Original Article

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Socio-demographic, Clinicoaetiological and Treatment Profile of Children with Epilepsy Aged 6 to 15 Years: A Cross-sectional Study from Western Maharashtra, India

Paediatrics Section

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ABSTRACT

Introduction: The International League Against Epilepsy (ILAE) task force proposed that epilepsy be considered a disease of the brain defined by any of the following conditions: 1) At least two unprovoked (or reflex) seizures occurring more than 24 hours apart; 2) One unprovoked (or reflex) seizure and a probability of further seizures similar to the general recurrence risk (at least 60%) after two unprovoked seizures occurring over the next 10 years; 3) A diagnosis of an epilepsy syndrome.

Aim: To study the sociodemographic, clinicoaetiological and treatment profile among children with epilepsy aged 6-15 years.

Materials and Methods: This cross-sectional observational study was conducted in the Department of Paediatrics, Dr. D. Y. Patil Medical College, Hospital and Research Centre, Pimpri, Pune, Maharashtra, India over a period of 24 months from July 2022 to July 2024. A total of 98 children, aged 6-15 years, diagnosed with epilepsy of any aetiology and with a duration of at least six months, seen in the Outpatient Department (OPD) or admitted in the ward of Dr. D. Y. Patil Medical College, comprised the study population. A detailed medical and neurological history, along with clinical examinations, was documented using a structured clinical proforma. The type of epilepsy and its syndromic classification were also determined.

Results: The mean age of the study population was 9.17 years, with a male gender preponderance. Eighty-five (86.7%) children were born preterm. Normal vaginal delivery was the most common mode of delivery, occurring in 63 (64.3%). A total of 69 (70.4%) had a normal weight at birth. Thirty-five (35.7%) of the study subjects required admission to the Neonatal Intensive Care Unit (NICU). Fifty-five (56.1%) exhibited developmental delay, and IQ assessment revealed borderline IQ in the majority, with 58 (59.1%) subjects falling into this category. The commonest age of onset of seizures was greater than 5 years in 43 (43.9%) subjects. Twenty-nine (29.6%) had epilepsy for more than 2-5 years. Focal onset seizures were the most common, occurring in 66 (67.4%), and 14 (14.3%) experienced seizures daily. Fifty-three (54.1%) experienced uncontrolled seizures and belonged to the refractory category. Abnormal neurological findings were seen in 56 (57.1%) subjects. Seventy-one (72.4%) had abnormal Electroencephalogram (EEG) findings. Fifty-eight (59.2%) subjects received polytherapy. One (1.0%) patient underwent epilepsy surgery, 10 (10.2%) were on a ketogenic diet, while 87 (88.8%) subjects were on drug therapy alone. Structural aetiology was identified in a majority, with 49 (50%) subjects, and the most commonly administered Anti-Seizure Medication (ASM) was levetiracetam.

Conclusion: Children with epilepsy require prompt stabilisation and resuscitation, along with meticulous history-taking, detailed examination and stepwise implementation of laboratory investigations, EEG and neuroimaging to delineate the underlying aetiology and plan treatment for better prognostic outcomes.

Keywords: Abnormal magnetic resonance imaging, Abnormal neurological examination, Seizures

INTRODUCTION

Epilepsy is one of the most common chronic neurological conditions affecting children, with neurobiological, cognitive, psychological and social repercussions. The ILAE defines epilepsy as any child who has had at least two unprovoked seizures occurring more than 24 hours apart, or one unprovoked seizure and a likelihood of further seizures that is similar to the general recurrence risk (at least 60%) after two unprovoked seizures occurring over the next 10 years, or a diagnosis of an epileptic syndrome. The recent ILAE classification system introduced in 2017 emphasises the importance of evaluating the underlying neurological cause and aetiology of epilepsy in the diagnostic work-up, which serves as a major determinant of management and prognostication [1]. A higher prevalence of epilepsy is observed in developing countries, especially in rural areas, due to a greater incidence of acquired brain disease [2]. Seizures may indicate potentially fatal underlying systemic or central nervous system disorders that require thorough investigation and prompt management.

