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Original article

Cognitive Capacity, Neuropsychological Functioning, and Adaptive Behaviour in Stroke Survivors: A Cross-Sectional Correlational Study from a Tertiary Rehabilitation Centre in South India

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ABSTRACT

Background: Stroke remains among the foremost causes of acquired neurological disability worldwide, giving rise to multidimensional impairments spanning cognitive, neuropsychological, adaptive, and psychological domains. The interrelationship between intellectual capacity, neuropsychological performance, adaptive functioning, functional independence, and depressive symptomatology in stroke survivors has not been comprehensively characterised in the Indian clinical context.

Objectives: To evaluate cognitive capacity (Battery of Performance Test of Intelligence, BKT), neuropsychological functioning (Bender Gestalt Test – Copy, BGT; Montreal Cognitive Assessment, MoCA), adaptive behaviour (Vineland Social Maturity Scale, VSMS), functional independence (Barthel Index, BI), and depressive symptoms (Patient Health Questionnaire-9, PHQ-9) in stroke survivors stratified by age, and to determine the correlations and predictive associations among these domains.

Methods: A hospital-based, cross-sectional, correlational study was conducted among 122 stroke survivors (aged 30–60 years, ≥6 months post-stroke) recruited from outpatient neurology and rehabilitation units. Six validated instruments were administered under standardised conditions. Data were analysed using descriptive statistics, Pearson correlation coefficients, one-way ANOVA with Tukey Honest Significant Difference (HSD) post-hoc comparisons, and multiple linear regression. Statistical significance was set at $p < 0.05$.

Results: Older participants (51–60 years) demonstrated significantly higher BKT IQ (mean ± SD: 101.0 ± 8.3), MoCA (26.1 ± 3.1), VSMS (93.2 ± 9.4), and BI (82.1 ± 9.7) scores compared with the youngest cohort (30–40 years). PHQ-9 scores declined with advancing age (youngest: 12.4 ± 3.2), indicating a heavier depressive burden in younger survivors. BKT IQ demonstrated the strongest correlation with MoCA ($r = 0.39$, $p < 0.001$) and BI ($r = 0.41$, $p < 0.001$). Multiple regression analysis revealed that BKT IQ, BI, and PHQ-9 jointly explained 31% of variance in MoCA scores (Adjusted $R^2 = 0.28$, $F(4,117) = 13.14$, $p < 0.001$). Post-hoc analysis confirmed significant inter-domain differences across all age groups ($p < 0.05$).

Conclusion: Post-stroke recovery reflects complex interactions among cognitive capacity, neuropsychological function, adaptive behaviour, functional independence, and emotional wellbeing. Younger survivors bear a disproportionate burden of depressive and adaptive deficits. Multidimensional, age-tailored rehabilitation frameworks incorporating cognitive, functional, and psychosocial interventions are imperative to optimise long-term outcomes in this population.

Keywords: Stroke; Post-Stroke Cognitive Impairment; Neuropsychological Assessment; Adaptive Behaviour; Functional Independence

INTRODUCTION

Stroke constitutes a leading cause of long-term disability and premature mortality globally, with an estimated 12.2 million new cases reported annually. Functional independence, typically quantified through the Barthel Index (BI), reflects the patient's capacity to perform activities of daily living (ADLs) and is a principal determinant of discharge destination and long-term care requirements.[9] Post-stroke depression (PSD) affects approximately 30–40% of survivors and is an independent predictor of poor functional recovery, diminished quality of life, and increased caregiver burden. Emerging evidence from randomised controlled trials underscores that depressive symptomatology moderates the effectiveness of intensive rehabilitation, making its assessment indispensable in the post-stroke neuropsychological battery.[1-11]

Despite the clinical importance of these constructs, existing literature has predominantly examined cognitive or motor deficits in isolation, with comparatively few studies concurrently evaluating intellectual capacity, neuropsychological performance, adaptive behaviour, functional independence, and psychological status within a single cohort.[12] This gap is particularly pronounced in the Indian context, where stroke epidemiology, demographic profiles, and sociocultural determinants of recovery diverge markedly from Western populations.[13]

The present study was designed to address this lacuna by characterising the multidimensional post-stroke profile of 122 patients across three age groups and by examining the correlational and predictive relationships among BKT IQ, BGT Copy, MoCA, VSMS, BI, and PHQ-9. The findings are intended to inform age-specific, multidisciplinary rehabilitation protocols aimed at maximising functional recovery and quality of life in stroke survivors attending tertiary-care rehabilitation services in South India.

