ORIGINAL ARTICLE

Diagnostic Utility of Common Brain MRI Technique in Pediatric Epilepsy: A Cross-Sectional Study

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ABSTRACT

Objectives: Pediatric epilepsy is a neurological condition that could be associated with structural brain abnormalities. Although the common magnetic resonance imaging (MRI) technique is a standard tool for detecting these abnormalities, its diagnostic utility remains unclear compared to advanced neuroimaging techniques. This study aimed to evaluate the effectiveness of the common brain MRI technique in identifying structural lesions in pediatric epilepsy.

Materials & Methods: In this cross-sectional investigation, 337 patients with pediatric epilepsy underwent a common brain MRI. The scans were examined for abnormal lesions and assessed for their connections with neurological characteristics. Chi-square tests were used in statistical analysis to detect essential connections.

Results: Brain MRI scans revealed abnormalities in 20.7% of patients. These abnormalities included white matter lesions (72%), gray matter lesions (22%), hippocampal lesions (12.8%), ventricular lesions (7%), and vascular lesions (2.8%). A significant relationship was found between abnormal neurological exam results and brain MRI findings ($p < 0.001$).

Conclusion: While standard brain MRI can help identify structural abnormalities in pediatric epilepsy, it is not the most sensitive method, particularly compared to advanced neuroimaging techniques. Higher-resolution imaging and advanced modalities such as diffusion tensor imaging (DTI) and functional MRI (fMRI) may enhance diagnostic accuracy and improve outcomes in pediatric epilepsy management.

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Introduction

The diagnosis and treatment of pediatric epilepsy are crucial for improving patients' outcomes due to its prevalence and complexity as a neurological disorder affecting around 0.5-1% of children globally (1). Identifying structural brain abnormalities is often part of diagnosing epilepsy, as these abnormalities can generate abnormal brain activity. Magnetic resonance imaging (MRI), as a non-invasive imaging modality, is valuable for identifying structural abnormalities and determining the etiology of pediatric epilepsy (2). The common brain MRI technique is essential for detecting structural abnormalities in pediatric epilepsy and remains a focus of research.

MRI, being a non-invasive method of capturing images, provides better clarity than other imaging methods, such as computed tomography (CT) (3). Studies have verified the crucial function of MRI in identifying brain lesions frequently associated with cases of childhood epilepsy. MRI was found to detect the etiology of pediatric epilepsy in 74% of cases, comparable with CT, identifying issues in 73% of individuals (4). MRI's capability to capture soft tissue

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structures with incredible detail is beneficial in identifying epilepsy-related lesions, such as white matter lesions, cortical dysplasia, and hippocampal sclerosis. Moreover, MRI is vital for finding structural abnormalities and causes of epilepsy in children, but EEG is still the primary tool for diagnosing and classifying epileptic syndromes. Accurate identification of the source of seizures is crucial in localization-related epilepsies for targeted interventions (5). MRI is beneficial when there is uncertainty in epilepsy classification or when investigating epilepsy syndromes with a suspected structural cause (6). Accordingly, MRI provides essential information for diagnosing and creating suitable treatment plans, particularly in children with persistent seizures.

Sophisticated MRI methods like high-resolution MRI and diffusion tensor imaging (DTI) have enhanced the identification of minor brain abnormalities, specifically in cases of medication-resistant epilepsy. These methods are particularly beneficial in detecting abnormalities that could be treated with surgery, providing a potential solution for seizure management in individuals unresponsive to medication. High-resolution MRI improved the detection of lesions not visible in conventional MRI techniques, leading to better surgical outcomes for children with epilepsy (7). Likewise, the potential usefulness of DTI in improving diagnostic methods for pediatric epilepsy by evaluating white matter damage was emphasized (8). The connection between MRI results and neurological outcomes underscores the importance of MRI findings in a clinical setting. Amirsalari et al. discovered strong connections between abnormal neurological examinations and MRI-detected lesions in children with epilepsy (9). This suggests that MRI can be a vital tool not only for the initial diagnosis of etiology but also for ongoing management and predicting outcomes. When structural abnormalities are believed to be the cause of epilepsy, MRI is essential in helping to determine the best medical and surgical treatment approaches.

Although the common MRI technique is widely accepted for diagnosing the etiology of pediatric epilepsy, there still exists space for enhancement. High-quality imaging methods, and incorporating advanced neuroimaging technologies such as fMRI, show promise for enhancing diagnostic outcomes. Basiratnia et al. highlighted that standard MRI scans could identify most structural abnormalities linked to epilepsy. Still, they might overlook small lesions, specifically those located in regions such as the hippocampus or deep brain structures (10). With advancements in neuroimaging technology, there is a greater likelihood of detecting these minor abnormalities with improved accuracy and at earlier disease stages, resulting in better patients outcome.

