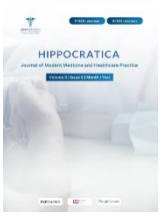

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Factors Associated with the Occurrence of Fever-Associated Seizures in Children in the Emergency Department of Harapan Anda Islamic General Hospital

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Abstract

Febrile seizures are commonly encountered in children aged 6 months to 5 years and are clinically classified as simple febrile seizures (SFS) or complex febrile seizures (CFS). This study aimed to identify factors associated with febrile seizure classification among children presenting to the Emergency Department of Harapan Anda Islamic General Hospital, Tegal City. A quantitative observational analytic study with a cross-sectional design was conducted from May to July 2026, involving 35 children selected using total sampling. The independent variables included age, gender, body temperature, previous febrile seizure history, and leukocyte, neutrophil, and lymphocyte counts, while the dependent variable was febrile seizure classification as SFS or CFS. Data were analyzed using univariate and bivariate analyses with the Chi-square test at a 5% significance level. CFS occurred in 19 participants (54.3%), while SFS occurred in 16 (45.7%). Significant associations were found between seizure classification and age (p=0.003), body temperature (p=0.012), and previous febrile seizure history (p=0.030), whereas gender (p=0.945), leukocyte count (p=0.070), neutrophil count (p=1.000), and lymphocyte count (p=0.659) were not significantly associated. Age, body temperature, and previous febrile seizure history were associated with febrile seizure classification and may provide useful information for the initial assessment and monitoring of children with febrile seizures in emergency care.

Keywords: *Age, Body Temperature, Complex Febrile Seizure, Febrile Seizure, Previous Febrile Seizure.*

INTRODUCTION

Febrile seizures are among the most common neurological events occurring during early childhood and remain an important clinical concern in emergency and pediatric practice because their presentation combines an acute febrile illness with transient seizure activity in a developmentally vulnerable nervous system. The condition predominantly affects children between approximately 6 months and 5 years of age and is generally defined by seizures occurring in association with fever without evidence of central nervous system infection, acute metabolic disturbance, or a previous history of afebrile seizures (Ami, 2022). Although most febrile seizures have a favorable prognosis, their sudden onset, potential recurrence, and clinically alarming manifestations frequently generate substantial concern among parents and caregivers, making accurate emergency assessment essential. Contemporary clinical perspectives emphasize that the distinction between simple and complex febrile seizures is particularly important because complex episodes may involve a duration exceeding 15 minutes, focal manifestations, or recurrence within 24 hours and consequently require closer clinical observation and evaluation (Adam & Matolić, 2025). The continuing development of evidence-based approaches to febrile seizure management has shifted attention from merely terminating the acute event toward identifying clinical characteristics that may indicate increased vulnerability to complex or recurrent episodes (Ferretti et al., 2024). This shift is clinically relevant in emergency departments, where decisions must be made rapidly from heterogeneous clinical and laboratory information while simultaneously excluding potentially serious causes of fever and seizure.

The occurrence of febrile seizures is not attributable to a single clinical characteristic but reflects the interaction between developmental susceptibility, individual history, fever characteristics, and the biological response to infection. Age represents an important determinant because the immature

central nervous system in early childhood has a relatively lower seizure threshold, whereas previous febrile seizures may indicate an underlying predisposition to subsequent episodes (Abbari et al., 2024). Evidence concerning sex differences is less consistent, as biological differences between males and females may influence neurological vulnerability, yet the magnitude and direction of sex-related associations vary across seizure populations and clinical contexts (Asadi-Pooya et al., 2024). Previous clinical studies have also demonstrated that age and sex may be associated with differences between simple and complex febrile seizures, although these relationships cannot be interpreted independently of other clinical characteristics (Fadillah et al., 2023). Temperature is another clinically important factor because changes in body temperature may influence neuronal excitability and the likelihood of seizure occurrence, particularly in susceptible children. The relevance of fever characteristics is reinforced by evidence that both unusually high and low body temperatures in critically ill pediatric populations may be associated with adverse outcomes, although such evidence concerns a broader clinical population than febrile seizures specifically (Chang et al., 2025). These observations indicate that demographic and temperature-related variables should be examined jointly rather than treated as isolated predictors of seizure presentation.

The infectious and inflammatory processes accompanying fever provide another biological pathway through which febrile illness may influence seizure susceptibility, as activation of the immune response can alter systemic temperature regulation and generate inflammatory mediators capable of affecting central nervous system activity. Hematological parameters therefore have attracted increasing attention as accessible indicators of the host response to infection, with leukocytes representing a broad component of immune defense and neutrophils and lymphocytes reflecting distinct aspects of innate and adaptive immune activity (Kwon et al., 2018). Research has reported associations between leukocyte-related parameters and febrile seizures, suggesting that changes in peripheral inflammatory profiles may provide clinically relevant information about the physiological context in which seizures occur (Acikdin et al., 2022). The neutrophil-to-lymphocyte ratio has received particular interest because it integrates two leukocyte subpopulations and may capture systemic inflammatory activity more effectively than either cell count alone (Hosseini et al., 2022). Nevertheless, inflammatory markers should not automatically be interpreted as direct causes of seizure activity because their changes may also reflect the type, severity, or timing of the underlying infection. Studies examining leukocyte count and C-reactive protein similarly indicate the potential diagnostic value of inflammatory parameters in children with febrile convulsions, while also illustrating the difficulty of separating seizure-related characteristics from the inflammatory condition producing the fever (Biyani et al., 2017). The biological plausibility of these markers therefore supports their investigation as complementary clinical variables rather than as standalone determinants of febrile seizure occurrence.

