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A Study to Assess the Effectiveness of Neurobic Exercise on Cognitive Impairment Among Post Stroke Old Age People at Selected Community Area, Namakkal District

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ABSTRACT

Background: Cognitive impairment after stroke has a significant impact on the quality of life of elderly patients. Neurobic exercise, a cognitive stimulation method involving physical and mental activity, has been suggested as a valuable intervention. The current study assesses its effect on cognitive function in post-stroke elderly patients.

Methods: A quasi-experimental design involved 60 elderly patients after stroke, assigned to an experimental group that underwent neurobic exercise and a control group receiving normal care. Cognitive function was measured before and after the intervention using standardized assessment tools. Statistical tests defined the significance of improvements.

Results: Pretest results indicated that 66.67% of the experimental group had moderate cognitive impairment and 33.33% had mild impairment. Following neurobic exercise, 63.33% attained normal cognitive function and 36.67% had mild impairment. In the control group, however, only 10% attained normal cognition, with 70% still having moderate impairment and 20% having mild impairment. Between-group analysis validated significant cognitive improvement in the experimental group. Younger and married participants also showed improved recovery outcomes.

Conclusion: Neurobic exercise is an extremely efficient non-pharmacological tool for cognitive rehabilitation in post-stroke patients. Considering its ease of access and efficacy, it should be incorporated into standard rehabilitation protocols. Long-term compliance, computerized cognitive training, and multicentric validation are areas to be investigated in future studies.

INTRODUCTION

Stroke is a common cause of chronic disability in older people, with post-stroke cognitive impairment (PSCI) occurring in a considerable percentage of survivors.[1] Cognitive impairment, which mainly includes memory, orientation, language, and attention, was identified in 35.2% of patients with stroke and influenced their independence to live.[2] Such impairments include various deficits such as memory loss, decreased attention, impaired executive function, and language problems, all of which severely affect daily living and overall well-being. Although the prevalence of PSCI is high, Multiple component interventions, physical activity interventions, and non-invasive brain stimulation (NIBS) protocols have some evidence of benefit in improving post-stroke cognitive deficits.[3] The European Stroke Organization and the European Academy of Neurology have acknowledged this gap, highlighting the importance of detailed cognitive assessment and intervention in their joint guidelines on post-stroke cognitive impairment.[4] Incorporation of cognitive rehabilitation strategies into routine post-stroke care has received growing interest, especially in the management of post-stroke cognitive impairment (PSCI). Neurobic training, which consists of performing new and complex mental tasks, has been suggested as a powerful way to stimulate neuroplasticity—the brain's capacity to reorganize through the creation of new neural pathways (Hebb, 1949).[5] Such training is intended to reverse cognitive impairment that is typically seen in survivors of stroke. But though theoretically promising, few studies rigorously have tested their particular effectiveness for PSCI. The majority of the current literature has concentrated on general cognitive training programs instead of neurobic interventions, which indicates the necessity for focused studies (Loetscher & Lincoln, 2016).[6] Lawrence et al. (2020) conducted a systematic review and discovered that cognitive training is associated with a moderate positive effect on global cognitive function, especially in memory and attention tasks, but neurobic exercises are underresearched.[6]

A number of studies have highlighted the significance of cognitive rehabilitation for post-stroke patients, especially for enhancing attention and memory. A Cochrane review by Loetscher and Lincoln (2016) compared 13 studies with 721 participants and found that cognitive rehabilitation for deficits in attention after a stroke is possible, although better-quality evidence is needed.[7] Further, Oberlin et al. (2019) performed a meta-analysis of 36 randomized controlled trials and established that exercise, particularly aerobic activity, improves cognitive functioning among the elderly, including stroke patients. These results indicate that integrating physical exercise with neurobic training can provide an integrative solution to cognitive rehabilitation. Lawrence et al. (2020) conducted another systematic review and illustrated that cognitive training interventions have a beneficial influence on cognitive function, especially memory and executive function, further supporting the effectiveness of formal neurobic interventions.[7]

To fill the research gap, in this study an attempt is being made to analyze the efficacy of neurobic exercises in reducing cognitive impairment among the elderly post-stroke patients from a chosen population. Through a systematic neurobic exercise program, the study would determine its efficacy on memory, attention, and executive function, the primary cognitive domains impaired in PSCI. Since cognitive rehabilitation has more supporting evidence now, this study attempts to deliver empirical evidence for the particular function of neurobic exercises in boosting cognitive outcomes. Results are hoped to help form inclusive rehabilitation interventions combining cognitive training that enhance post-stroke survivors' quality of life (Lawrence et al., 2020; Oberlin et al., 2019).[7,8]