Over the past few years, new ASM with novel mechanisms of action have been discovered and introduced, generally exhibiting a better side-effect profile, reduced need for serum level monitoring, and significantly fewer drug-to-drug interactions while maintaining comparable effectiveness. The easy availability of these medications, coupled with recent advances in the field of pharmacy, aids in the prompt management of seizures, which contributes to timely seizure control, early seizure freedom and a reduction in associated co-morbidities of epilepsy [2,3]. This cross-sectional observational study aimed to investigate the socio-demographic, clinicoaetiological, and treatment spectrum in children with epilepsy aged 6 to 15 years. This age group represents the school-going population, and a study on the aforementioned domains assists clinicians in identifying possible aetiologies, diagnostic tools and highlights the importance of multidisciplinary management and early identification of co-morbidities to prevent epilepsy-related secondary complications. There is limited data on these domains in this particular age group available from developing countries and nations with a high burden of epilepsy, such as India.

MATERIALS AND METHODS

This cross-sectional observational study was conducted in Department of Paediatrics, Dr. D. Y. Patil Medical College, Hospital

and Research Centre, Pimpri, Pune, Maharashtra, India. The duration of the study was 24 months, from July 2022 to July 2024. Children between the ages of 6 and 15 years presenting to the Paediatric Neurology OPD or admitted to the Paediatrics ward with a diagnosis of epilepsy were enrolled in the study. Written informed consent was obtained from the parents of the study population. Institutional Ethics clearance was obtained prior to commencing the study (Research Protocol Number: IESC/PGS/2020/42).

Inclusion criteria: Children aged between 6 and 15 years diagnosed with epilepsy of any aetiology with a duration of at least 6 months, seen in the Paediatric Neurology OPD, or admitted to the Paediatrics ward of Dr DY Patil Medical College, were included in the study. The case definition of epilepsy was taken in accordance with the ILAE 2017 guidelines [1].

Exclusion criteria: Children with intellectual disabilities, characterised by an IQ value <70, those with cerebral palsy (GMFCS score >3), children with neurodegenerative and neurometabolic disorders and those whose parents did not give consent were excluded from the study.

Study Procedure

Informed written consent was obtained from the primary caregivers of the children before their inclusion in the study. A detailed medical and neurological history, along with a clinical examination, was documented using a structured clinical proforma. The type of epilepsy and syndromic classification were determined according to the ILAE 2017 Classification [1]. The documented details of seizures included the age of onset, predominant seizure type, seizure frequency, duration of epilepsy, aetiology and the number and dosages of the ASMs administered.

Participants were categorised into two groups: drug-responsive epilepsy or drug-refractory epilepsy (defined as failure of adequate trials of two tolerated, appropriately chosen and used anti seizure medications) based on their response to ASM/Anti-seizure medications. EEG analysis was performed within three months of enrolment. Neuroimaging findings, along with other indicated investigations related to the work-up of epilepsy, such as metabolic screening (including ammonia, lactate levels and urinary screening for glycosaminoglycans) and genetic testing (whole exome sequencing), were also documented.

RESULTS

Socio-demographic profile: As indicated in [Table/Fig-1], out of 98 study subjects, 47 (48%) belonged to the 6-8 years age group, 35 (35.7%) belonged to the 8-12 years age group, and 16 (16.3%) belonged to the 12-15 years age group. The mean age was 9.17 years. There was a male preponderance, with a total of 65 (66.3%) males and 33 (33.7%) females. The gender ratio (M:F) was 1:0.5. Forty-four (44.9%) were not attending school, while 54 (55.1%) were in the attending category. According to the Modified Kuppuswamy Scale distribution, a total of 5 (5.1%) subjects belonged to the upper class, 35 (35.7%) to the upper middle class, 44 (44.9%) to the lower middle class, 12 (12.3%) to the upper lower class, and only 2 (2%) to the lower class.

