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EEG in Children with Mental Health Disorders: Why and When?

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ABSTRACT

Background: Pediatric mental health disorders are challenging for both parents and clinicians. These challenges often raise greater concern when accompanied by symptoms such as seizures, sleep disturbances, or recent-onset behavioral changes that are difficult to manage. In such cases, an Electroencephalogram (EEG) is frequently recommended to rule out underlying neurological causes. **Aim of the study:** To evaluate the clinical indications, EEG findings, and diagnostic utility of EEG in children presenting with mental health and behavioral disorders, and to clarify when EEG should be appropriately used in pediatric mental health disorders. **Methods & Materials:** This retrospective observational study was conducted at the Neurophysiology Laboratory of Bangladesh Shishu Hospital and Institute over one year, and included children aged 6 months to 15 years referred for EEG due to mental health or neurodevelopmental disorders. Standard EEG recordings using the international 10–20 system were analyzed. EEG findings were categorized as normal or abnormal, with abnormalities further classified into focal epileptiform discharges, generalized epileptiform discharges, or background dysfunction. Data were analyzed using SPSS version 26. Descriptive statistics were used for frequencies and percentages, and associations between clinical variables and EEG findings were assessed using Chi-square or Fisher's exact tests. **Result:** Among 230 children included, EEG recordings were normal in 178 cases and abnormal in 52. Abnormal EEGs included focal epileptiform discharges (n=23), generalized epileptiform discharges (n=15), and background dysfunction (n=14). Abnormal findings were most frequent in children with disruptive behavior disorders (11/23) and intellectual disability (9/33), compared with autism spectrum disorder (15/79) and ADHD (12/58). The most common referral indications associated with abnormal EEGs were sleep disturbance (19/74), episodic abnormal body or eye movements (13/46), and febrile convulsions (8/36). Error! Bookmark not defined.**Conclusion:** EEG has a selective but clinically relevant role in the evaluation of children with mental health disorders. Its use is best justified in cases with atypical features, neurological symptoms, or treatment-resistant behavioral presentations, rather than as a routine screening investigation.

Keywords: *Electroencephalography, Neurodevelopmental disorders, Epileptiform discharges*

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Introduction

Paediatric mental health disorders are increasingly prevalent worldwide, posing significant challenges for both parents and clinicians. Globally, mental health disorders affect a substantial proportion of children and adolescents, with reported prevalence rates ranging from approximately 11% to 13.4%, depending on age group and diagnostic criteria [1]. In Bangladesh, the burden appears even higher, with prevalence estimates among children and adolescents ranging from 13.4% to 22.9% [2]. Common paediatric mental health disorders include attention-deficit/hyperactivity disorder (ADHD), anxiety disorders (such as separation anxiety and generalized anxiety disorder), behavioural disorders (including oppositional defiant disorder), autism spectrum disorder, and mood disorders such as depression [3]. These conditions can significantly impair a child's daily functioning and developmental trajectory, underscoring the importance of early identification and appropriate intervention.

Behavioural problems are often a presenting feature of mental health disorders; while many are transient, a subset may persist or represent manifestations of underlying neurodevelopmental or medical conditions [4]. Consequently, clinicians frequently refer children with mental health and behavioural concerns for electroencephalography (EEG). EEG is primarily used in the diagnosis of epilepsy and other neurological disorders [5]. Still, it may also be considered in specific clinical contexts, such as new-onset mental health problem, rapidly fluctuating mood or behaviour, or progressive or fluctuating cognitive impairment [6]. In such scenarios, EEG can help differentiate neurological dysfunction from primary mental health illness, thereby guiding diagnostic and therapeutic decision-making [7].

However, the role of routine EEG in paediatric mental health disorders remains controversial. Some studies report a relatively high yield of EEG abnormalities; for example, abnormalities were identified in 21.3% of patients in one cohort of 319 children referred for EEG [8]. In contrast, other studies suggest that EEGs performed for psychiatric indications have among the lowest rates of abnormal findings [9]. This variability highlights ongoing uncertainty regarding the clinical utility of routine EEG in this population.

