Open Access

ISSN: 2663-9491 e-ISSN: 2789-6897

ORIGINAL ARTICLE

Brain MRI Patterns in Pediatric Patients with Epilepsy

DOI: 10.5281/zenodo.18548036

Mamun Or Rashid[1], Jahangir Alam[2], Shafiqul Ahsan[3], S M Sorowar Kamal[4], Ishaque Ali[5], Sudipta Saha[6]

Received: 26 Jan 2026
Accepted: 29 Jan 2026
Published Online: 9 Feb 2026

Published by:
Gopalganj Medical College, Gopalganj, Bangladesh

Correspondence to
Mamun Or Rashid

ABSTRACT

Background: *Epilepsy is a common neurological disorder in children, often associated with identifiable structural brain abnormalities. Magnetic Resonance Imaging (MRI) is a critical tool for detecting these lesions, which can guide diagnosis, management, and prognosis. Local data on the spectrum of MRI findings in pediatric epilepsy patients in Bangladesh remains limited.* ***Objective:*** *To determine the frequency and patterns of brain MRI abnormalities in pediatric epilepsy patients.* ***Methods & Materials:*** *A prospective cohort study was conducted at the Department of Radiology & Imaging, Shaheed Tajuddin Ahmad Medical College & Hospital, Gazipur, Bangladesh, from September 2024 to August 2025. A purposive sample of 43 pediatric epilepsy patients was recruited. All participants underwent a dedicated 1.5 Tesla brain MRI protocol for epilepsy. Clinical and neuroimaging data were analyzed using SPSS version 23.0, with descriptive statistics presented as frequencies and percentages.* ***Result:*** *Analysis of 43 patients revealed abnormal brain MRI findings in 72.1% (n=31). Hippocampal sclerosis was the most common pattern (20.9%), followed by malformations of cortical development (16.3%). Abnormal MRI findings showed a significant association with focal-onset seizures (88.9%; p=0.018) and a younger mean age at seizure onset (4.2 years vs. 7.1 years in normal MRI; p=0.012).* ***Conclusion:*** *This study confirms a high yield of abnormal MRI findings in pediatric epilepsy, predominantly hippocampal sclerosis. Dedicated neuroimaging is essential for identifying structural etiologies, guiding targeted management, and optimizing outcomes, especially for children with focal seizures or early onset.*

Keywords: *Brain MRI, Epilepsy, hippocampal sclerosis, neuroimaging, pediatric neurology, structural abnormality.*

(The Insight 2025; 8(4): 874-877)

1. *Assistant Professor, Department of Radiology & Imaging, Shaheed Tajuddin Ahmad Medical College & Hospital, Gazipur, Bangladesh (ORCID: 0009-0001-0318-0540)*
2. *Assistant Professor, Department of Radiology & Imaging, Shaheed Tajuddin Ahmad Medical College & Hospital, Gazipur, Bangladesh*
3. *Associate Professor, Department of Radiology & Imaging, Dhaka Medical College Hospital, Dhaka, Bangladesh*
4. *Assistant Professor, Department of Radiology & Imaging, National Gastroliver Institute & Hospital, Dhaka, Bangladesh*
5. *Assistant Professor, Department of Radiology & Imaging, National Institute of Ophthalmology & Hospital, Dhaka, Bangladesh*
6. *Assistant Professor, Radiology & Imaging, Brahmanbaria Sadar Hospital, Brahmanbaria, Bangladesh*