Previous studies have consequently examined a broad range of factors associated with febrile seizure recurrence and complexity, yet their findings remain heterogeneous because different investigations have used different populations, outcome definitions, clinical thresholds, and laboratory indicators. A ten-year cohort study demonstrated that selected clinical and laboratory parameters were associated with recurrence of febrile seizures within the first 24 hours, emphasizing that the immediate clinical course may provide information beyond the initial seizure event itself (Castellazzi et al., 2024). Other clinical evidence has identified age, fever characteristics, previous seizure history, and selected inflammatory indicators as relevant factors, but the strength of individual associations varies across studies and does not consistently establish a single dominant predictor (Heydarian et al., 2024). Research on recurrence has also shown that previous febrile seizure history is clinically meaningful, although recurrence is influenced by multiple interacting characteristics rather than by history alone (Civan et al., 2022). Earlier evidence concerning family history further indicates that susceptibility may extend beyond the immediate clinical circumstances of a single febrile episode, suggesting a multifactorial framework for understanding recurrence risk (van Esch et al., 1994). The literature is also constrained by the frequent separation of demographic, clinical, and inflammatory variables into different analytical frameworks, which can obscure how these factors operate together in the emergency setting. In addition, evidence concerning hemoglobin and seizure type suggests that hematological characteristics may have differential relationships with simple and complex seizures, indicating that laboratory assessment may provide information that is not fully captured by temperature or clinical history alone (Andini et al., 2018). These inconsistencies create a need for context-specific studies that

examine several readily available clinical and hematological characteristics within a single analytical framework.

The unresolved evidence has both scientific and practical implications because emergency clinicians and nurses require clinically accessible indicators that can support early recognition of children who may experience more complicated seizure presentations. Management recommendations emphasize structured assessment of the seizure characteristics, underlying febrile illness, and factors relevant to recurrence or complexity, while avoiding unnecessary interventions that are not supported by the clinical presentation (Ferretti et al., 2024). From a nursing perspective, temperature monitoring and systematic assessment of seizure characteristics are particularly important because changes in fever and neurological status can occur rapidly during emergency care. Supportive temperature-management approaches have also been investigated in children experiencing febrile seizures, reflecting the practical importance of fever control as part of immediate care (Apriliani & Cahyaningrum, 2023). At the same time, the clinical interpretation of febrile seizures must distinguish the physiological response to infection from potentially serious neurological conditions and should not rely on temperature alone. The inflammatory dimension of febrile seizures has recently expanded through studies examining composite inflammation indices, including the neutrophil-to-lymphocyte ratio, which have demonstrated potential value in differentiating seizure characteristics (Söğütlü & Altaş, 2024). Earlier work has likewise suggested that recurrence is influenced by multiple risk factors, reinforcing the importance of multidimensional assessment rather than single-variable prediction (Indriani et al., 2017). Against this background, examining demographic, clinical, and hematological characteristics simultaneously in an emergency-department population can address an empirical gap while producing evidence that is directly relevant to frontline pediatric assessment.

The present study is positioned within this research landscape by examining febrile seizures as a multifactorial clinical phenomenon and by integrating characteristics that are routinely obtainable during emergency assessment rather than focusing exclusively on one demographic, temperature-related, historical, or inflammatory variable. The study specifically investigates the relationships of age, sex, previous history of febrile seizures, body temperature, and infection-response parameters represented by leukocyte, neutrophil, and lymphocyte counts with the category of febrile seizure among children presenting to the Emergency Department of Harapan Anda Islamic General Hospital. This approach is intended to clarify whether readily available patient characteristics and hematological findings are associated with differences in simple and complex febrile seizure presentations within a real-world hospital setting. The empirical contribution lies in generating context-specific evidence from an emergency population, where the combination of clinical history, temperature assessment, seizure classification, and laboratory findings forms the basis of immediate decision-making. The methodological contribution lies in bringing demographic, clinical, and hematological variables into one analytical framework, allowing their relationships with seizure category to be examined more systematically than approaches that evaluate isolated predictors. The findings are expected to strengthen the evidence base for early risk recognition and support more focused assessment and monitoring of children with febrile seizures in emergency care. Accordingly, this study aims to analyze the associations between age, sex, previous febrile seizure history, body temperature, leukocyte count, neutrophil count, and lymphocyte count and the category of febrile seizures in children treated in the Emergency Department of Harapan Anda Islamic General Hospital, while contributing clinically applicable evidence to the broader understanding of factors associated with febrile seizure presentation.

RESEARCH METHODS

This study employed a quantitative empirical research design using an analytical observational approach with a cross-sectional design to examine factors associated with the occurrence of fever-associated seizures among children presenting to the Emergency Department of Harapan Anda Islamic General Hospital, Tegal City. The study population comprised children aged 6 months to 5 years who experienced seizures accompanied by fever and presented to the emergency department between May and July 2026, with 38 children identified during the study period and 35 included after application of the predetermined eligibility criteria. The inclusion criteria were children aged 6 months to 5 years who presented with fever-associated seizures and had sufficient clinical and medical-record information, whereas children with incomplete relevant records or information required for seizure classification were excluded. Because all children who fulfilled the eligibility criteria were included in the study, total

sampling was applied, which is appropriate when the accessible population is limited and all eligible members can be incorporated as research participants (Amin et al., 2023). Data were collected through direct observation and medical-record review, including demographic characteristics, previous febrile-seizure history, axillary body temperature, and laboratory findings consisting of leukocyte, neutrophil, and lymphocyte counts. The collection of clinical and laboratory information was designed to capture factors that have been reported to be relevant to the clinical characteristics and risk profile of febrile seizures in children (Abbari et al., 2024).