Incorporating advanced imaging methods is crucial to improving diagnostic effectiveness and offering more thorough assessments of children with epilepsy. These developments can have a significant influence on the management and outlook of the condition, particularly in resistant epilepsy cases, where prompt and precise identification of epileptogenic lesions is crucial for successful therapy. This study aims to evaluate the capability of a common brain MRI technique (utilized in our center) to detect pathological brain lesions in pediatric epilepsy and to investigate the relationship between MRI findings and neurological characteristics.

Materials and Methods

Study population and sample size

The study population consisted of 704 cases, comprised of children and adolescent patients referred to the pediatric neurology clinic at Imam Ali Hospital in Bojnurd, Iran, between 2018 and 2022. These patients had been diagnosed with epilepsy and had undergone a common brain MRI technique as part of their diagnostic workup. Based on the inclusion and exclusion criteria, 337 patients out of the mentioned number were finally included in this study.

Inclusion and exclusion criteria

The inclusion criteria required patients aged between 1 and 18 years with a confirmed diagnosis of epilepsy (at least two unprovoked seizures with an interval of at least 24hours), and brain MRI results accessible via the hospital's picture archiving and communication system (PACS). Furthermore, only patients with complete medical records and informed consent from their guardians were included in the study.

Exclusion criteria were used to eliminate cases that could confound the assessment of MRI utility. Patients were excluded if epilepsy was secondary to trauma or if a CT scan was done instead of an MRI for evaluation. Additionally, any cases with incomplete medical records or missing MRI data were excluded.

Data collection

Demographic and clinical data were collected from patients' records using a researcher-made checklist based on the study objectives. The checklist included demographic information (age, sex), clinical symptoms, seizure type, and MRI findings. The MRIs were reviewed in person and electronically through the hospital's PACS by a child neurologist and a child radiologist with 15 years of work experience. The MRI

findings were reviewed using a standard questionnaire. MRI results were categorized as normal or abnormal. Abnormal findings were further classified into non-pathological/incidental abnormalities (findings not related to seizures) and pathological lesions considered to be the cause of the patient's epilepsy.

MRI protocol

The common brain MRI technique was performed using a Toshiba 1.5T MRI scanner. Imaging sequences included T1-weighted, T2-weighted, and FLAIR sequences. The protocol involved imaging with 3-mm slice thickness in both axial and coronal planes, using T2 and FLAIR sequences to maximize the detection of structural lesions, such as cortical dysplasia commonly seen in pediatric epilepsy patients. This study highlights the effectiveness of standard brain MRI techniques for neuroimaging in pediatric epilepsy, particularly in non-specialized centers worldwide. It contrasts these traditional methods with advanced imaging techniques, specifically those designed for epilepsy (11,12).

Statistical analysis

Data analysis was performed using SPSS version 21. Descriptive statistics were calculated for all demographic and clinical variables. Chi-square tests were employed to assess the relationships between clinical features (such as abnormal neurologic examination or seizure type) and MRI findings. Continuous variables, such as age, were expressed as means and standard deviations, while categorical variables were reported as frequencies and percentages. A p-value of <0.05 with 95% confidence intervals (CI)was considered statistically significant.

Results

Studied population

Of the 704 cases initially examined, 337 pediatric patients diagnosed with epilepsy were included in this study (see Figure 1), with a gender distribution of 205 males (60.8%) and 132 females (39.2%). The mean age was 8.5 years, with the patients ranging from 1 to 18 years. Most patients had normal neurological examination findings (64%), while 36% had abnormal findings.

MRI findings

Of the 337 MRI scans analyzed, 79 (23.5%) showed some abnormality on imaging. This includes both incidental findings and pathological lesions. Specifically, 70 patients (20.7%) had MRI findings that were deemed pathological, meaning they were considered relevant to the etiology of the patient's seizures. The remaining nine patients (2.7%) had non-pathological abnormalities (incidental findings not related to epilepsy).

Among the 70 patients with pathological MRI lesions, the distribution of lesion types was as follows: white matter lesions were the most common, observed in 51 cases. These white matter abnormalities (such as areas of gliosis or white matter hyperintensities) accounted for about 72% of the abnormal MRI scans. The next most frequent were gray matter lesions, found in 16 patients (22%). Most gray matter lesions corresponded to cortical developmental anomalies (like focal cortical dysplasia or neuronal migration disorders). Hippocampal lesions (e.g., signs of hippocampal sclerosis) were present in nine cases (12.8%). Additionally, ventricular abnormalities (e.g., hydrocephalus or enlarged ventricles) were identified in five cases (7%), and vascular lesions were in two cases (2.8%), both of which were stroke-related changes. Notably, gray matter lesions were more frequently detected than hippocampal lesions in our pediatric cohort, indicating that cortical developmental pathologies constituted a larger portion of MRI-detected lesions. No significant extra-axial lesions (such as meningeal abnormalities or external masses) were observed. These findings are summarized in Table 1.