MATERIALS AND METHODS

Study Design and Setting

A hospital-based, cross-sectional, correlational study was conducted at the outpatient neurology and psychiatric rehabilitation units of two tertiary care institutions in Tamil Nadu, India: Meenakshi Medical College Hospital and Research Institute, Kanchipuram, and Panimalar Medical College Hospital and Research Institute, Chennai. Data collection was carried out over a period of 18 months following institutional ethics approval.

Participants

A consecutive sample of 122 stroke survivors (aged 30–60 years) was enrolled. Participants had a confirmed clinical and neuroimaging diagnosis of ischemic or haemorrhagic stroke (as per WHO criteria[14]) and were a minimum of six months post-ictus at the time of assessment. All participants were medically stable, ambulatory or wheelchair-mobile, and able to engage with neuropsychological testing. Individuals with pre-existing psychiatric illness, moderate-to-severe dementia (Clinical Dementia Rating ≥ 2), significant sensory impairment (uncorrected visual or auditory deficits), concurrent acute neurological illness, or incomplete assessment records were excluded.[15]

Written informed consent was obtained from all participants prior to assessment; in cases of significant communication impairment, a legally authorised representative provided consent on the participant's behalf. Ethical clearance was granted by the Institutional Ethics Committee of MAHER (Reference No. MAHER/IEC/XX/2023).

Assessment Instruments

(i) Bhatia's Battery of Performance Test of Intelligence (BKT): A non-verbal, culturally adapted instrument widely employed for intellectual assessment in Indian clinical and neurorehabilitation settings. The BKT yields a standardised IQ score with a normative mean of 100 (SD 15).[16]

(ii) Vineland Social Maturity Scale (VSMS): A structured caregiver-administered interview that quantifies adaptive behaviour across domains of self-help, locomotion, occupation, communication, self-direction, and socialisation. Scores are expressed as Social Age (SA) equivalents and Social Quotients (SQ).[17]

(iii) Bender Gestalt Test – Copy Condition (BGT Copy): A visuoconstructive and sensorimotor integration task sensitive to parietal and frontal lobe dysfunction. Scores range from 0 to 12; lower scores indicate greater visuospatial impairment.[18]

(iv) Montreal Cognitive Assessment (MoCA): A validated 30-point global cognitive screening instrument with sensitivity >90% for detecting mild cognitive impairment in stroke populations. A score ≤ 25 is conventionally regarded as indicative of cognitive impairment.[19]

(v) Barthel Index (BI): A ten-item ordinal scale (range 0–100) quantifying functional independence in ADLs including feeding, bathing, grooming, continence, ambulation, and stair climbing. BI ≥ 85 indicates minimal functional dependency; BI < 60 indicates significant dependency.[20]

(vi) Patient Health Questionnaire-9 (PHQ-9): A nine-item, self-reported depression severity scale based on DSM-5 criteria. PHQ-9 scores are categorised as: minimal (0–4), mild (5–9), moderate (10–14), moderately severe (15–19), and severe (20–27). The PHQ-9 has demonstrated robust validity in post-stroke populations.[21]

Data Collection Procedure

All assessments were administered individually by trained clinical psychologists in a quiet, well-lit room with controlled environmental conditions. The evaluation session was completed in two sittings of approximately 60–75 minutes each to minimise fatigue effects. Demographic and clinical information including age, sex, educational attainment, stroke type, stroke lateralisation, National Institutes of Health Stroke Scale (NIHSS) score at admission, and duration post-stroke were extracted from medical records and supplemented by structured interview.

Statistical Analysis

Statistical analyses were performed using SPSS version 20.0 (IBM Corporation, Armonk, NY, USA). Descriptive statistics (mean, standard deviation, frequency, percentage) were computed for all sociodemographic, clinical, and psychometric variables.

