Effect of Adding Physical Exercises to Cognitive Rehabilitation in Post-Ischemic Stroke Patients

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Abstract

Abstract: Cognitive impairment is a prevalent concern in post-ischemic stroke patients. And independently linked to lower quality of life, increased mortality rates as well as increases the risk of falling, institutionalization, and healthcare costs. Therefore, multicomponent rehabilitation is necessary for managing it. **Aim of the research:** To evaluate the effect of adding physical exercises to cognitive rehabilitation in post-ischemic stroke patients. **Research design:** A quasi-experimental research design (study/ control) was utilized in the current research. **Research setting:** The current research was conducted at intermediate stroke department and follow-up at rehabilitation out-patient clinic. **Sample:** purposive sample of 90 patients (male and female) with cognitive impairment after being diagnosed with ischemic stroke were recruited into three groups with equal rate; the intervention groups (cognitive training = 30, and combined physical and cognitive training =30) and one control group = 30. **Tools:** structured interview questionnaire, Montreal cognitive assessment scale and modified Rankin Scale. **Results**: The study findings showed a significant improvement in the cognitive functions from moderate impairment at baseline for combined physical and cognitive training and cognitive training groups (80% and 73.3 %) respectively to mild impairment post six-months intervention (100 % and 76.6 %) respectively. **Conclusion:** Adding physical exercises to cognitive rehabilitation intervention induced greater advantages on cognitive function and disability levels among post-ischemic stroke patients. **Recommendation**: Establishing training programs for patients that contain a multi-component intervention and cognitive training for PSCI.

Keywords: Cognitive Rehabilitation, Physical Exercises, Post-Ischemic Stroke.

Introduction

Stroke is one of the leading causes of disability and death worldwide. Around 200 cases of stroke occur in every 10,000 people globally. **(Amorós-Aguilar, et al., 2021).** Stroke defined as "rapidly developing clinical signs of focal (or global) disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than of vascular origin " **(Srithumsuk, et al., 2020).** In general, Stroke affects the individual's physical, social, psychological status, as well as, the patient's cognitive functions are significantly deteriorated especially executive, attention and memory. **(Hernández & González-Gálvez, 2021)**.

Strokes are classified to ischemic and hemorrhagic. Ischemic stroke is more common, and causes obstruction of the blood vessel, either atherosclerosis of large arteries or cardio-embolic and small vessels diseases. The hemorrhagic type causes a blood vessel rupture and is more severe and fatal. **(Fava-Felix, et al., 2022).** Stroke patients symptomized by impaired physical and sensory functions, vision loss, speech disorders and cognitive impairment **(Li, et al., 2022).** Ischemic stroke represents 85% of the total patients with stroke and it is a medical emergency; if untreated, can cause cerebral infarctions or global hypoxic-ischemic, encephalopathy, which can cause death or permanent disability. **(Juli, 2022), (DeSai & Shapshak 2021).**

Stroke is the second leading cause of cognitive deterioration. Cognition is consisted of attention, memory, executive function, visuospatial ability, verbal information, language, and other aspects. Post-stroke cognitive impairment (PSCI) included a set of deficits across multiple domains such as

memory, attention, executive function, language, and visuo-perceptual ability. Different cognitive domains enable complex mental processes to occur, which enable an individual to select and process information within their environment **(Jokinen, et al., 2015; Fava-Felix, et al., 2022).** PSCI is usually underdiagnosed, and neglected consequence compared to other neurological deficits as it may be observed in the other distressing signs as sensory or motor symptoms **(Kalaria, et al., 2016; Kim, et al., 2022).** Various studies demonstrated that, PSCI accounts more than 66% at the acute stage of patient's stroke and 69.8–96% of patients in the following three to six months post the stroke's inception **(Kalaria, Akinyemi, & Ihara, 2016; Li, et al., 2020; Dowling, et al., 2022)**. Also, a recent study displayed that, total PSCI incidence was 78.8% **He, et al., (2022)**. PSCI is significantly associated with older age, hypertension, diabetes mellitus type 2, atrial fibrillation, high homocysteine, cardiac and carotid arterial diseases, overweight, metabolic syndrome, physical inactivity, alcohol as well as drug misuse **(Soliman, et al., 2018 & Omran et al., 2022) .**

Numerous studies demonstrated that even minor degrees of cognitive impairments have a detrimental effect on the patient's activities of daily living and quality of life. by increasing functional decline, reducing the degree of independence, increase recurrence of stroke, impeding patients from returning to family and society. In addition, it increases the difficulty of overall rehabilitation with long-term morbidity and disability, as well as, caregiver's burden and health care resources were also, increased **(Almalki, et al., 2018; & Zhang & Bi, 2020; O'Donoghue, et al., 2022).** One out of every three stroke survivors develop dementia as a consequence of post-stroke cognitive and physical disability, and more than 50 % of patients have difficulties in implementing activities of daily living (ADL). Cognitive and physical deterioration are between the early associated manifestations of stroke **(Heshmatollah, et al., 2020).**