The research instruments consisted of a structured observation sheet and a ThermoOne digital thermometer, while supporting information was obtained from patients' medical records and laboratory examination results. Age and sex were recorded from patient identification data, previous febrile-seizure history was obtained through medical-record review, and body temperature was measured directly at the axillary site, while leukocyte, neutrophil, and lymphocyte counts were obtained from documented laboratory results. The independent variables comprised age, sex, previous febrile-seizure history, body temperature, leukocyte count, neutrophil count, and lymphocyte count, whereas the dependent variable was febrile-seizure classification into simple and complex types. Data analysis consisted of univariate analysis to describe participant characteristics and variable distributions, followed by bivariate analysis to examine the association between each independent variable and febrile-seizure classification. The Chi-Square test was applied at a significance level of 0.05, with $p<0.05$ interpreted as indicating a statistically significant association, consistent with previous research examining relationships between leukocyte-related laboratory parameters and febrile seizures (Acikdin et al., 2022). Ethical principles were observed throughout the study by maintaining patient confidentiality, restricting the use of medical information to research purposes, and obtaining approval from the relevant institutional ethics committee before data collection.

RESULTS AND DISCUSSION

Participant Characteristics and Distribution of Febrile Seizure Classification

The study involved 35 children aged 6–60 months who presented to the Emergency Department of Harapan Anda Islamic General Hospital with fever-associated seizures during the study period. Children aged 6–24 months constituted the largest age group, comprising 20 participants (57.1%), while 15 participants (42.9%) were aged >24–60 months. Among children aged 6–24 months, 14 (70.0%) were classified as having simple febrile seizures (KDS), whereas 6 (30.0%) were classified as having complex febrile seizures (KDK). In the >24–60-month group, only 2 children (13.3%) were classified as KDS, while 13 (86.7%) were classified as KDK. The distribution indicates a marked difference in seizure classification across the two age groups. Early childhood is recognized as a period of increased susceptibility to febrile seizures because neurological maturation and the regulation of neuronal excitability are still developing (Abbari et al., 2024).

Table 1. Frequency Distribution of Respondents' Age Characteristics

Age	Febrile Seizure Occurrence				Frequency (n)	Percentage (%)
	KDS		KDK			
	n	%	n	%		
6–24 months	14	70%	6	30%	20	57.1%
>24–60 months	2	13.3%	13	86.7%	15	42.9%
Total	**16**	**45.7%**	**19**	**54.3%**	**35**	**100%**

The data in Table 1 demonstrate that the 6–24-month group contributed the largest proportion of participants and had a predominance of KDS. In contrast, the >24–60-month group showed a substantially higher proportion of KDK, with 86.7% of children in this age category classified as KDK. The difference suggests that age may be relevant not only to the occurrence of febrile seizures but also to the clinical pattern used to distinguish simple and complex seizures. The concentration of febrile seizure cases in younger children is consistent with the recognized peak occurrence during early childhood, when the central nervous system remains particularly responsive to physiological changes associated with fever (Eilbert & Chan, 2022). Fadillah et al. (2023) also identified age as an important

characteristic in the distribution of simple and complex febrile seizures among children. From a clinical perspective, the predominance of KDS among younger children and KDK among older children in this sample warrants further statistical evaluation rather than interpretation based solely on frequency. The subsequent analysis therefore examines whether the observed age-related distribution represents a statistically significant association.

The sex distribution showed that 21 participants (60.0%) were male and 14 participants (40.0%) were female. Among male participants, 9 children (42.9%) experienced KDS and 12 children (57.1%) experienced KDK. Among female participants, the distribution was equal, with 7 children (50.0%) classified as KDS and 7 children (50.0%) classified as KDK. Although boys constituted a larger proportion of the study population, the difference between male and female participants was not accompanied by a markedly different distribution of seizure classification. Gender-related differences in neurological disorders can involve hormonal, genetic, and neurophysiological mechanisms, although their contribution may vary across specific seizure conditions (Asadi-Pooya et al., 2024). The descriptive distribution in this study therefore provides a basis for assessing whether gender has a statistically meaningful relationship with the classification of febrile seizures.

Table 2. Frequency Distribution of Respondents' Gender Characteristics

Gender	Febrile Seizure Occurrence				Frequency (n)	Percentage (%)
	KDS		KDK			
	n	%	n	%		
Male	9	42.9%	12	57.1%	21	60%
Female	7	50%	7	50%	14	40%
Total	**16**	**45.7%**	**19**	**54.3%**	**35**	**100%**

As presented in Table 2, KDK occurred in 57.1% of male participants and 50.0% of female participants. The difference of 7.1 percentage points is relatively small and does not indicate a pronounced disparity in seizure classification based on gender at the descriptive level. The greater number of male participants may reflect the composition of the observed clinical population rather than a specific biological effect of sex on seizure severity. Previous evidence concerning sex differences in seizure disorders indicates that biological sex may influence seizure susceptibility through complex interactions involving sex hormones, neural development, and immune regulation (Asadi-Pooya et al., 2024). In febrile seizures, however, age, fever characteristics, previous seizure history, and individual susceptibility may have greater relevance to clinical classification. The present distribution is therefore interpreted cautiously, with statistical testing required to distinguish a true association from variation arising from the relatively small sample. This approach is particularly important because the study outcome represents seizure classification rather than the general occurrence of seizures.