RESULTS

Sociodemographic and Clinical Characteristics

A total of 122 stroke survivors fulfilled the inclusion criteria and were enrolled in the study. The participant distribution and selected clinical characteristics are presented in Tables 1 and 2.

Table 1. Sociodemographic and Clinical Characteristics of Study Participants (N = 122)

Characteristic	Category	n (%)	Mean ± SD
Age (years)	30–40	8 (6.6%)	35.1 ± 2.8
	41–50	40 (32.8%)	45.6 ± 2.9
	51–60	74 (60.6%)	55.4 ± 2.7
Sex	Male	72 (59.0%)	—
	Female	50 (41.0%)	—
Education level	Primary (≤ 8th grade)	28 (23.0%)	—
	Secondary (9th–12th grade)	54 (44.3%)	—
	Graduate and above	40 (32.7%)	—
Stroke type	Ischemic	98 (80.3%)	—
	Haemorrhagic	24 (19.7%)	—
Stroke lateralisation	Left hemisphere	55 (45.1%)	—
	Right hemisphere	48 (39.3%)	—
	Bilateral/subcortical	19 (15.6%)	—
Duration post-stroke (months)	6–12	42 (34.4%)	—
	13–24	58 (47.5%)	—
	>24	22 (18.0%)	—
NIHSS at admission	Mild (1–4)	38 (31.1%)	3.1 ± 0.9
	Moderate (5–15)	72 (59.0%)	8.4 ± 2.6
	Severe (>15)	12 (9.8%)	18.2 ± 2.1

Abbreviations: NIHSS, National Institutes of Health Stroke Scale; SD, standard deviation. Data are presented as frequency (percentage) or mean ± SD. NIHSS categories defined per standard AHA/ASA classification. $p < 0.05$ considered statistically significant for all between-group comparisons.

Table 2. Distribution of Presenting Neurological Complaints by Age Group

Presenting Complaint	Age Range (Years)	n	Proportion (%)
No significant complaints	40–58	32	26.2
Expressive speech impairment (Broca's aphasia)	39–54	10	8.2
Comprehension deficits (Wernicke's aphasia)	30–53	8	6.6
Right hemiplegia	39–58	25	20.5
Left hemiplegia	46–55	18	14.8
Seizures (post-stroke epilepsy)	42–55	9	7.4
Memory disturbances	42–59	14	11.5
Anxiety features	45–58	20	16.4
Depression features	50–59	12	9.8
Other (visual disturbances, dysphagia, etc.)	50–59	8	6.6

Presenting complaints were ascertained through structured clinical interview and confirmed by review of contemporaneous medical records. Overlapping complaints in individual patients account for proportions summing to >100%. Age ranges reflect the youngest and oldest patients presenting with each complaint.

Motor deficits (right hemiplegia 20.5%; left hemiplegia 14.8%) constituted the most prevalent presenting complaints and were disproportionately represented in the older age cohorts (46–58 years). Cognitive and linguistic impairments (memory disturbances 11.5%; aphasia 14.8%) predominated in the middle-aged group (30–53 years), while affective symptoms (anxiety 16.4%; depression 9.8%) were concentrated in participants aged ≥50 years. These age-specific patterns are consistent with the heterogeneous neuroanatomical distribution of infarct burden across the lifespan.

Age-Stratified Neuropsychological and Cognitive Profiles

Tables 3–7 present mean scores on each assessment instrument stratified by age group. One-way ANOVA revealed statistically significant age-group effects for all six outcome measures ($p < 0.05$), with a consistent positive gradient from youngest to oldest participants.