Many evidence showed that physical exercises can positively affect several physical and cognitive domains after a stroke. **(Di Raimondo, 2020)**. Physical exercise (both walking and resistance training) are widely accessible, low-cost and safe interventions, and is strongly linked to reduced disability and improved cognitive functioning among post ischemic stroke patients, gains the ability to ambulate and more likely independent walking, demonstrate self-care skills, effective support and stability, prevent or correct deformities, and compensate for functional deformities. Physical exercise is "a subset of physical activity that is planned, structured, and repetitive and has as a final or an intermediate objective for improvement or maintenance of physical fitness." **(Deijle, et al., 2022).** Exercise is a crucial part of preventing and treating cerebral ischemia. In fact, physical exercises primarily increase cerebral blood flow and neuro-growth factor release, to aid the structural and functional repair of the brain's damaged areas, then improve the brain arousal while restoring cognitive function, before strengthening the brain capacity for limb coordination and control and minimizing anxiety and depressed symptoms **(Amorós-Aguilar, et al., 2021**; **Zhang et al., 2022).** Cognitive rehabilitation is "a systematic functionally orientated intervention of therapeutic cognitive activities established on the assessment and understanding of the patient's brain behavior deficits". (**O'Donoghue, et al., 2022).** Several cognitive rehabilitation techniques have been explored on stroke patients who have cognitive damage following their strokes **(Zhao, et al., 2021).** Cognitive training in stroke patients enhances synapse density, improves cerebral gray matter, and increases hippocampus volume, all of which have a positive effect on the intrinsic activity of the brain at rest and its anatomical connections. Additionally, cognitive training improved one's capacity to perceive, articulate, and responds to questions accurately as well as their overall cellular activity and metabolic rate in particular brain regions **(Farokhi-Sisakht, et al., 2019).** Regular cognitive training has preventive effects that can postpone cognitive decline and improves cognitive performance even people are aged. The structural connectivity and intrinsic activity of the brain at rest are both altered positively by training. Increased synaptic density, improved cerebral grey matter, increased hippocampal volume, and enhancements to overall cellular activity

and metabolic rate in certain brain regions are examples of neuroplasticity changes. **(Alia, et al., 2017).**

Findings of a previous meta-analysis studies, combined regular exercises with cognitive training improve physical abilities, level of independency, as well as, cognitive functioning through enhancing neurogenesis, angiogenesis, upregulate factor of neurotrophic, and increase neurons and neuronal networks. Walking is one of the complex action involving the interplay of neuromuscular, sensory and cognitive functions. Regular and long-term physical exercises over time increases muscle strength, joint flexibility and activity tolerance as well as, the synthesis of nerve growth factor and brain derived neurotrophic factor, which affects neuronal cells and promotes neurogenesis, inducing positive changes in the brain **(Kang, et al., 2021).** Thus, incorporated physical exercise and cognitive training have shown synergistic positive impact on improving cognitive function post-ischemic stroke compared with each intervention alone. **(Di Benedetto, et al., 2017; Sipilä, et al., 2018).**

Research Significance

Stroke is the third cause of disability and the leading reason of mortality worldwide. 795,000 people in the United States are affected each year **(Omran et al., 2022)**. According the data published by WHO, in April 2011, there were 52,166 stroke fatalities in Egypt, or 14.37% of all deaths **(WHO, 2011)**. Acute Ischemic Stroke (AIS) represented 69.6-70.8% of all case's stroke in China **(Li, et al., 2022)**. Recent study reported that, PSCI affects 66% of stroke patients **(Omran et al., 2022)**. Another recent study performed in china documented that, PSCI affects 53–81% of stroke patients (**Li, et al., 2022)**. Although patients may recover from physical disability after stroke, PSCI limits autonomy and independence, impacts patient quality of life, and significantly increases the cost of care and use of medical resources, as well as, readmissions and mortality rate. **(Zhao, et al., 2021).** Stroke rehabilitation usually highlights on motor deficits, and the hidden cognitive deficits often neglected. On the other hand, several studies reported that adding physical exercises to cognitive rehabilitation has demonstrated a positive synergetic effect on the outcomes of general cognitive functioning for post- ischemic stroke patients.

Aim of the research:

Evaluate the effect of adding physical exercises to cognitive rehabilitation in post-ischemic stroke patients.

Research hypothesis:

Participants who are subjected to combined physical and cognitive training is more likely to show improvement in the cognitive functions and low disability levels (AD) compared with other study groups.

Methods:

Research design: Quasi-experimental research design (study/control), aims to establish a cause-and-effect relationship between an independent and dependent variable. The common types are nonequivalent groups' designs, pretest-posttest, and interrupted time series designs, and combination design **(Baker, 2017).**

Research setting: The current study was performed at intermediate stroke department which located in the third floor and consist of three rooms each room contains six bed. Follow-up was performed in the rehabilitation out-patient clinic which present in the grounded floor and contained three rooms for patients' examination in the main Minia university hospital, which locates in Minia City, Egypt.