Table 1. Distribution of MRI abnormalities in epileptic patients

Lesion Type	Number of Cases	Percentage
White Matter Lesions	51	72%
Hippocampal Lesions	9	12.8%
Gray Matter Lesions	16	22%
Ventricular Lesions	5	7%
Vascular Lesions	2	2.8%

Association between MRI findings and neurologic features

This study observed significant relationships between MRI findings and specific clinical features (see Table 2). Patients who had an abnormal neurological examination were much more likely to have a pathological lesion on MRI than those with a routine exam. Specifically, 43 out of 117 patients with abnormal neurologic exams (36.7%) had pathologic MRI findings, compared to only 27 out of 220 patients with regular exams (12.2%). This difference was statistically significant (chi-square test, $p < 0.001$), underscoring that clinical neurologic deficits are strongly associated with detectable structural abnormalities on MRI.

Similarly, the type of epilepsy (based on presumed etiology and seizure semiology) correlated with MRI yield. Children classified as having focal epilepsy

(typically corresponding to focal seizures, often due to structural causes) had pathological MRI lesions in 49 of 122 cases (40.1%). In contrast, among children with generalized or unknown epilepsy, only 21 of 152 (9.7%) had a pathogenic MRI lesion identified. This difference was also highly significant ($p < 0.001$). In other words, patients with focal-onset seizures (suggestive of a structural cause) were far more likely to show an MRI abnormality than those with generalized or unknown epilepsy.

Table 2. MRI findings and their association with neurologic features

Clinical Feature	Total Patients (n=337)	Pathological MRI (n=70)	Percentage (%)	P-Value
Abnormal neurological exam	117	43	36.7%	<0.001
Normal neurological exam	220	27	12.2%	
focal epilepsy	122	49	40.1%	<0.001
Unknown /Generalized epilepsy	215	21	9/7%	

P-values indicate the significance of the association between the clinical feature and having a pathological MRI. (—) indicates the same p-value as the category above. Both associations shown above are statistically significant ($p < 0.001$)