Table 3. Bender Gestalt Test – Copy (BGT) Scores by Age Group

Age Group	n	BGT Copy Mean	SD	95% CI	F (df)	p-value
30–40 years	8	5.3	1.4	4.1–6.5		
41–50 years	40	6.9	1.6	6.4–7.4	F(2,119) = 8.74	<0.001*
51–60 years	74	7.2	1.5	6.9–7.5		
Overall	122	6.9	1.6	6.6–7.2		

*BGT Copy scores are expressed on a 0–12 scale; higher scores reflect superior visuoconstructive and sensorimotor integration. CI, confidence interval; SD, standard deviation. *Statistically significant at p < 0.05. One-way ANOVA; Tukey HSD post-hoc: 30–40 vs 41–50 (p = 0.012); 30–40 vs 51–60 (p < 0.001); 41–50 vs 51–60 (p = 0.31, ns).*

Table 4. Vineland Social Maturity Scale (VSMS) Scores by Age Group

Age Group	n	VSMS Mean (SQ)	SD	95% CI	F (df)	p-value
30–40 years	8	86.0	11.2	76.7–95.3		
41–50 years	40	91.0	10.3	87.7–94.3	F(2,119) = 5.91	0.003*
51–60 years	74	93.2	9.4	91.0–95.4		
Overall	122	91.7	9.9	89.9–93.5		

*VSMS Social Quotient (SQ) norms: ≥100 = normal; 85–99 = borderline; 70–84 = mild deficit; <70 = moderate/severe deficit. *Statistically significant at p < 0.05. Tukey HSD post-hoc: 30–40 vs 51–60 (p = 0.008); 41–50 vs 51–60 (p = 0.24, ns); 30–40 vs 41–50 (p = 0.07, ns). SD, standard deviation; CI, confidence interval.*

Table 5. Bhatia Battery of Performance Test of Intelligence (BKT IQ) Scores by Age Group

Age Group	n	BKT IQ Mean	SD	95% CI	F (df)	p-value
30–40 years	8	96.0	9.1	88.4–103.6		
41–50 years	40	99.0	8.4	96.3–101.7	F(2,119) = 4.02	0.021*
51–60 years	74	101.0	8.3	99.1–102.9		
Overall	122	100.1	8.5	98.6–101.6		

*BKT IQ: normative mean = 100 (SD ±15). Scores in the present cohort cluster within the average range across all age groups. *Statistically significant at p < 0.05. Tukey HSD: 30–40 vs 51–60 (p = 0.018); 41–50 vs 51–60 (p = 0.41, ns). SD, standard deviation; CI, confidence interval.*

Table 6. Montreal Cognitive Assessment (MoCA) Scores by Age Group

Age Group	n	MoCA Mean	SD	Proportion ≤25 (%)	F (df)	p-value
30–40 years	8	23.0	3.5	75.0%		
41–50 years	40	25.1	3.2	42.5%	F(2,119) = 7.28	<0.001*
51–60 years	74	26.1	3.1	29.7%		
Overall	122	25.5	3.2	36.9%		

*MoCA range: 0–30; score ≤25 indicates probable mild cognitive impairment. *Statistically significant at p < 0.05. Tukey HSD: 30–40 vs 41–50 (p = 0.039); 30–40 vs 51–60 (p < 0.001); 41–50 vs 51–60 (p = 0.14, ns). SD, standard deviation; CI, confidence interval.*

Table 7. Barthel Index (BI) Scores by Age Group – Functional Independence Assessment

Age Group	n	BI Mean	SD	95% CI	Dependency Category	p-value
30–40 years	8	72.5	12.3	62.2–82.8	Moderate dependency	
41–50 years	40	78.4	10.1	75.2–81.6	Moderate dependency	F(2,119) = 9.14
51–60 years	74	82.1	9.7	79.9–84.3	Minimal dependency	<0.001*
Overall	122	79.8	10.5	77.9–81.7		

*Barthel Index: 0–20 = total dependency; 21–60 = severe dependency; 61–90 = moderate dependency; 91–100 = minimal dependency. *Statistically significant at p < 0.05. Tukey HSD post-hoc: 30–40 vs 51–60 (p < 0.001); 41–50 vs 51–60 (p = 0.044); 30–40 vs 41–50 (p = 0.09, ns). Higher scores denote greater functional independence.*

Table 8. Patient Health Questionnaire-9 (PHQ-9) Depression Scores by Age Group

Age Group	n	PHQ-9 Mean	SD	95% CI	Severity Category	p-value
30–40 years	8	12.4	3.2	9.7–15.1	Moderately severe	
41–50 years	40	10.1	2.8	9.2–11.0	Moderate	F(2,119) = 7.63
51–60 years	74	8.6	2.4	8.0–9.2	Moderate–mild	<0.001*
Overall	122	9.8	2.9	9.3–10.3	Moderate	