Methodology

Research Design and Setting

This research utilized a quasi-experimental design with a pre-test and post-test control group design to evaluate the efficacy of neurobic exercises on cognitive impairment in post-stroke elderly people. The study was carried out at Sure Trust Annai Muthuyour Illam, Namakkal District, a community center that provides rehabilitative care to elderly people. This environment was selected because of the ease of accessing a stable and diverse group of post-stroke elderly patients with cognitive impairment. The controlled design facilitated inter-group comparisons to ascertain the intervention effect on cognition.

Study Population and Sampling

The study population comprised elderly individuals aged 50 and above who had suffered a stroke and exhibited cognitive impairment. A total of 60 participants were recruited through a convenience sampling technique, ensuring that individuals met the inclusion criteria. Participants were divided equally into two groups: 30 in the experimental group, who received neurobic exercise intervention, and 30 in the control group, who continued with their routine care. Inclusion criteria were old persons who agreed to participate and gave informed consent and were able to understand and communicate in Tamil. Exclusion criteria were patients with severe psychiatric disorders, terminal illness, and those who were part of the pilot study previously. This sample size was taken according to previous research and power calculations for statistics to provide a proper validity and reliability.

Intervention: Neurobic Exercise Program

The intervention was a systematic neurobic exercise program that was specifically designed to stimulate cognitive function through multisensory stimulation. Neurobic exercises include memory improvement activities, non-dominant hand training activities, sensory stimulation activities, word association activities, and problem-solving activities. These activities were intended to enhance neural connectivity by providing new activities that challenged the cognitive processing capabilities of the participants. The experimental group received 25-minute guided neurobic exercise sessions, with a 10-minute question-and-answer period to allow for understanding and participation. Sessions were held three times a week for four weeks. The control group, in contrast, was given only regular care without the extra cognitive exercises to provide for a comparison of results.

Pre-Test and Post-Test Evaluations

To evaluate the intervention's effect, cognitive impairment was measured both prior to the intervention and subsequent to the intervention through the use of the Cognitive Impairment Assessment Scale (CIAS). The pre-test measure gave an initial cognitive function score, and the post-test measure assessed post-intervention gains through neurobic exercises. Identical cognitive assessing instrument was administered to both groups to maintain the reliability and comparability of measurements. Data were gathered using face-to-face interviews in a quiet and comfortable environment, with a focus on participant comfort and confidentiality.

Data Collection Procedure

The data collection procedure adhered to standardized protocols for reliability and accuracy. Participants were informed regarding the study, and informed consent was secured prior to conducting any tests. Data collection was conducted over a period of four weeks, with tests administered at baseline (pre-test) and post-intervention (post-test). The duration of each test was about 25 minutes, which ensured sufficient cognitive assessment without causing participant fatigue. During the study, privacy was preserved, and responses were kept confidential.

Data Analysis and Statistical Methods

Collected data were processed using descriptive and inferential statistical techniques to assess the effect of the intervention:

- Descriptive statistics were employed to present demographic information, such as mean scores, standard deviations, and percentages.
- Paired t-tests were utilized to compare pre-test and post-test scores within groups, establishing whether the intervention resulted in significant cognitive gains.
- Independent t-tests were employed to compare cognitive gains between the experimental and control groups.
- Chi-square analysis was used to test for associations between cognitive improvement and demographic factors like age, gender, and education level.

Statistical analysis was done with SPSS 25.0 (Statistical Package for Social Sciences) to ensure strong and reliable results. A p-value of <0.05 was used to determine statistical significance, reflecting significant differences in cognitive function as a result of the intervention.

Ethical Considerations

The research complied with rigorous ethical standards to secure participant rights and confidentiality. The Institutional Ethics Committee granted ethical permission, and thus the research aligned with research quality standards. The researcher secured signed informed consent from all participants prior to study recruitment. Participants were guaranteed that the study was purely voluntary and could withdraw at any time without facing any repercussions. Furthermore, data gathered were all anonymized and safely stored for the sake of confidentiality.

