

# Effect of Cognitive Rehabilitation Program on Cognitive Function and Sleep Quality in Stroke Patients: Quasi Experimental Study

Reena Sheokand<sup>1</sup>, Megha Gakhar<sup>2</sup>, Surekha Dabla<sup>3</sup>, Bhawna Verma<sup>4</sup>,  
Aasha Soni<sup>5</sup>

<sup>1</sup>PG Student, College of Physiotherapy, Pt. B.D. Sharma UHS, Rohtak. India.

<sup>2</sup>Assistant Professor, College of Physiotherapy, Pt. B.D. Sharma UHS, Rohtak. India.

<sup>3</sup>Senior Professor & Head of Department of Neurology, Pt. B.D. Sharma UHS, Rohtak. India.

<sup>4</sup>Assistant Professor, College of Physiotherapy, Pt. B.D. Sharma UHS, Rohtak. India.

<sup>5</sup>PG Student, College of Physiotherapy, Pt. B.D. Sharma UHS, Rohtak. India.

Corresponding Author: Reena Sheokand

DOI: <https://doi.org/10.52403/ijhsr.20241006>

## ABSTRACT

**Introduction:** Stroke is one of the leading causes of death and disability worldwide. According to WHO stroke is the second commonest cause of mortality. The most frequent post stroke consequences were found to be cognitive impairment and sleep quality.

**Objective:** To find the effect of cognitive rehabilitation program on cognitive function and sleep quality in post stroke patients.

**Material and Methods:** The quasi-experimental study was performed with 25 patients with stroke between October 2022 to October 2023. The patients received 8 weeks cognitive rehabilitation program. Outcome measures include Hindi version of MOCA and PSQI. Outcomes measures were assessed at baseline, after 4 weeks and after 8 weeks of cognitive rehabilitation.

**Result:** Data from 25 individuals were analysed by using repeated measures of ANOVA. Analysis of data reflected that after eight weeks of cognitive rehabilitation, there was a significant ( $p < 0.01$ ) improvement in cognitive function and depression. Cognitive function improved from  $15.76 \pm 3.33$  to  $18.8 \pm 3.43$  after 4 weeks and  $22.72 \pm 3.61$  after 8 weeks. The sleep problems score decreased from  $29.28 \pm 6.674$  to  $21.56 \pm 6.178$  after 4 weeks of intervention and  $17.04 \pm 7.027$  after 8 weeks of rehabilitation.

**Conclusion:** This study concluded that cognitive rehabilitation program had significant improvement in the cognitive function and sleep quality after the cognitive rehabilitation program.

**Keywords:** Post stroke rehabilitation, Cognitive function, sleep problems, Cognitive rehabilitation program.

## INTRODUCTION

Across the world, stroke is one of the leading causes of mortality and disability. As per the World Health Organization (WHO), stroke ranks as the second most

common cause of death.<sup>1</sup> Cognitive decline is a serious, disabling consequence of stroke. The decline in cognition due to stroke causes mild to moderate cognitive impairment. According to Nys GM et al.

(2007) a large number of stroke survivors develop cognitive impairment within 3 months. In India, the prevalence of post-stroke cognitive decline measured by the MOCA scale at 3 months was 67% and the MMSE scale prevalence at 3 months was 46.3%.<sup>2</sup>

Up to 60% of stroke survivors experience post-stroke cognitive impairment (PSCI), which can range in severity from mild to severe and it is most common in the first year following stroke. With mild PSCI, up to 20% of patients totally recover; the greatest recovery rate occurs soon after the stroke.<sup>3</sup> PSCI has varying level of visual spatial function, attention, orientation and memory impairment and occurrence of cognitive impairment have delayed the recovery of other body function of stroke patients. So, it affects the recovery process and prognosis of the patient.<sup>4</sup> Risk factors for mild cognitive impairment (MCI) include old age, poor education, low social support, isolation, hypertension, diabetes, hyperlipidemia, decreased physical activity, depression and smoking.<sup>5</sup>

