Original Research Article

Study on Various Demographic Factors Among Breakthrough Seizures Individuals

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Abstract:

Introduction: Breakthrough seizures (BTS) occur in patients previously well-controlled on antiepileptic drugs. Demographic factors like age, gender, socioeconomic status, and compliance significantly influence BTS incidence. Understanding these variables helps in tailoring interventions and improving seizure control. This study explores their impact to enhance long-term epilepsy management strategies.

Methods: This prospective observational study was conducted over two years in a pediatric department in Tamil Nadu, including 80 children aged 1–18 years with breakthrough seizures. Data on demographics, epilepsy type, AED use, and precipitating factors were collected using structured proformas. Informed consent and ethical clearance were obtained.

Results: Among 80 children with breakthrough seizures, most were toddlers (48.75%) and male (M:F ratio 1.96). Generalized seizures predominated (73.75%). EEG was not performed in 50% of cases. Most lived in urban nuclear families. Lower middle socioeconomic status (37.5%) and positive family history (40%) were common associations.

Conclusion: Breakthrough seizures in children were more frequent among toddlers, males, urban nuclear families, and those from lower middle socioeconomic groups. Generalized seizures predominated, but EEG was underused. Family history played a significant role. Addressing demographic and diagnostic gaps may enhance seizure control and therapeutic outcomes in pediatric epilepsy management.

Keywords: Breakthrough seizures, Pediatrics, demographic factors, EEG findings.

Introduction

Breakthrough seizures (BTS) are defined as epileptic seizures occurring in individuals who were previously well-controlled on antiepileptic drug (AED) therapy [1]. Despite optimal management, a significant proportion of patients continue to experience these episodes, posing challenges to treatment efficacy and quality of life. Various demographic factors, including age, gender, socioeconomic status, education level, and compliance with medication, are believed to influence the incidence and recurrence of BTS [2]. Children and the elderly are particularly vulnerable due to age-specific metabolic rates and comorbidities that may interfere with pharmacological management. Additionally, lower socioeconomic status and limited health literacy have been linked to poor medication adherence, contributing to BTS. Cultural beliefs, access to healthcare facilities, and parental supervision in pediatric patients further modulate the seizure threshold [3]. Identifying and analyzing these demographic determinants is essential for tailored interventions to reduce BTS frequency and improve seizure control [4]. Understanding how these variables affect seizure recurrence can guide treating specialist in developing individualized care plans and targeted educational strategies. This study aims to systematically explore the influence of demographic characteristics on the incidence and pattern of BTS to enhance long-term management of epilepsy.

Methods

It was a prospective, observational study conducted in the department of paediatrics, Masonic Medical Centre for Children, Coimbatore, Tamil Nadu. Study was conducted from October 2018 to 2020, 2

years. Ethical clearance was obtained from the Institutional Ethics Committee. Eligible patients and caregivers were briefed about the study, and written informed consent was obtained from those willing to participate.

Children aged between 1 and 18 years who presented with BTS despite being previously well-controlled on AED therapy for more than six months were included in the study. Children < 1 month, those with anatomical abnormalities or neurological impairments such as cerebral palsy, hypoxic-ischemic encephalopathy (HIE), syndromic conditions, or stroke, as well as children with seizures secondary to metabolic causes or head injury, were excluded from the study. This is continuation of our previous research; sample size was confirmed to be 80 [5].

Prior to enrollment, the purpose, procedures, and potential benefits of the study were thoroughly explained to all participants or their legal guardians in their preferred language. Ample time was provided to clarify any doubts, ensuring informed and voluntary participation. Written informed consent was obtained from all study members. A pre-tested, structured proforma was employed to systematically collect relevant demographic data including age, sex, level of education, socioeconomic status as per Modified Kuppuswamy scale, and place of residence (urban or rural). Clinical variables such as the type of epilepsy (generalized or focal), duration of illness, number and type of AEDs, adherence to prescribed medications, and presence of comorbidities were carefully documented. Potential precipitating factors for breakthrough seizures—including missed medication, sleep deprivation, fever, emotional stress, or illness—were recorded based on patient interviews and a review of medical records. Medication compliance was assessed using self-reports and pharmacy refill records.

Statistical analysis: Data were entered in Excel and analyzed using SAS 9.2. Categorical variables were presented as frequencies and percentages, and continuous variables as mean ± SD. Associations were tested using Chi-square or Fisher's exact test, depending on distribution. A p-value < 0.05 was considered statistically significant.