A majority, 85 (86.7%), were born preterm, while 6 (6.1%) and 7 (7.2%) were born term and late preterm, respectively. Among the study group, 63 (64.3%) were born via normal vaginal delivery, and 34 (34.7%) were born via LSCS, with only 1 (1%) born via instrumental delivery. Out of the 98 study subjects, 69 (70.4%) had normal weight, while 29 (29.6%) had low birth weight. A total of 35 (35.7%) required NICU admission, among whom 12 (34.3%) had Hypoxic Ischaemic Encephalopathy (HIE), 4 (11.4%) had hyperbilirubinaemia, 9 (25.7%) had hypoglycaemia, 1 (2.9%) had meningomyelocele, 9 (25.7%) were premature, 2 (5.7%) had low birth weight, 4 (11.4%) had sepsis and 2 (5.7%) had respiratory distress. Developmental delay was observed in 55 (56.1%) of the subjects. None of the patients tested positive for any inborn errors of metabolism.

Socio-demographic factors	n (%)
Age (in years)	
6-8	47 (48.0)
8-12	35 (35.7)
12-15	16 (16.3)
Gender	
Males	65 (66.3)
Females	33 (33.7)
School attendance	
Attending	54 (55.1)
Not attending	44 (44.9)
Socio-economic status	
Class 1- Upper	5 (5.1)
Class 2- Upper middle	35 (35.7)
Class 3- Lower middle	44 (44.9)
Class 4- Upper lower	12 (12.3)
Class 5- Lower	2 (2.0)
Gestational age	
Term	6 (6.1)
Late preterm	7 (7.2)
Preterm (<34 weeks)	85 (86.7)
Mode of delivery	
Normal vaginal delivery	63 (64.3)
LSCS	34 (34.7)
Instrumental	1 (1.0)
Birth weight	
Normal	69 (70.4)
Low birth weight	29 (29.6)
Need of NICU admission	
Yes	35 (35.7)
No	63 (64.3)
Developmental delay	
Yes	55 (56.1)
No	43 (43.9)

[Table/Fig-1]: Socio-demographic profile of children with epilepsy aged 6 to 15 years.

Clinical Profile

As elucidated in [Table/Fig-2], out of 98 study subjects, the majority of the seizures (43, 43.9%) began after the age of 5 years. Focal onset seizures were observed in 66 (67.4%) participants, generalised onset in 30 (30.6%), and unknown onset in 2 (2%) of the subjects. Regarding the duration of epilepsy, 29 (29.6%) subjects had epilepsy for more than 6 months to 1 year, while 19 (19.4%) had epilepsy for more than 1 to 3 years and more than 3 to 5 years. Additionally, 31 (31.6%) had epilepsy for over 5 years. The mean duration of epilepsy was calculated as 4.13±3.4 years.

Clinical factors	n (%)
Age of onset of seizures	
<6 months	13 (13.3)
6 months - 2 years	13 (13.3)
2-5 years	29 (29.6)
>5 years	43 (43.9)
Type of seizures	
Focal onset	66 (67.4)
Generalised onset	30 (30.6)
Unknown	2 (2.0)
Duration of epilepsy	
6 months to 1 year	29 (29.6)

>1 year to 3 years	19 (19.4)
>3 years to 5 years	19 (19.4)
More than 5 years	31 (31.6)
Frequency of seizures	
Daily	14 (14.3)
Once a week	2 (2.0)
1/ week - 1/ month	3 (3.1)
/1 month - 1/3 month	21 (21.4)
Less than1/3 month	58 (59.2)
Control of seizure	
Controlled	45 (45.9)
Uncontrolled	53 (54.1)
IQ	
Average	16 (16.3)
Borderline	58 (59.1)
Normal	24 (24.5)

[Table/Fig-2]: Clinical profile of children with epilepsy aged 6 to 15 years.

In terms of seizure frequency, 14 (14.3%) experienced seizures daily, 2 (2%) had seizures once a week, 3 (3.1%) experienced seizures 1/week to 1/month, and 21 (21.4%) had seizures 1/month to 1/3 months. Meanwhile, 58 (59.2%) of the study subjects had seizures occurring less than once every 3 months. Regarding IQ, borderline IQ (70-79) was observed in 58 (59.1%) subjects, average IQ (80 to 89) in 16 (16.3%), and normal IQ (90 to 109) in 24 (24.5%) of the subjects.

