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Cognitive Impairment in Young Stroke Survivors: An Epidemiological Study from Eastern India

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Abstract

Background: Post-stroke cognitive impairment (PSCI) represents a significant but under-recognized burden in young stroke survivors, affecting productive life years and functional independence. Evidence on cognitive recovery patterns in this population remains limited. ***Objective:*** To determine the prevalence and pattern of cognitive impairment three months after acute stroke in adults aged 18-50 years using neuropsychological assessment. ***Methods:*** A prospective observational study enrolled 98 consecutive young stroke patients (mean age 42.9 ± 6.7 years; 62.2% male) within the acute phase for 2 years. A comprehensive cognitive evaluation was performed at 3 months, assessing six cognitive domains: attention/executive function, episodic memory, language, and visuospatial skills. Clinical variables, including stroke type, vascular territory, severity (GCS), and functional outcome (mRS) were recorded. ***Results:*** Ischemic stroke predominated (85.7%), with the middle cerebral artery (MCA) territory most affected (49.0%). Cognitive assessment showed globally uniform performance across all domains, with mean scores falling within the 25th–50th percentile range relative to normative data. Montreal Cognitive Assessment (MoCA) showed no significant association with admission GCS scores, 3-month Modified Rankin Scale(mRS), or stroke risk factors. Vascular territory involvement (ACA vs. MCA vs. posterior circulation) did not substantially influence cognition. ***Conclusions:*** At three-month post-stroke evaluation, young stroke survivors in this cohort demonstrated remarkably uniform cognitive performance without marked domain-specific deficits. This pattern suggests either preserved cognitive reserve in younger patients or underutilization of comprehensive neuropsychological assessment tools compared to brief screening measures. Further longitudinal research with extended follow-up and control groups is warranted to elucidate cognitive recovery trajectories and predictors of persistent impairment in young stroke populations.

Keywords: Stroke, young adults, cognitive impairment, neuropsychological assessment, prospective study

INTRODUCTION

Stroke has traditionally been characterized as a disease of aging; however, emerging epidemiological evidence demonstrates a rising incidence in younger adults, particularly those under 50 years of age.[1] While stroke mortality and major disability rates have declined due to advances in thrombolysis and rehabilitation, cognitive impairment—a frequent but under-recognized sequela—significantly impacts quality of life, vocational rehabilitation, and long-term functional independence in this productive population.

The World Health Organization defines stroke as a rapidly developing focal or global disturbance of cerebral function with symptoms lasting ≥24 hours without apparent non-vascular cause 2 Young stroke, defined in the Indian context as stroke occurring before age 50, comprises approximately 10–18.6% of all stroke cases, with increasing prevalence over the past two decades. Unlike elderly stroke populations, where physical recovery dominates clinical discourse, young stroke survivors face prolonged societal engagement, career progression, and family responsibilities that are substantially disrupted by cognitive sequelae.

Post-stroke cognitive impairment (PSCI) represents one of the most disabling consequences, affecting 30–70% of stroke survivors depending on assessment timing, methodology, and cohort characteristics.3 Earlier studies documented that 60% of patients develop cognitive impairment within 4–12 months post-stroke, with impairment persisting in 35% even at 11-year follow-up. More recent longitudinal analyses indicate that cognitive

improvement predominantly occurs within the first six months, with minimal recovery thereafter—a finding suggesting that the critical three-month evaluation window captures early recovery dynamics and provides predictive value for long-term trajectories.4

Contrary to robust physical recovery documented in many young stroke patients, cognitive domains, including attention, executive function, processing speed, and memory, demonstrate inconsistent and often incomplete recovery patterns.5 This dissociation between physical and cognitive recovery has critical implications for return-to-work, academic pursuits, and social reintegration.6

A notable gap exists between cognitive assessment approaches in clinical practice versus research settings. Brief screening instruments (Mini-Mental State Examination, Montreal Cognitive Assessment) are more frequently employed in acute stroke settings than comprehensive neuropsychological batteries, potentially underestimating domain-specific impairments.7,8 Comprehensive cognitive assessment remains underutilized in young stroke cohorts, particularly in resource-limited settings.

