

Magnetic resonance imaging and electroencephalography findings in a sample of Iranian patients with epilepsy

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Background: The present study is aimed to evaluate the magnetic resonance imaging (MRI) and electroencephalography (EEG) findings based on characteristics variables in patients with epilepsy. **Materials and Methods:** In this cross-sectional study, all patients with epilepsy who referred between March 2016 and March 2017 to Al-Zahra and Kashani Hospitals in Isfahan, Iran, were enrolled. The completed files of 199 patients were assessed to collect information about characteristic data and MRI and EEG findings. MRI and EEG findings were recorded as normal or abnormal. The characteristic data and risk factors in patients with normal MRI and EEG were compared with those patients with abnormal MRI and EEG. **Results:** History of seizures and trauma are reported in 84 (42.2%) and 47 (23.6%) of patients, respectively. The most frequent type of seizures was generalized. MRI finding in 51 patients (25.6%) was abnormal, and EEG finding in 124 patients (62.3%) was abnormal. Patients with abnormal MRI were significantly older than those with normal MRI (37.3 vs. 31.4, respectively, $P = 0.024$). Abnormal MRI in men patients was significantly more frequent than women (31.2% vs. 18.9%, respectively, $P = 0.048$). In patients with abnormal EEG, seizure was more frequent than patients with normal EEG (50.8% vs. 28%, respectively, $P = 0.002$). Other characteristics and risk factors were not significant differences between patients with normal or abnormal MRI or EEG findings. **Conclusion:** In patients with epilepsy, older age and being a male were the risk factors of having abnormal MRI, and seizure was the risk factor of having abnormal EEG.

Key words: Electroencephalography, epilepsy, magnetic resonance imaging, seizures

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INTRODUCTION

Epilepsy, as a condition that characterized by recurrent and unpredictable seizures of cerebral origin, is associated with an increased risk of a variety of psychological and psychiatric problems.^[1-3] Epilepsy affects people in all ages from neonates to the elderly and it is estimated that 65 million people affected by epilepsy in the world,^[3-5] whereas in developed countries, its lifetime prevalence ranges from 3.5 to 10.7/1000 population,^[6] and in Latin America, Asia, and Sub-Saharan Africa, it ranges from 0.9 to 74.4/1000 population.^[7-10] The prevalence of epilepsy in Iran is around 5%.^[11]

The diagnostic evaluation of epilepsy is based on medical history, physical and neurologic examination, laboratory evaluations, and electroencephalography (EEG).^[12] EEG is one of the most important diagnostic tests in the evaluation of epileptic seizures in patients with possible epilepsy, providing evidence that helps confirm or refute the diagnosis.^[13] Interracial epileptiform discharges as a common epileptiform of abnormal EEG is found in 20%–55% of first routine EEG of patients and increases to 80%–90% with repeated recordings.^[14-17] Imaging with magnetic resonance imaging (MRI) is the other test that is virtually recommended for all patients with epilepsy to screen a potential structural cause of epilepsy.^[18] All MRI findings in epileptic patients are not relevant, and some abnormalities are not known to be epileptogenic;

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it is shown that between 1% and 57% of neuroimaging in patients with epilepsy are abnormal.^[19,20] Consequently, the patients' seizure semiology and EEG findings should be considered in the MRI finding interpretation.^[21]

Data about the association between MRI and EEG findings in patients with epilepsy with patients' characteristics and clinical symptoms are limited. In some previous studies, age, duration of epilepsy, and seizure were associated with abnormalities in MRI or EEG findings in patients with epilepsy.^[16,22,23] The epidemiology of epilepsy is diverse in different countries and regions in Iran, spatially Isfahan; there are no data on abnormalities in MRI and EEG findings and associated factors in patients with epilepsy, so the present study was done to evaluate and compare the frequency distribution of MRI and EEG findings based on demographic variables in a sample of epilepsy patients in Isfahan, Iran.

MATERIALS AND METHODS

This cross-sectional study was conducted between September 2016 and September 2017 on patients with epilepsy in Al-Zahra and Kashani Hospitals in Isfahan, Iran. All epilepsy patients with medical record, identified by a neurologist, older than 18 years old were eligible if the MRI and EEG results were filed in their medical records. The protocol of this study is reviewed and approved by the Ethics Committee of Isfahan University of Medical Sciences.

