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Prevalence and Clinical Correlates of Cognitive Impairment in Adults With Epilepsy at a Tertiary Care Center in Rajasthan: A Cross-Sectional Study.

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Abstract

Background: Cognitive impairment is a frequent and under-recognized comorbidity of epilepsy that adversely affects quality of life, treatment adherence, and long-term outcomes. Data from tertiary centers in northern and northwestern India, including Rajasthan, remain limited despite the substantial epilepsy burden in these regions. ***Methods:*** We conducted a hospital-based cross-sectional study at Dr. S. S. Tantia Medical College, Hospital and Research Centre, Sri Ganganagar, Rajasthan, between 5 May 2026 and 23 July 2026. Consecutive adults aged 18 years or older with a clinical diagnosis of epilepsy of at least one year duration who had been receiving a stable anti-seizure medication regimen for a minimum of three months were enrolled after written informed consent. Cognitive function was assessed with the Hindi version of the Montreal Cognitive Assessment (MoCA). A total score below 26 defined cognitive impairment. Clinical variables included seizure type, average monthly seizure frequency, duration of epilepsy, number of current anti-seizure medications, and years of formal education. Associations were examined with independent-samples t-tests or Mann-Whitney U tests, chi-square or Fisher exact tests, and multivariable logistic regression. A two-sided p-value less than 0.05 was considered statistically significant. ***Results:*** Of 128 patients screened, 16 were excluded and 112 completed the full assessment (mean age 34.6 ± 12.1 years; 66 male, 58.9%). Cognitive impairment (MoCA score <26) was present in 61 participants (54.5%, 95% confidence interval [CI] 45.2–63.5). Mean MoCA score in the overall cohort was 24.1 ± 3.8. In the multivariable logistic regression model, three variables remained independently associated with cognitive impairment: duration of epilepsy greater than 10 years (adjusted odds ratio [aOR] 2.84, 95% CI 1.21–6.67, p = 0.017), polytherapy with two or more anti-seizure medications (aOR 2.31, 95% CI 1.05–5.08, p = 0.037), and educational attainment limited to primary level or less (aOR 3.12, 95% CI 1.38–7.05, p = 0.006). Average monthly seizure frequency of two or more showed a non-significant trend (aOR 1.98, 95% CI 0.92–4.26, p = 0.081). ***Conclusions:*** More than half of adults with epilepsy evaluated at this tertiary center demonstrated cognitive impairment on MoCA screening. Longer disease duration, polytherapy, and limited formal education were independently associated with impaired performance. These findings support the incorporation of brief cognitive screening into routine epilepsy care in similar resource-constrained settings.

Keywords: epilepsy; cognitive impairment; Montreal Cognitive Assessment; MoCA; anti-seizure medication; polytherapy; India; cross-sectional study.

INTRODUCTION

Epilepsy affects approximately 50 million people worldwide, with the majority living in low- and middle-income countries [1]. Beyond recurrent seizures, cognitive dysfunction ranks among the most disabling comorbidities. It contributes to reduced educational attainment, unemployment, social stigma, and poorer health-related quality of life [2,3].

Cognitive deficits in epilepsy are multifactorial. They arise from the underlying etiology, interictal and ictal network disruption, adverse effects of anti-seizure medications, and psychosocial factors [4,5]. Memory, attention, executive function, and processing speed are the domains most frequently affected. Importantly, measurable cognitive impairment may persist even in patients whose seizures appear clinically controlled [6].

Most published Indian data on cognition in epilepsy originate from large metropolitan tertiary centers. Rural and semi-urban teaching hospitals in northern and northwestern India, including those serving Rajasthan, remain under-represented in the literature. This geographic gap matters because literacy rates, patterns of polytherapy, delayed diagnosis, and access to specialized neuropsychological services differ substantially from urban referral hospitals.

The present study was designed to estimate the prevalence of cognitive impairment, defined by the Montreal Cognitive Assessment (MoCA), among adults with epilepsy attending a tertiary care teaching hospital in Sri Ganganagar, Rajasthan, and to identify demographic and clinical factors independently associated with impaired performance.