This prospective observational study aimed to: (1) characterize the prevalence of cognitive impairment in young stroke survivors (aged 18–50 years) at three months post-stroke using MoCA (2) correlate cognitive outcomes with stroke risk factors and stroke characteristics (type, location, severity). This investigation addresses a significant gap in the Indian literature regarding structured cognitive assessment in young stroke survivors during the critical early recovery period.

MATERIALS AND METHODS

Study Design and Setting

A prospective observational study was conducted at the Department of Neurology, Kalinga Institute of Medical Sciences (KIMS), Bhubaneswar, Odisha, India, from May 2023 to April 2025.

Participant Selection

All consecutive patients presenting with acute stroke (within 72 hours of symptom onset) who fulfilled the WHO definition of stroke were screened and enrolled after obtaining informed consent.

Inclusion Criteria

- Age 18–50 years
- First-ever ischemic or hemorrhagic stroke confirmed by neuroimaging
- Presentation within 72 hours of symptom onset
- Completion of baseline clinical assessments

Exclusion Criteria

- Transient ischemic attack (TIA)
- Pre-existing neurological disorders (e.g., epilepsy, neurodegenerative diseases)
- Major psychiatric comorbidities (e.g., bipolar disorder, schizophrenia)
- Severe aphasia precluding neuropsychological evaluation
- History of alcohol or substance abuse

No participants were excluded on the basis of stroke severity.

Clinical Assessment

All patients underwent detailed clinical evaluation at hospital admission including demographics, vascular risk factors, stroke classification (TOAST criteria),9 and neurological severity (Glasgow Coma Scale10). Acute neuroimaging (CT or MRI) was performed to confirm stroke diagnosis, determine stroke type (ischemic vs. haemorrhagic), and localize lesions to vascular territories (anterior cerebral artery, middle cerebral artery, posterior circulation). Montreal Cognitive Assessment (MoCA)11 was administered as a global cognitive assessment. Functional outcome at three months was measured using the Modified Rankin Scale (mRS; 0–6 scale, with higher scores indicating greater dependence).12

Cognitive Assessment

At three months post-stroke (±2 weeks), patients underwent a comprehensive cognitive evaluation. Attention and Executive Function were assessed by Trail Making Tests A & B, along with Verbal Fluency Tests.13 Episodic Memory was assessed for both verbal and visuospatial memory by Ten-Word List Learning Task and Test des Neuf Images-93 (TNI-93), respectively. 14, 15 Language was assessed by Philadelphia Naming Test.16 Visuospatial Skills was assessed by Modified Taylor Complex Figure test.17

Statistical Analysis

Data were analyzed using SPSS version 27.0. Descriptive statistics summarized demographic and clinical characteristics (counts, percentages for categorical variables; mean ± SD for continuous variables).

RESULTS

The study cohort comprised 98 young stroke patients with a mean age of 42.9 ± 6.7 years (range 21–50), demonstrating a male predominance (62.2%). Slightly more than half of the participants were from rural areas (53.1%). The majority had educational attainment up to matriculation (75.5%), while 16.3% were graduates and 8.2% had post-graduate education, indicating a predominantly moderate educational background within the cohort (Table 1).

Table 1. Baseline Cohort Characteristics (n = 98)

Parameter	Value
Mean age (years)	42.9 ± 6.7 (range 21–50)
Male sex	61 (62.2%)
Rural residence	52 (53.1%)
Education – Matriculation	74 (75.5%)
Education – Graduation	16 (16.3%)
Education – Post-graduation	8 (8.2%)

Table 2. Stroke Characteristics in the study cohort:

Parameter	Value
Stroke Type	
Ischemic stroke	84 (85.7%)
Hemorrhagic stroke	14 (14.3%)
Ischemic Stroke Subtypes	
Large-vessel disease	42 (42.9%)
Lacunar infarction	21 (21.4%)
Cardioembolic stroke	12 (12.2%)
Other subtypes	23 (23.5%)
Vascular Territory	
MCA	48 (49.0%)
Posterior circulation	34 (34.7%)
ACA	16 (16.3%)
Presenting Symptoms	
Hemiparesis	76.5%
Dysphagia/Dysarthria	14.3%
Visual disturbance	10.2%
Ataxia	10.2%
Admission GCS (mean ± SD)	10.6 ± 1.2
3-month mRS (mean ± SD)	1.9 ± 0.7
3-month MoCA (mean ± SD)	20.3 ± 4.0