One of the most crucial physiological processes in our body is sleep. Twenty percent to forty percent of a day is spent sleeping. During this period, sleep serves a number of functions in the body, such as lowering stress level, controlling metabolism, improving memory and supporting immune system and tissue repair.<sup>6</sup> Around fifty percent of the patients may experience sleeplessness in the initial months after a stroke. Comorbidities such as depression and environmental factors are the main causes of insomnia in stroke patients.<sup>7,8</sup> Insomnia, restless legs syndrome (RLS), sleep behavior disorder (SBD), and rapid eye movement (REM) are examples of sleep disorders. Strokes and sleep disturbances have been found to be closely associated.<sup>9</sup>

In stroke patients, depression is an important component affecting the quality of their sleep.<sup>10</sup> The psychological and mental issues that arise from stroke symptoms make it hard to sleep at night.

Fatigue is one of the negative psychological and physical impacts of sleep disruptions.<sup>11</sup> Studies have shown that thalamic stroke causes abnormal brain waves, while pontomesencephalic stroke causes almost total loss of sleep.<sup>12</sup> Treatment for sleep disorders is necessary in order to maintain the mental and physiological equilibrium for active stroke rehabilitation. Treatment for sleep disorders gives stroke survivors an opportunity to rest and feel stable.<sup>13,14</sup>

A cognitive rehabilitation program includes both cognitive and physical exercises. These exercises are simple, safe and easy to perform. Cognitive rehabilitation through physical exercises like emotion, recreational, manipulative and coordination exercises combined with some mind-body games and spiritual activities is part of this complex cognitive rehabilitation program, so this program should be beneficial to all cognitive domains.

Numerous studies have been conducted using cognitive rehabilitation alone and combining it with physical exercises, but to our knowledge, few studies have evaluated the effect of cognitive rehabilitation on cognitive functions and depression in patients with stroke. Therefore, this study was aimed to explore the effects of cognitive rehabilitation that help to strengthen executive ability, attention, memory in stroke patient after 3 months of initial stroke with mild cognitive impairment.

## **MATERIALS & METHODS**

### **Type of study:**

One group pre-test and post-test study design (quasi experimental study)

### **Sample and setting:**

Patients were recruited from the inpatient and outpatient unit of Neurology Department of PGIMS, Rohtak. A total 25 subjects were included in the study as per inclusion and exclusion criteria. After comprehensive description of study, participants were asked to sign an informed consent. Post stroke patients with MOCA

score between 11 to 26 after 3 months of initial stroke with stable vitals and both sexes with age between 40 to 60 years. Person who understands purpose of research, voluntarily agree to participate in research and can complete this program were included in the study. Patients had medical history of other diseases that might affect the cognitive function, such as Parkinson's disease, traumatic brain injury or mental diseases; unable to walk; who had history of recurrence of stroke or communication problem; patient who could go along with the cognitive rehabilitation program prior; patient diagnosed with severe hearts, liver, lung or kidney diseases and who had used psychotropic medication for a long time were excluded from the study.

**Intervention:**

Only one group was taken in the study, which was assessed before intervention and after intervention to find the effects of this rehabilitation program. The exercise protocol plan is:

Intervention given for 8 weeks (twice in a week-70 min. session)

1. 5 min warm up (stretching).
2. 25 min physical exercise program (emotional, manipulative, coordination & recreational exercises).
3. 30 min cognitive exercises.
4. 10 min cool down (repetition of warm up exercise and talk about today exercise).
5. Advice for home exercises.