Body temperature was assessed directly at the axillary site when the children presented to the emergency department. A total of 22 children (62.9%) had a body temperature of ≥38°C, while 13 children (37.1%) had a temperature below 38°C. Of the children with temperatures <38°C, 10 (76.9%) were classified as KDS and 3 (23.1%) as KDK. Among children with temperatures ≥38°C, 6 (27.3%) were classified as KDS and 16 (72.7%) as KDK. The distribution indicates that KDK was more frequently observed among children with temperatures ≥38°C. Fever represents a major precipitating factor in febrile seizures because elevated temperature can interact with neuronal excitability and the immature regulatory mechanisms of the developing central nervous system (Han & Han, 2023).

Table 3. Distribution of Respondents' Body Temperature Characteristics

Body Temperature	Febrile Seizure Occurrence				Frequency (n)	Percentage (%)
	KDS		KDK			
	n	%	n	%		
<38°C	10	76.9%	3	23.1%	13	37.1%
≥38°C	6	27.3%	16	72.7%	22	62.9%
Total	**16**	**45.7%**	**19**	**54.3%**	**35**	**100%**

Table 3 shows a clear difference in the distribution of seizure classification according to body temperature. Children with temperatures ≥38°C had a KDK proportion of 72.7%, compared with only 23.1% among children with temperatures <38°C. The higher proportion of KDK in the higher-temperature group suggests that the intensity of fever at presentation may be clinically relevant to seizure characteristics. Elevated temperature can increase metabolic demand and influence neuronal membrane stability, while inflammatory responses accompanying infection may further affect central nervous system excitability (Han & Han, 2023). Clinical assessment of children presenting with febrile seizures therefore requires attention to both the presence of fever and the characteristics of the seizure episode. Adam and Matolić (2025) emphasize the importance of systematic assessment of temperature, seizure characteristics, and associated clinical conditions in children presenting to emergency departments. The observed temperature pattern in this population provides an empirical basis for further evaluating the relationship between body temperature and KDS or KDK.

Previous seizure history was documented in 16 participants (45.7%), whereas 19 participants (54.3%) had no previous seizure history. Among children without previous seizure history, 11 (68.8%) were classified as KDS and 5 (31.2%) as KDK. In contrast, among children with a previous seizure history, 5 (26.3%) were classified as KDS and 14 (73.7%) as KDK. The proportion of KDK was therefore substantially higher among children who had experienced seizures previously. This pattern indicates that previous seizure history may serve as an important marker of individual susceptibility to more complex seizure manifestations. Previous febrile seizure episodes have been associated with recurrence and may reflect underlying susceptibility related to neurological development and genetic factors (Civan et al., 2022). Familial and individual predisposition may also influence recurrence, although the presence of previous seizures should be considered together with other clinical characteristics rather than as an isolated determinant (van Esch et al., 1994).

Table 4. Frequency Distribution of Respondents' Previous Seizure History

Previous Seizure History	Febrile Seizure Occurrence				Frequency (n)	Percentage (%)
	KDS		KDK			
	n	%	n	%		
No	11	68.8%	5	31.2%	16	45.7%
Yes	5	26.3%	14	73.7%	19	54.3%
Total	**16**	**45.7%**	**19**	**54.3%**	**35**	**100%**

The findings in Table 4 demonstrate that KDK represented 73.7% of cases among children with previous seizure history, compared with 31.2% among children without such a history. The difference suggests a substantial descriptive gradient between previous seizure history and the classification of the current seizure episode. A previous seizure episode may indicate a lower individual seizure threshold, particularly when the child is exposed again to physiological stress associated with fever. Recurrence studies have identified previous febrile seizures as an important clinical characteristic when evaluating the risk profile of children with subsequent febrile seizure episodes (Civan et al., 2022). The association may also involve genetic and familial susceptibility that modifies neuronal responsiveness to fever and other physiological stimuli (van Esch et al., 1994). Nevertheless, the descriptive pattern cannot establish an independent effect because age, temperature, infection, and other characteristics may coexist with previous seizure history. Statistical analysis is therefore required to determine whether the apparent difference remains significant within the analytical framework of the present study.

Laboratory examination included leukocyte, neutrophil, and lymphocyte counts as indicators of the inflammatory response associated with febrile illness. Leukocytosis was identified in 20 children (57.1%), while 15 children (42.9%) had leukocyte counts within the normal range. Neutrophil counts were normal in 18 children (51.4%) and classified as neutrophilia in 17 children (48.6%), whereas lymphocytosis was identified in 20 children (57.1%) and normal lymphocyte counts in 15 children (42.9%). Among children with leukocytosis, 14 (70.0%) were classified as KDK and 6 (30.0%) as KDS. For neutrophils, KDK accounted for 55.6% of children with normal neutrophil counts and 52.9% of those with neutrophilia, while 60.0% of children with lymphocytosis were classified as KDK. These

findings demonstrate that inflammatory hematological responses varied across individual leukocyte parameters.