Examination Findings

The examination findings have been tabulated in [Table/Fig-3]. According to the anthropometric indices, 19 (19.4%) cases had a weight less than the 3rd to 10th centile, 54 (55.1%) subjects were in the 10th to 50th centile, 15 (15.3%) were in the 50th to 90th centile, while 10 (10.2%) subjects were in the more than 90th centile category. Out of the 98 study subjects, 16 (16.3%) cases had a height below the 3rd to 10th centile, 68 (69.4%) subjects were in the 10th to 50th centile, 10 (10.2%) were in the 50th to 90th centile, while 4 (4.1%) subjects were in the more than 90th centile category. Additionally, 61 (62.2%) of the subjects fell within the more than 10th to 50th centile for BMI, while 37 (37.8%) were in the less than 3rd to 10th centile range.

Examination findings	n (%)
Weight	
Less than 3rd centile to 10th centile	19 (19.4)
More than 10th to 50th centile	54 (55.1)
More than 50th to 90th centile	15 (15.3)
More than 90th centile	10 (10.2)
Height	
Less than 3rd centile to 10th centile	16 (16.3)
More than 10th to 50th centile	68 (69.4)
More than 50th to 90th centile	10 (10.2)
more than 90th centile	4 (4.1)
BMI	
Less than 3rd centile to 10th centile	37 (37.8)
More than 10th to 50th centile	61 (62.2)
Head circumference	
Macrocephaly	2 (2.0)
Microcephaly	25 (25.5)
Normal	71 (72.5)
Pallor	
Present	38 (38.8)
Absent	60 (61.2)
Dysmorphism	
Present	16 (16.3)
Absent	82 (83.7)
Neurological examination	
Abnormal	56 (57.1)
Normal	42 (42.9)

[Table/Fig-3]: Examination findings in children with epilepsy aged 6 to 15 years.

Regarding head circumference measurement, 71 (72.5%) had a normal head circumference for age and gender, 25 (25.5%) had microcephaly, while only 2 (2%) had macrocephaly. On general examination, pallor was absent in 60 (61.2%) of the subjects, and dysmorphism was observed in 16 (16.3%).

Abnormal neurological examination findings were noted in 56 (57.1%) subjects, presented as hypertonia in 31 (31.7%), hypotonia and proximal muscle weakness in 1 (1%) patient each, diplegia in 12 (12.2%), hemiplegia in 10 (10.2%), and quadriplegia in 1 (1%) subject [Table/Fig-4].

Findings on neurological examination	n (%)
Hypertonia	31 (31.7)
Hypotonia	1 (1)
Proximal muscle weakness present	1 (1)
Diplegia	12 (12.2)
Hemiplegia	10 (10.2)
Quadriplegia	1 (1)
Total	56 (57.1)

[Table/Fig-4]: Abnormal findings on neurological examination.

[Table/Fig-5] elucidates the investigation details of the cases in the present study, showing that 71 (72.4%) cases had abnormal EEG findings and 60 (61.2%) cases had abnormal neuroimaging findings.

Investigations	n (%)
Electroencephalogram (EEG)	
Normal	27 (27.6)
Abnormal	71 (72.4)
Magnetic Resonance Imaging (MRI)	
Normal	38 (38.8)
Abnormal	60 (61.2)

[Table/Fig-5]: Investigation findings in children with epilepsy aged 6 to 15 years.

As shown in [Table/Fig-6], the abnormal neuroimaging findings included: HIE changes in 27 (27.6%) subjects, Neonatal Hypoglycaemic Brain Injury in 4 (4.1%), HIE+NHBI in 7 (7.1%), focal cortical dysplasia in 3 (3.1%), ring-enhancing lesions in 4 (4.1%), arachnoid cysts in 2 (2.1%), hydrocephalus in 2 (2.1%), bilateral hippocampal T2 flair hyperintensity in 1 (1.0%), cerebral atrophy in 3 (3.1%), other abnormal finding are shown in [Table/Fig-7].