INTRODUCTION

Epilepsy, characterized by recurrent unprovoked seizures, represents one of the most common serious neurological disorders affecting the pediatric population globally, with a significant proportion of cases originating in childhood [1]. The condition imposes a substantial burden on affected children and their families, impacting neurodevelopment, cognitive function, quality of life, and long-term psychosocial outcomes [2]. The etiological landscape of pediatric epilepsy is diverse, encompassing genetic, structural, metabolic, and infectious causes. In contemporary clinical practice, the identification of an underlying structural brain abnormality is a pivotal diagnostic step, as it directly influences classification, informs therapeutic decisions, and provides prognostic information [3,4]. Neuroimaging, particularly Magnetic Resonance Imaging (MRI), serves as the cornerstone for the structural evaluation of epilepsy. The advent of high-resolution MRI protocols tailored for epilepsy has dramatically improved the detection of subtle cerebral pathologies that were previously undetectable with conventional imaging [5]. The identification of a specific lesion, such as hippocampal sclerosis, focal cortical dysplasia, or a low-grade tumor, can shift management from purely pharmacological to potentially curative surgical interventions, especially in cases of drug-resistant epilepsy [6]. The diagnostic yield of brain MRI in children with epilepsy is notably high, with studies reporting abnormalities in approximately 60-80% of cases, varying based on epilepsy syndrome, age of onset, and clinical presentation [7,8]. Despite established international guidelines advocating for early neuroimaging in new-onset epilepsy, its utilization and the spectrum of findings can vary significantly across different geographical and resource settings [9]. In Bangladesh, epilepsy remains a major public health concern, yet comprehensive data on the neuroimaging profiles of affected children are sparse. Most existing studies in the region are either retrospective, have small sample sizes, or utilize varied imaging protocols, limiting the generalizability of findings [10]. This gap in localized evidence hinders the development of optimized, context-specific diagnostic algorithms and resource allocation. Previous research from South Asia indicates a high prevalence of potentially treatable structural lesions, such as neurocysticercosis and tuberculomas, though patterns may be evolving with improved public health measures [11]. Furthermore, recent international studies from the last five years continue to refine the phenotypic and imaging correlates of various

ISSN: 2663-9491 e-ISSN: 2789-6897

epileptogenic lesions, emphasizing the need for standardized, protocol-based MRI evaluation [12,13]. A detailed understanding of the prevalent MRI patterns in a given population is crucial for radiologists and neurologists to prioritize differential diagnoses and for healthcare planners to ensure the availability of necessary investigative tools. Therefore, this prospective study was designed to systematically evaluate the brain MRI patterns in a cohort of pediatric epilepsy patients at Shaheed Tajuddin Ahmad Medical College & Hospital, Gazipur, Bangladesh. By employing a standardized imaging protocol and prospective design, the study aims to provide contemporary, justified data on the frequency and types of structural abnormalities. The findings are expected to reinforce the critical role of neuroimaging in the local clinical workflow, highlight the most common etiologies, and contribute to improving the diagnostic precision and management strategies for children with epilepsy in this setting.

METHODS & MATERIALS

A prospective cross-sectional study was conducted at the Department of Radiology & Imaging, Shaheed Tajuddin Ahmad Medical College & Hospital, Gazipur, Bangladesh, from September 2024 to August 2025. The study population comprised pediatric patients (age ≤18 years) with a clinical diagnosis of epilepsy who were referred for neuroimaging evaluation. A purposive sampling technique was employed, yielding a final sample size of 43 participants.

Inclusion criteria

Patients were included if they met the following criteria: 1) a clinical diagnosis of epilepsy as defined by the International League Against Epilepsy (ILAE), 2) age at enrollment between 1 and 18 years, and 3) referral for a brain MRI as part of their diagnostic workup. Informed written consent was obtained from parents or legal guardians.

Exclusion criteria

Patients were excluded from the analysis if they had: 1) a known major chromosomal abnormality or metabolic disorder, 2) a history of prior epilepsy surgery, or 3) an MRI scan deemed technically inadequate for diagnostic interpretation due to motion artifacts.

Study procedure

All participants underwent a dedicated epilepsy protocol brain MRI on a 1.5 Tesla scanner. The protocol included 3D T1-weighted, T2-weighted, FLAIR, and susceptibility-weighted sequences. Images were independently reviewed by two experienced radiologists, with a third resolving discrepancies. Clinical data, including seizure type and age of onset, were collected via a structured questionnaire and patient records.

Data analysis

Data were analyzed using SPSS version 23.0. Descriptive statistics were computed for demographic and clinical variables. MRI findings were categorized, and frequencies/percentages were calculated. Inter-rater agreement for MRI findings was assessed using Cohen's kappa.