Each medical record was reviewed, and information about patients' characteristics, medical history, and MRI and EEG were collected in a self-designed checklist. The patients' characteristics included age, sex, region (urban or rural), marital status (married or single), job (employed, housekeeper, or unemployed), and education status (unread, under diploma, diploma, or upper diploma). The patients' medical history included a history of febrile seizure, trauma (moderate-to-severe trauma), seizure (late onset of seizure after trauma), family history of epilepsy, duration of disease, comorbid disease, and types of seizure (focal, generalized, focal and generalized, secondarily generalized, and unknown). MRI findings were recorded as normal or abnormal based on an independent radiologist reports (those MRI abnormalities that were associated with epileptic seizures such as focal atrophy, porencephalic cyst, and gliosis). The EEGs were read by a study-independent neuroradiologist, and the findings were recorded as normal EEG or abnormal EEG (epileptiform or EEG abnormalities included specific and nonspecific abnormalities).

All data were analyzed using SPSS 24 for Windows (SPSS Inc., Chicago, IL, USA). Descriptive statistics are

presented as means \pm standard deviation for continuous data and number (percent) for categorical data. Age and duration of disease were compared between patients with abnormal findings and those patients with normal findings using independent sample *t*-test. Sex, region, marital status, job, education status, presence of fever, trauma, seizure, and family history of epilepsy, duration of disease, and types of seizure were compared in patients with abnormal findings and patients with normal findings by Chi-square test. Statistical significance was set at $P < 0.05$.

RESULTS

Of all patients with epilepsy who referred to studied clinics between September 2016 and September 2017, 199 patients were eligible and analyzed. The mean age of patients was 32.9 ± 14.1 years. About 86% of patients reside in urban area and they comprised 54.8% of men and 45.2% of women. Nearly, 51% of patients were married, and only 33.2% of patients were employed. One patient had a family history of epilepsy. History of febrile seizure and trauma are reported in 13.1% and 23.6% of patients, respectively. Seizures are observed in 42.2% of patients, and 17.1% of them had comorbid disease. The most common type of seizures was generalized (58.8%). Nearly, one-fourth of patients had abnormal MRI finding, and EEG finding in 62.3% of patients was abnormal [Table 1].

Table 2 shows the comparison of characteristics and risk factors in patients based on MRI finding. Patients with abnormal MRI were significantly older than those patients with normal MRI (37.3 vs. 31.4, respectively, $P = 0.024$). There was a statistically significant difference in gender distribution between patients with abnormal MRI and normal MRI ($P = 0.048$); half of the patients with normal MRI were male, whereas 66.7% of patients with abnormal MRI were male. In both groups (those with normal or abnormal MRI), most of the patients were lived in urban areas ($P = 0.187$). The other patients' variables including marital status, job, education, family history of epilepsy, presence of fever trauma and seizures, types of seizures, duration of disease, and comorbid disease were similar in patients with normal or abnormal MRI ($P > 0.05$).

Characteristics and risk factors in patients with abnormal EEG compared to patients with normal EEG were assessed using independent sample *t*-test or Chi-square test, and results are presented in Table 3. As shown, the mean of age in both groups was similar ($P = 0.264$). Sex distribution, region, marital status, job, education, family history of epilepsy, presence of fever and trauma, types of seizures, duration of disease, and comorbid disease in patients with abnormal EEG were similar to those patients who had normal EEG ($P > 0.05$). Seizures are observed in patients with

Table 1: Characteristics of 199 Iranian patients with epilepsy

Characteristics	Values
Age (year)	32.9±14.1
Sex	
Man	109 (54.8)
Woman	90 (45.2)
Region	
Urban	171 (85.9)
Rural	28 (14.1)
Marital status	
Married	102 (51.3)
Single	97 (48.7)
Job	
Employed	66 (33.2)
Unemployed	78 (39.2)
Housekeeper	55 (27.6)
Education	
Unread	15 (7.5)
Under diploma	97 (48.7)
Diploma	56 (28.1)
Upper diploma	31 (15.6)
Family history	1 (0.5)
Fever	26 (13.1)
Trauma	47 (23.6)
Seizures	84 (42.2)
Comorbid disease	34 (17.1)
Types of seizure	
Focal	59 (29.6)
Generalized	117 (58.8)
Focal and generalized	6 (3.0)
Secondarily generalized	13 (6.5)
Unknown	4 (2.0)
Disease duration	16.1±10.6
MRI findings	
Normal	148 (74.4)
Abnormal	51 (25.6)
EEG findings	
Normal	75 (37.7)
Abnormal	124 (62.3)

Data are mean±SD or n (%). MRI=Magnetic resonance imaging; EEG=Electroencephalography; SD=Standard deviation

abnormal EEG significantly more than patients with normal EEG ($P = 0.002$); half of the patients with abnormal EEG reported seizures whereas, is reported in only one-fourth of the patients with normal EEG. MRI finding between patients with abnormal and normal EEG was not significantly different (29.8% vs. 17.1%, respectively, $P = 0.080$).

