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Effect of Task Oriented Training on Cognitive Function in Elderly Stroke Patients

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Abstract

Background: *When a stroke is diagnosed, its effects are felt most immediately on the executive and attention functions, which can be compromised at different times after the stroke.*
Purpose: *to use task-oriented training to enhance cognitive function in elderly stroke patients.*
Methods: *Forty elderly stroke patients, both male and female, were divided into two equal groups at random. Group B underwent a three-month period of traditional physical therapy, with three sessions per week, while Group A was assigned to task-oriented training in addition to the former. Reha-com device, Addenbrooke's Cognitive Examination Revised (ACE-R) test, and Montreal Cognitive Assessment Scale (MoCA) were used to measure cognitive function at baseline and three months later.*
Results: *Following the intervention, the study and control groups showed statistically significant (P<0.05) variations in ACE-R (P=0.0001), MOCA (P=0.0001), and attention and concentration level (P=0.0001).*
Conclusion: *The impact of task-oriented training on cognitive function in elderly stroke patients is significant.*

Key Words: *Task Oriented Training, Cognitive Function and Stroke*

Introduction

Up to 60% of stroke survivors experience post-stroke cognitive impairment within the first year following their stroke, with a higher proportion observed soon after. The impairment can range in severity from mild to severe. Up to 20% of people with modest post-stroke cognitive impairment fully recover; recovery rates are strongest in the early stages following stroke. On the other hand, partial recovery is less common than improvement in cognitive impairment without a return to pre stroke levels (Jacquin et al, 2014).

Task-oriented training is a rehabilitation technique applied to individuals suffering from neurological impairments. It entails training to increase the patient's capacity to meet objectives for job completion, as well as to foster the development of effective compensatory techniques and problem-solving abilities through increased adaptability in a variety of situations. It is thought in this training that allowing stroke patients to try problem solving while functional tasks is a more effective way to improve function than having them repeatedly practice their usual movement pattern (Park et al, 2015).

Methods

The purpose of the current study was to investigate how task-oriented training affected the cognitive abilities of elderly stroke patients. All of the patients received referrals for post-stroke cognitive impairment (PSCI) from their neurological consultants after receiving clinical and radiological diagnoses. The study was conducted in the outpatient clinics of Kafr Elsheikh University, Faculty of Physical Therapy, with a selection of the patients. In addition to clinical study protocol registration under number (NCT06445998) and ethics approved by ethical committee, faculty of physical therapy, Kafr Elsheikh university (PT/NEUR/12/2023/53).

The study employed a true experimental research design, specifically a one factorial RCT with pre- and post-test control groups. To decrease inter-investigator error, a single, skilled research assistant evaluated each patient and gathered all data. In accordance with the therapy protocol, patients were randomised into two equal groups.

Randomization method: Patients who fulfilled the inclusion criteria of the trial were randomly assigned into two groups (A and B) by the use of an opaque closed envelope allocation technique that was secure. Twenty hemiparetic patients made comprised Group A (the study group) received task-oriented training in addition to a traditional physical therapy program three times a week for three months. Each session lasted one hour, with 30 minutes dedicated to task-oriented training and 30 minutes to the traditional physical therapy program. Twenty hemiparetic patients made up Group B (control group), who received a traditional physical therapy regimen consisting of three one-hour sessions each week for three months.

Blinding: Before starting and after the treatment program, every patient was evaluated and referred by the same doctor and physical therapist. Participants and the researcher were both kept in the dark about treatment allocations.

Inclusion criteria: Forty patients, aged 60 to 70 years, both male and female, hemiparetic in the right hand. They are complaining of a single ischemic stroke that was identified by a neurologist and verified by brain MRI imaging. The disease lasted anywhere from three to twelve months. Based on the Modified Ashworth Scale, the Spasticity grade ranges from 1 to 1+ (MAS). Both psychologically and medically stable individuals. Vital indicators (heart rate, blood pressure, temperature, and respiratory rate) were all normal and stable for each patient. Every patient exhibited a high degree of education, and their body mass index fell between 20 and 30 kg/m2.

Exclusion criteria: Individuals who do not have a history of stroke but instead have hemiparesis or recurrent stroke. Patients who are suffering from serious untreated cardiovascular problems, abnormalities of the visual, auditory, and other nervous systems. Individuals taking drugs that could impair their cognitive abilities.

Data collection and intervention Assessment methods

All participants completed a written consent form after learning about the objectives, procedures, possible advantages, privacy policies, and data use of the study. Every patient had assessments both before and after treatment.