RESULT

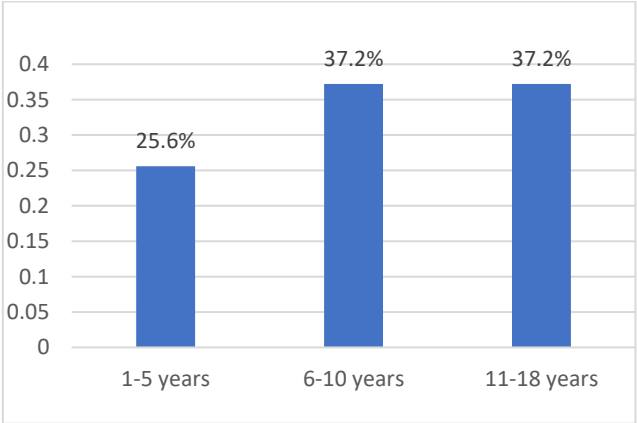

Figure – 1: Age distribution of participants

The study comprised 43 pediatric epilepsy patients with a mean age of 8.7 years (±4.3 SD) (Figure 1).

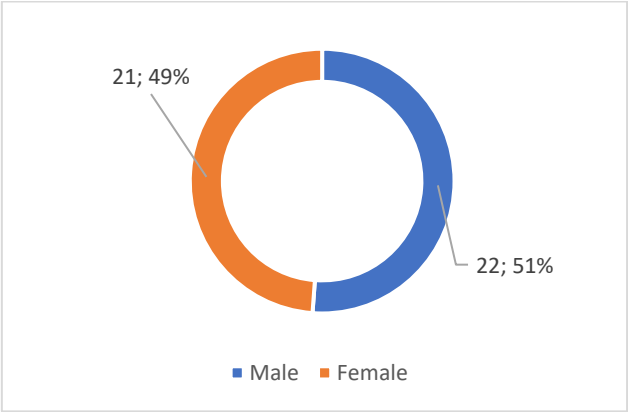

Figure – 2: Gender distribution of participants

The gender distribution was nearly equal, with 51.2% male and 48.8% female participants (Figure 2).

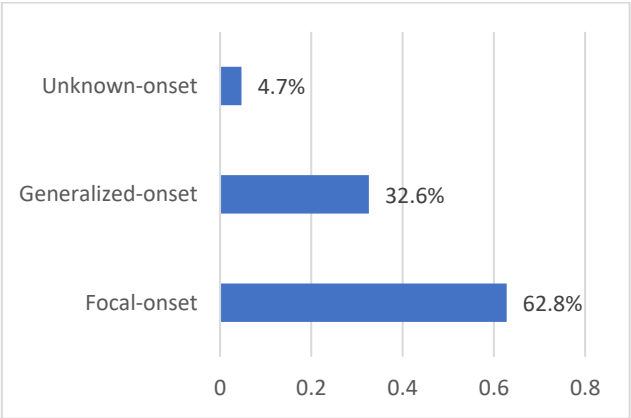

Figure – 3: Seizure type distribution

Clinically, focal-onset seizures were the most common presentation, observed in 62.8% of the cohort, followed by generalized-onset seizures in 32.6%, and unknown-onset seizures in 4.7% (Figure 3).

ISSN: 2663-9491 e-ISSN: 2789-6897

CD: Cortical development

Overall, brain MRI revealed abnormal findings in a significant majority of patients (72.1%, n=31). A diverse spectrum of structural lesions was identified. The most prevalent abnormality was hippocampal sclerosis, found in 20.9% of the total cohort (n=9). This was followed by malformations of cortical development (16.3%, n=7), including focal cortical dysplasia and heterotopia. Gliotic or encephalomalacic changes were present in 14.0% (n=6), while tumors, primarily low-grade glioneuronal tumors, were identified in 9.3% (n=4). Other, less frequent findings included vascular malformations and nonspecific white matter signal changes. Notably, 27.9% (n = 12) of patients had a normal MRI study (Table I).