Table 5. Frequency Distribution of Respondents' Laboratory Findings

Laboratory	Febrile Seizure Occurrence				Frequency (n)	Percentage (%)
	KDS		KDK			
	n	%	n	%		
Leukocyte						
Normal	10	66.7%	5	33.3%	15	42.9%
Leukocytosis	6	30%	14	70%	20	57.1%
Neutrophil						
Normal	8	44.4%	10	55.6%	18	51.4%
Neutrophilia	8	47.1%	9	52.9%	17	48.6%
Lymphocyte						
Normal	8	53.3%	7	46.7%	15	42.9%
Lymphocytosis	8	40%	12	60%	20	57.1%
Total	**16**	**45.7%**	**19**	**54.3%**	**35**	**100%**

Table 5 indicates that leukocytosis and lymphocytosis were observed in more than half of the participants, whereas neutrophilia occurred in nearly half of the sample. The descriptive distribution of leukocytes showed the largest difference between KDS and KDK, with KDK occurring in 70.0% of children with leukocytosis compared with 33.3% of those with normal leukocyte counts. The neutrophil distribution was considerably more balanced, with KDK proportions of 55.6% and 52.9% among children with normal neutrophil counts and neutrophilia, respectively. Lymphocytosis also showed a higher proportion of KDK, although the difference was less pronounced than that observed for leukocytes. Hematological inflammatory markers have been examined as potential indicators of systemic inflammatory responses in children with febrile seizures, but their interpretation depends on the underlying infection and the timing of laboratory assessment (Erdede et al., 2023). Acikdin et al. (2022) likewise examined leukocyte-related laboratory parameters in relation to febrile seizures, supporting the clinical relevance of hematological assessment while not implying that an abnormal leukocyte count directly determines seizure classification. The variation among leukocyte subtypes indicates that inflammatory responses should be interpreted as part of the broader clinical context rather than as isolated determinants of KDS or KDK.

The final outcome distribution showed that 16 children (45.7%) were classified as having simple febrile seizures and 19 children (54.3%) as having complex febrile seizures. KDK therefore represented a slightly larger proportion of the study population, exceeding KDS by three children or 8.6 percentage points. The predominance of KDK is relevant to emergency care because complex febrile seizures require careful assessment of seizure characteristics and the underlying clinical condition. Accurate classification is based on clinical features rather than temperature or laboratory abnormalities alone, particularly because complex seizures may involve prolonged duration, focal manifestations, or recurrence during the same febrile episode (Eilbert & Chan, 2022). Clinical guidelines emphasize systematic evaluation of seizure characteristics, neurological status, fever, medical history, and possible underlying infection in children presenting with febrile seizures (Ferretti et al., 2024). The distribution of KDS and KDK in this study provides the principal outcome profile for evaluating the associations between demographic, clinical, and hematological characteristics.

Table 6. Frequency Distribution of Respondents According to Febrile Seizure Occurrence

Respondent Characteristics	Frequency (n)	Percentage (%)
Previous Febrile Seizure Occurrence		
KDS	16	45.7%
KDK	19	54.3%
Total	**35**	**100%**

The distribution presented in Table 6 shows that KDK was slightly more frequent than KDS among the 35 children included in the study. This difference provides an important descriptive context for interpreting the subsequent bivariate analysis because the dependent variable was categorized into two seizure phenotypes. The predominance of KDK should not be interpreted as evidence that the investigated factors independently caused complex seizures, particularly because the cross-sectional design evaluates exposure characteristics and seizure classification within the same clinical episode. Febrile seizures are considered multifactorial conditions involving interactions among age, fever, genetic susceptibility, inflammatory processes, and individual neurological characteristics (Chaorsiya et al., 2025). The present descriptive findings identify several characteristics that warrant further statistical examination, particularly age, body temperature, previous seizure history, and hematological parameters. The bivariate analysis is therefore necessary to determine which of these observed characteristics are statistically associated with the distinction between KDS and KDK.

Association of Age and Gender with Febrile Seizure Classification

Age is an important demographic characteristic in the clinical presentation of febrile seizures because susceptibility is closely related to neurological maturation during early childhood. In the present study, children aged 6–24 months accounted for 20 of the 35 participants (57.1%), while those aged >24–60 months accounted for 15 participants (42.9%). The distribution of seizure classification differed considerably between these age groups, with KDS predominating among children aged 6–24 months and KDK predominating among those aged >24–60 months. This pattern is consistent with the recognized concentration of febrile seizures during early childhood, when changes in neuronal excitability associated with fever can more readily trigger seizures (Abbari et al., 2024). The age-related distribution also suggests that chronological age may influence not only susceptibility to febrile seizures but also the clinical characteristics of the seizure episode. The magnitude of the observed difference warranted further examination through bivariate analysis.

Table 7. Association of Age with Febrile Seizure Classification

Age	Febrile Seizure Occurrence		OR	95% CI	p-value
	KDS	KDK			
6–24 months	14 (70%)	6 (30%)			
>24–60 months	2 (13.3%)	13 (86.7%)	**15.167**	**2.585–88.990**	**0.003**
Total	**16 (45.7%)**	**19 (54.3%)**			

As shown in Table 7, a statistically significant association was identified between age and febrile seizure classification ($p = 0.003$). Children aged 6–24 months had 15.167 times the odds of being classified as KDS compared with children aged >24–60 months. The 95% confidence interval of 2.585–88.990 indicates that the estimated association was positive, although the relatively wide interval reflects the limited sample size. The descriptive pattern supports this finding, as 70.0% of children aged 6–24 months were classified as KDS, whereas 86.7% of children aged >24–60 months were classified as KDK. Fadillah et al. (2023) similarly reported an association between age and the distribution of simple and complex febrile seizures, indicating that age may contribute to differences in seizure phenotype. The present finding is also compatible with evidence that febrile seizure characteristics change across developmental stages as the child's neurological system matures (Han & Han, 2023).