Results and Analysis

Demographic Characteristics of Participants

The research was carried out on 60 post-stroke elderly people, who were equally distributed into an experimental group (30 participants) and a control group (30 participants). A demographic survey was conducted to identify the characteristics of participants prior to starting the intervention. The results indicated that most of the participants in the two groups belonged to the 61-70 years age bracket, representing 56.67% in the experimental group and 53.33% in the control group. The next most significant age group was 71-80 years (43.33% in the experimental group and 46.67% in the control group), which showed the high incidence of cognitive impairment in this older age group. As far as gender distribution is concerned, the experimental group consisted of 60% males and 40% females, while the control group consisted of 46.67% males and 53.33% females. This gender difference indicates that post-stroke cognitive impairment is common in both genders, although slightly more common in males in the experimental group. Analysis of marital status revealed that 100% of the participants in both groups were married, which reflects a stable social background.

Additionally, family structure was evaluated and found that 53.33% of the experimental group consisted of joint families, while 46.67% comprised nuclear families. However, the control group consisted of more nuclear family members (60%) than joint family members (40%). Such information is significant in analyzing the support systems which are present for stroke survivors, as family support is a major contributor to cognitive and emotional recovery. Occupational status was also studied, and the results showed that most of the participants of both groups were doing non-skilled jobs or were retired. To be specific, 60% of the experimental group and 53.33% of the control group were included in the "others" category, meaning they were unemployed or doing irregular jobs. Also, both groups of participants had a monthly income of over Rs. 10,000, showing a comparatively comparable economic status. The research also took into account the prevalence of chronic illness among participants since this aspect may affect cognitive impairment. It was found that 56.67% of the experimental group and 63.33% of the control group suffered from chronic illnesses, including hypertension, diabetes, or cardiovascular diseases. This observation lends support to the correlation of cognitive impairment with chronic illness in the post-stroke population.

Table 1: Frequency and Percentage Distribution of Demographic Variables (N=60)

S.NO.	DEMOGRAPHIC VARIABLES	EXPERIMENTAL GROUP		CONTROL GROUP	
		No.	%	No.	%
1.	**Age (in years)**				
	51 – 60	0	0.00	0	0.00
	61 – 70	17	56.67	16	53.33
	71 – 80	13	43.33	14	46.67
2.	**Gender**				
	Male	18	60.00	14	46.67
	Female	12	40.00	16	53.3
3.	**Marital Status**				
	Married	30	100.00	30	100.00
	Unmarried	0	0.00	0	0.00
	Divorced	0	0.00	0	0.00
	Widow/Widower	0	0.00	0	0.00
4.	**Type of Family**				
	Nuclear Family	14	46.67	18	60.00
	Joint Family	16	53.33	12	40.00
	Extended Family	0	0.00	0	0.00
5.	**Occupation**				
	Skilled	3	10.00	2	6.67
	Semi-skilled	5	16.67	7	23.33
	Professional	4	13.33	5	16.67
	Others	18	60.00	16	53.33
6.	**Family Monthly Income**				
	Less than Rs.5000	0	0.00	0	0.00
	Rs.5000 - Rs.10,000	0	0.00	0	0.00
	>10,000	30	100.00	30	100.00
7.	**Chronic Illness**				
	Yes	17	56.67	19	63.33
	No	13	43.33	11	36.67

Pre-Test and Post-Test Cognitive Impairment Levels

Pre-test assessment was done prior to the administration of the neurobic exercise intervention, and findings indicated that the majority of participants had moderate cognitive impairment. In the experimental group, 66.67% had moderate impairment, and 33.33% had mild impairment. For the control group, 93.3% had moderate cognitive impairment, and a mere 6.7% had mild impairment. These findings attest to the high incidence of cognitive impairment in post-stroke elderly individuals prior to any intervention.

After the four-week neurobic exercise intervention, the experimental group showed significant improvement in cognitive function. The post-test result showed that 63.33% of the experimental group had normal cognitive function, whereas 36.67% had mild impairment. This significant improvement supports that neurobic exercises had a significant effect on improving cognitive abilities in post-stroke elderly patients.

On the other hand, the control group showed only minimal improvement, with 70% of them still showing moderate cognitive impairment, 20% showing mild impairment, and only 10% showing normal cognitive function. The minimal improvement in the control group indicates the necessity for formal cognitive rehabilitation interventions, like neurobic exercises, to enhance cognitive function in post-stroke patients.

