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# COMPARATIVE STUDY OF NEUROBEHAVIORAL PROFILE AND SLEEP DISORDER IN EPILEPTIC CHILDREN AND NON-EPILEPTIC CHILDREN

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ABSTRACT

**Background:** Epilepsy is a common pediatric neurological disorder with a global prevalence of 0.5–1%, significantly higher in low- and middle-income countries. Beyond seizures, epileptic children frequently exhibit neurobehavioral challenges and sleep disturbances, often underrecognized in clinical care. This study aimed to compare the neurobehavioral profiles and sleep patterns in epileptic children versus non-epileptic controls to emphasize the need for holistic epilepsy management.

**Materials and Methods:** A hospital-based case-control study was conducted over one year in a tertiary care center in Navi Mumbai. Fifty children aged 1–12 years were enrolled—25 with epilepsy (Group A) and 25 with non-neurological illnesses (Group B). Behavioral assessment was conducted using the Child Behavior Checklist (CBCL), while sleep disturbances were screened using the BEARS questionnaire. Statistical analysis was performed using t-tests and Chi-square tests with $p<0.05$ considered significant.

**Results:** Epileptic children had significantly higher CBCL scores across all domains, including Anxious/Depressed (64.4 vs. 51.16), Withdrawn/Depressed (67.88 vs. 53.52), and Attention Problems (65.08 vs. 52.04) with $p<0.001$. Sixty percent of epileptic children had clinically significant behavioral issues versus 0% in controls ($p<0.001$). Sleep disturbances were more prevalent in the epilepsy group (68%) compared to controls (44%), though not statistically significant ($p=0.087$). However, all epileptic children with behavioral issues had co-existing sleep disturbances ($p<0.001$).

**Conclusion:** Children with epilepsy exhibit significantly more behavioral problems and sleep disturbances than non-epileptic peers. These findings highlight the importance of integrating behavioral and sleep assessments into routine epilepsy care for better developmental outcomes.

**Keywords:** Epilepsy, Child Behavior Checklist, Sleep Disorders, BEARS Questionnaire, Neurobehavioral profile, Neurodevelopment.

## INTRODUCTION

Epilepsy is one of the most prevalent chronic neurological disorders in children, affecting approximately 0.5–1% of the global pediatric population, with over 11 million children under the age of 15 currently living with the condition worldwide. The burden is disproportionately higher in low- and middle-income countries, including India, where prevalence rates among children vary between 2.02 to 22.2 per 1,000 depending on region and healthcare access.[1,2]

Defined by the International League Against Epilepsy (ILAE), epilepsy is characterized by recurrent unprovoked seizures or the diagnosis of an epilepsy syndrome.[3] While seizures are the hallmark of the disease, epilepsy also imposes significant neurodevelopmental, cognitive, and psychosocial burdens, often exacerbated by antiepileptic drugs

(AEDs), socioeconomic status, and family dynamics.[4,5]

Children with epilepsy frequently demonstrate behavioral issues such as aggression, hyperactivity, anxiety, and attention deficits, with studies reporting psychological disorders in up to 58% of such children, particularly when brain abnormalities are present.[6] Cognitive impairments are also common, with reduced memory, language function, and school attendance cited in numerous studies.[7,8] These issues are not isolated to seizure activity but may persist interictally and worsen over time, especially in those with early-onset or refractory epilepsy.[9]

Sleep disturbances form a critical but underrecognized comorbidity in pediatric epilepsy. Sleep and seizures have a bidirectional relationship—disrupted sleep can precipitate seizures, while seizures (especially nocturnal) can impair sleep architecture. Epileptiform discharges such as centrotemporal spikes and generalized spike-wave discharges often occur or intensify during non-REM sleep, affecting memory consolidation and cognitive performance.[10,11] Syndromes such as Electrical Status Epilepticus during Sleep (ESES) exemplify the severity of this interaction. Tools like the BEARS questionnaire help screen for common sleep disorders including insomnia, night awakenings, and sleep apnea, all of which are more prevalent in children with epilepsy than their peers.[12]

The role of AEDs in modulating both behavior and sleep are significant. While newer AEDs like lamotrigine and levetiracetam have improved side effect profiles, many traditional agents are linked to sedation, cognitive dulling, and mood changes.[13] Polytherapy, in particular, exacerbates behavioral and cognitive disturbances. Studies have shown that children on multiple AEDs are more prone to attention deficits, irritability, and academic difficulties.[14]