Research sample: Purposive sample of 90 patients (male and female), with cognitive impairment being diagnosed with ischemic stroke, the participants were recruited and allocated into three groups with equal rate; the intervention groups (cognitive training= 30, or combined physical and cognitive training =30) and control group = 30.

Sample size:

The Isaac and Michael (1995) Formula, which is determined as (N=nx30/100), was used to determine the sample size.

N=minimum sample size

n=total number of 200 of stroke patients during the period 2021:2022.

N=300x30/100=60 patient

Minimum Sample size: 90 patients

Study groups (cognitive training: 30 patients + combined cognitive and physical training: 30 patients) and for control group: 30 patients

Inclusion criteria:

Participants eligible to the allocated study if they have the following inclusion criteria: (1) Age between 20 to more than 65 years (2) Ischemic stroke. (3) Admission to a stroke department within the first 24 hours of stroke onset. (4) Be conscious, and medically stable. (5) Being able to walk with or without aids. (5) Patients accepted to share in the current study.

Exclusion criteria:

If participants had one or more of the following criteria, they were excluded from the current study: (1) Previous stroke. (2) Participants with severe language problem, vision and/or auditory issues or a neuropsychiatric problem interfering with cognitive assessment. (3) Direct admission to the stroke intensive care department. (4) Participants with serious medical conditions, such as those affecting the heart, liver, kidney, endocrine system, or hemotopoietic system. (5) Enrolment in another intervention trial. (6) Musculoskeletal contraindication to exercises.

Data collection Tools:

One tool and two scales were utilized for data collection of the current research:

Tools I: Structured interview questionnaire developed by the researchers based on review of extensive relevant literature, it included two parts:-

Part I: Socio-demographic characteristics such as name, age, gender, and educational qualifications, residence, marital status, occupation, living condition, and monthly income

Part II; Medical history of post stroke cognitive impairment such as history of smoking, diabetes, hypertension, Stroke severity.

Second tool: Montreal Cognitive Assessment (MoCA) scale:

It was created by Ziad Nasreddine in Montreal, Canada in 1996. MoCA scale was designed for assessing different cognitive functions. It contains 30 questions and can be administered in 10 minutes. Scoring of MoCA range from zero to 30. A score of 26 and higher is considered normal. MoCA assesses eight domains of cognitive which included; Visuospatial/executive (five points), Animal Naming (three points), Memory, (five points) Attention, (six points), Language (three points), Abstraction (two points) Delayed recall (five points), as well as orientation (to time and place). (six points), And finally, one point for education level is added to the test-taker's score if they have twelve years or less of formal education. **(Julayanont & Nasreddine, 2017).**

Scoring system for MoCA scale: Normal equal more than 26, Mild equal 18 – 25, Moderate equal 10 – 17**,** severe equal less than 10.

Third tool: modified Rankin Scale (mRS):

Modified Rankin Scale (mRS) was originally introduced in Scotland in1957 by Rankin for evaluating the level of disability or dependence in the daily activities in post-stroke patients. mRS composed of a single item that had five ratings to signify including; no disability, moderate disability, moderately severe disability, and severe disability. This scale commonly requires yes or no answers by a patient or a caregiver, it requires 5 minutes to complete. **(Broderick, Adeoye, & Elm, 2017)**. **Scoring system** of mRS defines 6 different levels of disability, from 0 for "no symptoms at all" to 6 indicating 'death'. A score from zero to three parallel mild to moderate disability, and a score from four to five parallel severe disability.

Modified Rankin Scale scoring (mRS)

Rankin Grade	Description
0	No symptoms
1	No significant disability despite symptoms; able to carry out all usual duties and activities
2	Slight disability: unable to carry out all previous activities but able to look after own affairs without assistance
3	Moderate disability: requiring some help, but *able to walk without assistance
4	Moderately severe disability: unable to walk without assistance, and unable to attend to own bodily needs without assistance
5	Severe disability: bedridden, incontinent, and requiring constant nursing care and attention

Ethical considerations:

All formal permits were taken from the convenient authorities to perform this research. The research's approval taken from Faculty of Nursing's Ethics Committee at Minia University after reviewing the proposal of the research. Each patient consented freely and voluntarily. There was no risk for patients during the conduction of the current research, and patients have the right to refuse participation in the current research or withdraw at any stage without penalty. Privacy as well as confidentiality also the anonymity were ensured during data collection and encoding.

Content validity:

The study tools were revised by a five-panel of Medical-Surgical nursing, Rehabilitation and physical medicine and Community Health Nursing, and Psychiatric and Mental Health Nursing to assess the tools' clarity, viability, and applicability, the field of nursing specialists with more than ten years of experience was consulted.

Reliability:

Test-retest and inter-rater reliability of the MoCA were 0.966 and 0.926, respectively, and Cronbach's alpha was 0.884. Strong test-re-test reliability demonstrated that, mRS has been reported (Ҡ 0.81 to 0.95)**.**

Pilot study:

A pilot study was conducted on ten percent (n = 9) of the total research sample to test the clarity of tools and determine the time required for completing it. Fieldwork should be modified, and any potential obstacles that could prevent the investigator from collecting data should be identified. There were no changes made. The trial sample was included in the basic sample.