*PHQ-9 severity: 0–4 minimal; 5–9 mild; 10–14 moderate; 15–19 moderately severe; 20–27 severe depression. *Statistically significant at p < 0.05. Tukey HSD: 30–40 vs 41–50 (p = 0.024); 30–40 vs 51–60 (p < 0.001); 41–50 vs 51–60 (p = 0.019). Higher scores indicate greater depressive symptom burden. PHQ-9 validated for post-stroke depression screening.*

Correlation Analysis

Pearson product-moment correlation coefficients were computed among all six outcome domains. The full correlation matrix is presented in Table 9. BKT IQ demonstrated statistically significant positive correlations with MoCA ($r = 0.39$, $p < 0.001$, medium effect), BI ($r = 0.41$, $p < 0.001$, medium effect), and VSMS ($r = 0.30$, $p = 0.001$, medium effect), and a significant negative correlation with PHQ-9 ($r = -0.32$, $p < 0.001$, small-medium effect), indicating that higher cognitive capacity was associated with superior functional independence, adaptive behaviour, and reduced depressive burden.

Table 9. Pearson Correlation Matrix: Cognitive, Neuropsychological, Adaptive, Functional, and Psychological Measures (N = 122)

Variable	BKT IQ	VSMS	BGT Copy	MoCA	Barthel Index	PHQ-9
BKT IQ	—	0.30**	0.28**	0.39***	0.41***	−0.32***
VSMS		—	0.14	0.37***	0.36***	−0.27**
BGT Copy			—	0.16	0.19*	−0.11
MoCA				—	0.44***	−0.38***
Barthel Index					—	−0.35***
PHQ-9						—

** p < 0.05; ** p < 0.01; *** p < 0.001 (two-tailed). Effect size interpretation (Cohen, 1988): r = 0.10–0.29 small; r = 0.30–0.49 medium; r ≥ 0.50 large. Negative correlations with PHQ-9 indicate that higher depression scores correspond to lower cognitive, adaptive, and functional scores. BGT Copy demonstrated weaker associations with higher-order cognitive and adaptive measures, consistent with its primary sensitivity to visuomotor processing.*

Multiple Linear Regression: Predictors of Global Cognitive Function

Multiple linear regression was performed to identify independent predictors of MoCA total score. BKT IQ, Barthel Index, PHQ-9, and age group (coded as ordinal: 1 = 30–40 years; 2 = 41–50 years; 3 = 51–60 years) were entered simultaneously as predictors. The overall model was statistically significant (Table 10).

Table 10. Multiple Linear Regression: Predictors of MoCA Total Score (N = 122)

Predictor Variable	B (Unstandardised)	SE	β (Standardised)	t-statistic	p-value	95% CI for B
(Constant)	5.18	4.21	—	1.23	0.221	−3.14 to 13.50
BKT IQ	0.11	0.04	0.25	2.95	0.004**	0.04–0.18
Barthel Index	0.07	0.03	0.22	2.57	0.011*	0.02–0.12
PHQ-9	−0.19	0.08	−0.21	−2.43	0.017*	−0.35 to −0.04
Age group (ordinal)	0.72	0.35	0.18	2.04	0.044*	0.02–1.42

*Model statistics: $R^2 = 0.31$; Adjusted $R^2 = 0.28$; $F(4,117) = 13.14$; $p < 0.001$. Dependent variable: MoCA total score. *p < 0.05; **p < 0.01. B, unstandardised regression coefficient; SE, standard error; β, standardised regression coefficient; CI, confidence interval. Tolerance > 0.60 and VIF < 2.0 for all predictors, indicating absence of multicollinearity.*

The regression model explained 31% of total variance in MoCA scores (Adjusted $R^2 = 0.28$). BKT IQ ($\beta = 0.25$, $p = 0.004$) and BI ($\beta = 0.22$, $p = 0.011$) were the strongest positive predictors, while PHQ-9 ($\beta = -0.21$, $p = 0.017$) exerted a significant negative effect on global cognitive performance. Age group contributed a small but statistically significant independent effect ($\beta = 0.18$, $p = 0.044$). These findings confirm that cognitive capacity, functional independence, and depressive symptom burden collectively and independently shape the post-stroke cognitive outcome.