Therefore, the present study aims to evaluate the appropriateness and utility of EEG referral in children with common mental health disorders, with a particular focus on identifying when and why EEG should be used to optimize clinical decision-making.

Methods & Materials

This retrospective observational study was conducted at the Neurophysiology Laboratory of Bangladesh Shishu Hospital and Institute over one year. The study reviewed electroencephalography (EEG) records and clinical data of children referred for EEG evaluation during the study period from 1st January 2023 to 31st December 2023. Ethical approval was obtained from the Institutional Review Board.

Inclusion and Exclusion Criteria

Children aged 6 months to 15 years who were referred for electroencephalography (EEG) evaluation with a clinical diagnosis of various mental health or neurodevelopmental disorders were included. Only children with complete clinical records and technically adequate EEG recordings were eligible for analysis.

Children with a previously established diagnosis of epilepsy, those receiving antiepileptic drugs at the time of EEG recording, patients with acute central nervous system infections, structural brain lesions, or metabolic encephalopathies, and cases with incomplete medical records or poor-quality EEG tracings were excluded from the study.

EEG Recording and Interpretation

Standard EEG recordings were performed using the international 10–20 electrode placement system. EEGs were recorded in awake and, sleep states. Hyperventilation and photic stimulation were applied when clinically appropriate. EEGs were interpreted independently by experienced neurologists and categorized as normal or abnormal. Abnormal findings were further classified into focal epileptiform discharges, generalized epileptiform discharges, or background dysfunction.

Data Collection

Data were retrieved retrospectively from EEG registers and patient medical records using a structured data extraction form. Collected variables included age, sex, residence, clinical diagnosis, indication for EEG referral (such as sleep disturbance, febrile convulsions, episodic abnormal movements, sudden behavioural changes, or H/O loss of consciousness), and EEG findings. Data extraction was performed independently by two investigators, with discrepancies resolved through consensus.

Statistical Analysis

Statistical analysis was performed using SPSS version 26 (IBM Corp., Armonk, NY, USA). Categorical variables were summarized as frequencies and percentages. Associations between clinical diagnoses, referral indications, and EEG findings were analyzed using Chi-square or Fisher's exact tests as appropriate. A p-value of <0.05 was considered statistically significant.

Result

The majority were aged 6 months to 5 years (47.8%), followed by 5–10 years (44.8%) and 10–15 years (7.4%). Males were predominant (71%), and most participants resided in urban areas (65.2%). Autism Spectrum Disorder (ASD) was the most common diagnosis (34.3%), followed by Attention-Deficit Hyperactivity Disorder (ADHD) (25.2%), Intellectual Disabilities (14.3%), Disruptive Behavior Disorders (10%), Somatoform Disorders (8.3%), Breath-Holding Attacks (4.8%), and Self-Gratification Syndrome (3%) (*Table 1*).

Table I
Sociodemographic and clinical profile of the study patients (*n*=230).

Variables	Frequency	Percentage
Age		
6months-5 years	110	47.8
>5years-10years	103	44.8
>10years-15years	17	7.4
Sex		
Male	163	71
Female	67	29
Residence		
Urban	150	65.2
Rural	80	34.8
Clinical diagnosis		
Autism Spectrum Disorder	79	34.3
Attention-deficit hyperactivity disorder	58	25.2
Somatoform disorder	19	8.3
Breath-holding attack	11	4.8
Intellectual disabilities	33	14.3
Disruptive behaviour	23	10
Self-gratification syndrome	7	3