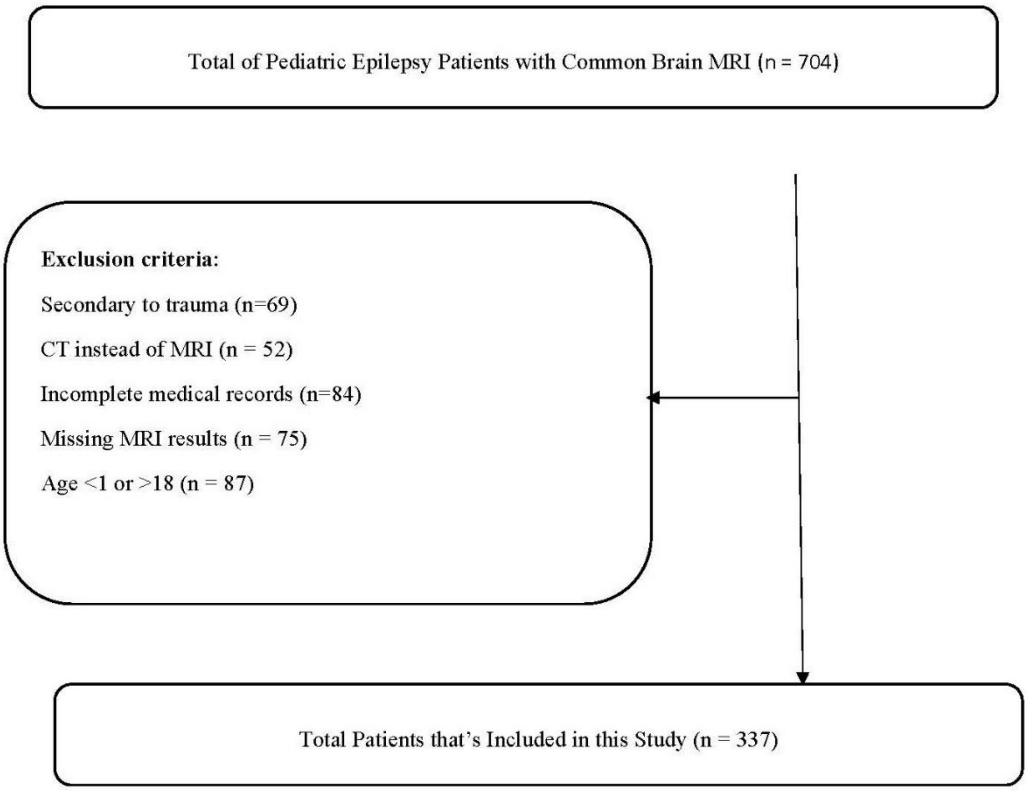


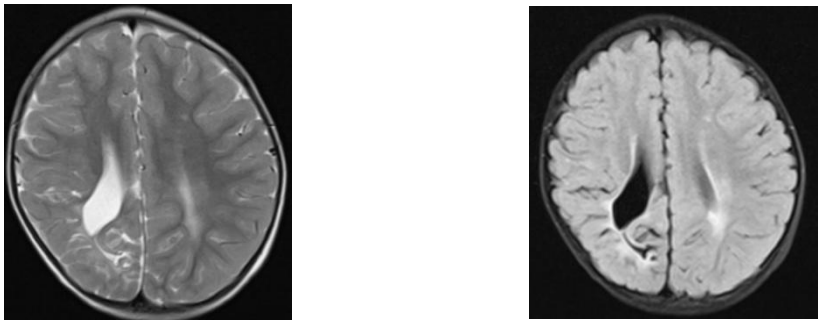
Figure 1. Flowchart of participants' selection (2018–2022).

Further analysis of age and gender groups (Table 3) revealed additional insights. A significant association existed between patient age and the likelihood of detecting a lesion on MRI ($p = 0.02$ across age groups). Younger children had higher rates of MRI abnormalities: For example, 23.8% of children aged 1-2 years had a pathologic MRI, as did 25.1% of those aged 2-8 years, compared to 16.4% in the 8-18 year group. This trend suggests that structural abnormalities are more often found in younger patients, possibly reflecting that many severe congenital or developmental brain lesions present with seizures early in life. In contrast, gender did not show a significant association with overall MRI findings, as 21.2% of females and 20.5% of males had a pathological MRI ($p = 0.15$).The present study also examined whether certain patient subgroups were associated with specific types of lesions. Notably, patients with an abnormal neurologic exam not only had a higher overall lesion rate, but also a significantly higher frequency of white matter lesions on MRI (observed in 28 of 117 patients with abnormal exams vs. 23 of 220 with regular exams,

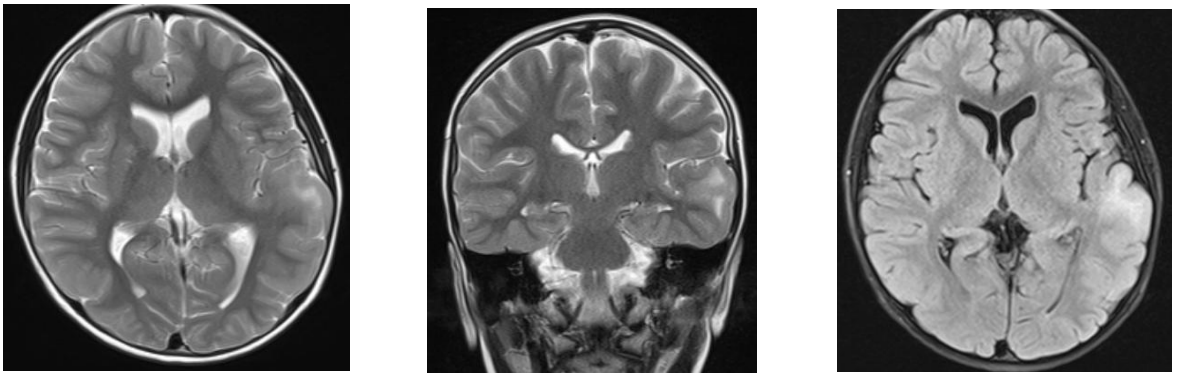
p = 0.003). This suggests that white matter abnormalities (such as gliosis) often underlie the neurologic deficits seen on exam. However, the occurrence of gray matter lesions did not differ significantly by exam status (p = 0.28). Regarding epilepsy etiology, children with structural epilepsy had the highest occurrence of white matter lesions (27 of 98 structural cases, vs. only 6 of 139 genetic cases; p < 0.001), consistent with the expectation that lesions like perinatal white matter injury or gliotic scars contribute to structural epilepsy. No significant difference was found in gray matter lesion rates among etiology groups (p = 0.10), likely due to the small number of cases with gray matter lesions. These detailed associations are presented in Table 3.

Distribution of lesions by age and gender

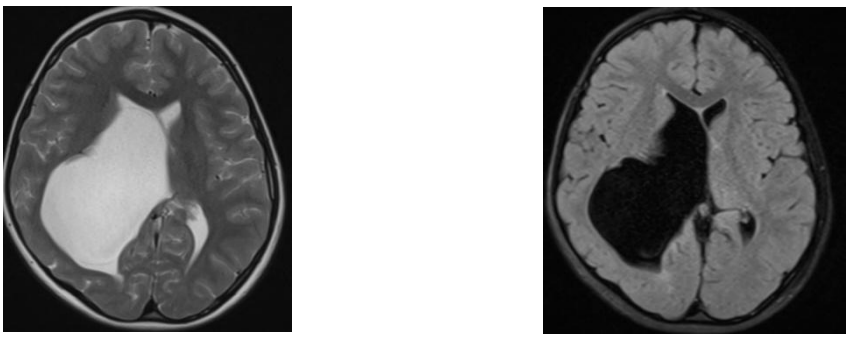
A significant association existed between age and the likelihood of detecting structural lesions on MRI. Younger patients (under 2 years and between 2 and 8 years) were more likely to show MRI abnormalities compared to older patients (8 to 18 years) (p = 0.02). Gender did not show a significant association with the presence of MRI abnormalities.