Fieldwork of the Research:

The current research was conducted in three phases as following: preparatory, implementation and finally evaluating phase.

Phase I: Preparatory phase:

The present research began by preparing the data collection tools, after reviewing the current and previous literature in the field of the study by using textbooks, journals, articles, periodicals, and the internet to have an evident picture of all aspects related to the topic of research such as **(Fava-Felix, et al., 2022; Zhang et al., 2022; Boutros, et al., 2022).** The researchers visited the selected setting before data collection to coordinate and establish the procedures for recruiting, and collection of data. This stage helped in guiding, directing, planning, and developing the nursing protocol as well as the formal paper agreement that was obtained one month before starting the research. Oral consent was taken from the patients who accepted to participate in the present study.

Implementation phase:

The current research data was collected over duration of six months with frequency three days a week, from the start of January 2022 to the end of June 2022. The researchers have started the collection of data from post-ischemic stroke patients; after 24 hours of their admission to the intermediate stroke department and after ensuring that they became medically stable, the researchers started a face to face interview with each patient individually and their relatives to establish the baseline assessment which included age, sex and stroke severity. All participants in the current study were subjected to a screening process for cognitive function using Montreal Cognitive Assessment (MoCA) scale, and disability or dependence in activity of daily living (ADL) by using the modified Rankin Scale (mRS). Following the initial baseline assessment, eligible participants were randomly assigned either to control group, or cognitive training group, or combined cognitive and physical training group.

Study groups:

Applying physical and cognitive training for patients with post-stroke cognitive impairment (PSCI): this training formulated by the researchers after revising extensive relevant literature review such as **(Kim & Cho, 2022; Amorós-Aguilar, et al., 2021; Abd Allah, et al., 2021).** This training was applied to improve cognitive functions and decrease level of disability for ischemic stroke patients; it was designed in the form of power point

presentation sessions in a simple Arabic language, containing photos, illustrations, and video clips to help the patients and their caregivers understanding this training. The educational training covered the following two parts. The first part was consisted of two theoretical sessions. The first session covered overview of stroke disease, its risk factors, managements and prevention of recurrence. The second sessions focused on the importance of the physical and cognitive training for stroke patients, the second part of this training; addressed two practical training sessions that included various types of both physical exercises and cognitive training. The demonstration and re-demonstration were carried out to ensure that the participants and their relatives can follow this procedure perfectly. The patients performed physical exercise and cognitive training during their staying in the hospital, and after discharge, during their attendance to the out-patient clinic of rehabilitation. The total number of sessions was 72 along study duration.

Combined physical and cognitive training group: received both physical and cognitive training.

Cognitive training group: received the same cognitive training of the first group.

Control group: received the routine hospital care, and at the end of study the researchers providing them the same physical and cognitive training that was given to the study group.

Components of the physical exercises and cognitive training include:

Walking exercise with or without assistive devices, accumulated in bouts of ten minutes each to attain the daily goal of thirty minutes.

Resistance exercise: the participants were asked to perform 60 minutes of resistance exercises. started by 5 minutes of warm up and finished with 5 minutes off cool down in the form of range of motion exercises (ROM) on both upper and lower body parts to maintain normal cardiac levels and avoid sudden drop in the blood pressure. Tolerable resistance exercise progress from 8-10 repetition through the first three months then progress to 10 to 12 repetition along the second three months. Wrist curls, wrist and hand stretches, shoulder openers, table towel slides, trunk bends, knee rotations, hip abductions, and sit-to-stands exercises.

Cognitive rehabilitation: consisted of a face-to-face interview for 60 minutes between the patient and the researchers, and it was administered in individual sessions. Training was customized according to the needs of each patient; and it included:

Orientation training: The patient was questioned by the researchers regarding the day's direction, the date, time, and the position of the hospital's various objects as well as the distances between those objects and the patient's left and right limbs; **Memory training:** the researchers asked the patient to look at pictures and remember numbers, memorize numbers, recite lyrics and verses, recall and tell a few things and individuals have just seen; **Attention and concentration training:** such as board games, listen to music and count money; it stimulates concentration and memory skills, as well as, enhance socialization and spend time with friends and family; **Training to solve problems**: Assemble tasks relating to daily living and let the patient to perform them on their own, such as eating after washing, putting on clothes and socks, and sitting in a chair. Other activities include Sudoku, word searches, and crossword puzzles; **Art therapy:** drawing, coloring, and painting to stimulate creativity, analytical skills and express their emotions, coordination hand as well as eye, and restoration of strength in the body's parts impacted by stroke. **Language training:** patients' verbal expressiveness and critical thinking abilities by frequent listening, reading, reciting stories and facts, asking questions, and discussing themes of interest to the patients.