Results

Among 80 children with BTS, the majority were toddlers aged 1–3 years (48.75%), followed by preschoolers (22.5%), school-age children (20%), and adolescents (8.75%). The overall mean age was 61.80 ± 55.54 months, ranging from 12 to 204 months. The male-to-female ratio was 1.96, indicating a male predominance. Regarding residential distribution, 45 children (56.25%) were from urban areas and 35 (43.75%) from rural

regions. Most children (83.75%) lived in nuclear families, and only 16.25% belonged to joint families. Among joint family cases, 92.31% were rural, while 65.67% of nuclear families resided in urban areas, showing a predominance of urban nuclear households. Generalized seizures were the most common type (59 cases), followed by focal (17) and unclassified (4). EEG was not performed in 50% of patients. Of the remaining, 16 (20%) had focal epileptic findings, 8 (10%) had generalized findings, and 16 (20%) showed normal EEGs. In focal seizure cases, 88.24% had focal EEG findings. Among generalized seizures, 61.02% had no EEG, and 23.73% showed normal EEGs. Socioeconomically, the lower middle class accounted for the highest proportion (37.5%), followed by upper middle (28.75%) and upper lower classes (26.25%). Only 1.25% were from the upper class. Additionally, 32 children (40%) had a positive family history of seizures, indicating a significant familial component.

Discussion

In this study of 80 children with BTS, toddlers aged 1–3 years represented the largest group (48.75%), followed by preschoolers (22.5%), school-age children (20%), and adolescents (8.75%), with a mean age of 61.80 ± 55.54 months. This age distribution suggests that early childhood may be a critical period for seizure recurrence, consistent with findings by Raju et al., who reported a higher incidence of BTS in younger pediatric populations due to evolving neurological maturation and inconsistent drug metabolism [6]. The male-to-female ratio of 1.96 also reflects a male preponderance, in line with literature and also found that boys were more prone to epilepsy-related complications, possibly due to hormonal or genetic influences [7]. Urban residency was more prevalent (56.25%) compared to rural (43.75%), echoing findings by Al Khalaf et al., who associated urban living with increased detection rates due to better healthcare access [8]. A significant majority of the children (83.75%) belonged to nuclear families, similar to observations by Sharma et al., who noted that children in nuclear households often lacked consistent supervision, contributing to poor adherence and higher seizure recurrence [9]. These demographic insights highlight the importance of targeted interventions focusing on early childhood, male children, and family structure in managing BTS.

In this study, a higher proportion of children in nuclear families (65.67%) resided in urban areas, indicating an urban preference for nuclear households. In contrast, 92.31% of children from joint families were from rural regions, which aligns with findings by Sharma et al., who highlighted the urban-rural disparity in family structures across pediatric populations [10]. Generalized seizures

were the most prevalent (59 cases), followed by focal seizures (17) and unclassified seizures (4). This distribution mirrors literature; it was reported that generalized seizures are more common in younger children due to their brain development, while focal seizures are more likely in older children [11]. EEG utilization in this study was suboptimal, with 50% of cases not undergoing EEG, despite its diagnostic significance. Of the patients who had EEGs, 20% showed normal findings, 10% had generalized findings, and 20% had focal findings, indicating the diversity in seizure activity. This is consistent with findings by Khan et al., who stressed the role of EEG in classifying seizure types, yet noted its limited use in certain regions [12]. In focal seizure cases, 88.24% had focal epileptic findings, reinforcing the importance of targeted diagnostic techniques in focal seizure management [13].

Among children with generalized seizures, EEG was not performed in 61.02% of cases, and 23.73% showed normal EEG findings. This limited utilization of EEG highlights a diagnostic gap despite its established value in epilepsy classification. Similar findings were noted by Khan et al., who emphasized the underuse of EEG in resource-limited settings, impacting seizure management and classification accuracy [12]. Socioeconomically, the majority of patients belonged to the lower middle class (37.5%), followed by the upper middle (28.75%) and upper lower classes (26.25%). This is consistent with the observations, reported a strong association between socioeconomic status and poor seizure control due to restricted access to medications and follow-up services [14]. Only 1.25% of children in the present study belonged to the upper class, indicating underrepresentation of this group, possibly due to better access to private care. Furthermore, a positive family history of seizures was observed in 40% of the children, suggesting a significant genetic or hereditary predisposition. Similar findings were reported, highlighting the familial clustering of epilepsy, especially in pediatric populations, due to inherited susceptibility and environmental influences [6].

Conclusion

This study highlights the significant role of demographic and clinical factors in the occurrence of BTS among children. Younger age, male gender, nuclear family setup in urban areas, and lower middle socioeconomic status were commonly observed characteristics. Generalized seizures were predominant, yet EEG utilization was suboptimal. A positive family history of seizures further emphasized the potential genetic influence in BTS occurrence. Understanding these factors is essential for early identification, improved patient education, and better compliance with antiepileptic therapy. Strengthening diagnostic tools and follow-up care

can help minimize BTS frequency and improve long-term seizure control in pediatric populations.

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