MATERIALS AND METHODS

Study Design and Setting

We conducted a hospital-based, cross-sectional observational study in the Medicine, neurology and psychiatry outpatient clinics of Dr. S. S. Tantia Medical College, Hospital and Research Centre (DRSSTMCH&RC), Sri Ganganagar, Rajasthan, India. Recruitment occurred between 5 May 2026 and 23 July 2026. The study protocol was reviewed and approved by the Institutional Ethics Committee of Dr. S. S. Tantia Medical College, Hospital and Research Centre (approval number to be inserted by the author; date of approval to be inserted). Written informed consent was obtained from every participant in Hindi or the local language before any study procedure. The study is reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies and was conducted in compliance with the Declaration of Helsinki.

Participants

Consecutive adults aged 18 years or older with a clinical diagnosis of epilepsy according to the International League Against Epilepsy practical definition [7] and a total duration of illness of at least one year were screened. Inclusion required a stable anti-seizure medication regimen (no change in drug or dose) for a minimum of three consecutive months preceding the assessment day. Exclusion criteria were progressive neurological disease, major psychiatric disorder requiring active psychotropic treatment, intellectual disability diagnosed before age 18 years, head injury with loss of consciousness within the preceding six months, active substance dependence, and inability to complete the MoCA in Hindi after two attempts.

Sample Size

Assuming an expected prevalence of cognitive impairment of 50% based on prior Indian tertiary-center reports [8,9], a precision of 10%, and a two-sided 95% confidence level, the minimum required sample size was 97. We enrolled 112 participants who completed assessment to allow for multivariable modeling and minor incomplete responses.

Data Collection and Cognitive Assessment

A structured case-record form captured age, sex, completed years of formal education, seizure onset type (focal versus generalized), average monthly seizure frequency calculated from patient and caregiver report over the preceding six months, total duration of epilepsy in years, and the number and names of current anti-seizure medications. Monotherapy was defined as a single anti-seizure medication; polytherapy was defined as two or more concurrent anti-seizure medications.

Cognitive status was assessed with the Hindi version of the Montreal Cognitive Assessment (MoCA) [10,11]. The MoCA evaluates attention and concentration, executive function, memory, language, visuoconstructional skills, conceptual thinking, calculations, and orientation (maximum score 30). A total score of less than 26 indicated cognitive impairment, consistent with the cut-off validated for use in Indian populations [11]. All assessments were performed by trained clinicians in a quiet room after confirming that the participant had not experienced a clinical seizure in the preceding 24 hours. The same version of the instrument and standardized instructions were used for every participant.

Statistical Analysis

Continuous variables are summarized as mean ± standard deviation or median with interquartile range, as appropriate. Categorical variables are presented as frequencies and percentages. Between-group comparisons used independent-samples t-tests for approximately normally distributed continuous data, Mann-Whitney U tests for skewed continuous data, and chi-square or Fisher exact tests for categorical data.

Variables associated with cognitive impairment at $p < 0.20$ on univariable analysis were entered into a multivariable binary logistic regression model with cognitive impairment (MoCA <26) as the dependent variable. Multicollinearity was assessed with variance inflation factors. Adjusted odds ratios (aOR) with 95% confidence intervals are reported. A two-sided p-value less than 0.05 was considered statistically significant. Analyses were performed with standard statistical software.

RESULTS

Participant Flow and Characteristics

Of 128 consecutive patients screened during the study period, 16 were excluded (progressive neurological disease n = 4, major psychiatric illness requiring active treatment n = 5, inability to complete the MoCA after two attempts n = 7). The final analytic sample comprised 112 adults. Mean age was 34.6 ± 12.1 years; 66 participants (58.9%) were male. Median duration of epilepsy was 7 years (interquartile range 3–14). Sixty-eight patients (60.7%) were receiving monotherapy and 44 (39.3%) were receiving polytherapy. Mean MoCA score for the entire cohort was 24.1 ± 3.8 (range 14–30). Demographic and clinical characteristics are summarized in Table 1.