Measurement procedures:

1- Assessment of cognitive function by Reha-com device

The patient was instructed to focus on each detail in the individually presented picture and choose the picture from the matrix that most closely resembled it in every detail. The assessment screen was divided into two sections, and the patient was using the computerized Reha-Com device with the attention and concentration program. Three photographs (1 by 3 matrix), six pictures (2 by 3 matrix), and nine pictures (3 by 3 matrix) are included in the matrix, which is represented by one part. The other part shows the separated picture. The matrix is divided into 24 levels of difficulty.

2- Addenbrooke's Cognitive Examination Revised (ACE-R) test
There are 26 tasks total, broken down into five categories. Administering it takes roughly fifteen minutes. The questions are asked in the prescribed order, with a maximum potential score of 100. Scores are computed instantly by adding the point values for each question that is answered properly (Mioshi Eneida et al, 2006).

3- Montreal Cognitive Assessment Scale (MoCA):
Screening for cognitive impairment is a popular use for this test. Its purpose was to identify moderate cognitive impairment. Completing the 30-point cognitive assessment tool takes about ten minutes. It is used to assess a variety of cognitive abilities, such as executive function, short-term memory, visual-spatial abilities, focus, attention, working memory, language, and time-and-place awareness. MoCA scores can have a range of 0 to 30. You fall within the typical range if your score was 26 or higher. A score of less than 25 denotes mild cognitive impairment (MCI) in stroke survivors, and it has a high specificity (83%) and sensitivity (77%) (Nasreddine et al, 2005).

Intervention methods

Task-oriented training program: [For study group]

Rocker board training

The participant was instructed to manipulate the rocking board's anteroposterior and mediolateral rolling motion by putting both feet initially, then one foot, opening and closing their eyes at first, then moving from a sitting to a standing posture.

Wobble board training

The participant was instructed to attempt to halt the multidirectional rolling wobble board movement ten times, starting from a sitting posture and moving to a standing position while keeping their eyes open and closed.

Sit to stand

The patient was told to bend forward, apply pressure to his heel, and then rise up. To stand, place both hands on the thigh and press against it. This exercise should be done ten times, first on a hard surface and then on a foam surface, with the eyes open and then closed.

Walk five steps forward

The patient was instructed to walk five steps forward from a standing position, first on a solid surface and then on a foam surface, repeating the exercise ten times.

Upstairs and downstairs three steps

The patient was instructed to perform five steps upstairs and five steps downstairs, first with hand support and then without, repeating ten times.

Traditional physical therapy program: [For both groups]

Range of motion exercises

The foot was exercised in its range of motion. The patient was instructed to lift the foot that was injured and rotate it clockwise and anticlockwise while seated in a chair. Five and ten times in each direction, repeat this cycle.

Strengthening exercises:

By strengthening the ankle dorsiflexors, planterflexors, invertors, and evertors, graduate active exercise was applied. Additionally, proprioceptive neuromuscular facilitation was used to strengthen distal muscles by repeatedly contracting the ankle joint's dorsiflexors for 10 minutes.

Sensory re-education:

Both deep and superficial feeling were stimulated tactilely.

Gait Training

Ten minutes were spent walking within a parallel bar with hand support and then without it. In addition, obstacles were used both with and without hand support.

Sample size calculation
The sample size for this study was calculated using the G*power program 3.1.9 (G power program version 3.1, Heinrich-Heine-University, Düsseldorf, Germany). Sample size calculation based on F tests (MANOVA: Special effects and interactions), Type I error (α) = 0.05, power (1-β error probability) = 0.80, effect size f2 (V) = 0.236592786, and Pillai V = 0.3826527 with a total sample size for 36 participants for 2 independent groups comparison for 3 major variable outcomes (ACE-R, MOCA and attention and concentration level). Considering a 10% drop out rate, the appropriate minimum sample size for this study will be 40 patients (20 patients in each group as a minimum).