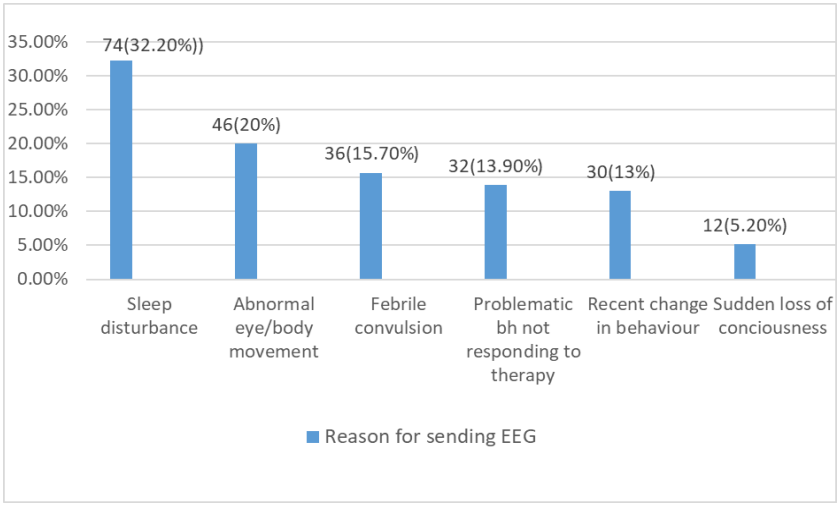

Figure 1 Reasons for sending EEG in study patients.

Figure 1 shows that sleep disturbance was the most common referral indication (32.2%), followed by episodic body or eye movements (20%), febrile convulsions (15.7%), behavioral changes (13%), treatment-resistant problematic behavior (13.9%), and sudden loss of consciousness (5.2%).

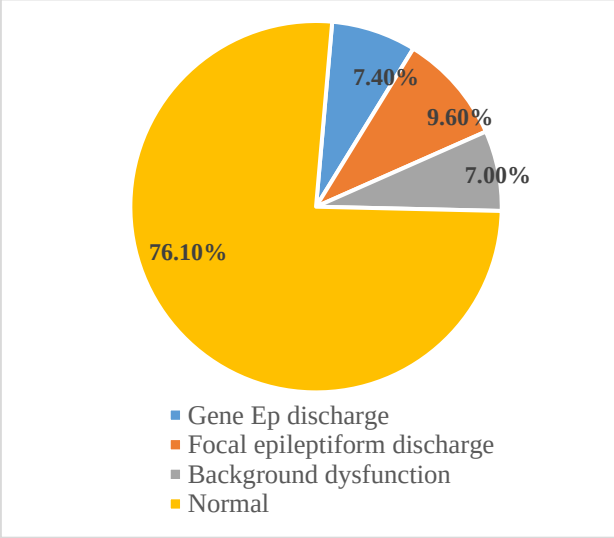

Figure 2 EEG findings in study patients (*n*=230).

Abnormal EEG findings mainly included focal epileptiform discharges (n=23), generalized epileptiform discharges (n=15), and background dysfunction (n=14) (*Figure 2*).

EEG recordings were normal in 178 children (77.4%) and abnormal in 52 children (22.6%). Abnormal EEGs were observed in 15 children with ASD (19%), 12 with ADHD (20.7%), 9 with Intellectual Disabilities (27.3%), 11 with Disruptive Behavior Disorders (47.8%), 4 with somatoform disorder (21%), 1 with Breath-Holding Attack (9%), and none with Self-Gratification Syndrome (*Table II*).

Table II
EEG findings in children with Mental health disorders.

Mental health disorder	EEG Findings		Total
	Normal	Abnormal	
Autism spectrum disorder	64	15	79
Attention-deficit hyperactivity disorder	46	12	58
Somatoform disorder	15	4	19
Breath-holding attack	10	1	11
Intellectual disability	24	9	33
Disruptive behaviour	12	11	23
Self-Gratification syndrome	7	0	7
Total	178	52	230

Febrile convulsions were predominantly associated with generalized discharges and background dysfunction, whereas sleep disturbances and episodic body or eye movement groups were more commonly linked to focal discharges and background abnormalities (*Table III*).

Table III
Reason for referral in children with mental health disorders and their EEG findings.