Table – I: Distribution of brain MRI findings in the study cohort

MRI Finding	n	%
Normal MRI	12	27.9
Abnormal MRI (Total)	31	72.1
Hippocampal sclerosis	9	20.9
Malformations of CD	7	16.3
Gliotic/Encephalomalacic change	6	14
Tumor	4	9.3
Vascular malformation	2	4.7
Other/Nonspecific findings	3	7.0

Chi-square test, p = 0.018

The prevalence of MRI abnormalities showed a statistically significant association with the clinical seizure type (p=0.018). Patients with focal-onset seizures exhibited a markedly higher rate of abnormal MRI findings (88.9%) compared to those with generalized-onset seizures (42.9%) (Table II).

Table – II: Association between clinical seizure type and MRI findings

Seizure type	MRI findings		n
	Normal	Abnormal	
	n (%)		
Focal-onset	3 (11.1%)	24 (88.9%)	27
Generalized-onset	8 (57.1%)	6 (42.9%)	14
Unknown-onset	1 (50.0%)	1 (50.0%)	2

Independent samples t-test, p = 0.012

The mean age at seizure onset was significantly lower in patients with abnormal MRI scans (4.2 ± 3.1 years) compared to those with normal MRIs (7.1 ± 3.8 years) (p=0.012) (Table III).

Table – III: Comparison of age at seizure onset by MRI category

MRI category	n	Mean age at onset
		Years
		Mean ± SD
Normal MRI	12	7.1 ± 3.8
Abnormal MRI	31	4.2 ± 3.1
Total	43	5.1 ± 3.6

Chi-square test, p = 0.432

However, no significant association was found between the presence of an MRI abnormality and the patient's gender (p = 0.432) (Table IV).

Table – IV: Association between patient gender and MRI findings

Gender	MRI findings		n
	Normal	Abnormal	
	n (%)		
Male	7 (31.8%)	15 (68.2%)	22
Female	5 (23.8%)	16 (76.2%)	21

Hippocampal sclerosis was more frequently unilateral (77.8%) than bilateral (22.2%), with a slight right-sided predominance. Among tumors, all were located in the cerebral hemispheres. The distribution of the most common pathologies also showed variation based on the lobe involved, with temporal lobe lesions being the most frequent site for epileptogenic abnormalities (Table V).

Table – V: Characteristics of key abnormal MRI findings (*n*=31)

Sub-category	n	Abnormality (%)
Hippocampal sclerosis (n=9)		
Unilateral	7	77.8
Right	4	44.4
Left	3	33.3
Bilateral	2	22.2
Tumors (n=4)		
Temporal lobe	2	50
Frontal lobe	1	25
Parietal lobe	1	25

DISCUSSION

This prospective study elucidates the significant role of dedicated brain MRI in identifying structural pathologies in a cohort of pediatric epilepsy patients in Bangladesh. The finding that 72.1% of children exhibited abnormal MRI scans aligns with and reinforces data from contemporary international literature, which reports yields between 60-80% in similar pediatric cohorts [7,8,14]. This high detection rate underscores MRI as an indispensable, non-invasive tool for uncovering the structural basis of epilepsy, moving beyond syndromic classification to specific etiological diagnosis. The most prevalent abnormality identified was hippocampal sclerosis (HS), accounting for 20.9% of all patients and 29.0% of those with abnormal scans. This finding is particularly salient. It contrasts with older regional studies from South Asia that frequently highlighted infectious etiologies like neurocysticercosis as predominant [11], suggesting a possible shift in disease patterns with improved public health measures or reflecting the specialized referral nature of our center. The high prevalence of HS, a classic substrate for focal epilepsy often associated with febrile seizures, emphasizes the critical need for high-resolution coronal imaging of the temporal lobes in every pediatric epilepsy protocol [5,12]. Our data further indicate that HS was predominantly unilateral, which is a favorable prognostic factor for potential surgical candidacy [6]. Malformations of cortical development (MCD) were the second most common finding (16.3%). This category, encompassing focal cortical dysplasia, is a major cause of drug-resistant epilepsy in children and a prime target for pre-surgical evaluation [15]. The detection of these often-subtle lesions is entirely contingent upon optimized MRI protocols with thin-slice volumetric sequences, as employed in this study [13]. The significant association between abnormal MRI findings and focal-onset seizures (88.9%) is both expected and clinically validating. It confirms the high pre-test probability of identifying a structural lesion in children presenting with focal features, reinforcing current guideline