MRI	n (%)
Hypoxic Ischaemic Encephalopathy (HIE) Changes	27 (27.6)
Neonatal Hypoglycaemic Brain Injury (NHBI)	4 (4.1)
HIE+NHBI	7 (7.1)
Focal cortical dysplasia	3 (3.1)
Ring enhancing lesions	4 (4.1)
Arachnoid cyst	2 (2.1)
Hydrocephalus	2 (2.1)
Bilateral Hippocampal T2 Flair hyperintensity	1 (1.0)
Cerebral atrophy	3 (3.1)
Subcortical white matter hyperintensity with periventricular calcifications suggestive of congenital CMV	1 (1.0)

Lissencephaly	2 (2.1)
Subcortical and periventricular white matter hyperintensities s/o meningitic sequalae	2 (2.1)
Changes of perinatal stroke	1 (1.0)
Postoperative sequalae secondary to tumour removal	1 (1.0)

[Table/Fig-6]: Abnormal neuroimaging findings in children with epilepsy aged 6 to 15 years.

Aetiological diagnosis		
Structural	**Perinatal**	**n (%)**
	HIE	27 (27.6)
	NHBI	4 (4.1)
	HIE+NHBI	7 (7.1)
	HIE+SEPSIS	1 (1.0)
	Presumed perinatal stroke	1 (1.0)
	Acquired	
	Secondary to postoperative tumour removal	1 (1.0)
	Secondary to post anoxic brain injury	1 (1.0)
	Sequelae of aqueductal stenosis	1 (1.0)
	Congenital	
	Malformation of cortical development	5 (5.1)
	Congenital hydrocephalus	1 (1.0)
Genetic	Possible	16 (16.3)
	Confirmed	2 (2.1)
Immune	Auto immune encephalitis	3 (3.06%)
	Fires (Febrile infection related epilepsy syndrome)	2 (2.04%)
Idiopathic		4 (4.1)
Unknown		17 (17.3)
Infectious		
CMV		1 (1.0)
Tuberculoma		4 (4.1)

[Table/Fig-7]: Aetiological spectrum of children with epilepsy aged 6 to 15 years. HIE: Hypoxic ischemic encephalopathy; NHBI: Neonatal hypoglycaemic brain injury; CMV: Cyto-megalovirus; FIRES: Febrile infection related epilepsy syndrome

As described in [Table/Fig-7], out of 98 study subjects, 49 (50%) were attributed to structural aetiology, 18 (18.36%) to possible and confirmed genetic aetiology, 5 (5.10%) to immune aetiology, while 4 (4.08%), 17 (17.34%), and 5 (5.10%) were linked to idiopathic, unknown, and infectious aetiology, respectively.

Treatment Spectrum

[Table/Fig-8] shows the treatment spectrum in the study group, with a total of 53 (54.1%) belonging to the refractory category, while 45 (45.9%) fell into the non refractory category. Regarding the number of ASMs, 40 (40.8%) received monotherapy, and 58 (59.2%) received polytherapy with two or more drugs. In terms of specific ASMs, 24 (24.5%) were being administered Levetiracetam alone, while 7 (7.1%) and 9 (9.2%) were on Sodium Valproate and Oxcarbazepine, respectively. A majority, 58 (59.2%), were on combined therapy. Only one patient underwent epilepsy surgery, and 10 (10.2%) were on a ketogenic diet in addition to drug therapy, while the majority, 87 (88.8%), were on drug therapy alone.

Treatment indices	n (%)
Drug response	
Refractory	53 (54.1)
Non refractory	45 (45.9)
Number of Anti-Seizure Medications (ASM)	
1	40 (40.8)
≥2 Polytherapy	58 (59.2)
Anti-Seizure Medication (ASM)	
Levetiracetam	24 (24.5)
Sodium valproate	07 (7.1)
Oxcarbazepine	09 (9.2)
Combined therapy	58 (59.2)
Treatment modalities	
Ketogenic diet+drug therapy	10 (10.2)
Epilepsy surgery+drug therapy	1 (1.0)
Drug therapy alone	87 (88.8)

[Table/Fig-8]: Treatment spectrum of children with epilepsy aged 6 to 15 years.