The detailed description of intervention is given in table1.<sup>15,16</sup>

**Table 1: Week-wise Cognitive rehabilitation program.**

| Weeks     | Cognitive Exercises   | Physical exercise  |
|-----------|---|--|
| 1-2 weeks | <ul style="list-style-type: none"> <li>• Time, day, date. Year, place (orientation)</li> <li>• Spot the difference</li> <li>• Card matching</li> <li>• Count money</li> <li>• Spell the family members name and reverse counting.</li> <li>• Om/ Gaytri mantra</li> </ul> | <ul style="list-style-type: none"> <li>• Grab an object (Emotional exercise)</li> <li>• Shifting a ball right to left then right (manipulative exercise)</li> <li>• Push ball/object with ring finger</li> <li>• Move toes (coordination exercise)</li> <li>• Throw balls into basin as many as possible</li> <li>• Throw a ball and hit a stood-up cup (Recreational exercise)</li> </ul>   |
| 3-5 weeks | <ul style="list-style-type: none"> <li>• Orientation</li> <li>• A picture puzzle</li> <li>• Rubic cube game</li> <li>• Simple brain maze</li> <li>• Spell the animal and picture name</li> <li>• Om/ Gaytri mantra</li> </ul>   | <ul style="list-style-type: none"> <li>• Roll a tool with palm and sole (emotional exercise)</li> <li>• Grab a ball with two fingers</li> <li>• Grab a ball after throwing it. (manipulative exercise)</li> <li>• Rock-paper-scissor game</li> <li>• Relay-pile-paper cups (coordination exercise)</li> <li>• Move balls</li> <li>• Hit a ball by covering eyes blind fold (recreational exercise)</li> <li>• Roll a ball and hit a stood-up cup-bowling play (recreational exercise)</li> </ul> |
| 6-8 weeks | <ul style="list-style-type: none"> <li>• Orientation</li> <li>• Brain maze-difficult</li> <li>• Bingo game</li> <li>• Frame a story by picture</li> <li>• Spell the words reversely</li> <li>• Om/ Gaytri mantra.</li> </ul>  | <ul style="list-style-type: none"> <li>• Moving arm with grabbing an object (emotional exercise)</li> <li>• Roll a ball</li> <li>• Exchange a ball with partner (manipulative)</li> <li>• Make symmetry in Rock-Paper-Scissor</li> <li>• Crumple newspaper with hand and feet (recreational exercise)</li> </ul>   |

**Note: Week-wise cognitive exercise and physical exercise protocol.**

### Outcome measures:

**Cognitive function:** – Hindi version of Montreal Cognitive Assessment (MOCA-H) scale was used to evaluate the level of cognitive impairment. MOCA-H is a valid and reliable scale to measure cognition level of patient. The Montreal Cognitive Assessment (MOCA) was designed as a rapid screening instrument for mild cognitive dysfunction. It assessed different cognitive domains: attention and concentration, executive functions, memory, language, visuoconstructional skills, conceptual thinking, calculations, and orientation. Time to administer the MOCA was approximately 10 minutes. Scoring Total possible score - 30 points; Score of 26 or above was considered normal.<sup>17</sup>

**Sleep quality:** – Hindi Version of Pittsburgh Sleep quality index (PSQI) was used to evaluate the quality of sleep in post stroke patients. This index is valid and reliable for measurement of sleep quality. It is a self-administered questionnaire which includes four open ended questions and 14 questions to be answered using event frequency and semantic scale. The tool had seven areas: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, the use of sleep promoting medication, day time dysfunction. The PSQI includes a scoring key for calculating a patient's seven

subscores, each of which can range from 0 to 3. The subscores were summated giving a 'global' score that can range from 0 to 21. A global score of 5 or more indicates poor sleep quality hence, the higher the score, the worse the sleep quality.<sup>18</sup>

Outcome measures were taken at baseline, after 4 weeks and after 8 weeks.

### STATISTICAL ANALYSIS

Data were tabulated in master chart. Statistical analysis of data was performed using SPSS software version 26.0. Categorical variables were expressed as frequency and percentages. Continuous variables were presented as mean  $\pm$  SD. For within group analysis repeated measures of ANOVA was used. For all statistical tests, p-value of  $\leq 0.05$  was considered as a significant difference.