Table 1: Demographic and clinical characteristics of the study cohort (N = 112)

Characteristic	Value
Age, years (mean ± SD)	34.6 ± 12.1
Male sex, n (%)	66 (58.9)
Education ≤ primary level, n (%)	41 (36.6)
Duration of epilepsy, years (median, IQR)	7 (3–14)
Focal onset seizures, n (%)	71 (63.4)
Average monthly seizures ≥2, n (%)	38 (33.9)
Polytherapy (≥2 anti-seizure medications), n (%)	44 (39.3)
MoCA score (mean ± SD)	24.1 ± 3.8
Cognitive impairment (MoCA <26), n (%)	61 (54.5)

SD: standard deviation; IQR: interquartile range; MoCA: Montreal Cognitive Assessment.

Prevalence of Cognitive Impairment

Cognitive impairment defined by a MoCA score below 26 was identified in 61 of 112 participants (54.5%, 95% CI 45.2–63.5). Mean MoCA score among participants with impairment was 21.3 ± 2.7, compared with 27.4 ± 1.5 among those without impairment (independent-samples t-test, $p < 0.001$).

Univariable Associations

Participants with cognitive impairment were older (37.2 ± 12.8 versus 31.5 ± 10.4 years; t-test p = 0.011), more likely to have education limited to primary level or less (47.5% versus 23.5%; chi-square p = 0.008), more likely to have epilepsy duration greater than 10 years (52.5% versus 27.5%; chi-square p = 0.007), and more likely to be receiving polytherapy (49.2% versus 27.5%; chi-square p = 0.018). Average monthly seizure frequency of two or more was more common in the impaired group but did not reach conventional statistical significance (41.0% versus 25.5%; chi-square p = 0.082). Sex and seizure onset type did not differ significantly between groups (Table 2).

Table 2: Comparison of participants with and without cognitive impairment

Variable	Impaired (n=61)	Not impaired (n=51)	p-value
Age, years (mean ± SD)	37.2 ± 12.8	31.5 ± 10.4	0.011*
Male sex, n (%)	35 (57.4)	31 (60.8)	0.715†
Education ≤ primary, n (%)	29 (47.5)	12 (23.5)	0.008†
Duration >10 years, n (%)	32 (52.5)	14 (27.5)	0.007†
Polytherapy, n (%)	30 (49.2)	14 (27.5)	0.018†
Seizures ≥2/month, n (%)	25 (41.0)	13 (25.5)	0.082†
Focal onset, n (%)	40 (65.6)	31 (60.8)	0.599†

* Independent-samples t-test. † Chi-square test. SD: standard deviation.

Multivariable Analysis

Variables with $p < 0.20$ on univariable testing were entered into the multivariable logistic regression model. After mutual adjustment, three factors remained independently associated with cognitive impairment: duration of epilepsy greater than 10 years (aOR 2.84, 95% CI 1.21–6.67, p = 0.017), polytherapy (aOR 2.31, 95% CI 1.05–5.08, p = 0.037), and education limited to primary level or less (aOR 3.12, 95% CI 1.38–7.05, p = 0.006). Average monthly seizure frequency of two or more showed a non-significant trend (aOR 1.98, 95% CI 0.92–4.26, p = 0.081). When age was entered as a continuous variable it was no longer significant after adjustment for duration of epilepsy, consistent with collinearity between chronological age and disease chronicity (Table 3). Variance inflation factors for all retained covariates were below 2.0, indicating acceptable multicollinearity.

Table 3: Multivariable logistic regression for cognitive impairment (MoCA score <26)

Variable	aOR	95% CI	p-value
Duration >10 years	2.84	1.21–6.67	0.017
Polytherapy	2.31	1.05–5.08	0.037
Education ≤ primary	3.12	1.38–7.05	0.006
Seizures ≥2/month	1.98	0.92–4.26	0.081
Age (per year)	1.02	0.98–1.06	0.312

aOR: adjusted odds ratio; CI: confidence interval. Model includes all listed covariates.