DISCUSSION

The results of our study show that 25.6% of studied patients had abnormal MRI and 62.3% had abnormal EEG. Age and sex were the significant factors associated with abnormal MRI. Patients with abnormal MRI were older and also male patients had significantly more abnormal MRI than women.

Table 2: Characteristics and risk factors in regard to magnetic resonance imaging findings in 199 Iranian patients with epilepsy

	Normal (148)	Abnormal (51)	P
Age (year)*	31.4±14.3	37.3±19.9	0.024
Sex†			
Man	75 (68.8)	34 (31.2)	0.048
Woman	73 (81.1)	17 (18.9)	
Region†			
Urban	130 (87.8)	41 (80.4)	0.187
Rural	18 (12.2)	10 (19.6)	
Marital status†			
Married	75 (50.7)	27 (52.9)	0.780
Single	73 (49.3)	24 (47.1)	
Job			
Employed	50 (33.8)	16 (31.4)	0.375
Unemployed	54 (36.5)	24 (47.1)	
Housekeeper	44 (29.7)	11 (26.1)	
Education			
Unread	8 (5.4)	7 (13.7)	0.158
Under diploma	71 (48.0)	26 (51.0)	
Diploma	43 (29.1)	13 (25.5)	
Upper diploma	26 (17.6)	5 (9.8)	
Family history†	1 (7)	0	0.774
Fever†	21 (14.2)	5 (9.8)	0.423
Trauma†	31 (20.9)	16 (31.4)	0.131
Seizures†	67 (45.3)	17 (33.3)	0.137
Types of seizure†			
Focal	41 (27.7)	18 (35.3)	0.172
Generalized	92 (62.2)	25 (49)	
Focal and generalized	4 (2.7)	2 (3.9)	
Secondarily generalized	7 (4.7)	6 (11.8)	
Unknown	4 (2.7)	0	
Disease duration*	14.2±11	13.7±9.6	0.810
Comorbid disease†	22 (14.9)	12 (23.5)	0.156

Data are mean±SD or n (%), P values calculated by *Independent sample t-test or †Chi-square test. SD=Standard deviation

In regard to EEG findings, only seizure was the significant factor associated with abnormality; those patients with abnormal EEG reported more seizures than those who had normal EEG. By the fact that the epidemiology of epilepsy is diverse in different countries and regions and is diverse in different races and ethnicities, knowing the epidemiological and clinical features of the disorder in Iran appears to be helpful for patients and health policy-makers. Our study shows the demographics and medical history of a small sample of patients with epilepsy based on MRI and EEG findings and suggests further study to know more about epidemiological and clinical features and factors associated with MRI and EEG findings in Iranian patients with epilepsy.

In developed countries, neuroimaging studies reported that in patients with epilepsy, a wide range between 1% and 57% of neuroimaging is abnormal.^[19,20] However, in

Table 3: Characteristics and risk factors in regard to electroencephalography findings in 199 Iranian patients with epilepsy

	Normal (148)	Abnormal (51)	P
Age (year)*	34.6±14.7	31.9±16.9	0.264
Sex†			
Man	38 (50.7)	71 (57.3)	0.381
Woman	37 (49.3)	53 (42.7)	
Region†			
Urban	97 (89.3)	104 (83.9)	0.303
Rural	8 (10.7)	20 (16.1)	
Marital status†			
Married	43 (57.3)	59 (47.6)	0.182
Single	32 (42.7)	65 (52.4)	
Job			
Employed	25 (33.3)	41 (33.1)	0.700
Unemployed	27 (36.0)	51 (41.1)	
Housekeeper	23 (30.7)	32 (25.8)	
Education			
Unread	4 (5.3)	11 (8.9)	0.707
Under diploma	35 (46.7)	62 (50.0)	
Diploma	23 (30.7)	33 (26.6)	
Upper diploma	13 (17.3)	18 (14.5)	
Family history†	1 (1.3)	0	0.377
Fever†	9 (12)	17 (13.7)	0.830
Trauma†	16 (21.3)	31 (25)	0.555
Seizures†	21 (28)	63 (50.8)	0.002
Types of seizure†			
Focal	21 (28)	38 (30.6)	0.472
Generalized	45 (60)	72 (58.1)	
Focal and generalized	1 (1.3)	5 (4)	
Secondarily generalized	5 (6.7)	8 (6.5)	
Unknown	3 (4)	1 (0.8)	
Disease duration*	12.4±9.5	15±11.1	0.126
Comorbid disease†	15 (20.0)	19 (15.3)	0.396
MRI findings			
Normal	61 (81.3)	87 (70.2)	0.080
Abnormal	14 (17.1)	37 (29.8)	