Evaluation phase:

The researchers assessed the participant's cognitive function and the degree of disability or dependence in the activities every day at baseline, then after 3 months of intervention, and lastly after 6 months of starting the intervention.

Statistical analysis

The statistical software for social sciences (SPSS) version 22 was used to arrange, classify, and analyze the collected data. For qualitative and quantitative variables, respectively, the mean and standard deviations of the data were reported using descriptive statistics. The paired t-test, chi-square test, and correlation r-test were the statistical tests that were applied. When the p-value was less than 0.05, strong significance was assumed, and no statistical significance difference was taken into account when the p-value was greater than 0.05.

Results

Table (1): Reveals that (40 %, 46.7%, 46.7%) of control, cognitive training and combined cognitive and training groups' ages located between (60 ≤ 80) with nearly similar mean age. Concerning to gender; it was observed that (46.7%) of the control group and the cognitive training group were male, while (56.7 %) of combined cognitive & physical training groups were female. In respect to residence, it was found that (46.7%, 53.3%, 50%) respectively of the studied groups are living in rural area. In relation to marital status, study data cleared that (53.3 %) among all studied groups are married. Regarding to level of education, it is found that (36.7 %, 46.7 %, 40 %) respectively of all the studied groups were illiterate. There are no statistically significant differences between the studied groups regarding their socio-demographic characteristics.

Table (2): Shows that (43.3 %, 53.3% & 50%) of the control, cognitive training and combined cognitive & physical training groups were hypertensive, while, (30 %, 33.3% & 33.3%) respectively of all studied groups were diabetic. In relation to, smoking, study data found that (36.7 %, 33.3 % and 33.3 %) respectively were cigarette smokers. Regarding to, stroke severity; it was observed (53.3 %, 60 %, and 56.7 %) of all the studied groups were suffering from Moderate stroke. Also, there are no statistical significant differences among intervention and control group regarding their medical history (p>0.05).

Table (3): Depicts that, there were steadily and significant improvement in the cognitive functions of combined physical and cognitive training and cognitive training groups from 80% and 73.3% respectively from moderate impairment at baseline to 100 % and 76.6 % respectively mild impairment post six-months intervention. There were statistical significant differences between the studied groups regarding MOCA scale scores.

Table (4): Shows that 36.7 %, 36.7 % and 36.7 % of control, cognitive training and combined physical and cognitive training groups respectively have moderate to severe disability at baseline assessment, compared to, 16.7%, 3.3 % and 0 % respectively have moderate to severe disability post six-months of intervention. There were statistical significant differences between the studied groups regarding modified ranking scale.

Fig (1): Illustrates that the mean score of Montreal cognitive assessment scale (MoCA) was nearly similar at baseline for the control, cognitive training and combined cognitive & physical training groups (16.3±1.27, 16.7±1.04, 16.8± 1.04) respectively. While, at 6 months post intervention, the mean scores of MoCA scale was increased for combined physical and cognitive training and cognitive training groups (21.4±0.535, 19.8±0.781) respectively compared with (17.7±0.881) for control group.

Table (1): Distribution of the studied Groups regarding to their Socio-demographic Characteristics (n=90)

Socio-demographic characteristics	Control (n=30)		Cognitive training (n=30)		Cognitive & physical (n=30)		X^2	P value
	No.	%	No.	%	No.	%		
Age / Years								
20 ≤40	8	26.7	11	36.7	7	23.3	**(1.10)**	**0.894**
40 < 60	10	33.3	5	16.7	9	30		
≥ 60	12	40	14	46.7	14	46.7		
Mean ± SD	68.5 ± 3.95		71.1 ± 4.38		70.9 ± 4.40			
Gender								
Male	14	46.7	14	46.7	13	43.3	**(0.623)**	**0.732**
Female	16	53.3	16	53.3	17	56.7		
Residence								
Rural	14	46.7	16	53.3	15	50	**(0.267)**	**0.875**
Urban	16	53.3	14	46.7	15	50		
Marital Status								
Single	5	16.7	6	20	5	16.7	**(0.768)**	**0.993**
Married	16	53.3	16	53.3	16	53.3		
Divorced	4	13.3	5	16.7	5	16.7		
Widow	5	16.7	3	10	4	13.3		
Level of Education								
Illiterate	11	36.7	14	46.7	12	40	**(2.22)**	**0.973**
Read and Write	8	26.7	7	23.3	9	30		
Elementary	5	16.7	3	10	2	6.7		
Secondary	3	10	3	10	3	10		
University	3	10	3	10	4	13.3		
Occupation								
House wife	10	33.3	10	33.3	13	43.3	**(2.26)**	**0.894**
Employer	4	13.3	2	6.7	4	13.3		
Farmer	6	20	6	20	5	16.7		
Unemployed / Retired	10	33.3	12	40	8	26.7		
Living condition								
Living alone	3	10	5	16.7	4	13.3	**(0.975)**	**0.916**
With the only wife/husband	14	46.7	15	50	15	50		
Living with closed family	13	43.3	10	33.3	11	36.7		
Monthly Income								
Enough	17	56.7	18	60	15	50	**(0.630)**	**0.730**
Not-enough	13	43.3	12	40	15	50		