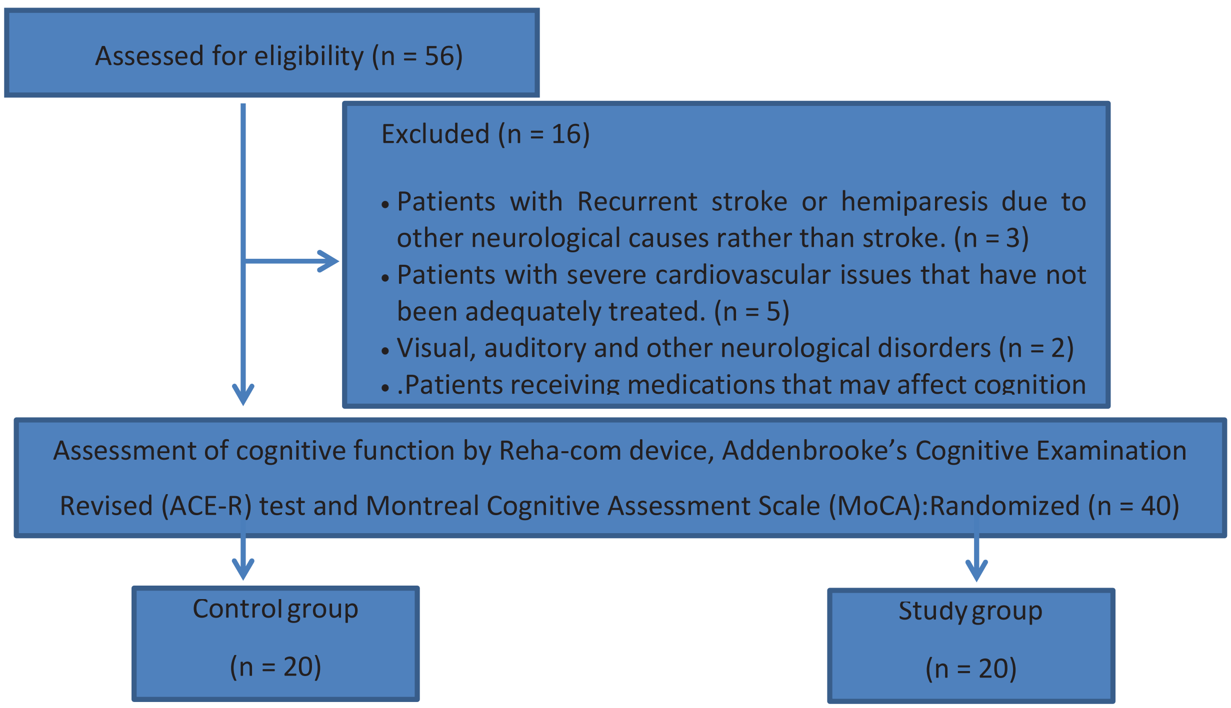

Fig 1: Flow Chart

Statistical analysis
Data were screened, for normality assumption test and homogeneity of variance. Normality test of data using Shapiro-Wilk test was used, that reflect the data was normally distributed (P>0.05) after removal outliers that detected by box and whiskers plots. Additionally, Levene's test for testing the homogeneity of variance revealed that there was no significant difference (P>0.05). All these findings allowed to conducted parametric and non-parametric analysis. The data is normally distributed and parametric analysis is done.

The statistical analysis was conducted by using statistical SPSS Package program version 25 for Windows (SPSS, Inc., Chicago, IL). Quantitative data for stroke patient's age, weight, height, ACE-R, MOCA, and attention and concentration level variables are reported as mean and standard deviation. Qualitative data are expressed as frequency and percentage for gender variables and compared statistically by Chi-square test. For demographic data (age, weight, height, and BMI) compared statistically by independent t-test between study group and control group. Mixed design 2 x 2 Multivariate analysis of variance (MANOVA) test was used for the first independent variable (between subject factors) was the tested group with 2 levels (study group vs. control group) and the second independent variable (within subject factor) was measuring periods with 2 levels (before-treatment vs. after-treatment) for the main dependent outcome variables (ACE-R, MOCA and attention and concentration level). Bonferroni correction test was used to compare between pairwise within and between groups of the tested variables which F was significant from MANOVA test. All statistical analyses were significant at level of probability (P ≤ 0.05).

Results:

A total of 40 patients from both gender (21 males: 19 females) suffering from post-stroke cognitive impairment were participated in this study and they distributed randomly into two equal groups (20 post-stroke patients/ group). The results of post-stroke patients demographic data showed that no significant differences (P>0.05) in mean values of age (P=0.791), weight (P=0.777), height (P=0.848), BMI (P=0.944), and gender (P=0.752) between study group and control group (Table 1).