Reasons for referral	EEG findings				Total
	Normal	Abnormal			
		Generalized Epileptiform discharge	Focal epileptiform discharge	Background dysfunction	
Febrile convulsion	28	4	2	2	36
Sleep disturbance	55	5	9	5	74
Problematic behaviour not responding to treatment	25	2	3	2	32
Recent changes in behaviour	26	1	2	1	30
Episodic body or eye movement	33	4	5	4	46
Sudden loss of consciousness	9	0	1	2	12
Total	176	16	22	16	230

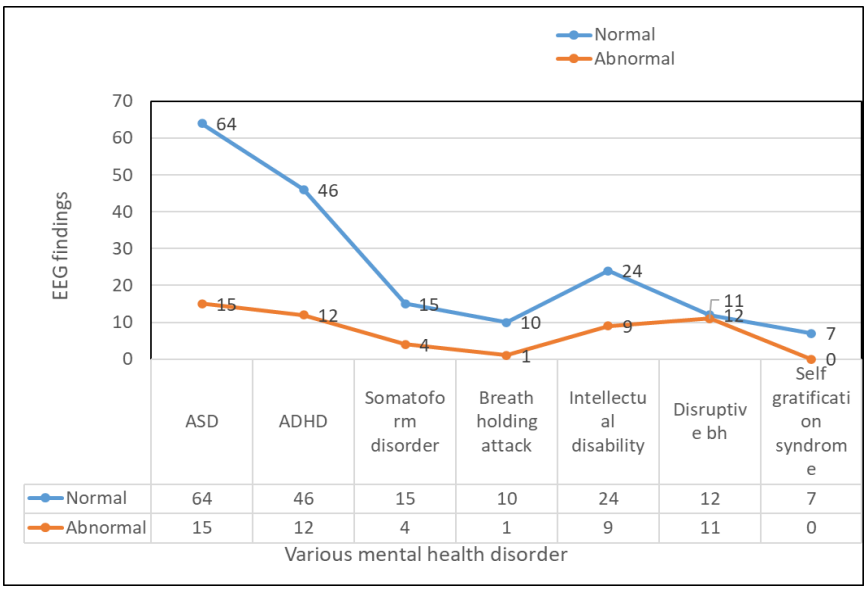

Figure 3 EEG Findings in Children across Various Mental Health Disorders.

The EEG findings chart shows a clear dominance of Normal results across most disorders, with Autism Spectrum Disorder (ASD) having the highest count (64 Normal, 15 Abnormal). Abnormal findings are generally low (64 Normal, 15 Abnormal), but their prevalence is highest relative to normal results in Disruptive Behavior Syndrome (12 Normal, 11 Abnormal) and Intellectual Disability (24 Normal, 9 Abnormal). Self-Gratification Syndrome recorded no abnormal EEGs (7 Normal, 0 Abnormal), while Breath-Holding Attack had the fewest total findings (*Figure 3*).

Discussion

Nearly half of the participants in this study (47.8%) were between the ages of six months and five years, followed by 44.8% who were between the ages of five and ten and 7.4% who were between the ages of ten and fifteen. On the other hand, 70.8% of children who visited the pediatric outpatient department were between the ages of five and ten [10]. Males formed 71% of the study population. This male preponderance is in line with the results of Alenezi et al., who found that approximately 74% of children with possible neurodevelopmental anomalies were male, indicating that boys are more likely to experience these issues [11]. Similarly, another clinical study documented that 75.82% of children diagnosed with neurodevelopmental disorders were male [12].