Despite these profound implications, routine clinical care often focuses solely on seizure control, overlooking associated behavioral and sleep-related comorbidities. This narrow focus delays early diagnosis and intervention, reducing the overall quality of life and developmental outcomes in these children. Early recognition through standardized tools like the Child Behavior Checklist (CBCL) and BEARS questionnaire can aid in identifying at-risk individuals and tailoring holistic interventions.[15,16]

This study aims to compare the neurobehavioral profiles and prevalence of sleep disorders in epileptic children and their age-matched non-epileptic counterparts. By identifying significant differences, the study emphasizes the need for integrative pediatric epilepsy care that addresses not only seizure control but also the broader spectrum of developmental and behavioral health.

## MATERIALS AND METHODS

A case-control study and was conducted over a period of one year, from January 2024 to January 2025, in the Department of Paediatrics at a tertiary care centre at Navi Mumbai. A total of 50 children, aged between 1 to 12 years, were enrolled in the study. Ethical clearance was obtained from the Institutional Ethics Committee prior to the commencement of the study. Informed written consent was collected from parents or legal guardians of all participants. All data collected during the study was handled confidentially, and privacy was ensured at every stage of the research process.

The participants were divided into two groups: Group A (cases) comprised 25 children diagnosed with epilepsy based on the International League Against Epilepsy (ILAE) criteria, while Group B (controls) included 25 children admitted for non-neurological illnesses such as acute gastroenteritis, viral fever, or respiratory tract infections. A simple random sampling technique was employed to select participants who fulfilled the inclusion and exclusion criteria.

Children were included in the study if they were aged 1 to 12 years, of either sex, and if informed consent was obtained from their parents or legal guardians. Children with known neurodevelopmental disorders such as autism spectrum disorder, cerebral palsy, intellectual disability, and those with febrile or metabolic seizures or congenital structural abnormalities were excluded from both groups to eliminate confounding variables.

The sample size was calculated assuming an epilepsy prevalence of 1.6% based on a study by Santhosh et al,[17] at a confidence interval of 95% and an absolute precision of 5%, the minimum required sample size was 24.18. This was rounded off to 25 participants per group.

Data was collected through structured interviews and clinical evaluations conducted during hospital admission. Each participant underwent a thorough history-taking and physical examination. Sociodemographic details, clinical diagnosis, antiepileptic medication use, EEG and imaging findings were recorded where applicable.

To assess the neurobehavioral profile, the Child Behavior Checklist (CBCL) was administered to parents or guardians. The CBCL is a standardized, validated tool that evaluates emotional and behavioral problems in children and provides both cumulative scores and T-scores for comparison with normative data. The internalizing and externalizing behavioral domains were analyzed.

For sleep disorder assessment, the BEARS questionnaire was used. This is a brief screening tool that evaluates five domains of pediatric sleep: Bedtime problems, Excessive daytime sleepiness, Awakenings during the night, Regularity of sleep, and Snoring. A positive response in any of these

domains was indicative of a potential sleep disturbance.

The collected data was entered into Microsoft Excel and analyzed using IBM SPSS Statistics for Windows, Version 26.0. Quantitative variables were expressed as means and standard deviations, while categorical data was presented in frequencies and percentages. Comparisons between groups were made using the independent t-test for continuous variables and the Chi-square or Fisher's exact test for categorical variables. A p-value of less than 0.05 was considered statistically significant.

## RESULTS

The present study was conducted among 50 children, 25 children admitted with epilepsy seizures (study group) and 25 children with non-neurological illnesses (control group) admitted to a tertiary care hospital in Nerul, Navi Mumbai. The mean age of the study participants was 7.26 + 3.08 years. The majority of the children in the study group (52%) and control group (52%) were boys while 48% were females.