A1, A2: hyperintensity in T2 and gliosis and volume loss in FLAIR, boss in occipital lobe at right hemisphere in a 5-year-old boy with epilepsy due to Neonatal hypoglycemia



B1, B2: left to right axial and coronal T2 sequence displayed mild hyperintense signal in addition of cortical thickening in parietal lobe at left hemisphere, B3: Axial FLAIR sequence at the same level with similar findings in a 4-year-old boy with focal epilepsy



C1, C2: Both axial T2 and FLAIR sequence at the same level showed right ventriculomegaly, volume loss and right hemisphere leukomalacia (PVL), in an 8-year-old girl with epilepsy due to fetal stroke

Figure 2. MRI findings in epileptic patients

Table 3. Association between study characteristics and lesions observed in MRI

Study Characteristics	Number of Cases	MRI Result		White Matter Lesion			Gray Matter Lesion	
		Pathological *n (%)*	Non-Pathological *n (%)*	P-value	*n (%)*	P-value	*n (%)*	P-value
Age								
1 to 2 years	42	10 (23.8%)	32 (76.2%)	**0.02**	7 (10 %)	0.09	2 (2.8%)	0.30
2 to 8 years	131	33 (25.1%)	98 (74.9%)		24(34.2%)		6 (8.5%)	
8 to 18 years	164	27 (16.4%)	137 (83.6%)		20		8 (11.4%)	
Gender								
Female	132	28 (21.2%)	104 (78.8%)	0.15	16 (22%)	0.10	11(15.7%)	0.45
Male	205	42 (20.4%)	163 (79.6%)		35 (50%)		8 (11.4%)	
Neurologic exam findings								
Abnormal	117	43 (36.8%)	74 (63.2%)	**0.001**	28 (40%)	**0.003**	15 (21.4%)	0.28
Normal	220	27 (12.2%)	193(87.8%)		23 (32%)		6 (8.5%)	

Note: **Infectious** and **neonatal epilepsy** cases (which together constituted 55 patients) were excluded from the above **Epilepsy Etiology** analysis due to their small numbers and heterogeneous nature. Additionally, due to the low frequency of **vascular** and **ventricular lesions**, statistical comparisons for these lesion types were not performed (they are not individually listed in the table). Statistically significant p-values are indicated in **bold**

Discussion

This cross-sectional study evaluated the diagnostic utility of a standard brain MRI protocol in children with epilepsy and examined the correlation between MRI findings and neurologic features. The obtained findings underscore that a common MRI technique can uncover structural abnormalities, with white matter abnormalities being the most prevalent. The high proportion of white matter lesions (mostly gliosis or leukoencephalopathy changes) in our series is consistent with previous research, showing that white matter changes are common MRI findings in childhood epilepsies, particularly those with focal seizures (13–16). Additionally, this study found gray matter lesions (such as cortical developmental malformations) to be an essential category, more so than hippocampal lesions, in this cohort. These results are notable because hippocampal sclerosis is a well-known cause of epilepsy (17,18), but it was less frequently identified here than cortical lesions. One possible explanation is that many of the studied patients' epilepsy etiologies were developmental or perinatal in origin (affecting the cortex). Furthermore, the standard MRI at 1.5T may be less sensitive in detecting subtle hippocampal sclerosis (10). This aligns with Basiratnia et al.'s observation that standard MRI might miss small lesions in structures like the hippocampus (10).

The present data reinforce the value of MRI in understanding the etiology of seizures and guiding treatment. When a structural lesion is identified, it confirms a structural epilepsy, which can directly influence management decisions such as considering epilepsy surgery or targeted medical therapy (19,20). The strong association we observed between abnormal neurological examinations and MRI lesions is in agreement with prior studies. Amirsalari et al. found that children with abnormal neurologic exams were more likely to have corresponding lesions on MRI (9). This relationship makes intuitive sense: a focal neurologic deficit (for example, hemiparesis or visual field cut) may indicate an underlying structural brain lesion that could also be causing seizures. Thus, MRI is particularly indicated in epileptic children with any focal deficits or developmental delays, as the yield is higher.