DISCUSSION

In this cross-sectional study of adults with epilepsy evaluated at a tertiary care teaching hospital in Sri Ganganagar, Rajasthan, cognitive impairment defined by a MoCA score below 26 was present in 54.5% of participants. Longer duration of epilepsy, polytherapy, and limited formal education emerged as factors independently associated with impaired performance after multivariable adjustment.

The observed prevalence falls within the range reported from other Indian tertiary centers (approximately 40–65%), which varies according to the cognitive instrument used and the proportion of refractory cases [8,9]. Our data extend these observations to a predominantly semi-urban and rural catchment area in northwestern India characterized by lower average educational attainment and more limited access to specialized cognitive services. This geographic context is relevant because cognitive reserve and health-system factors may modify both the expression and the detection of impairment.

Duration of epilepsy greater than 10 years was associated with nearly threefold higher odds of cognitive impairment. This finding is consistent with the cumulative-burden hypothesis, in which repeated seizures, interictal epileptiform activity, and progressive network reorganization produce lasting effects on memory and executive networks [4,12]. Polytherapy remained independently associated with impairment, aligning with evidence that certain anti-seizure medications and drug combinations exert adverse cognitive effects [13]. Whether the association reflects direct medication toxicity, greater underlying disease severity that necessitates polytherapy, or both cannot be resolved in a cross-sectional design.

Limited educational attainment showed the strongest adjusted association. Education may confer cognitive reserve that buffers against epilepsy-related decline, or it may simply proxy for socioeconomic factors that influence both health-seeking behavior and performance on formal cognitive tests [14]. Regardless of mechanism, the finding underscores the need for screening instruments and interpretive norms that account for educational background in this setting.

Average monthly seizure frequency demonstrated only a borderline association after adjustment. This may reflect the inclusion requirement of relative clinical stability (unchanged medication regimen for at least three months) or the inherent limitations of retrospectively reported seizure counts. Prospective seizure diaries and, where feasible, prolonged electroencephalographic monitoring would clarify the relationship more precisely.

Strengths of the study include consecutive sampling during a defined recruitment window, use of a validated Hindi MoCA with a population-appropriate cut-off, explicit reporting of statistical tests, assessment of multicollinearity, and multivariable adjustment for key covariates. Limitations must be acknowledged. The cross-sectional design precludes causal inference. Recruitment from a single teaching hospital limits generalizability to primary-care or purely rural populations. No matched healthy control group was included, so absolute deficit relative to local norms cannot be quantified. The MoCA is a screening instrument; formal domain-specific neuropsychological batteries would refine the cognitive phenotype. Residual confounding by unmeasured variables (etiology, interictal burden, specific medication types, and mood symptoms) remains possible. Finally, educational bias on MoCA performance cannot be fully excluded despite adjustment.

From a clinical perspective, these results support the feasibility of incorporating brief MoCA screening into routine epilepsy clinics for adults with long disease duration or those receiving polytherapy, particularly in resource-constrained settings where specialist neuropsychology is unavailable. Positive screens can prompt medication review, counseling about cognitive risk, and referral to available rehabilitation or educational support services.

CONCLUSION

Cognitive impairment, defined by a MoCA score below 26, affected approximately one in two adults with epilepsy evaluated at this tertiary center in Rajasthan. Longer disease duration, polytherapy, and limited formal education were

independently associated with impaired performance. Incorporating brief, education-sensitive cognitive screening into routine epilepsy care is feasible and may identify patients who would benefit from medication optimization and supportive interventions.

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Declarations

Ethics approval and consent to participate

The study protocol was reviewed and approved by the Institutional Ethics Committee of Dr. S. S. Tantia Medical College, Hospital and Research Centre, Sri Ganganagar, Rajasthan (approval number and date to be inserted by the author prior to submission). Written informed consent was obtained from all participants. The study was conducted in accordance with the Declaration of Helsinki.

Consent for publication

Not applicable. No individual patient data or identifiable images are presented.

Availability of data and materials

De-identified data supporting the findings of this study are available from the corresponding author upon reasonable request.

Competing interests

The author declares that there are no competing interests.

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Authors' contributions

Reddy Spoorti Channa conceived and designed the study, collected and analysed the data, drafted and revised the manuscript, and approved the final version for submission.

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