With 65.2% of participants residing in cities and 34.8% in rural regions, metropolitan areas accounted for the bulk of research participants. Mullick and Goodman, on the other hand, found that the prevalence was greater in rural children (15.4%) than in urban children (10.0%) [13]. In contrast, Xiang et al. reported approximately comparable prevalence rates of mental health issues among urban (9.85%) and rural children (9.70%) in central China. [14]. The clinical diagnoses in this study were heterogeneous. With 34.3% of cases, autism spectrum disorder (ASD) was the most common diagnosis. Attention-deficit hyperactivity disorder (ADHD) came in second with 25.2%, and intellectual disability with 14.3%. Similarly, ADHD accounted for 44.5% of diagnoses in a Nordic child and adolescent mental health outpatient cohort of 407 children, while ASD accounted for 6.1% of neurodevelopmental disorders. Hansen et al. highlighted the predominance of ADHD in referred paediatric populations [15]. In this analysis, 77.4% of participants had normal EEG findings, while 22.6% showed abnormal EEG results. The percentage of aberrant EEGs varied by diagnostic category, with Intellectual Disabilities (27.3%) and Disruptive Behavior Disorders (47.8%) having the greatest rates, followed by ASD (19.0%) and ADHD (20.7%). Similarly, a retrospective study of 319 pediatric patients attending an outpatient mental health clinic found EEG abnormalities in 21.3% of them, including interictal epileptiform discharges and background abnormalities, with the highest prevalence seen in those with neurodevelopmental disorders [8]. In contrast to this study, Tekin et al. discovered far higher rates of epileptiform EEG activity, with abnormalities observed in 42% of children with ADHD and 52% of children with autism [16]. In the present investigation, reasons for EEG referral and corresponding findings varied across clinical presentations. Sleep disturbance was the most common indication for EEG referral, accounting for 32.2% (n = 74) of cases, with 19 exhibiting abnormal EEG findings. Nashwa M. Samra et al. found that EEG abnormalities were commonly identified in children with autism who had sleep difficulties and aggressive behaviors, with rates of 50.0% and 83.3%, respectively [17]. These findings indicate that clinicians frequently request EEG evaluations for children with abnormal sleep patterns, nocturnal episodes, or concerns about epileptiform activity during sleep. Abnormal eye or body movements were the second most common reason for an EEG referral (20%, n = 46). Among these children, 33 had normal EEGs, while 13 demonstrated abnormal patterns, including generalized epileptiform discharges (n = 4), focal epileptiform discharges (n = 5), and background dysfunction (n = 4). Barua et al. reported that focal EEG abnormalities are characteristic of benign childhood focal epilepsies, which account for approximately 20% of pediatric epilepsy syndromes [18]. These findings underscore that, although stereotyped movements are frequently observed in children with neurodevelopmental disorders, EEG evaluation remains crucial for differentiating epileptic seizures from non-epileptic stereotypies, tics, or other behavioral manifestations. Among children referred for febrile convulsions, 28 had normal EEG findings, while 8 exhibited abnormalities. In contrast, Cappellari et al. found abnormal EEG readings in 71% of children with a history of febrile seizures. Background dysfunction and slower activity were observed in 56% of cases. [19]. These differences may reflect variations in referral practices, with EEGs more frequently performed in cases of atypical, recurrent, or prolonged febrile seizures to exclude underlying epileptic syndromes. In

this study, recent behavioral changes accounted for 13% (n = 30) of EEG referrals, among whom 13.2% (n = 4) demonstrated abnormal EEG findings, including generalized epileptiform discharges (n = 1), focal epileptiform discharges (n = 2), and background dysfunction (n = 1). Ko Jun et al. reported higher rates of EEG abnormalities (21.3%) in children referred to outpatient mental health clinics, including background abnormalities in 14.7% and interictal epileptiform discharges in 10.3% [8]. These findings highlight that sudden behavioral changes warrant careful evaluation, as they may occasionally reflect underlying neurological dysfunction.

Finally, among children referred for sudden loss of consciousness, 9 had normal EEGs, while 3 exhibited abnormal findings, including focal epileptiform discharges (n = 1) and background dysfunction (n = 2). Many episodes of apparent loss of consciousness in children are not epileptic in character, and routine EEGs are frequently normal, which is consistent with earlier research on seizure mimics [20]. These findings support the use of EEG in juvenile populations to distinguish epileptic seizures from syncope or functional disturbances.

Limitations

The limitations are

- Use of routine EEG only, without quantitative EEG or advanced analytical techniques
- Lack of standardized psychiatric severity scales across diagnoses
- Lack of longitudinal follow-up to assess the influence of EEG findings on treatment decisions and outcomes.

Conclusion

The selective use of EEG in children with neurodevelopmental and mental health issues is highlighted in this study. youngsters with intellectual disabilities and disruptive behavior issues were more likely to have abnormal EEGs than youngsters with attention deficit hyperactivity disorder or autism spectrum disorder. EEG yielded greater diagnostic value in the presence of sleep disturbances, episodic abnormal movements, or febrile convulsions, while isolated behavioral symptoms showed limited utility. In order to assist an accurate diagnosis and well-informed therapeutic decision-making, EEG should be used in cases where symptoms are atypical, resistant to standard treatment, or accompanied by neurological abnormalities rather than as a routine screening technique in pediatric psychiatry.

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