Table (2): Distribution of the Studied Groups Regarding Their Medical History (n=90)

Medical History	Control (n=30)		Cognitive training (n=30)		Cognitive & physical training (n=30)		X^2	P value
	No.	%	No.	%	No.	%		
Presence of chronic illness								
Diabetes mellitus	**9**	**30**	**10**	**33.3**	**10**	**33.3**	**8.83**	**0.183**
Hypertension	**13**	**43.3**	**16**	**53.3**	**15**	**50**		
Diabetes & Hypertension	**5**	**16.7**	**0**	**0**	**0**	**0**		
Heart disease	**3**	**10**	**4**	**13.3**	**5**	**16.7**		
Smoking								
No smoking	**15**	**50**	**17**	**56.7**	**18**	**60**	**1.01**	**0.913**
Cigarette	**11**	**36.7**	**10**	**33.3**	**10**	**33.3**		
Shisha	**4**	**13.3**	**3**	**10**	**2**	**6.7**		
Stroke severity								
Minor stroke	**11**	**36.7**	**9**	**30**	**9**	**30**	**0.594**	**0.964**
Moderate stroke	**16**	**53.3**	**18**	**60**	**17**	**56.7**		
Severe stroke	**3**	**10**	**3**	**10**	**4**	**13.3**		

NS= not significant *** p = ≤.05 (statistical significance)** **** p = ≤.01 (highly statistical significance).**

Table (3): Comparison between the Studied groups regarding Montreal Cognitive Assessment Score at Baseline, 3 and 6 Months among Study Groups (n=90)

MOCA	Baseline						3rd months						6th months						P value[a]
	Control (n=30)		Cognitive training (n=30)		Combined physical training (n=30)		Control (n=30)		Cognitive training (n=30)		Combined physical training (n=30		Control (n=30)		Cognitive training (n=30)		Combined physical training (n=30		
Mild Impairment	3	10	4	13.3	2	6.6	5	16.6	21	70	28	93.3	10	33.3	23	76.6	30	100	F (173.1) 0.001**
Moderate Impairment	24	80	22	73.3	24	80	22	73.3	6	20	0	0	18	60	6	20	0	0	
Severe Impairment	3	10	4	13.3	4	13.3	3	10	3	10	2	6.6	2	6.6	1	3.3	0	0	
P value[b]	F (4.15) 0.200						F (74.9) 0.001**						F (74.9) 0.001**						

NS= not significant * p = ≤.05 (statistical significance) ** p = ≤.01 (highly statistical significance).

Table (4): Comparison between The Studied Groups regarding modified Rankin Scores at Baseline, Three and Six Months among Study Groups (n=90)

Rankin score	Control (n=30)		Cognitive training (n=30)		Cognitive & physical training (n=30)		X^2	P value[a]
	No	%	No	%	No	%		
Baseline								
- No symptoms	0	0	0	0	0	0	(0.423)	0.625
- No significant disability	0	0	0	0	0	0		
- Slightly disability	6	20	8	26.7	7	23.3		
- Moderate disability	13	43.3	11	36.7	12	40		
- Moderate severe disability	11	36.7	11	36.7	11	36.7		
- Severe disability	0	0	0	0	0	0		
3rd Months								
- No symptoms	0	0	0	0	0	0	(2.27)	0.109
- No significant disability	0	0	0	0	0	0		
- Slightly disability	5	16.7	7	23.3	12	40		
- Moderate disability	17	56.6	17	53.7	14	46.7		
- Moderate severe disability	8	26.7	6	20	4	13.3		
6th months								
- No symptoms	0	0	0	0	0	0	(8.89)	0.001**
- No significant disability	0	0	0	0	0	0		
- Slightly disability	7	23.3	10	33.3	20	66.7		
- Moderate disability	18	60	19	63.3	10	33.3		
- Moderate severe disability	5	16.7	1	3.3	0	0		

NS= not significant * p = ≤.05 (statistical significance) ** p = ≤.01 (highly statistical significance).