Table 3. Detailed Cognitive Test Performance

Test	Mean ± SD
Executive Function	
TMT-A (seconds)	68.1 ± 9.8
TMT-B (seconds)	171.4 ± 20.1
Categorical Verbal Fluency	
Animals	12.1 ± 1.9
Food	11.6 ± 2.5
Vegetables	10.7 ± 2.6
Phonemic Fluency	
Ka	7.6 ± 1.0
Ma	7.5 ± 1.2
Pa	7.1 ± 1.5
Memory (Ten-Word List)	
Total recall	17.3 ± 3.4
Delayed recall	7.9 ± 1.8
Delayed recognition	14.0 ± 1.6
Other Cognitive Measures	
TNI-93 total	6.8 ± 0.9
TNI-93 spatial	8.1 ± 1.0
Philadelphia Naming Test	86.7 ± 6.6
Modified Taylor Complex Figure (copy)	29.8 ± 5.4

Ischemic stroke constituted the majority of cases (85.7%), with hemorrhagic stroke accounting for 14.3%. Among ischemic subtypes, large-vessel disease was most common (42.9%), followed by lacunar infarction (21.4%) and cardioembolic

stroke (12.2%). The middle cerebral artery territory was most frequently involved (49.0%), and hemiparesis was the predominant presenting symptom (76.5%). The mean admission GCS was 10.6 ± 1.2, while at three months patients demonstrated relatively favorable functional outcomes (mean mRS 1.9 ± 0.7) but reduced global cognitive performance (mean MoCA 20.3 ± 4.0) (Table 2).

At the three-month follow-up, a detailed neuropsychological assessment demonstrated uniform cognitive performance across domains. Mean TMT-A and TMT-B completion times were 68.1 ± 9.8 seconds and 171.4 ± 20.1 seconds, respectively. Verbal fluency, memory, language, visuospatial, and executive function scores—including Ten-Word List recall, TNI-93, Philadelphia Naming Test, and Taylor Complex Figure—were consistently within the 25th–50th percentile range relative to normative data. Territory-specific analysis revealed no significant domain-specific deficits attributable to stroke location, indicating mild but globally distributed cognitive impairment (Table 3).

Presence or absence of hypertension, diabetes mellitus, smoking, obesity, dyslipidemia, and cardiac abnormalities did not significantly influence MoCA scores or domain-specific cognitive test performance (all $p>0.05$). This finding suggests that in young stroke populations, vascular risk factor burden does not substantially modulate cognitive outcomes at the three-month assessment window.

DISCUSSION

This prospective assessment of 98 young stroke survivors at three months post-stroke using comprehensive neuropsychological testing demonstrated globally uniform cognitive performance across all assessed domains, without marked domain-specific deficits despite neuroimaging evidence of acute ischemia or hemorrhage. Several mechanisms may account for this pattern. First, cognitive reserve- the capacity of the brain to tolerate pathological insult through flexible cognitive processing- is substantially greater in younger cohorts compared to elderly populations[18]. Younger individuals exhibit enhanced neural plasticity, greater social and occupational cognitive engagement, and relatively higher educational attainment (75.5% completed matriculation or higher), potentially conferring protection against overt cognitive decline during early recovery. Second, timing of assessment is critical. The three-month interval represents a phase of maximal neuroplasticity and spontaneous recovery, characterized by cortical reorganization and restoration of penumbral tissue viability[19]. Longitudinal studies indicate that cognitive improvement often plateaus after six months, suggesting that persistent deficits may emerge later. Third, methodological considerations are relevant. Brief screening tools such as the MoCA, which demonstrate lower specificity, may report higher impairment prevalence (50-70% across populations) compared to detailed domain-specific batteries[20].

The findings differ from literature reporting post-stroke cognitive impairment (PSCI) prevalence of 30-70% at three months. Such variation may reflect methodological heterogeneity and differences in study populations. International studies frequently include older cohorts (mean age 65-75 years) with greater baseline cognitive vulnerability and vascular burden[3]. In contrast, the present young cohort (mean age 42.9 years) likely represents a biologically distinct phenotype characterized by greater cognitive reserve. Longitudinal analyses by Pendlebury and Rothwell[2] and data from the Stroke and Cognition Consortium demonstrate that cognitive decline often accelerates between one and three years post-stroke rather than within the initial three-month period. This temporal pattern supports preserved early cognitive performance with potential for delayed deterioration in younger survivors.