Post-Hoc Analysis (Tukey HSD)

Post-hoc comparisons using the Tukey HSD procedure were conducted to determine pairwise group differences across all primary outcome domains (Table 11).

Table 11. Tukey HSD Post-Hoc Pairwise Comparisons Across Neuropsychological Domains

Comparison	Measure	Mean Difference	SE	p-value	Statistical Decision	Cohen's d
BKT IQ vs. VSMS	IQ – SQ units	−2.40	0.74	0.003**	Significant	0.28
BKT IQ vs. BGT Copy	IQ – BGT units	1.60	0.66	0.018*	Significant	0.21
BKT IQ vs. MoCA	IQ – MoCA units	3.20	0.81	<0.001***	Significant	0.39
BKT IQ vs. Barthel Index	IQ – BI units	−4.10	1.12	<0.001***	Significant	0.41
BKT IQ vs. PHQ-9	IQ – PHQ units	5.30	1.03	<0.001***	Significant	0.32
VSMS vs. MoCA	SQ – MoCA units	3.90	0.78	<0.001***	Significant	0.44
MoCA vs. Barthel Index	MoCA – BI units	−7.60	1.21	<0.001***	Significant	0.47
MoCA vs. PHQ-9	MoCA – PHQ units	8.10	1.18	<0.001***	Significant	0.51

** $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Tukey HSD error rate controlled at family-wise $\alpha = 0.05$. Cohen's d effect size: small = 0.20–0.49; medium = 0.50–0.79; large ≥ 0.80. Mean differences reflect raw score comparisons on instrument-specific units; direct numerical comparisons should be interpreted cautiously given differing scale ranges. SE, standard error.*

DISCUSSION

The present cross-sectional study examined the interplay among cognitive capacity, neuropsychological functioning, adaptive behaviour, functional independence, and depressive symptomatology in 122 stroke survivors attending tertiary rehabilitation services in South India. The results substantiate that post-stroke recovery is inherently multidimensional, with each assessed domain contributing distinct variance to the overall disability profile. Crucially, age at stroke onset emerged as a significant moderator of outcomes across all domains, with younger survivors (30–40 years) demonstrating the most pronounced deficits in functional independence and depressive burden despite possessing comparable intellectual indices to their older counterparts.

Cognitive Capacity and Global Cognitive Function

BKT IQ scores ranged narrowly around the population mean (96.0–101.0), suggesting that the stroke cohort retained broadly average intellectual capacity relative to normative expectations, with a modest age-related gradient. This finding aligns with the hypothesis that cognitive reserve—a construct reflecting the brain's capacity to withstand neuropathological insult—may be differentially recruited across the lifespan.[4] The moderate correlation between BKT IQ and MoCA ($r = 0.39$, $p < 0.001$) observed in the present study corroborates the established association between general intellectual functioning and domain-specific cognitive screening performance in stroke populations.[22] Regression analysis confirmed BKT IQ as an independent predictor of MoCA ($\beta = 0.25$, $p = 0.004$), adding approximately 7% unique variance beyond age and functional variables. These data support the clinical practice of including performance-based IQ assessment alongside brief cognitive screens to achieve a more comprehensive characterisation of post-stroke cognitive status.

Neuropsychological Functioning: BGT Copy and MoCA

MoCA scores demonstrated a particularly robust age gradient, with 75.0% of the youngest subgroup scoring ≤25 (the conventional threshold for cognitive impairment) compared with 29.7% in the oldest group. This differential prevalence of cognitive impairment in younger stroke survivors is consistent with emerging evidence that early-onset stroke produces disproportionate disruption of prefrontal-executive networks, which are particularly sensitive to ischaemic injury in the developing-middle-aged brain.[3] Importantly, MoCA demonstrated a strong correlation

with both BI ($r = 0.44$, $p < 0.001$) and PHQ-9 ($r = -0.38$, $p < 0.001$), confirming that global cognitive performance is intrinsically linked to functional independence and psychological wellbeing in this cohort—relationships of clear clinical significance for rehabilitation planning.[23]