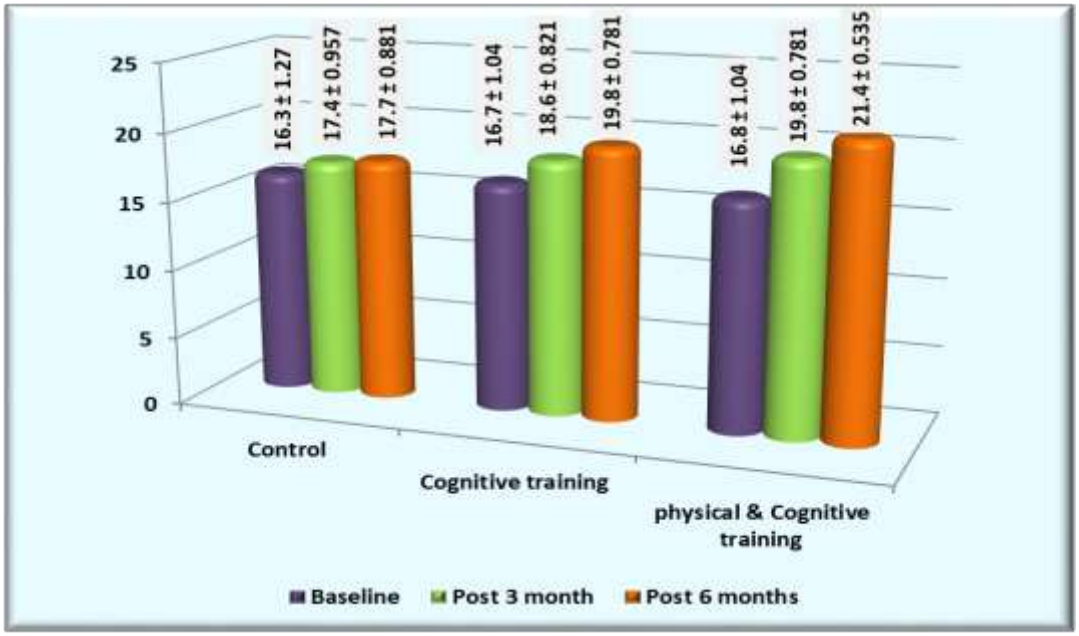

Figure (1): Mean Score of Montreal Cognitive Assessment Scale at baseline, three months and Six months among the Studied groups (n=90)

Discussion

Results of the current research demonstrated that, near to half percent of the studied groups their ages more than 60 years, this due to age-related physiological changes in the blood vessels, heart, as well as, old age are risk for hypertension that elevate the risk for stroke, which come in accordance with **Yousufuddin, & Young, (2019)**, who investigated the relation between aging and ischemic stroke. The authors explained that, aging is the most significant non-modifiable risk factor associated with stroke, which doubles every 10 years after age 55 years. About three-quarters of all strokes occur in persons aged ≥65 years, due to structural and functional changes in the cerebral micro and macro-circulations leading impaired cerebral autoregulation, causing microvascular injury, and impaired neurovascular together increases a decline in cortical function, which increased incidence of stroke.

Current research results represents that, more than half of the participants in all studied groups were female, due to women have a number of sex differences in the impact of conventional risk factors to stroke than men for PSCI, which was in line with **Dong, et al., (2020)** who analyzed the gender differences in cognitive outcomes at 90 days after stroke among first-ever stroke patients, the author reported that, women had significantly decreased levels of cognitive function and an increased percentages of dementia than men. Another, recent population-based study explored the risk factors, and outcomes of stroke in women operated by **Yoon & Bushnell, (2023)**, discussed that, women have specific risk factors for PSCI than men such as exogenous hormone, endogenous hormone levels, pregnancy, and therapy, hypertensive disorders of pregnancy, preterm delivery, gestational diabetes, oral postmenopausal hormone therapy, oral contraceptive, early & late menarche, early menopause - natural menopause - surgical menopause (oophorectomy with/without hysterectomy)

Regarding to educational qualifications; the participated sample data explained that, more than one third of all studied groups were illiterate; this may be due to around half of the study participants living in rural area, where there is no interest in education. These come in accordance of a recent study implemented by **Boutros, et al., (2023)**, which calculated the rate of PSCI, the results revealed that, more than one third of the studied samples were illiterate. Similarly, a recent cross-sectional study performed by **He, et al., (2023)**, to investigate the incidence of PSCI in first-ever ischemic stroke Chinese, summarized

that, lower education level was linked to an increased risk of PSCI.

Concerning to presence of chronic illness, findings of the current research explored that, the highest percentages of the control group, cognitive training and combined cognitive & physical training had hypertension as well as, about one third of all the studied groups had diabetes (DM). The researcher's point of view revealed that, hypertension is one of the strongest risk factors for stroke; it increases the heart workload and damages the arteries and organs over time, also, DM is responsible for increasing coagulation factors and hyperinsulinemia, and developing micro-angiopathy strokes. As well as, DM increase risk of atherosclerosis of the large cerebral arteries causing macro-angiopathy infarction. Which was compatible with **Yang, et al., (2021)** found that more than half of PSCI patients were having hypertension. Also, further validation by **Gorgui, et al., (2014)**, who discuss that; the risk of stroke increases in gradually with blood pressure (BP) levels over 115/75 mm Hg. A 10-mm Hg increase in systolic BP is linked to more than one third increase in the risk of stroke. Another, study by **Soliman, et al., (2020)**, who assessed the ischemic stroke risk factors. The authors mentioned that, more than one third of the patients had diabetes mellitus.

Regarding to stroke severity, the study results found that, around two third of all study groups were had moderate stroke, which was coincident with a study conducted to assess the number of risk factors which increase the recurrence of ischemic stroke, operated by **Juli, et al., (2022)**, who observed that, the majority of the first-ever ischemic stroke patients were admitted with moderate stroke. National Institutes of Health Stroke Scale (NIHSS) scores 103 (59.9%).