### RESULT

The mean age of participants was  $51.40 \pm 6.886$  years, with 22 male and 3 female patients. Repeated measures of ANOVA were used to compare the readings (pre-test, intermediate and post-test) of participants. There was statistically significant difference in the mean values of MOCA-H and Hindi version PSQI at 0 week, after 4 weeks and after 8 weeks (shown in table 2). Therefore, the result reveals cognitive rehabilitation improve cognition as well as depression.

Table 2: Mean MOCA-H and PSQI score from baseline to post intervention

| Outcome Measures       | Mean $\pm$ SD      |
|------------------------|--------------------|
| At 0 week (MOCA-1)     | 15.76 $\pm$ 3.333  |
| After 4 weeks (MOCA-2) | 18.8 $\pm$ 3.428   |
| After 8 weeks (MOCA-3) | 22.72 $\pm$ 3.612  |
| 0 week (PSQI-1)        | 20.320 $\pm$ 5.154 |
| 4 weeks (PSQI-2)       | 15.440 $\pm$ 4.501 |
| 8 weeks (PSQI-3)       | 11.920 $\pm$ 5.098 |

**Note:** Data are presented as mean  $\pm$  standard deviation (SD). Abbreviations: MOCA-H, Hindi version of Montreal Cognitive Assessment; PSQI, Pittsburgh Sleep quality index.

Table 3 shows, using repeated measures of ANOVA with Green-Geisser correction as assumption of sphericity violated, the mean score for MOCA-H and PSQI were statistically significant differences as obtained value for p was  $< 0.01$ . The results

showed that cognitive rehabilitation program had a positive and significant improvement on cognitive function ( $f=80.605$ ;  $p<0.01$ ) and sleep quality ( $f=69.412$ ;  $p<0.01$ ).

**Table 3: Repeated measures of ANOVA test for within groups analysis**

| Variable | Sum of squares | df    | Mean square | F-ratio | p-value |
|----------|----------------|-------|-------------|---------|---------|
| MOCA-H   | 608.747        | 1.519 | 400.683     | 80.605  | .000**  |
| PSQI-H   | 889.707        | 1.631 | 545.526     | 69.412  | .000**  |

\*\* Highly significant (p<0.01).  
# Repeated measures of analysis of variance (ANOVA). Note: Repeated measures of ANOVA with Green-Geisser correction as assumption of sphericity violated. Abbreviations: df- degree of freedom.

Table 4 shows, post hoc pairwise comparison using Bonferroni correction which showed improvement between the baseline (at 0 week), intermediate (after 4 weeks) and final (after 8 weeks) assessment.

There was statistically significant difference in cognitive function (p<0.01) and sleep quality (p<0.01) at 0 week, after 4 weeks and after 8 weeks.

**Table 4. Post-hoc analysis of MOCA-H and PSQI-H score at 0 week, after 4 weeks and after 8 weeks with using repeated measures of ANOVA:**

|                     | (I) group | (J) group | Mean Differences (I-J) | p value |
|---------------------|-----------|-----------|------------------------|---------|
| <b>MOCA-H Score</b> | 0 week    | 4 weeks   | -3.04                  | .00**   |
|                     |           | 8 weeks   | -6.96                  | .00**   |
|                     | 4 weeks   | 0 week    | 3.04                   | .00**   |
|                     |           | 8 weeks   | -3.92                  | .00**   |
|                     | 8 weeks   | 0 week    | 6.96                   | .00**   |
|                     |           | 4 weeks   | 3.92                   | .00**   |
| <b>PSQI-H Score</b> | 0 week    | 4 weeks   | 4.880                  | .00**   |
|                     |           | 8 weeks   | 8.4                    | .00**   |
|                     | 4 weeks   | 0 week    | -4.88                  | .00**   |
|                     |           | 8 weeks   | 3.52                   | .00**   |
|                     | 8 weeks   | 0 week    | -8.40                  | .00**   |
|                     |           | 4 weeks   | -3.52                  | .00**   |