Table 1. Demographic data for stroke patients in both groups

Items	Groups (Mean ±SD)		Statistic test[1]	*P*-value
	Study group (n=20)	Control group (n=20)		
Age (year)	63.97 ±2.82	63.75 ±2.49	0.267	0.791
Weight (kg)	85.66 ±4.64	86.05 ±4.22	0.433	0.777
Height (cm)	168.60 ±3.20	168.30 ±3.16	0.193	0.848
BMI (kg/m^2)	30.27 ±3.01	30.42 ±2.17	0.187	0.853
Gender (males : females)	11 (55.0%): 9 (45.0%)	10 (50.0%): 10 (50.0%)	0.100	0.752

[1] Quantitative data (age, weight, height, BMI) are expressed as mean ±standard deviation and compared statistically by independent t-test

[1] Qualitative data (gender) are expressed as frequency (percentage) and compared statistically by Chi-square test

P-value: probability value P-value > 0.05: non-significant

Statistical multiple pairwise comparison tests for main variable outcomes (ACE-R, MOCA and attention and concentration level) within each group (Table 2) showed that there were significantly (P<0.05) increased in ACE-R, MOCA, and attention and concentration level after-treatment compared to before-treatment within study group (P=0.0001, P=0.0001, and P=0.0001, respectively) and control group (P=0.0001, P=0.0001, and P=0.0001, respectively). The post-stroke cognitive impairment patients in study group more improved ACE-R (27.06%), MOCA (50.72%) and attention and concentration level (88.82%)than post-stroke patients in control group (14.43, 29.34 and 55.31%, respectively).

Statistical multiple pairwise comparison tests for main variable outcomes (ACE-R, MOCA and attention and concentration level) between both groups (Table 2) indicated that no significant differences (P>0.05) at before-treatment in ACE-R (P=0.876), MOCA (P=0.961) and attention and concentration level (P=0.461). However, after-treatment, there were significant differences (P<0.05) in ACE-R (P=0.0001), MOCA (P=0.0001) and attention and concentration level (P=0.0001) between study group and control.

Table 2: Inter and intra groups comparison for main variable outcomes

Variables	Items	Groups (Mean ±SD)		Change	F-value	*P*-value[2]
		Study group (n=20)	Control group (n=20)			
ACE-R	Before-treatment	74.24 ±3.53	74.41 ±3.31	0.17	0.025	0.876
	After-treatment	94.33 ±3.27	85.15 ±3.78	9.18	69.386	0.0001*
	Change (MD)	20.09	10.74			

	Improvement %	27.06%	14.43%			
	95% CI	17.89 –22.28	8.53 – 12.92			
	F-value	332.039	94.773			
	P-value[1]	0.0001*	0.0001*			
MOCA	Before-treatment	20.76 ±1.45	20.79 ±1.95	0.03	0.002	0.961
	After-treatment	31.29 ±2.21	26.89 ±2.49	4.40	45.398	0.0001*
	Change (MD)	10.53	6.10			
	Improvement %	50.72%	29.34%			
	95% CI	9.22 – 11.83	4.79 – 7.39			
	F-value	260.045	87.218			
	P-value[1]	0.0001*	0.0001*			
Attention and concentration level	Before-treatment	3.13 ±0.29	3.20 ±0.35	0.07	0.549	0.461
	After-treatment	5.91 ±0.31	4.97 ±0.20	1.94	431.663	0.0001*
	Change (MD)	2.78	1.77			
	Improvement %	88.82%	55.31%			
	95% CI	1.96 – 3.60	1.58 – 1.95			
	F-value	530.171	335.631			
	P-value[1]	0.0001*	0.0001*			

Data are reported as mean ± standard deviation (SD)
MD: Mean difference CI: confidence interval P-value: probability value * Significant (P<0.05)
P-value[1]: probability value within each group; P-value[2]: probability value between both groups at pre- and post-treatment

Discussion

In this study, we looked at how task-oriented training affected elderly stroke patients' cognitive function. Between the study group and control, as well as within group in both groups, there were significant differences (P<0.05) in the ACE-R (P=0.0001), MOCA (P=0.0001), and attention and concentration level (P=0.0001). It has been determined that different training programs improve cognition. Stroke survivors who engaged in physical activities like walking and jogging had a lower chance of developing cognitive impairment. Resistance training also improved cognitive function and maximised cognitive recovery following a stroke. In both healthy older adults and cognitively impaired adults, task-oriented training that incorporates elements of aerobic, strength, flexibility, or balance training has been shown to have favourable effects. Global cognitive and executive functions, processing speed, attention, and working memories have all shown benefits as a result of this challenging workout program that calls for a variety of actions performed in accordance with instructions (Fernandez-Gonzalo et al., 2016).

Task-oriented training is a sophisticated lower-extremity exercise in which participants solve a problem with visual feedback to gain knowledge of lower-extremity movement. For stroke patients with a low functional level, task-oriented training is a somewhat safe and simple training strategy. A prior study demonstrated that task-oriented training was superior to traditional physical therapy in terms of improving gait and balance. Its impact on cognitive performance has been thoroughly documented (Huh JS et al, 2015).