The study findings illustrated that, there were improving in the cognitive function scores of both cognitive training and combined physical and cognitive training groups by more than 3 points post six months of cognitive rehabilitation, with a statistical significant differences between the study groups, as assuming interventions that combine physical exercises with cognitive training have positive influences on the global cognitive functions of post-ischemic stroke patients, which was consistent with, **Kim & Cho, (2022)**, who established that, patients who subjected to cognitive rehabilitation program, their cognitive functions scores improved by more than three points after intervention (from 20.00±4.53 points before intervention to 23.25±4.43 points post-intervention; the score was 1.98). This confirmed by **Abd Allah, et al., (2021)**, who revealed that half of the study participants, had severe cognitive impairment before the intervention which reduced to ten percent in the post-intervention phase, this may be due to physical exercises and cognitive rehabilitation that has a positive effect on the outcomes of general cognitive functions. Similarly, **Bo, et al., (2019)**, discussed that, physical exercise improves neuronal metabolic capacity, oxygen delivery, and decrease brain tissue loss as well as, increase the level of brain derived neurotropic factor. Their study results summarized that, physical exercises produce protective effects to the brain cells. Additionally, cognitive training induces rearrange of neuronal networks and enhancing more efficient perceptual and executive processing. The author concluded that, combined intervention of physical exercise and cognitive training are complementarily produced greater on the cognitive functioning compared with the single intervention alone. Further documentation by **Park et al., (2015)**, who reported that improving cognitive function of stroke patients from 15.20±4.83 points at baseline to 18.00±5.67 points post-intervention

The current research described that, more than one third of each of the studied groups had moderate to severe disability at baseline assessment, compared to a significant decrease in these percentages post six-months of intervention, as coordinated intervention of using physical exercises and cognitive session may yield greater benefit in restoring cognitive function post-ischemic stroke as several studies reported that, exercises improve perfusion and plasticity, and improve synaptic strength and structure through producing central and peripheral growth factor, which agreed by **Huber, et al., (2022)**, who explained that, motor-cognitive training were superior in improving gait speed, endurance, cadence, and stride length in stroke patients compared to non-combined control interventions, which was in accordance with a previous study by **Alamri, et al., (2019)**, who documented that before intervention, near to two thirds of patients were had severe disability and near to half were had grade moderate severe disability, compared to

post intervention, only one third of the patients progress to moderate disability, and the majority of patients two thirds progressed to slightly disability with statistical significant differences (p=0.001). Also, **Stuart, et al., (2019)**, explained that, physical exercises have a consistent benefit in gait speed and mobility of stroke patients through improving cardiovascular health, indices of insulin sensitivity, glucose tolerance physical fitness, bone health, depression, and social isolation, even years after the stroke, as well as, reducing health care costs. Their study results demonstrated that, adaptive physical activity group improved significantly (P = .004) on the 6 minutes walking test with a mean increase in gait speed of 7.6 cm/s over the 6-month period of the study. The 95% confidence interval for this change was 2.6 to 12.6. Significant improvement was also seen in the 30-foot walk (P = .02). Significant changes were observed neither for the Short Physical Performance Battery; (P = .54) and Berg (P = .23) nor for the Stroke Impact Scale (SIS) total (P = .90), and SIS mobility subscale (P = .89).

Conclusion

The present study findings concluded that the post-stroke cognitive impairment is prevalent but neglected between post-ischemic stroke patients compared to other neurological deficits, also, Rehabilitation strategies have a positive impact on improving post-stroke functional outcomes Finally, the present study has demonstrated that approaches that combine physical activity and cognitive training is more effective for post-ischemic stroke patients and are recommended to decrease the cognitive deficits among patients post-ischemic stroke compared to any intervention alone. Recommendation

Based on the results of the present study; the researchers suggested that:

Recommendations for Department and Nurses:

Establishing a routine screening for early detection PSCI among stroke patients.

Teaching nursing staff regarding the importance of being knowledgeable regarding PSCI, its impact on the patient's physical, psychological and social status and overall quality of life, in addition to, identifying others cognitive rehabilitation methods.

Direct the nursing education and interventions toward the risk factors of stroke and instruct about management and follow- up, other rehabilitation facilities in consistent with their level of education, in a simple appropriate language.

Recommendations for stroke Patients:

Establishing a multi-component approach and cognitive training rehabilitation programs for PSCI patients.

Establish updated protocol of different life style modifications to help patients to control stress, hypertension and other risk factors of stroke.

Recommendations for Further Researches:

Replication of the study on a great probability sample in different geographical areas in Egypt to formulate the main aspects of these problems, for generalizing the findings.

Formulate a standard of care for post-ischemic stroke patients.

Encourage further researches regarding different cognitive rehabilitation approaches for stroke patients and use randomization to ensure suitable representation of population and a large sample size.

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