Table 2: Comparison of Pretest and Posttest Levels of Cognitive Impairment Among Post-Stroke Old Age People in Experimental and Control Groups

Level of Cognitive Impairment	Group	Pre-Test (F)	Pre-Test (%)	Post-Test (F)	Post-Test (%)
Normal	Experimental	0	0.00%	19	63.33%
	Control	0	0.00%	3	10.00%
Mild	Experimental	10	33.33%	11	36.67%
	Control	2	6.67%	6	20.00%
Moderate	Experimental	20	66.67%	0	0.00%
	Control	28	93.33%	21	70.00%

Effectiveness of Neurobic Exercises on Cognitive Function

To statistically confirm the effect of neurobic exercises, a comparison of pre-test and post-test cognitive impairment scores was made. The findings indicated that in the experimental group, the pre-test cognitive impairment score was 13.47 (SD = 4.058), which increased to 22.37 (SD = 2.773) on the post-test. The computed t-value was 20.332 ($p<0.01$), reflecting a very significant improvement in cognitive function as a result of the intervention. In contrast, for the control group, the pre-test mean was 13.97 (SD = 4.081) and the post-test mean was 14.27 (SD = 4.323). The computed t-value was 1.104, and this was not statistically significant, implying that post-stroke cognitive ability without cognitive intervention does not enhance significantly with time.

Comparison of Experimental and Control Groups

To further ascertain the efficacy of neurobic exercises, the mean post-test scores of both groups were compared. The experimental group's post-test mean score was 22.37, while that of the control group was 14.27, thus creating a difference of 8.1 in means. The t-value so calculated for the comparison was 20.41, which at $p<0.001$ was statistically significant. This validates that neurobic exercises contributed a lot towards enhancing cognitive ability in post-stroke older adults, whereas the control group revealed minimal changes.

Table 3: Effectiveness of Neurobic Exercise on Cognitive Impairment Among Post-Stroke Old Age People in Both Experimental and Control Groups

LEVEL OF COGNITIVE IMPAIRMENT	Experimental Post-Test		Control Post-Test		Mean Difference	't'-value
EXPERIMENTAL & CONTROL GROUP	Mean	SD	Mean	SD	8.1	

	22.37	2.773	14.27	4.323		20.41*** *P = 0.01 S*

Association Between Cognitive Impairment and Demographic Variables

Chi-square testing was done to identify whether levels of cognitive impairment were impacted by demographic characteristics including age, gender, marital status, household structure, and chronic disease. Analysis showed there was a statistically significant relationship between cognitive impairment and age ($p=0.01$), signifying that increased age was related to a higher risk of cognitive impairment. But other variables like gender, marital status, family type, and chronic illness were not found to have statistically significant associations ($p>0.05$). These results indicate that age is a main factor for post-stroke cognitive impairment, while other demographic factors are not significant.

DISCUSSION

The findings of the study are highly consistent with the efficacy of neurobic exercise in enhancing cognitive function among elderly post-stroke patients. In the experimental group, on pretest, 66.67% of the participants demonstrated moderate cognitive impairment, and 33.33% had mild cognitive impairment. After the intervention of neurobic exercise, the posttest findings showed that 63.33% of the subjects had improved to normal cognitive function, while 36.67% had moved to mild cognitive impairment, and there were no individuals who still fell under the moderate category. In contrast, the control group that was not subjected to neurobic exercise only had 10% reach normal cognition, while 70% still had moderate impairment, and 20% had mild impairment. These results corroborate the studies by Bo W et al. (2018), who compared the combined intervention of physical training and cognitive training yielded more pronounced effects on cognitive function in vascular cognitive impairment patients with stroke.[9] In the same manner, Huang Y et al. (2024) showed that moderate-intensity aerobic exercise could improve working memory, visuospatial/executive, and delayed recall functions in patients with mild cognitive impairment induced by stroke.[10]}

The efficacy of neurobic exercise was also confirmed using statistical tests. The mean cognitive impairment score on the pretest in the experimental group was 13.47 (SD = 4.058), which on post-intervention significantly increased to 22.37 (SD = 2.773). The t-value calculated was 20.332, which at $p < 0.01$ was statistically significant, indicating that neurobic exercise had a significant effect on cognitive improvement. In the control group, in contrast, pretest mean score was 13.97 (SD = 4.081), while the posttest mean score was 14.27 (SD = 4.323) with a computed t-value of 1.104, and was not found statistically significant. Between-group mean difference was 8.1 and overall t-value was 20.41 ($p < 0.01$), thus once again emphasizing significant cognitive enhancement within the experimental group. These findings are in agreement with the evidence by Li G et al. (2024), Exercise, particularly aerobic exercise for at least 3 times a week for 30-60 minutes, substantially enhances cognitive ability among stroke patients.[11] Likewise, McEwen SC et al. (2018) in their meta-analysis reported that 4-week combined memory training and aerobic exercise program enhances memory, attention, and reasoning capacity in elderly with subjective memory impairments.[12]