Data are mean±SD or n (%), P values calculated by *Independent sample t-test or †Chi-square test. SD=Standard deviation; MRI=Magnetic resonance imaging

low- and middle-income countries, data about the use of MRI in patients with epilepsy are limited. In a prospective study, Bruno *et al.*, performed brain MRI in 217 patients with epilepsy and found abnormalities in 81% of patients.^[22] In another prospective study, the brain abnormalities on head computed tomography or MRI are reported in 21% of 366 studied patients with epilepsy.^[24] In the present study, 25.6% of studied patients had abnormal MRI. The differences between study findings may reflect study design, the technology used, the patient population studied, and the range of MRI abnormalities included as abnormal. In addition, our results show that age and sex were the significant factors associated with abnormal MRI, whereas in Bruno *et al.* study, among assessed factors (age, duration of epilepsy, and seizures in the last month), only the duration of epilepsy was significantly associated with abnormality

on patients MRI and they indicated that longer duration of epilepsy could be a predictor of abnormal MRI.^[22] The difference maybe explained by the different samples and methods, our study was a retrospective study and medical records of patients older than 18 years old were evaluated, but Bruno *et al.* study was a prospective study on patients in any age, nearly 25 of studied patients in their study were younger than 18-year- old.

EEG provides evidence that helps confirm or refute the diagnosis of epilepsy, and also, in some patients with no other evidence of disease, it can be abnormal.^[12] Interictal epileptiform discharges as the main abnormality in EEG findings associated with epilepsy on a first routine EEG is found in 20%–55% of patients. This value increases when four or more EEGs are obtained to 80%–90%.^[14-17] In Narayanan *et al.* study, the abnormality in EEG is reported in 43% of 46 studied patients in the 1st h of recording, and after 24 h, abnormality is reported in 89% of EEG finding.^[25] In another study by Baldin *et al.*, the epileptiform abnormalities are founded in 53% of patients with epilepsy after the first EEG and 72% after the third EEG.^[16] Friedman and Hirsch reported about 86% of epileptiform abnormalities in EEG in patients with confirmed epileptic seizures in the first 2 days of EEG monitoring.^[26] In the present study, epileptiform abnormalities in EEG are observed that in 62.3% of patients with epilepsy, this is higher than those reported by Narayanan *et al.*^[25] in the 1st h of recording and Baldin *et al.*^[16] in the first EEG, and our finding is lower than those studies that reported findings in repeated EEG in longer time.^[23,26] The difference between findings may explain by the different studies design and the fact that, in the present study, data about the exact time of EEG recording were not available in patients' medical records.

Our finding revealed that seizures are significantly associated with abnormality in EEG. This is similar to other studies that report the association between more frequent seizures with higher frequency of abnormalities in patients' EEG. Janszky *et al.* reported that in patients with epilepsy, higher seizure frequency was associated with higher interictal epileptiform discharge frequency in patients' EEG.^[23] Among another factor in Janszky *et al.* study, age at monitoring and epilepsy duration were the significant associated factors with abnormality in patients' EEG, and another study by Baldin *et al.* show that young age at diagnosis was the risk factor for finding abnormalities in patients' EEG.^[16,23] In contrast to Janszky *et al.* and Baldin *et al.* studies,^[16,23] we do not find any association between age and epilepsy duration with abnormalities in patients' EEG. Mean of age, in our study, is similar to patients' age in Janszky *et al.* study, but epilepsy duration in our study was nearly half of those reports in Janszky *et al.* study.^[23] Furthermore, in Baldin *et al.* study,^[16] age between 1 and

19 years old at diagnosis compared to age >20 years was reported as a risk factor, whereas all studied patients in our study were older than 18 years.

Our study has some limitation. First, data about the use of antiepileptic drugs before EEG, whereas it is shown that antiepileptic drugs could affect the detection of an epileptiform abnormality on the EEG.^[27] Second, we could not assess the inter-rater reliability of EEG findings because our study is retrospective, and data were collected through patients' medical records. We suggest the prospective investigations for accurate comparisons. Finally, we studied those patients who had a complete medical record including both MRI and EEG, and patients without MRI and EEG were excluded from the study, so our findings must be interpreted with caution for all patients with epilepsy.

CONCLUSION

The results of the present study show that in patients with abnormal MRI, age and sex are the significant associated factors, whereas in patients with abnormal EEG, only seizure was the significant associated factor. Future studies are needed to assess these associations in a large number of Iranian patients with epilepsy.

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Conflicts of interest

There are no conflicts of interest.

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