recommendations for mandatory MRI in this group [4,16]. Conversely, the lower yield (42.9%) in generalized-onset seizures aligns with the understanding that many such syndromes have genetic or metabolic bases not visible on conventional MRI. The statistically significant younger age at seizure onset in children with abnormal MRIs (p=0.012) is a crucial observation supported by other studies [17,18]. This suggests that early-onset epilepsy is more frequently symptomatic of an underlying structural brain anomaly, warranting particularly urgent and thorough neuroimaging investigation to guide early intervention, which may include surgery to mitigate epileptic encephalopathy [19]. Our study has several limitations. The purposive sampling at a single tertiary care hospital may introduce selection bias, potentially overrepresenting complex or drug-resistant cases, thus inflating the abnormality rate compared to a community-based sample. The sample size, while adequate for a preliminary prospective analysis, limits subgroup analyses and the generalizability of the prevalence of rarer lesions. Furthermore, advanced quantitative MRI techniques or genetic testing were not part of the protocol, which might have increased the diagnostic yield further [20]. Despite these limitations, our findings carry important implications for clinical practice in Bangladesh and similar settings. They strongly advocate for the standardized implementation of dedicated pediatric epilepsy MRI protocols as a first-line investigation [13]. The high prevalence of potentially surgically remediable lesions like HS and focal MCD highlights the need to develop and strengthen multidisciplinary pediatric epilepsy surgery programs to improve outcomes for children with drug-resistant epilepsy [21,22]. Future research should focus on longitudinal studies correlating specific MRI findings with long-term seizure outcomes and surgical results, and on integrating advanced imaging with genetic studies for a more comprehensive etiological understanding [23,24]. This study confirms a high frequency of identifiable structural brain abnormalities in Bangladeshi children with epilepsy, with hippocampal sclerosis emerging as the most common pattern. It validates the critical importance of early and protocol-based neuroimaging to optimize diagnosis, inform targeted treatment strategies, and ultimately improve the neurological prognosis for these children [25].

Limitations:

The limitations include a modest sample size and a single-center, purposive sampling design, which may limit generalizability and introduce selection bias. Advanced imaging techniques and genetic correlations were not incorporated into the study protocol.

CONCLUSION

This study affirms a high prevalence, nearly three-fourths of structural brain abnormalities on MRI in pediatric epilepsy, with hippocampal sclerosis being the most frequent. These findings strongly advocate for protocol-based neuroimaging as an essential first-line diagnostic tool. Identifying specific etiologies, particularly surgically remediable lesions, is crucial for optimizing management strategies and improving long-term outcomes for children with epilepsy in this setting.

Recommendation:

Implement dedicated pediatric epilepsy MRI protocols as standard care. Strengthen multidisciplinary epilepsy programs to evaluate surgical candidacy for focal lesions. Promote longitudinal studies correlating imaging with treatment outcomes. Increase accessibility to advanced neuroimaging in regional healthcare centers.