Among the cases, 60% had generalised epilepsy, 28% had focal epilepsy, 8% had generalised idiopathic epilepsy while 4% had syndromic epilepsy. 60% of the children were on Levetiracetam, 44% were on Valproate and 4% were on Lamotrigine. (Figure 1)

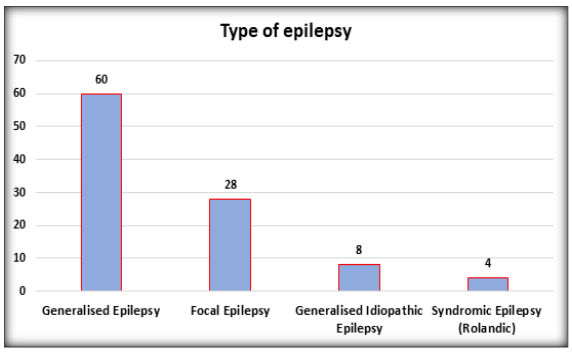


**Figure 1: Distribution of cases based on Type of epilepsy**

While a subset of children with epilepsy had identifiable abnormalities such as gliosis or cortical dysplasia, the majority showed normal imaging underlining that the neurobehavioral problems in epilepsy may occur even in the absence of visible anatomical lesions, pointing to functional disruptions as contributing factors. (Figure 2)

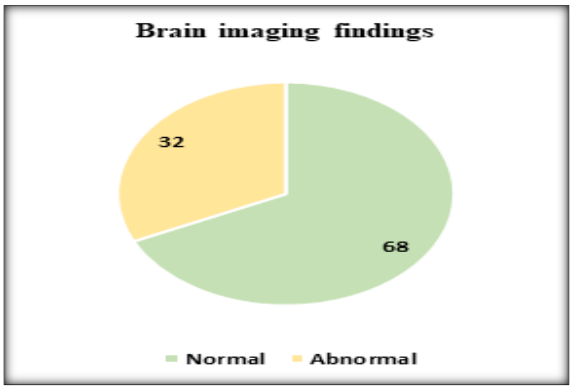


**Figure 2: Distribution of cases based on Brain imaging findings**

Among the CBCL subscales used to assess the neurobehavioral problems, the maximum clinical significance was observed for Withdrawn/Depressed (56%) followed by Anxious/Depressed (52%) and Thought Problems (52%), Somatic Complaints (44%) and Rule-Breaking Behavior (44%), Social Problems (40%) and Rule-Breaking Behavior (40%). The least clinical significance was observed for Aggressive Behavior (4%).

Table 1 compares the mean CBCL subscale scores between epileptic and non-epileptic children. The study group (epileptic children) had significantly higher scores across all domains including Anxious/Depressed (64.4 ± 10.6 vs. 51.16 ± 2.57), Withdrawn/Depressed (67.88 ± 12.75 vs. 53.52 ± 5.42), Somatic Complaints (66.04 ± 11.45 vs. 55.92 ± 6.33), Social Problems (64.76 ± 10.22 vs. 54.40 ± 5.78), Thought Problems (65.72 ± 11.18 vs. 54.92 ± 5.58), Attention Problems (65.08 ± 10.53 vs. 52.04 ± 3.97), Rule-Breaking Behavior (63.72 ± 10.14 vs. 52.44 ± 4.65), and Aggressive Behavior (58.12 ± 7.59 vs. 52.08 ± 3.13). All differences were statistically significant ($p < 0.001$), indicating that epileptic children demonstrate significantly greater emotional and behavioral disturbances than their non-epileptic peers. (Table 1)

**Table 1: CBCL subscale score among cases and controls**

| CBCL subscale score | Group | Mean | Std. Deviation | t-value | p-value |
|---|---|---|---|---|---|
| Anxious/Depressed | Cases | 64.400 | 10.661 | 6.035 | **<0.001*** |
| | Controls | 51.160 | 2.576 | | |
| Withdrawn/Depressed | Cases | 67.880 | 12.758 | 5.179 | 0.001 |
| | Controls | 53.520 | 5.424 | | |
| Somatic Complaints | Cases | 66.040 | 11.454 | 3.865 | 0.001 |
| | Controls | 55.920 | 6.337 | | |
| Social Problems | Cases | 64.760 | 10.223 | 4.409 | 0.001 |
| | Controls | 54.400 | 5.787 | | |
| Thought Problems | Cases | 65.720 | 11.182 | 4.321 | **<0.001*** |
| | Controls | 54.920 | 5.582 | | |
| Attention Problems | Cases | 65.080 | 10.531 | 5.792 | **<0.001*** |
| | Controls | 52.040 | 3.973 | | |
| Rule-Breaking Behavior | Cases | 63.720 | 10.146 | 5.052 | **<0.001*** |

| | | | | | |
|---|---|---|---|---|---|
| | Controls | 52.440 | 4.655 | | |
| Aggressive Behavior | Cases | 58.120 | 7.590 | 3.678 | **<0.001*** |
| | Controls | 52.080 | 3.134 | | |