Several implications for clinical practice and research emerge. Comprehensive neuropsychological evaluation is essential, as brief screening measures may underestimate subtle but functionally relevant deficits in young stroke survivors[21]. Extended longitudinal follow-up at 6, 12, and 24 months is necessary to delineate cognitive trajectories and identify individuals at risk for progressive impairment[4,22]. Interventions aimed at enhancing cognitive reserve-including structured cognitive rehabilitation, physical activity, occupational engagement, and continued education-may be particularly beneficial in younger populations where neuroplasticity remains robust[23]. Given the central role of cognition in vocational functioning, detailed neuropsychological assessment should inform occupational rehabilitation planning, especially for individuals engaged in cognitively demanding professions[6].

Several limitations warrant consideration. The absence of an age-matched control group limits determination of whether observed performance reflects preserved cognition or subtle impairment relative to stroke-free peers. The cross-sectional assessment at a single three-month time point restricts inference regarding cognitive trajectories, while the modest sample size may reduce power to detect subtle clinicocognitive associations. Minor variability in assessment timing (±2 weeks) and potential selection bias, particularly if more cognitively impaired individuals were unable to participate, may have influenced results. Educational heterogeneity may further limit applicability of normative comparisons. Future longitudinal studies incorporating assessments at 3, 6, 12, and 24 months[4,24], inclusion of age-matched controls, larger sample sizes, advanced neuroimaging correlates such as diffusion tensor imaging and perfusion metrics[25,26], occupational outcome evaluation, and

biomarker profiling including inflammatory markers[26,27] are necessary to better delineate cognitive trajectories and predictors of outcome.

CONCLUSION

This three-month neuropsychological evaluation of 98 young stroke survivors (18–50 years) demonstrated globally uniform cognitive performance across attention, executive, memory, language, and visuospatial domains, possibly reflecting greater cognitive reserve and neuroplasticity during early recovery or limitations of available assessment tools in detecting subtle deficits. Although these findings suggest relatively preserved early cognitive outcomes, interpretation requires caution due to the cross-sectional design, single timepoint assessment, and absence of control comparisons. Longitudinal prospective studies are necessary to delineate cognitive recovery trajectories, identify individuals at risk for delayed impairment, and refine targeted rehabilitation strategies in this economically productive population.