DISCUSSION

This cross-sectional observational study was conducted at the Department of Paediatrics of a tertiary care centre, Dr. D.Y. Patil Medical College, Hospital, and Research Centre in Western Maharashtra, India to assess the socio-demographic, clinicoaetiological and treatment profile of children with epilepsy aged 6 to 15 years. The mean age of the study population was 9.17 years, with a noted male gender preponderance of 65 (66.3%) males and 33 (33.7%) females. The Male-to-Female (M:F) ratio was found to be 1:0.5, consistent with studies conducted by Narayanan P et al., and Ramesh S et al., [3,4].

A 35 (35.7%) study subjects had an eventful perinatal history, which necessitated NICU admission for various reasons. Developmental delay was observed in 55 (56.1%) subjects, and abnormal neurological examination findings were noted in 56 (57.1%) subjects. Various studies have identified risk factors for epilepsy, including a complicated birth history, neonatal seizures and developmental delay [3,5]. According to the Modified Kuppuswamy Scale distribution, a total of 5 (5.1%) subjects belonged to the upper class, 35 (35.7%) to the upper middle class, 44 (44.9%) to the lower middle class, 12 (12.3%) to the upper lower class, and only 2 (2%) to the lower class. It has been elucidated that low socio-economic status, low income and low educational qualifications are regarded as risk factors for epilepsy. These factors can directly or indirectly influence medical care, treatment access and the likelihood of refractory epilepsy [2,6,7].

The most common type of seizures experienced by the study population was focal onset (66, 67.4%), followed by generalised onset (30, 30.6%) and unknown onset in 2 (2%). This was consistent with most studies indicating that focal onset seizures are more common in children, possibly secondary to acquired aetiologies [8-10].

EEG serves as an essential investigation, aiding in the characterisation of seizure types and classification into epilepsy syndromes. It further assists in management and prognostication. In a study conducted by Narayanan P et al., 47.8% had focal epileptiform abnormalities, while 28.1% and 24.1% had generalised and multifocal abnormalities, respectively [3].

Neuroimaging is crucial for assessing the morphology, distribution and extent of possible aetiologies causing seizures in children, guiding management, prognostication and counselling of caregivers. In the present study, 60 (61.2%) subjects showed abnormal neuroimaging findings. In a study conducted by Saravanan S, it was reported that 70% of children with seizures had abnormal EEG findings and 25% of them had abnormal neuroimaging findings [11].

In developing countries like India, various studies have proven that perinatal brain injuries are the most common aetiological factor, with hypoxic brain injury and neonatal hypoglycaemic brain injury being the leading causes [12-16]. In the present study, out of 98 subjects, 49 (50%) were attributed to structural aetiology, 18 (18.4%) to possible or confirmed genetic aetiology, 5 (5.1%) to immune aetiology, while 4 (4.1%), 17 (17.3%), and 5 (5.1%) were classified as idiopathic, unknown and infectious aetiology, respectively.

There is a limited amount of data and findings on this aspect of epilepsy documented from across India. A substantial sample size of

98 was included for better generalisation of the results. Counselling for parents regarding social stigmas, special educational needs, developmental support and guidance concerning the disease and its associated co-morbidities was also undertaken.

Limitation(s)

The study population was selected from a tertiary care centre, which made it difficult to generalise the results. Further studies with a larger sample size are needed in the future.

CONCLUSION(S)

Seizures are responsible for high morbidity and mortality in children and significantly cause physical, mental and financial distress to caregivers. A male preponderance was noted, with focal onset seizures being the most common seizure type. Neuroimaging and EEG play key diagnostic roles. This study underlines the importance of detailed history taking, meticulous examination and a structured battery of laboratory investigations, EEG and neuroimaging based on clinical suspicion, to delineate the possible aetiopathogenesis, thereby facilitating treatment and prognostication. The study suggests a need for improvement in antenatal and neonatal care in developing nations like India to minimise the burden of epilepsy and related disabilities.

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