**\*\* Highly significant (p<0.01).**  
**Note: Post hoc pairwise comparison using Bonferroni correction between the baseline (at 0 week), intermediate (after 4 weeks) and final (after 8 weeks) assessment.**

## DISCUSSION

The present study aimed to explore the effect of cognitive rehabilitation program on cognitive function and depression in post stroke patients with mild to moderate cognition impaired patients. It was hypothesized that cognitive rehabilitation would affect the cognition and depression in chronic stroke patients. The cognitive function includes many aspects like perception, reasoning, problem solving, memory, attention, language and information processing speed. Whenever one of them is impaired, the function of cognitive domain is impaired and if two or more cognitive domains are impaired, it leads cognitive dysfunction. Brain functional training, relearning process of cognitive function is considered as the best means of the cognitive rehabilitation. The

plasticity of central nervous system provides theoretical support to functional training in cognitive rehabilitation, so that the brain can promote the reconstruction of neural networks and functions by the release of various neurotransmitter.<sup>19</sup>

The objective of this study was to see the improvement in cognitive function by applying the cognitive rehabilitation program on post stroke patients with mild to moderate cognitive impairment, who had learning function before their cognitive function became irreversible. MOCA scale translated in Hindi was used for the assessment of cognitive impairment and results were compared for pre and post intervention. As a result of the study, the subject participated in the study improved their cognitive function scores by more than 3 points after the intervention, from 15.76 ±

3.33 to  $18.8 \pm 3.43$  after 4 weeks of intervention and  $22.72 \pm 3.61$  after 8 weeks of intervention.

Similar results were obtained by Kim S et al. in 2021 who investigated the effectiveness of cognitive rehabilitation combined with the physical exercise and mental activities for the chronic stroke patients with MCI revealed that cognitive rehabilitation program had shown significant improvement in cognitive function, depression and sleep quality of chronic stroke patients with MCI.<sup>16</sup> Another study conducted by Park I et al. in 2013 to investigate the changes in cognitive functions, depression and life-satisfaction for elderly participants with mild cognitive impairments participating in an individual cognitive improvement program also show similar results by indicating that the individual cognitive improvement program was effective in improving cognitive functions and depression among the elderly with mild cognitive impairments.<sup>20</sup> Alike Sukontapol C et al. in 2018 conducted a study to explore the effectiveness of a cognitive Training Program in People with mild cognitive Impairment and showed significant improvement in cognitive function.<sup>21</sup>

Pittsburgh sleep quality inventory was used for the assessment post stroke sleep quality. Cognitive rehabilitation program showed significant improvement in sleep quality score from  $20.320 \pm 5.154$  to  $11.920 \pm 5.098$  after intervention. Similar study was conducted by Kim S, Cho SH et al. in 2021 to verifying the effect of cognitive rehabilitation on sleep quality in chronic stroke patients with mild cognitive impairment. The Results of this study showed decrease in sleep disturbance score but there was no significant difference found in the PSQI score.<sup>16</sup>

Results of the present study were in agreement with the results of Keramtejad M et al. in 2018 who conducted a study to evaluate the effect of cognitive training program on improving cognitive function and ageing-related sleep quality in

