the control group. Kim and Kim [51] conducted concurrent motor tasks, such as ball throwing, clapping, and elastic bands, with cognitive tasks, including matching picture cards, finding vocabulary, and calculations in the experimental group, and showed a significant improvement in executive function compared to the control group, which performed single motor or cognitive tasks; this was consistent with the results of the present study. The results of the K-TMT-e B test used in this study showed a statistically significant reduction in the time taken for completion in the experimental group compared to the control group. The study by Mirelman et al. [52] reported that cognitive processing speed improved when motor function improved, while Han [44] reported an improvement in high-dimensional cognitive function as a result of activation of the cerebral cortex during dual-task training involving cognitive tasks. In this study, daily life activity training was consistently performed in addition to cognitive tasks that focused on attention and executive function, and the improved motor function is thought to have exerted a positive effect on cognitive processing speed. This combination of daily living

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and cognitive activities could have had a greater effect on the improvement of cognitive function in the experimental group.

When changes in the quality of life in the experimental and the control groups were examined, both the experimental group, which performed dual tasks, and the control group, which performed single tasks and received conventional occupational therapy, showed significant improvements in quality of life. In a study by Meester et al. [53], the experimental group was asked to perform dual tasks in which cognitive tasks were carried out or daily life activities were explained while on the treadmill, and the control group was asked to perform a single task on the treadmill. When quality of life was measured, both groups showed an improvement in confidence in their quality of life, but the quality of life in the experimental group was significantly higher. Similarly, in this study, the magnitude of the improvement after the intervention was significantly higher in the experimental group than in the control group. This seems to suggest that dual tasks have a greater effect on quality of life in stroke patients than single tasks, which is in line with the results of previous studies.

Although we were able to demonstrate that dual-task training involving daily living activities with a focus on attention and executive function can have positive effects on upper extremity function, cognitive function, and the quality of life in stroke patients, there are several limitations of this study. First, the results are difficult to generalize as there was only a small number of subjects. Second, the dual tasks could not be presented in accordance with individual competency. Third, follow-up tests were not performed, which could have identified continuing effects of the intervention. To supplement these limitations, additional research should be conducted with more subjects and with a comparison of the effects between the groups based on the individual competency of the subjects, as the impact of dual-task training may vary depending on individual competency [54]. Despite these limitations, this study has clinical significance in that executive function training was implemented in addition to attention in the cognitive function tasks, and that the study elicited active participation and motivation from the subjects since the daily living activities consisted of familiar activities.

Conclusion

This study demonstrated that dual-task training that focused on attention and executive function combined with daily living activities had a positive effect on upper extremity function, cognitive function, and the quality of life in stroke patients. This dual-task training represents a new method to help stroke patients return to their daily routines, and it is expected to be used as a foundation for the treatment of stroke patients in the future.

Supplementary Material

Table S1. Dual task programs per session. Supplementary data are available at https://doi.org/10.24171/j.phrp.2021.0177.

Notes

Ethics Approval

This study was approved by the Institutional Review Board (IRB) from the Cheongju University (IRB No: 1041107-202006-HR-031-01). Written informed consent was obtained from the subject before the intervention.

Conflicts of Interest

The authors have no conflicts of interest to declare.

Funding

None.

Availability of Data

The datasets are not publicly available but are available from the corresponding author upon reasonable request.

Additional Contributions

The authors would like to express their appreciation to all the participants and their families for their cooperation and participation in this study.

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