Table 2 provides the overall behavioral burden as assessed by cumulative and T-scores. The mean total cumulative CBCL score was markedly higher in epileptic children (54.04 ± 37.90) compared to controls (11.96 ± 11.96), with a significant mean difference of 42.08 ($p < 0.001$). Similarly, the mean total CBCL T-score was significantly higher in the case group (58.88 ± 19.41) than in controls (39.92 ± 12.61), with a mean difference of 18.96 ($p = 0.026$). These results reflect a higher degree of clinical emotional-behavioral difficulties in children with epilepsy. (Table 2)

**Table 2: Total CBCL Cumulative Score among cased and controls**

| CBCL Score | | Mean | SD | Mean difference | t-value | p-value |
|---|---|---|---|---|---|---|
| **Total CBCL Cumulative Score** | **Cases** | 54.040 | 37.905 | 42.080 | 5.293 | **<0.001*** |
| | **Controls** | 11.960 | 11.966 | | | |
| **Total CBCL T Score** | **Cases** | 58.880 | 19.412 | 18.960 | 4.095 | **0.026*** |
| | **Controls** | 39.920 | 12.612 | | | |
| | **Independent t-test** | | | | | |

Table 3 shows that among epileptic children, 60% (15 out of 25) had clinically significant behavioral problems, 4% (1 child) were borderline, and 36% (9 children) were normal. In contrast, 96% (24 out of 25) of non-epileptic children were normal, with only 4% (1 child) being borderline and none showing clinically significant issues. This difference was statistically significant (Chi-square = 24.73, $p < 0.001$), indicating a higher prevalence of behavioral disturbances in epileptic children compared to controls. (Table 3)

**Table 3: Overall Interpretation based on the CBCL score**

| Group | Overall CBCL Interpretation | | | Chi-square value | p-value |
|---|---|---|---|---|---|
| | Normal | Borderline | Clinically Significant | | |
| Case | 9 (36) | 1 (4) | 15 (60) | 24.730 | <0.001* |
| Control | 24 (96) | 1 (4) | 0 (0) | | |

68% of the cases and 44% of the controls had sleep disorders in our study as per the the BEARS questionnaire. Sleep disorder among both groups were not found to have a statistical significance with a chi-square value of 2.922 and a p-value of 0.087.
Table 4 shows a significant association between neurobehavioral problems and sleep disorders in epileptic children. All children (100%) with clinically significant CBCL scores had sleep disorders, while only 22.2% of those with normal behavior had sleep issues. This association was statistically significant (Chi-square = 18.309, $p < 0.001$). In contrast, among non-epileptic children, 41.7% of those with normal behavior had sleep disorders, but this was not statistically significant (Chi-square = 1.326, $p = 0.440$). Thus, sleep disturbances were closely linked to behavioral problems in epileptic children, but not in controls. (Table 4)

**Table 4: Association between Neurobehavioral profile and sleep disorder**

| Group | Overall CBCL Interpretation | Sleep Disorder | | Chi-square value | p-value |
|---|---|---|---|---|---|
| | | Yes | No | | |
| Case | Normal | 2 (22.2) | 7 (77.8) | 18.309 | **<0.001*** |
| | Borderline | 0 (0) | 1 (100) | | |
| | Clinically Significant | 15 (100) | 0 (0) | | |
| Control | Normal | 10 (41.7) | 14 (58.3) | 1.326 | 0.440 |
| | Borderline | 1 (100) | 0 (0) | | |
| | Clinically Significant | 0 (0) | 0 (0) | | |

## DISCUSSION

This study aimed to assess and compare the neurobehavioral profiles and sleep disturbances in epileptic children and non-epileptic controls. The results revealed a significantly higher prevalence of behavioral issues and sleep disturbances among epileptic children, aligning with existing literature on the multidimensional impact of epilepsy on child development.