The stronger occurrence of KDS among children aged 6–24 months can be interpreted in relation to the developmental characteristics of the immature brain. During this period, neuronal networks remain in an active stage of maturation, and the balance between excitatory and inhibitory neurotransmission differs from that of older children. Fever-related physiological changes may consequently produce a greater tendency toward generalized seizure activity in susceptible children. In contrast, the higher proportion of KDK among children aged >24–60 months in this study suggests that age-related factors may interact with previous seizure susceptibility or other clinical characteristics. Civan et al. (2022) demonstrated that febrile seizure characteristics and subsequent neurological outcomes are influenced by multiple clinical risk factors, indicating that age should be considered as part of a broader risk profile. The present result does not imply that older age directly causes complex

febrile seizures, but it indicates that age was significantly associated with the classification observed in this clinical population. The substantial odds ratio further highlights the importance of age as a variable requiring attention during the emergency assessment of children with fever-associated seizures.

Gender was also examined to determine whether the distribution of KDS and KDK differed between male and female children. In this study, 21 participants (60.0%) were male and 14 participants (40.0%) were female. Among male children, 9 (42.9%) were classified as KDS and 12 (57.1%) as KDK, whereas among female children, 7 (50.0%) were classified as KDS and 7 (50.0%) as KDK. The difference in the proportion of KDK between male and female participants was relatively small. Biological sex can influence seizure susceptibility through hormonal, genetic, and neurophysiological mechanisms, although the relevance of these mechanisms varies according to the type of seizure disorder (Asadi-Pooya et al., 2024). The observed distribution in this study therefore requires statistical testing to determine whether the apparent difference represents a meaningful association.

Table 8. Association of Gender with Febrile Seizure Classification

Gender	Febrile Seizure Occurrence		OR	95% CI	p-value
	KDS	KDK			
Male	9 (42.9%)	12 (57.1%)			
Female	7 (50%)	7 (50%)	**0.750**	**0.193–2.917**	**0.945**
Total	**16 (45.7%)**	**19 (54.3%)**			

Table 8 shows that gender was not significantly associated with febrile seizure classification ($p = 0.945$). The odds ratio of 0.750 indicates that the odds of KDS relative to KDK among male children were not substantially different from those among female children. The 95% confidence interval of 0.193–2.917 crosses the null value of 1, further supporting the absence of a statistically significant association. Although KDK occurred in 57.1% of male participants compared with 50.0% of female participants, the difference was insufficient to demonstrate a meaningful relationship within this sample. This finding indicates that the higher proportion of male participants was primarily a characteristic of the study population rather than evidence of a gender-related difference in seizure classification. Research on sex differences in seizure disorders recognizes that biological mechanisms may contribute to seizure susceptibility, but these mechanisms do not necessarily produce consistent differences across specific seizure phenotypes (Asadi-Pooya et al., 2024).

The absence of a significant association between gender and seizure classification can also be understood within the multifactorial nature of febrile seizures. Factors such as age, fever characteristics, previous seizure history, genetic susceptibility, and inflammatory responses may have greater relevance to the distinction between simple and complex febrile seizures than gender alone. Ferretti et al. (2024) emphasize that clinical assessment of febrile seizures should integrate demographic information with seizure characteristics, medical history, neurological findings, and the underlying febrile illness. In the present study, the strong association observed for age contrasts with the non-significant association observed for gender, suggesting that demographic variables do not contribute equally to seizure classification. The difference may also reflect the relatively small number of participants, which limits the statistical power to detect modest associations. Gender should therefore remain part of the patient's clinical profile, but it should not be considered an independent indicator of KDS or KDK classification based on the present findings. The analytical pattern reinforces the need to prioritize variables with stronger empirical associations when developing clinical assessments for children presenting with fever-associated seizures.

Association of Body Temperature and Previous Febrile Seizure History with Febrile Seizure Classification

Body temperature represents an important clinical characteristic in children presenting with fever-associated seizures because fever is the principal physiological trigger underlying this condition. In the present study, 22 children (62.9%) had an axillary body temperature of ≥38°C, while 13 children (37.1%) had a temperature of <38°C. The distribution of seizure classification differed substantially between the two temperature groups, with KDS predominating among children with temperatures <38°C and KDK predominating among those with temperatures ≥38°C. Among children with

temperatures <38°C, 10 (76.9%) were classified as KDS and 3 (23.1%) as KDK, whereas 6 (27.3%) and 16 (72.7%) were classified as KDS and KDK, respectively, among children with temperatures ≥38°C. Fever can influence neuronal excitability through changes in metabolic activity, inflammatory signaling, and the physiological environment of the developing brain (Han & Han, 2023). This distribution suggests that body temperature may be related to the clinical classification of febrile seizures and warrants statistical assessment.