REFERENCES

1. *Fiest, Kirsten M., et al. "Prevalence and incidence of epilepsy: a systematic review and meta-analysis of international studies." Neurology 88.3 (2017): 296-303.*
2. *Reilly, Colin, et al. "Neurobehavioral comorbidities in children with active epilepsy: a population-based study." Pediatrics 133.6 (2014): e1586-e1593.*
3. *Scheffer, Ingrid E., et al. "ILAE classification of the epilepsies: Position paper of the ILAE Commission for Classification and Terminology." Epilepsia 58.4 (2017): 512-521.*
4. *Gaillard, William D., et al. "Guidelines for imaging infants and children with recent-onset epilepsy." Epilepsia 50.9 (2009): 2147-2153.*
5. *Zentner, Josef. Surgical treatment of epilepsies: diagnosis, surgical strategies, results. Springer Nature, 2020.*
6. *Consales, Alessandro, et al. "The surgical treatment of epilepsy." Neurological Sciences 42.6 (2021): 2249-2260.*
7. *Koh, Hyun Yong, et al. "Utility of exome sequencing for diagnosis in unexplained pediatric-onset epilepsy." JAMA Network Open 6.7 (2023): e2324380-e2324380.*
8. *Morrissey, Brenda, and Shaughn Maxwell. "Paramedicine Literature Search: July-September 2023." International Journal of Paramedicine 4 (2023): 68-115.*
9. *Astrocytoma, Pilocytic, and Anaplastic Astrocytoma. "DX DIAGNOSIS." Ferri's Clinical Advisor 2022, E-Book (2021): 195.*
10. *Azim, Ehsamul, et al. "Green Life Medical College Journal."*
11. *Sahu, Priyadarshi Soumyaranjan, et al. "Imaging and serological evidence of neurocysticercosis among patients with seizures in Odisha, an unexplored eastern coastal province in India." Journal of Clinical and Diagnostic Research: JCDR 9.5 (2015): DC06.*
12. *Lee, Seul Bi, et al. "Diagnosis of hippocampal sclerosis in children: comparison of automated brain MRI volumetry and readers of varying experience." American Journal of Roentgenology 217.1 (2021): 223-234.*
13. *Larivière, Sara, et al. "Network-based atrophy modeling in the common epilepsies: A worldwide ENIGMA study." Science advances 6.47 (2020): eabc6457.*
14. *Fatema, Kanij, et al. "Clinicoradiologic profile and outcome of children with tubercular meningitis in a tertiary care hospital in Bangladesh." Journal of Child Neurology 35.3 (2020): 195-201.*
15. *Guerrini, Renzo, and Carmen Barba. "Focal cortical dysplasia: an update on diagnosis and treatment." Expert Review of Neurotherapeutics 21.11 (2021): 1213-1224.*
16. *Goldman-Yassen, Adam E., and Seena Dehkharghani. "Neuroimaging in pediatric stroke and cerebrovascular disease." Exon Publications (2021): 25-51.*
17. *Alsumaili, Mohammad, et al. "Seizure outcome after epilepsy surgery for patients with normal MRI: a single center experience." Epilepsy Research 173 (2021): 106620.*
18. *Bartolini, Emanuele, et al. "Glycaemic imbalances in seizures and epilepsy of paediatric age: a literature review." Journal of Clinical Medicine 12.7 (2023): 2580.*
19. *Cross, J. Helen, et al. "Proposed criteria for referral and evaluation of children for epilepsy surgery: recommendations of the Subcommission for Pediatric Epilepsy Surgery." Epilepsia 47.6 (2006): 952-959.*
20. *Caldairou, Benoit, et al. "MRI-based machine learning prediction framework to lateralize hippocampal sclerosis in patients with temporal lobe epilepsy." Neurology 97.16 (2021): e1583-e1593.*
21. *Baumgartner, Christoph, et al. "Presurgical epilepsy evaluation and epilepsy surgery." F1000Research 8 (2019): F1000-Faculty.*
22. *Dash, Gopal K., et al. "Predictors of seizure outcome following resective surgery for drug-resistant epilepsy associated with focal gliosis." Journal of Neurosurgery 130.6 (2018): 2071-2079.*
23. *McGinn, Ryan James, et al. "Precision medicine in epilepsy." Progress in Molecular Biology and Translational Science 190.1 (2022): 147-188.*
24. *Wang, Ge, et al. "Imaging genetics in epilepsy: current knowledge and new perspectives." Frontiers in Molecular Neuroscience 15 (2022): 891621.*
25. *Gaillard, William D., et al. "Establishing criteria for pediatric epilepsy surgery center levels of care: report from the ILAE Pediatric Epilepsy Surgery Task Force." Epilepsia 61.12 (2020): 2629-2642.*