Moreover, the present researchfound that children with focal-onset seizures (often indicative of localized brain pathology) had a significantly higher MRI lesion yield than those with generalized-onset seizures or unknown etiologies. This supports the notion that MRI is especially useful in focal epilepsy, where finding a causative lesion is more likely. It also parallels the classification of epilepsy: Structural epilepsies (many of which manifest as focal seizures) are expected to have imaging abnormalities, whereas genetic epilepsies (often generalized) usually do not have structural brain changes on MRI (21,22). The present results are in line with those of other investigators who have reported low yield of MRI in generalized genetic epilepsies and higher yield in focal cases. For instance, a study by Raafat et al. found that about 24% of pediatric epilepsy patients had abnormalities on MRI, with white matter lesions being the most common finding (23). The detection rate of 20.7% is slightly lower but falls within a similar range, considering the differences in population and MRI protocols. Research from tertiary centers has indicated that abnormal MRI rates can be even higher, affecting around one-third of cases. This increase may be attributed to referral bias,

where more severe cases are referred for imaging, or the use of higher-field MRI scanners (24).

The age-related difference in MRI yield observed (higher in younger children) is an interesting finding. It suggests that many structural epilepsies in infants and young children are due to identifiable structural anomalies, such as malformations of cortical development or perinatal injuries, which are caught early. By contrast, epilepsies manifesting in older children may more often be genetic (previously named idiopathic, with normal MRI). Another interpretation is that if a child's initial MRI is normal but seizures persist, some lesions might only become apparent with time or with repeat advanced imaging. However, the present cross-sectional design captures only the initial MRI; longitudinal studies would be needed to see if lesions "appear" later or if advanced techniques could find them.

While this study confirms the usefulness of standard MRI in the first-line workup of pediatric epilepsy, it also highlights its limitations. A considerable majority of patients (about 79%) had no abnormalities detected on MRI. This could be because many epilepsy cases (especially generalized epilepsies like childhood absence epilepsy or other genetic epilepsies) truly have no structural brain lesion. However, it could also be due to the limitations of a 1.5T MRI in resolving subtle abnormalities. A higher magnetic field strength (3T or above) has been shown to improve the detection of small lesions, such as focal cortical dysplasias or subtle hippocampal sclerosis. Additionally, using an epilepsy-specific MRI protocol (with thinner slices and specialized sequences, particularly for the temporal lobes) might increase yield (10).

Another limitation is that this study did not incorporate advanced imaging modalities. Techniques such as functional MRI (fMRI), DTI, positron emission tomography (PET), or magnetoencephalography (MEG) can provide complementary information in epilepsy cases, particularly when a common MRI is normal . However, a lesion is still suspected (25,26). These modalities have proven value in pre-surgical evaluation of epilepsy to localize seizure foci when the MRI appears normal (so-called "MRI-negative" epilepsy) (25,26). For example, PET scans can reveal areas of hypometabolism that correspond to epileptic foci, and MEG can localize interictal spikes, guiding where to look on MRI or where to resect. In this resource-limited setting, such tools were not readily available for most patients; however, this represents an area for future improvement in comprehensive epilepsy care.

The present findings suggest the need for future research and improvements in practice. First, optimizing MRI protocols for pediatric epilepsy in general hospitals could increase lesion detection. For example, comparative studies between 1.5T and 3T MRI in the same patient cohort would be valuable to quantify the difference in diagnostic yield for subtle lesions. Additionally, there may be a benefit in performing a repeat MRI after a specific interval in cases with high clinical suspicion. Winston et al. reported that repeating MRI with an improved technique or higher field strength can uncover lesions that were initially missed (27). Therefore, a normal MRI at baseline should not deter clinicians from re-imaging if the child's epilepsy is persistant or focal in nature and no other cause has been identified.

Furthermore, larger multi-center studies could help address the generalizability of these results and determine the frequency at which advanced imaging influences management. The cost-effectiveness of routinely using advanced MRI sequences or other modalities is another critical consideration. While techniques like DTI or PET can increase diagnostic yield, they are expensive and not widely accessible. An analysis of outcomes could help justify these tools for certain high-risk groups of patients (for example, children with epileptic spasm or those with MRI-negative focal epilepsy).

To improve care for children with epilepsy, there is a need to enhance imaging strategies the development of better protocols, the use of higher-field magnets, repeat imaging when necessary, and integration of advanced neuroimaging techniques. These steps could lead to earlier identification of the brain lesions and more tailored therapeutic interventions, such as epilepsy surgery, ultimately improving patient outcomes.

In conclusion

The present study highlights that standard MRI is quite effective in detecting significant lesions, such as white matter abnormalities and cortical malformations, which are often associated with abnormal neurological exams and focal seizure presentations. However, this research also acknowledges that common MRI has limitations in visualizing more subtle changes. Overall, although the common MRI protocol is a valuable first-line tool in determining the etiology of pediatric epilepsy (approximately 21% in this study), a specific epilepsy protocol in patients with negative MRI, particularly with resistant seizures, is beneficial and expanding.