Analysis of the demographic variables also indicated a significant relationship between the level of cognitive impairment and age, where the elderly people aged 71-80 years had a higher incidence of moderate cognitive impairment in the pretest period. This result is also found by Joundi RA et al. (2023), which stated that Cognitive decline is a strong mediator of functional decline after stroke, and memory decline and executive decline explained 5% and 13% and 22%, respectively.[13] It was also found in the study that married participants showed greater cognitive improvement post-intervention, which could be attributed to greater social interaction and emotional support. This aligns with results by Elayoubi J et al. (2021), who identified greater pre-stroke social engagement/connection as being predictive of more favorable episodic memory at stroke, reduced reduction in episodic memory with stroke, and diminished reduction in episodic memory with time.[14] The work also agrees with Hong C et al. (2024), who discovered Home-based and remotely supervised combined exercise and cognitive intervention could have a more beneficial influence on cognitive components, including global cognition, memory, executive functions, and attention.[15].

In general, the present study is strong proof that neurobic exercise is a useful non-medication intervention for enhancing post-stroke elderly cognitive impairment. With the statistically significant cognitive improvement noted in the present study, long-term compliance with neurobic exercise, incorporation of technology-based cognitive training (e.g., virtual reality-based neurobic activities), and larger multicentric studies are recommended to apply results to a wide variety of populations. This research supports the necessity of cognitive interventions in the form of a structured program within post-stroke rehabilitation and demonstrates the promise of neurobic exercise as a fundamental element of stroke rehabilitation programs.

CONCLUSION

The current research evaluated the efficacy of neurobic exercise on enhancing cognitive impairment in post-stroke elderly patients. The results strongly suggest that neurobic exercises have a significant effect on improving cognitive function and alleviating the severity of cognitive impairment in post-stroke patients. In the experimental group, pretest data showed that 66.67% of the participants had moderate cognitive impairment, whereas 33.33% had mild impairment. After the neurobic exercise intervention, 63.33% of the subjects showed normal cognitive ability, and 36.67% showed mild cognitive impairment, with no subject remaining in the moderate group. In comparison, the control group that did not undergo neurobic exercises showed minimal change, with only 10% showing normal cognition, and 70% remaining moderately impaired, and 20% showing mild impairment. Furthermore, demographic analysis indicated that older adults (71-80 years) were more likely to have cognitive impairment, and married participants showed improved cognitive gains, perhaps because they had greater social interaction and emotional support. These results are consistent with prior research, endorsing organized cognitive retraining techniques like the Montessori-based cognitive training model and light therapy. With the considerable positive changes seen, further research into long-term commitment to neurobic exercises, embedding technology-based cognitive training (i.e., using virtual reality neurobic exercises), and larger multicentric trials so as to include more heterogeneous groups needs to be pursued. This research firmly emphasizes the promise of neurobic exercise as a key element of post-stroke rehabilitation, highlighting its role as an effective, non-drug intervention to facilitate cognitive recovery and enhance overall quality of life in geriatric stroke survivors.

Declaration

We, the researchers of this research work entitled "A Study to Assess the Effectiveness of Neurobic Exercise on Cognitive Impairment Among Post-Stroke Old Age People at Selected Community Area, Namakkal District", hereby confirm that this research work is our original work and has not been published or submitted for publication elsewhere. All sources of information used in this research work have been properly acknowledged.

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Conflict of Interest

The authors confirm that they have no conflict of interest related to this study.

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Authors' Contributions

Sathiya S: Conceptualization, methodology, data collection, and drafting of the initial manuscript.

Uma K: Review of literature, data analysis, and interpretation.

Radha S: Methodology review, writing of the manuscript, and editing.

Jamunarani M: Supervision, critical revision, and final approval of the manuscript.

All authors have read and approved the final version of the manuscript.

Availability of Data and Materials

The data analyzed and utilized in this research are available from the corresponding author on reasonable request.

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