community-dwelling elderly. The findings of this study showed cognitive training program was effective in improving cognitive function and sleep quality in older adults with cognitive impairment and insomnia.<sup>22</sup> Pa J et al. in 2014 conducted a study to compare the effects of different types of physical and mental activity on self-reported sleep quality over 12 weeks in older adults with cognitive and sleep complaints and found that Self-reported sleep quality improved significantly more with low-intensity physical and mental activities than with moderate or high-intensity activities in older adults with self-reported cognitive and sleep difficulties.<sup>23</sup> When Jung HW et al. in 2008 looked at the laughter therapy programme for the enhancement of sleep quality in older people living in communities, they likewise found noteworthy outcomes.<sup>24</sup> Limitations of the study are as follow: (i) This study was conducted on 25 stroke patients only at one health institute. Therefore, the included sample size was small. Thus, there is limitation to generalize the results to all stroke patients with all MCIs. (ii) Because there was no control group due to single group pre-post design; internal and external validity are lacking. (iii) Most of the participants were male and only 3 females participated in the study due to the lack of awareness and family support. So, there are chances of gender bias. (iv) Results of cognitive rehabilitation can be affected by the family education, economic level, presence and absence of a spouse, which were excluded in the study. (v) Lastly, since this was a pre-post experimental study design, patient monitoring and follow up were lacking.

#### **Strength of study:**

This study provides a common rehabilitation program for cognitive impairment and sleep problems in chronic stroke patients. Computer based cognitive rehabilitation program are used for cognitive rehabilitation which are costly program, this is a cost-effective cognitive

rehabilitation program with the help of physical exercises as well as body mind games.

### Future scope of study:

(I)The basic information from this study can help person who have had repeated strokes with their complex emotional and cognitive health issues. It is believed that by highlighting the need for research to create different cognitive rehabilitation programs for people with cognitive impairments, this study can be beneficial in the creation of cognitive rehabilitation programs in the future. (II) Study can carry out with large sample size and more female participants for elimination of gender biasing chances and to generalize the results to stroke patients with MCIs. (III) Patients with cognitive impairment from neurological diseases other than stroke can benefit from our cognitive rehabilitation program.

### CONCLUSION

The cognitive rehabilitation program applied in this study was expected to be usefully utilized as a rehabilitation program to improve cognitive function and sleep quality in the local community and clinical practice. This study concluded that cognitive rehabilitation program had significant improvement in the cognitive function and sleep quality after the cognitive rehabilitation.

### Declaration by Authors

**Ethical Approval:** Approved

**Acknowledgement:** None

**Source of Funding:** None

**Conflict of Interest:** The authors declare no conflict of interest.

### REFERENCES

1. Kaur P, Verma SJ, Singh G, Bansal R, Paul BS, Singla M et al. Stroke profile and outcome between urban and rural regions of Northwest India: Data from Ludhiana population-based stroke registry. *Eur Stroke J.* 2017;2(4):377-84.
2. Chaurasia RN, Sharma J, Pathak A, Mishra VN, Joshi D. Poststroke Cognitive Decline: A Longitudinal Study from a Tertiary Care Center. *J Neurosci Rural Pract.* 2019;10(3):459-64.
3. El Husseini N, Katzan IL, Rost NS, Blake ML, Byun E, Pendlebury ST et al. Cognitive Impairment After Ischemic and Hemorrhagic Stroke: A Scientific Statement from the American Heart Association/American Stroke Association. *Stroke.* 2023;54(6):272-91.
4. Al-Qazzaz NK, Ali SH, Ahmad SA, Islam S, Mohamad K. Cognitive impairment and memory dysfunction after a stroke diagnosis: a post-stroke memory assessment. *Neuropsychiatr Dis Treat.* 2014; 10:1677-91.
5. Kim MS. Development and Effect of a Cognitive Intervention program Based on process of Behavior Change for the Elderly with Mild Cognitive Impairment. Daejeon: Chungnam National University. 2014.
6. Cai H, Wang XP, Yang GY. Sleep Disorders in Stroke: An Update on Management. *Aging Dis.* 2021;12(2):570-85.
7. Plante DT. The Importance of Sleep Phenotypes in Bipolar Disorders. *JAMA Psychiatry.* 2020;77(3):235-236.
8. Eugene AR, Masiak J. The neuroprotective aspects of sleep. *MEDtube science.* 2015;3(1):35.
9. Yaremchuk K. Sleep disorders in the elderly. *Clin. Geriatr. med.* 2018;34(2):205-16.
10. Wu MP, Lin HJ, Weng SF, Ho CH, Wang JJ, Hsu YW. Insomnia subtypes and the subsequent risks of stroke: report from a nationally representative cohort. *Stroke.* 2014;45(5):1349-54.
11. Wi SH. The Relationship between Depression and Sleep in Stroke Patients. Seoul: Ewha Woman University. 2009.
12. Mims KN, Kirsch D. Sleep and stroke. *Sleep med clin.* 2016;11(1):39-51. 42
13. Leppävuori A, Pohjasvaara T, Vataja R, Kaste M, Erkinjuntti T. Insomnia in ischemic stroke patients. *Cerebrovasc Dis.* 2002;14(2):90-7.
14. Kim DY. Sleep Disorders after Stroke. *Brain Neurorehabil.* 2015 ;8(2):73-80.
15. Choi MR, Kim JY, Yi ES. Development and validation of exercise rehabilitation program for cognitive function and activity of daily living improvement in mild dementia