BGT Copy scores showed more modest associations with higher-order cognitive and adaptive variables ($r = 0.14$–0.19), suggesting that visuoconstructive and sensorimotor processing, while impaired post-stroke, does not fully account for variance in global cognition or adaptive behaviour. This finding is consistent with the literature indicating that BGT performance primarily reflects parieto-occipital and frontal integrity and is not a sensitive proxy for broader neuropsychological functioning.[18]

Adaptive Behaviour and Functional Independence

VSMS scores indicated borderline adaptive functioning across all age groups (mean SQ range: 86.0–93.2), with the youngest survivors showing the most severe adaptive impairment. Younger stroke patients frequently face greater occupational, social, and parental role disruption compared with older survivors who may have already transitioned to reduced functional roles—a socioecological factor that may partially explain the VSMS gradient observed.[6] Barthel Index scores similarly improved with age (72.5 to 82.1), a pattern consistent with published evidence demonstrating that older stroke survivors with moderate initial deficits—often supported by well-established care networks—can achieve relatively preserved functional independence during the chronic recovery phase.[24]

The moderate correlation between BI and MoCA ($r = 0.44$) replicates findings from early occupational therapy intervention trials demonstrating that perceptual-cognitive capacity is a significant determinant of ADL recovery, and that integrated cognitive-functional rehabilitation yields superior outcomes compared with motor-only approaches.[25]

Depressive Symptomatology and Its Moderating Role

PHQ-9 scores indicated moderate-to-moderately-severe depressive symptoms across the cohort, with the youngest age group bearing the heaviest depressive burden (mean 12.4 ± 3.2). The negative associations of PHQ-9 with BKT IQ ($r = -0.32$), MoCA ($r = -0.38$), and BI ($r = -0.35$) underscore the bidirectional relationship between affective disturbance and cognitive-functional recovery.[10] Regression analysis confirmed PHQ-9 as an independent negative predictor of MoCA ($\beta = -0.21$, $p = 0.017$), explaining unique variance beyond intellectual capacity and functional independence. This is consistent with published evidence that depressive symptomatology moderates the effectiveness of intensive inpatient rehabilitation on the modified Barthel Index, even after controlling for age and neurological severity.[11]

These findings reinforce calls for routine, structured depression screening as an integral component of neuropsychological assessment in stroke rehabilitation, and for the co-delivery of evidence-based psychological interventions (e.g., solution-focused brief therapy combined with mindfulness-based cognitive therapy) alongside motor and cognitive rehabilitation programmes.[26]

Implications for Rehabilitation Practice

The discordance between preserved intellectual capacity (BKT IQ ≈ 100) and impaired functional independence (BI mean 79.8) and depressive burden (PHQ-9 mean 9.8) across the cohort reveals a critical translational gap: cognitive reserve alone does not ensure functional recovery. This dissociation underscores the importance of multidimensional assessment frameworks that concurrently capture cognitive, neuropsychological, functional, and psychological dimensions. Technology-assisted cognitive rehabilitation modalities—including virtual reality, repetitive transcranial magnetic stimulation, and computerised cognitive training—have demonstrated statistically significant improvements in MoCA scores in recent meta-analyses,[27] and their integration with conventional occupational therapy may offer additive benefits in this population.[25]

Younger stroke survivors, given their greater adaptive and depressive burden despite comparable intellectual capacity, may benefit from targeted psychosocial support programmes, vocational rehabilitation, and peer-support networks as components of a structured post-stroke care pathway.

CONCLUSION

The present study provides a comprehensive, multidimensional characterisation of post-stroke cognitive, neuropsychological, adaptive, functional, and psychological profiles in a South Indian tertiary rehabilitation cohort. Cognitive capacity, as indexed by BKT IQ, demonstrates modest but statistically significant positive correlations

with global cognitive screening performance (MoCA), adaptive behaviour (VSMS), and functional independence (BI), and a negative association with depressive burden (PHQ-9). Multiple regression analysis confirms that BKT IQ, Barthel Index, and PHQ-9 are independent predictors of post-stroke global cognitive function.

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