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Authors' Contribution

Meisam Babaei contributed to the study design, data collection, MRI analysis, data interpretation, and manuscript review and editing.

Maryam Tavakoli contributed to interpreting MRI results and assisted with data collection.

Faeze Heidari contributed to the study design, data collection, and MRI analysis.

All authors contributed to writing the original draft and approved the final version of the manuscript. All authors have read and agreed to the published version of the manuscript.

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Conflict of Interest

The authors declare that they have no conflicts of interest.

References

1. Zhang D, Liu X, Deng X. Genetic basis of pediatric epilepsy syndromes. Exp Ther Med [Internet]. 2017 May 1 [cited 2024 Sep 4];13(5):2129–33. Available from: /pmc/articles/ PMC5443213/

2. (UK) NGA. Magnetic resonance imaging scan to detectrelevant abnormalities in people with epilepsy. Magnetic resonance imaging scan to detectrelevant abnormalities in people with epilepsy: Epilepsies in children, young people and adults: Evidence review A [Internet]. 2022 [cited 2024 Sep 4]; Available from: https://www.ncbi.nlm.nih.gov/ books/ NBK581149/

3. Florkow MC, Willemsen K, Mascarenhas V V., Oei EHG, van Stralen M, Seevinck PR. Magnetic Resonance Imaging Versus Computed Tomography for Three-Dimensional Bone Imaging of Musculoskeletal Pathologies: A Review. Journal of Magnetic Resonance Imaging [Internet]. 2022 Jul 1 [cited 2024 Sep 4];56(1):11–34. Available from: /pmc/articles/PMC9305220/

4. Alam-Eldeen MH, Hasan NMA. Assessment of the diagnostic reliability of brain CT and MRI in pediatric epilepsy patients. Egyptian Journal of Radiology and Nuclear Medicine. 2015 Dec 1;46(4):1129–41.

5. Dur-Trav T, Eugenia M, Esparza-Estan J, Gallinas-Victoriano F, Aguilera-Albesa S, Sagastibelza-Zabalet A. Central Nervous System Findings on Magnetic Resonance Imaging in Children with Epilepsy. Neuroimaging - Clinical Applications [Internet]. 2012 Mar 9 [cited 2024 Sep 4]; Available from: https://www.intechopen.com/chapters/31414

6. Gaillard WD, Chiron C, Helen Cross J, Simon Harvey A, Kuzniecky R, Hertz-Pannier L, et al. Guidelines for imaging infants and children with recent-onset epilepsy. Epilepsia [Internet]. 2009 Sep 1 [cited 2024 Sep 4];50(9):2147–53. Available from: https://onlinelibrary.wiley.com/doi/full/ 10.1111/j.1528-1167.2009.02075.x

7. Goyal M, Bangert BA, Lewin JS, Cohen ML, Robinson S. High-resolution MRI enhances identification of lesions amenable to surgical therapy in children with intractable epilepsy. Epilepsia [Internet]. 2004 Aug 1 [cited 2024 Sep 4];45(8):954–9. Available from: https://onlinelibrary.wiley.com/doi/full/10.1111/j.0013-9580.2004.39403.x

8. Carlson HL, Laliberté C, Brooks BL, Hodge J, Kirton A, Bello-Espinosa L, et al. Reliability and variability of diffusion tensor imaging (DTI) tractography in pediatric epilepsy. Epilepsy and Behavior [Internet]. 2014 Aug 1 [cited 2024 Sep 4];37:116–22. Available from: http://www.epilepsybehavior.com/article/S1525505014002261 /fulltext

9. Amirsalari S, Saburi A, Hadi R, Mirmohammad SM. Magnetic Resonance Imaging (MRI) Findings in Epileptic Children and its Relation with Clinical and Demographic Findings. Pediatr Res [Internet]. 2011 Nov [cited 2024 Sep 4];70(5):146–146. Available from: https://www.nature.com/articles/pr2011371

10. Basiratnia R, Rezaei M, Mottaghi M, Naghshineh F. Imaging of Pediatric Epilepsy. Iranian Journal of Radiology [Internet]. 2014 Mar 1 [cited 2024 Sep 4];11(S1). Available from: https://brieflands.com/articles/ijradiology-77841

11. Bernasconi A, Cendes F, Theodore WH, Gill RS, Koepp MJ, Hogan RE, et al. Recommendations for the use of structural magnetic resonance imaging in the care of patients with epilepsy: A consensus report from the International League Against Epilepsy Neuroimaging Task Force. Epilepsia [Internet]. 2019 Jun 1 [cited 2025 Mar 1];60(6):1054–68. Available from: https://pubmed.ncbi.nlm.nih.gov/31135062/