Table 9. Association of Body Temperature with Febrile Seizure Classification

Body Temperature	Febrile Seizure Occurrence		OR	95% CI	p-value
	KDS	KDK			
<38°C	10 (76.9%)	3 (23.1%)			
≥38°C	6 (27.3%)	16 (72.7%)	**8.889**	**1.803–43.820**	**0.012**
Total	**16 (45.7%)**	**19 (54.3%)**			

Table 9 demonstrates a statistically significant association between body temperature and febrile seizure classification (p = 0.012). Children with a temperature of ≥38°C had 8.889 times the odds of being classified as KDK compared with children with a temperature of <38°C. The 95% confidence interval of 1.803–43.820 does not include 1, supporting the statistical significance of the observed association. The descriptive distribution is also consistent with the analytical result, as nearly three-quarters of children in the ≥38°C group were classified as KDK. A higher temperature may increase neuronal excitability and amplify physiological responses to infection, although seizure susceptibility is determined by interactions between fever and individual neurological vulnerability rather than temperature alone (Han & Han, 2023). Heydarian et al. (2024) similarly identified clinical characteristics related to fever as relevant factors in distinguishing seizure patterns among febrile children. The present finding indicates that body temperature at emergency presentation may provide useful clinical information when evaluating the potential classification of a febrile seizure episode.

The relationship between temperature and seizure classification can be interpreted through the pathophysiological effects of fever on the developing central nervous system. An increase in body temperature may alter neuronal membrane properties and neurotransmitter activity, creating conditions that facilitate abnormal neuronal synchronization in susceptible children. Inflammatory mediators released during infection may further contribute to changes in neuronal excitability and seizure threshold. Han and Han (2023) describe febrile seizures as a condition involving interactions between fever, inflammatory processes, genetic susceptibility, and developmental characteristics of the nervous system. This multifactorial mechanism explains why temperature should not be interpreted as an isolated determinant of seizure severity. The findings of the present study nevertheless demonstrate that the ≥38°C category was associated with a markedly higher proportion of KDK than the <38°C category. Clinical evaluation should therefore consider measured body temperature alongside seizure duration, focality, recurrence, neurological status, and the underlying source of infection, consistent with recommended approaches to febrile seizure management (Ferretti et al., 2024).

Previous febrile seizure history represents another clinical characteristic that may reflect an individual child's susceptibility to recurrent seizure episodes. In this study, 19 children (54.3%) had a previous seizure history, whereas 16 children (45.7%) had no previous seizure history. Among children without previous seizure history, 11 (68.8%) were classified as KDS and 5 (31.2%) as KDK. In contrast, among children with previous seizure history, only 5 (26.3%) were classified as KDS, while 14 (73.7%) were classified as KDK. The substantially higher proportion of KDK among children with previous seizure history suggests that prior episodes may characterize children with greater susceptibility to more complex seizure manifestations. Previous febrile seizures are recognized as an important factor in evaluating recurrence risk and subsequent seizure characteristics (Civan et al., 2022).

Table 10. Association of Previous Febrile Seizure History with Febrile Seizure Classification

Previous Febrile Seizure History	Febrile Seizure Occurrence		OR	95% CI	p-value
	KDS	KDK			
No	11 (68.8%)	5 (31.2%)			
Yes	5 (26.3%)	14 (73.7%)	**6.160**	**1.417–26.785**	**0.030**
Total	**16 (45.7%)**	**19 (54.3%)**			

The data in Table 10 show a statistically significant association between previous febrile seizure history and current seizure classification ($p = 0.030$). Children with a previous seizure history had 6.160 times the odds of being classified as KDK compared with children without a previous seizure history. The 95% confidence interval of 1.417–26.785 remains above 1, supporting the presence of a statistically significant association. The descriptive pattern is particularly pronounced because 73.7% of children with previous seizure history were classified as KDK, compared with 31.2% among children without previous seizure history. A history of previous seizures may reflect persistent individual susceptibility, including differences in seizure threshold and genetic predisposition. Civan et al. (2022) reported that clinical characteristics surrounding febrile seizure episodes are relevant to recurrence and the development of subsequent neurological outcomes. Family susceptibility may also contribute to recurrent febrile seizures, indicating that seizure history can function as a marker of underlying predisposition rather than merely representing a previous clinical event (van Esch et al., 1994).

The association between previous seizure history and KDK can be further understood through the concept of an individual seizure threshold. Children who have previously experienced febrile seizures may possess intrinsic susceptibility that makes neuronal networks more responsive to subsequent febrile or inflammatory stimuli. This susceptibility can arise from a combination of genetic factors, developmental characteristics, and previous neurological responses to fever. Abbari et al. (2024) emphasize that febrile seizure risk involves multiple interacting factors rather than a single clinical determinant. The current finding is clinically relevant because a previous seizure episode may help identify children who require closer assessment when they present again with fever-associated seizures. However, previous seizure history should not be interpreted as a direct cause of complex seizure classification because the present cross-sectional design cannot establish temporal or causal relationships beyond the observed association. The clinical significance of this variable lies in its potential role as an indicator of increased vulnerability that can complement information obtained from temperature, age, seizure characteristics, and laboratory findings.

Taken together, body temperature and previous febrile seizure history showed statistically significant associations with febrile seizure classification in this study. The association was stronger descriptively for body temperature, with an OR of 8.889, while previous seizure history had an OR of 6.160. Both variables demonstrated a consistent pattern in which KDK occurred more frequently among children exposed to the respective risk characteristics. These findings support the concept that the classification of febrile seizures reflects interactions between acute physiological stressors, such as fever, and pre-existing individual susceptibility. Ferretti et al. (2024) recommend comprehensive clinical assessment because no single characteristic can adequately capture the clinical spectrum of febrile seizures. The present findings also reinforce the importance of obtaining a detailed seizure history and accurately measuring body temperature during emergency assessment. Further interpretation should integrate these variables with age and hematological parameters to determine the broader pattern of factors associated with KDS and KDK in the study population.