- elderly. *J Exerc Rehabil.* 2018;14(2):207-12.
16. Xuefang L, Guihua W, Fengru M. The effect of early cognitive training and rehabilitation for patients with cognitive dysfunction in stroke. *Int J Meth Psych Res.* 2021;30(3):1882.
  17. Gupta M, Gupta V, Nagar Buckshee R, Sharma V. Validity and reliability of hindi translated version of Montreal cognitive assessment in older adults. *Asian J Psychiatr.* 2019; 125-28.
  18. Kumar A, Handa R, Upadhyaya SK, Gupta SJ. Validation of Hindi version of the Pittsburg Sleep Quality Index. *J Assoc Physicians India.* 2021;69(4):11-12.
  19. Kapoor A, Scott C, Lanctot KL, Herrmann N, Murray BJ, Thorpe KE, Lien K, Sicard M, Swartz RH. Symptoms of depression and cognitive impairment in young adults after stroke/transient ischemic attack. *Psychiatry Res.* 2019; 279:361-363.
  20. Park I, Choi I-H, Kang SY, Kim Y, Lee CM. The Effects of an Individual Cognitive Improvement Program on the Elderly with Mild Cognitive Impairments [Internet]. Vol. 26, *J. Korean Acad. Community Health Nurs.* 2015;1.
  21. Sukontapol C, Kemsan S, Chansirikarn S, Nakawiro D, Kuha O, Taameeyapradit U. The effectiveness of a cognitive training program in people with mild cognitive impairment: A study in urban community. *Asian J Psychiatr.* 2018; 35:18-23
  22. Keramtinejad M, Azadi A, Taghinejad H, Khorshidi A. The effectiveness of cognitive training on improving cognitive function and sleep quality in community-dwelling elderly in Iran. *Sleep Sci.* 2019;12(2):88-93.
  23. Pa J, Goodson W, Bloch A, King AC, Yaffe K, Barnes DE. Effect of exercise and cognitive activity on self-reported sleep quality in community-dwelling older adults with cognitive complaints: a randomized controlled trial. *J Am Geriatr Soc.* 2014;62(12):2319-26.
  24. Jung HW, Youn CH, Cho NR, Lee MK. The Effect of Laughter Therapy on Sleep in the Community-dwelling Elderly. *Korean J Fam Med.* 2009;30(7):511-518

How to cite this article: Reena Sheokand, Megha Gakhar, Surekha Dabla, Bhawna Verma, Aasha Soni. Effect of cognitive rehabilitation program on cognitive function and sleep quality in stroke patients: quasi experimental study. *Int J Health Sci Res.* 2024; 14(10):45-52. DOI: <https://doi.org/10.52403/ijhsr.20241006>

\*\*\*\*\*