Our findings showed that epileptic children had significantly elevated scores in all CBCL subscales, including\ Anxious/Depressed, Withdrawn/Depressed, Somatic Complaints, Social Problems, Thought Problems, Attention Problems, Rule-Breaking, and Aggressive Behavior domains. These results are consistent with the population-based study by Reilly et al., which found that children with epilepsy are at a significantly higher risk of developing emotional and behavioral comorbidities

compared to their peers, with internalizing problems being most common (e.g., anxiety, depression).[5] Similarly, Rodenburg et al. conducted a meta-analysis confirming that children with epilepsy experience a higher rate of psychopathology than the general pediatric population.[13]

The current study also demonstrated that 60% of epileptic children had clinically significant behavioral problems, in contrast to none in the control group. This supports findings from the study by Srinivas and Shah, who reported high psychiatric comorbidity rates in pediatric epilepsy, emphasizing the need for regular behavioral screening in this group.[14] Karrasch et al., in a longitudinal cohort study, observed that behavioral and cognitive issues may persist or even worsen over time, particularly in children with early-onset or poorly controlled epilepsy.[6] This highlights that behavioral changes in epilepsy are not only seizure-related but can be influenced by underlying neurological dysfunction and long-term AED use.

A major contributor to behavioral changes in children with epilepsy is the use of antiepileptic drugs (AEDs). In our study, most children were on Levetiracetam and Valproate. Although newer AEDs like Levetiracetam are considered to have better neurobehavioral profiles, several studies have reported irritability, aggression, and mood changes associated with its use.[13] Polytherapy, in particular, increases the risk of behavioral side effects, as supported by Rodenburg et al. and Owens et al., who found that children on multiple AEDs tend to exhibit greater attention deficits, emotional lability, and academic underperformance.[12,13]

Sleep disturbances were also more prevalent among epileptic children (68%) compared to controls (44%). Though the association between epilepsy and sleep disorder was not statistically significant overall, a strong correlation was seen between clinically significant behavioral scores and the presence of sleep disorders in the epilepsy group ($p < 0.001$). This suggests a strong interdependence between behavioral and sleep issues in children with epilepsy. Nobili et al. emphasized the bidirectional relationship between epilepsy and sleep disturbances, where nocturnal seizures and interictal epileptiform discharges during non-REM sleep disrupt sleep architecture, contributing to cognitive and behavioral deficits.[10]

The role of sleep disturbances in aggravating behavioral problems has also been well established. Owens highlighted that children with epilepsy often present with insomnia, night awakenings, and daytime sleepiness, which further impair mood and attention regulation.[12] The BEARS questionnaire, used in our study for sleep screening, effectively identified these common disturbances, underscoring its utility in clinical settings.

Despite the strong evidence for neurobehavioral and sleep comorbidities in pediatric epilepsy, these issues are often underrecognized and undertreated. Achenbach and Rescorla have advocated for the routine use of standardized behavioral tools such as the CBCL in pediatric populations to aid in early detection and intervention.[16] Our findings support this recommendation and emphasize the need for integrative care approaches that encompass seizure management along with behavioral and psychosocial support.

This study had several limitations. The sample size was relatively small, which may limit the generalizability of the findings to the broader pediatric population. As a hospital-based study, selection bias may have influenced the results, as more severe cases tend to be admitted. The cross-sectional design prevented the assessment of causal relationships or longitudinal changes in behavior and sleep. Additionally, reliance on parent-reported tools like the CBCL and BEARS may introduce reporting bias. EEG and imaging findings were not correlated in detail with behavioral outcomes, which could have provided further insights into neuroanatomical or functional contributions.

## CONCLUSION

This study highlights the significant neurobehavioral and sleep disturbances experienced by children with epilepsy compared to their non-epileptic peers. Epileptic children demonstrated markedly higher scores in all domains of the Child Behavior Checklist (CBCL), with a majority exhibiting clinically significant behavioral issues. Sleep disorders were also more prevalent in this group, and a strong association was observed between behavioral abnormalities and sleep disturbances. These findings emphasize that epilepsy in children is not merely a seizure disorder but a complex condition affecting multiple aspects of development and daily functioning. Despite seizure control being the primary treatment focus, it is crucial to incorporate routine behavioral and sleep assessments into clinical management. Early identification and intervention can substantially improve quality of life, academic performance, and long-term developmental outcomes. A multidisciplinary approach involving pediatricians, neurologists, psychologists, and caregivers is essential to address the broader spectrum of challenges faced by children with epilepsy.

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