12. Wang I, Bernasconi A, Bernhardt B, Blumenfeld H, Cendes F, Chinvarun Y, et al. MRI essentials in epileptology: a review from the ILAE Imaging Taskforce. Epileptic Disord [Internet]. 2020 Aug 1 [cited 2025 Mar 1];22(4):421–37. Available from: https://pubmed.ncbi.nlm.nih.gov/32763869/

13. Ozateş M, Acar M, Başak F. Cranial MRI findings in epileptic children. Tani Girisim Radyol [Internet]. 2003 [cited 2024 Sep 4];9(4):427–31. Available from: https://europepmc.org/ article/med/ 14730950

14. Hatton SN, Huynh KH, Bonilha L, Abela E, Alhusaini S, Altmann A, et al. White matter abnormalities across different epilepsy syndromes in adults: an ENIGMA-Epilepsy study. Brain [Internet]. 2020 Aug 1 [cited 2025 Feb 26];143(8):2454.

15. Kalnin AJ, Fastenau PS, deGrauw TJ, Musick BS, Perkins SM, Johnson CS, et al. MR Imaging Findings in Children with First Recognized Seizure. Pediatr Neurol [Internet]. 2008 Dec

[cited 2025 Feb 26];39(6):404. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC2677696/

16. Hildebrandt M, Amann K, Schröder R, Pieper T, Kolodziejczyk D, Holthausen H, et al. White matter angiopathy is common in pediatric patients with intractable focal epilepsies. Epilepsia [Internet]. 2008 May 1 [cited 2025 Feb 26];49(5):804–15. Available from: https://onlinelibrary.wiley.com/doi/full/10.1111/j.1528-1167.2007.01514.x

17. Charles Walker M. Hippocampal Sclerosis: Causes and Prevention. Semin Neurol [Internet]. 2015 [cited 2025 Feb 26];35:193–200. Available from: http://dx.doi.org/

18. Thom M. Review: Hippocampal sclerosis in epilepsy: a neuropathology review. Neuropathol Appl Neurobiol [Internet]. 2014 [cited 2025 Feb 26];40(5):520. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC4265206/

19. Yoganathan K, Malek N, Torzillo E, Paranathala M, Greene J. Neurological update: structural and functional imaging in epilepsy surgery. J Neurol [Internet]. 2023 May 1 [cited 2025 Feb 26];270(5):2798. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC10130132/

20. Adamczyk B, Węgrzyn K, Wilczyński T, Maciarz J, Morawiec N, Adamczyk-Sowa M. The Most Common Lesions Detected by Neuroimaging as Causes of Epilepsy. Medicina (B Aires) [Internet]. 2021 Mar 1 [cited 2025 Feb 26];57(3):294. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC8004256/

21. Scheffer IE, Berkovic S, Capovilla G, Connolly MB, French J, Guilhoto L, et al. ILAE Classification of the Epilepsies Position Paper of the ILAE Commission for Classification and Terminology. Epilepsia [Internet]. 2017 Apr 1 [cited 2025 Feb 26];58(4):512. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC5386840/

22. Nascimento FA, Friedman D, Peters JM, Bensalem-Owen MK, Cendes F, Rampp S, et al. Focal epilepsies: Update on diagnosis and classification. Epileptic Disorders [Internet]. 2023 Feb 1 [cited 2025 Feb 26];25(1):1–17. Available from: https://onlinelibrary.wiley.com/doi/full/10.1002/epd2.20045

23. Raafat BM, Alotaibi A, Alfaqih W, Alotaibi Y, Alotaibi J, Alghoraibi F, et al. The effectiveness of MRI in the management of pediatric epilepsy at a tertiary care hospital in Taif, Saudi Arabia. J Radiat Res Appl Sci. 2024 Jun 1;17(2):100916.

24. Samia P, Odero N, Njoroge M, Ochieng S, Mavuti J, Waa S, et al. Magnetic Resonance Imaging Findings in Childhood Epilepsy at a Tertiary Hospital in Kenya. Front Neurol [Internet]. 2021 Feb 12 [cited 2024 Sep 4];12. Available from: https://pubmed.ncbi.nlm.nih.gov/33643201/

25. Juhász C, John F. Utility of MRI, PET, and ictal SPECT in presurgical evaluation of non-lesional pediatric epilepsy. Seizure. 2020 Apr 1;77:15–28.

26. Goodman AM, Szaflarski JP. Recent Advances in Neuroimaging of Epilepsy. Neurotherapeutics [Internet]. 2021 Apr 1 [cited 2024 Sep 11];18(2):811–26. Available from: /pmc/articles/PMC8423975/

27. Winston GP, Micallef C, Kendell BE, Bartlett PA, Williams EJ, Burdett JL, et al. The value of repeat neuroimaging for epilepsy at a tertiary referral centre: 16 years of experience. Epilepsy Res. 2013 Aug 1;105(3):349–55.