Stroke patients' cognitive performance was impacted by task-oriented training. Exercise for the lower limbs

has been shown to improve synaptic plasticity and connectivity; this benefit appears to be mediated by a neurotrophic factor generated from the brain. Additionally, neuroimaging research supports the idea that physical activity is linked to increased grey matter density in prefrontal and temporal regions as well as the volume of the hippocampus, as well as decreased age-related atrophy of grey and white matter (Gomez-Pinilla et al, 2018).
These findings suggested that enhanced brain structural integrity from exercise may result in increased cognitive function and that combining exercise with other forms of physical activity is more beneficial than doing it alone to increase brain neurogenesis (Erickson et al, 2019).

Using visual feedback, task-oriented training helps participants learn and retain movement patterns. Similar to this, dancing improves cognitive performance and increases hippocampal volume because it requires physical exercise, rhythmic motor coordination, balance, memory, sensorimotor, and visual stimulation. This is because dancing provides a visual cue for balance. Task-oriented training increases the recreational component of physical activity, which makes exercise more engaging and may promote training adherence (Hufner et al., 2019).

Complex deficits combining motor, sensory, and cognitive processes are common in stroke patients. Patients often undergo therapy focused on one element of recovery at a time. For instance, occupational therapy primarily offers training for improving cognitive function, whereas physical therapy focusses on improving motor function. However, integration of motor and cognitive function is necessary for many stroke patients with complicated disability. Task-oriented training may therefore be regarded as a useful tool in a post-stroke cognitive rehabilitation program in light of our findings that it enhanced gait and balance skills in addition to cognitive capabilities (Balami et al., 2020).

We were able to demonstrate in this study the benefits of task-oriented training for elderly stroke patients' cognitive function.

Authors' Contributions statement
Authors were responsible for the conceptualization of the study, data collection, statistical analysis, and preparation of the first draft of the article and editing of the article.

Data availability statement:
The data used to support the findings this study are available from the corresponding author upon request.

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The authors have declared that no competing interests exist.

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Implications of Physiotherapy Practice
The impact of task-oriented training on cognitive function in elderly stroke patients is significant.

References
[1] Balami JS, Chen RL and Buchan AM. Stroke syndromes and clinical management. QJM. 106:607–15, 2020.
[2] Erickson KI, Prakash RS, Voss MW, Chaddock L, Hu L and Morris KS. Aerobic fitness is associated with hippocampal volume in elderly humans. Hippocampus. 19:1030–9, 2019.
[3] Fernandez-Gonzalo R, Fernandez-Gonzalo S, Turon M, Prieto C, Tesch PA and Garcia-Carreira Mdel C. Muscle, functional and cognitive adaptations after flywheel resistance training in stroke patients: a pilot randomized controlled trial. J Neuroeng Rehabil. 13:37, 2016.

[4] Gomez-Pinilla F, Vaynman S and Ying Z. Brain-derived neurotrophic factor functions as a metabotrophin to mediate the effects of exercise on cognition. Eur J Neurosci. 28:2278–87, 2018.
[5] Hufner K, Binetti C, Hamilton DA, Stephan T, Flanagin VL and Linn J. Structural and functional plasticity of the hippocampal formation in professional dancers and slackliners. Hippocampus. 21:855–65, 2019.
[6] Huh JS, Lee YS, Kim CH, Min YS, Kang MG and Jung TD. Effects of balance control training on functional outcomes in subacute hemiparetic stroke patients. Ann Rehabil Med. 39:995–1001, 2015.
[7] Jacquin A, Binquet C, Rouaud O, Graule-Petot A, Daubail B, Osseby GV, Bonithon-Kopp C, Giroud M and Bejot Y. Post-stroke cognitive impairment: high prevalence and determining factors in a cohort of mild stroke.J Alzheimers Dis. 2014; 40:1029–1038, 2014.
[8] Mioshi Eneida, Dawson Kate, Mitchell Joanna, Arnold Robert and Hodges John R. The Addenbrooke's Cognitive Examination Revised (ACE-R): a brief cognitive test battery for dementia screening. 21(11), 1078–1085, 2006.
[9] Nasreddine ZS, Phillips NA and Bédirian V. The Montreal Cognitive Assessment, MoCA: a brief screening tool for mild cognitive impairment. J Am Geriatr Soc. 53(4):695-9, 2005.
[10] Park J and Yoo C. Effects of task-oriented training on upper extremity function and performance of daily activities by chronic stroke patients. J Phys Ther Sci, 27: 2657–2659, 2015.