REFERENCES

1. Kissela BM, Khoury JC, Alwell K, Moomaw CJ, Woo D, Adeoye O, et al. Age at stroke: temporal trends in stroke incidence in a large, biracial population. Neurology. 2012;79(17):1781-7.
2. Jacquin A, Binquet C, Rouaud O, Graule-Petot A, Daubail B, Osseby GV, et al. Post-stroke cognitive impairment: high prevalence and determining factors in a cohort of mild stroke. J Alzheimers Dis. 2014;40(4):1029-38.
3. Maaijwee NA, Rutten-Jacobs LC, Schaapsmeerders P, van Dijk EJ, de Leeuw FE. Ischaemic stroke in young adults: risk factors and long-term consequences. Nat Rev Neurol. 2014;10(6):315-25.
4. Schaapsmeerders P, Maaijwee NA, van Dijk EJ, Rutten-Jacobs LC, Arntz RM, Schoonderwaldt HC, et al. Long-term cognitive impairment after first-ever ischemic stroke in young adults. Stroke. 2013;44(6):1621-8.
5. Edwards JD, Kapoor A, Linkewich E, Swartz RH. Return to work after young stroke: a systematic review. Int J Stroke. 2018;13(3):243-56.
6. Kauranen T, Turunen K, Laari S, Mustanoja S, Baumann P, Poutiainen E. The severity of cognitive deficits predicts return to work after a first-ever ischaemic stroke. J Neurol Neurosurg Psychiatry. 2013;84(3):316-21.
7. Zhou DH, Wang JY, Li J, Deng J, Gao C, Chen ME. Frequency and risk factors of vascular cognitive impairment three months after ischemic stroke in China: the Chongqing stroke study. Neuroepidemiology. 2004;24(1-2):87-95.
8. Tomlinson BE, Blessed G, Roth M. Observations on the brains of demented old people. J Neurol Sci. 1970;11(3):205-42.
9. Lisabeth LD, Sánchez BN, Baek J, Skolarus LE, Smith MA, Garcia N, et al. Neurological, functional, and cognitive stroke outcomes in Mexican Americans. Stroke. 2014;45(4):1096-101.
10. Chausson N, Olindo S, Cabre P, Saint-Vil M, Smadja D. Five-year outcome of a stroke cohort in Martinique, French West Indies. Stroke. 2010;41(4):594-9.
11. Zhou DH, Wang JY, Li J, Deng J, Gao C, Chen ME. Frequency and risk factors of vascular cognitive impairment three months after ischemic stroke in China: the Chongqing stroke study. Neuroepidemiology. 2004;24(1-2):87-95.
12. Yu KH, Cho SJ, Oh MS, Jung S, Lee JH, Shin JH, et al. Cognitive impairment evaluated with Vascular Cognitive Impairment Harmonization Standards in a multicenter prospective stroke cohort in Korea. Stroke. 2013;44(3):786-8.
13. Tombaugh TN. Trail Making Test A and B: normative data stratified by age and education. Arch Clin Neuropsychol. 2004;19(2):203-14.
14. Morris JC, Heyman A, Mohs RC, Hughes JP, van Belle G, Fillenbaum G, et al. The Consortium to Establish a Registry for Alzheimer's Disease (CERAD). Part I. Clinical and neuropsychological assessment of Alzheimer's disease. Neurology. 1989;39(9):1159-65.
15. Maillet D, Matharan F, Le Clésiau H, Bailon O, Pérès K, Amieva H, et al. TNI-93: a new memory test for dementia detection in illiterate and low-educated patients. Arch Clin Neuropsychol. 2016;31(8):896-903.
16. Roach A, Schwartz MF, Martin N, Grewal RS, Brecher A. The Philadelphia Naming Test: scoring and rationale. Clin Aphasiol. 1996;24:121-33.
17. Hubley AM. The modified Taylor complex figure: a comparable measure to the Rey-Osterrieth figure. Arch Clin Neuropsychol. 1999;14(8):734.
18. Wagle J, Farner L, Flekkøy K, Wyller TB, Sandvik L, Eiklid KL, et al. Association between ApoE ε4 and cognitive impairment after stroke. Dement Geriatr Cogn Disord. 2009;27(6):525-33.
19. Wu WU, Hettiarachchy NS, Qi M. Hydrophobicity, solubility, and emulsifying properties of soy protein peptides prepared by papain modification and ultrafiltration. J Am Oil Chem Soc. 1998;75:845-50.
20. Pendlebury ST, Rothwell PM. Prevalence, incidence, and factors associated with pre-stroke and post-stroke dementia: a systematic review and meta-analysis. Lancet Neurol. 2009;8(11):1006-18.
21. Li W, Huang R, Shetty RA, Thangthaeng N, Liu R, Chen Z, et al. Transient focal cerebral ischemia induces long-term cognitive function deficit in an experimental ischemic stroke model. Neurobiol Dis. 2013;59:18-25.
22. Charlton RA, Morris RG, Nitkunan A, Markus HS. The cognitive profiles of CADASIL and sporadic small vessel disease. Neurology. 2006;66(10):1523-6.
23. Edwards JD, Kapoor A, Linkewich E, Swartz RH. Return to work after young stroke: a systematic review. Int J Stroke. 2018;13(3):243-56.

24. Cho DR, Lee SH. Effects of virtual reality immersive training with computerized cognitive training on cognitive function and activities of daily living performance in patients with acute stage stroke: a preliminary randomized controlled trial. Medicine (Baltimore). 2019;98(11):e14752.
25. Tene O, Rutten-Jacobs LCA, Arntz RM, et al. Subacute cognitive impairment after first-ever transient ischemic attack or ischemic stroke in young adults: the ODYSSEY study. Eur Stroke J. 2023;8(1):19-27.
26. Rutten-Jacobs LCA, Tene O, Arntz RM, et al. Cognitive trajectory in the first year after first-ever ischaemic stroke in young adults: the ODYSSEY study. J Neurol Neurosurg Psychiatry. 2024;95(4):345-352.
27. Gorelick PB, Scuteri A, Black SE, DeCarli C, Greenberg SM, Iadecola C, et al. Vascular contributions to cognitive impairment and dementia: a statement for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2011;42(9):2672-713.