Association of Hematological Parameters with Febrile Seizure Classification and Clinical Implications

Hematological parameters provide clinically relevant information regarding the systemic inflammatory response accompanying febrile illness in children with seizures. In the present study, leukocyte counts were classified as normal in 15 children (42.9%) and leukocytosis in 20 children (57.1%), while neutrophil counts were normal in 18 children (51.4%) and classified as neutrophilia in 17 children (48.6%). Lymphocyte counts were normal in 15 children (42.9%) and classified as lymphocytosis in 20 children (57.1%). Among children with leukocytosis, 14 (70.0%) were classified as KDK and 6 (30.0%) as KDS, whereas the distribution was more balanced for neutrophil and

lymphocyte categories. The predominance of leukocytosis and lymphocytosis indicates that inflammatory or infectious processes were common clinical characteristics in this population. Inflammatory responses have been proposed as potential contributors to febrile seizure susceptibility through interactions between immune mediators and neuronal excitability (Hosseini et al., 2022). These findings provide a basis for examining whether individual hematological parameters are statistically associated with the distinction between KDS and KDK.

Table 11. Association of Leukocyte Count with Febrile Seizure Classification

Leukocyte Count	Febrile Seizure Occurrence		OR	95% CI	p-value
	KDS	KDK			
Normal	10 (66.7%)	5 (33.3%)			
Leukocytosis	6 (30%)	14 (70%)	**4.667**	**1.108–19.652**	**0.070**
Total	**16 (45.7%)**	**19 (54.3%)**			

Table 11 shows that leukocytosis was more frequently accompanied by KDK than KDS, with 70.0% of children with leukocytosis classified as KDK compared with 33.3% among children with normal leukocyte counts. The odds ratio of 4.667 indicates a substantial difference in the observed odds of seizure classification between the two leukocyte categories. However, based on the reported p-value of 0.070, the association did not reach the predetermined significance level of 0.05. The 95% confidence interval of 1.108–19.652 suggests considerable uncertainty around the estimated effect, which may be related to the limited number of observations in the study. Acikdin et al. (2022) reported an association between leukocyte-related laboratory findings and febrile seizure occurrence, supporting the biological relevance of leukocyte assessment in children with febrile seizures. Leukocytosis may reflect an acute inflammatory or infectious response that accompanies fever, but its presence alone cannot establish whether a seizure will manifest as simple or complex (Erdede et al., 2023). The discrepancy between the descriptive distribution and statistical significance indicates that leukocyte count should be interpreted as a supportive clinical parameter rather than a definitive marker of seizure classification.

Table 12. Association of Neutrophil Count with Febrile Seizure Classification

Neutrophil Count	Febrile Seizure Occurrence		OR	95% CI	p-value
	KDS	KDK			
Normal	8 (44.4%)	10 (55.6%)			
Neutrophilia	8 (47.1%)	9 (52.9%)	**0.900**	**0.239–3.406**	**1.000**
Total	**16 (45.7%)**	**19 (54.3%)**			

The distribution of neutrophil counts in Table 12 shows a relatively similar proportion of KDK among children with normal neutrophil counts and those with neutrophilia. KDK occurred in 55.6% of children with normal neutrophil counts and 52.9% of children with neutrophilia, producing only a small descriptive difference. The statistical analysis confirmed the absence of an association between neutrophil status and febrile seizure classification, with an OR of 0.900, a 95% CI of 0.239–3.406, and a p-value of 1.000. The confidence interval crosses 1, indicating that the observed difference does not provide sufficient evidence of a meaningful relationship between neutrophil status and KDS or KDK. Although neutrophils participate prominently in the acute inflammatory response, their circulating concentration may be influenced by the type, severity, and timing of infection as well as by the physiological stress associated with seizure activity. Söğütlü and Altaş (2024) identified the neutrophil–lymphocyte ratio and other inflammatory indices as potentially useful in evaluating febrile seizures, suggesting that relationships between inflammation and seizure characteristics may be more informative when multiple hematological parameters are considered together. Hosseini et al. (2022) similarly emphasized the potential relevance of inflammatory responses to febrile seizure pathophysiology while highlighting the need for broader evaluation of inflammatory markers.

Table 13. Association of Lymphocyte Count with Febrile Seizure Classification

Lymphocyte Count	Febrile Seizure Occurrence		OR	95% CI	p-value
	KDS	KDK			
Normal	8 (53.3%)	7 (46.7%)			
Lymphocytosis	8 (40%)	12 (60%)	**1.714**	**0.44–6.62**	**0.659**
Total	**16 (45.7%)**	**19 (54.3%)**			

As presented in Table 13, lymphocytosis was associated descriptively with a higher proportion of KDK, with 60.0% of children with lymphocytosis classified as KDK compared with 46.7% among children with normal lymphocyte counts. The odds ratio of 1.714 indicates higher observed odds of KDK in the lymphocytosis group, but the association was not statistically significant ($p = 0.659$). The 95% confidence interval of 0.44–6.62 includes 1, indicating that the observed difference may reflect sampling variation. Lymphocyte responses are closely related to the host immune response and may vary according to the infectious agent, stage of illness, age, and timing of blood collection. Erdede et al. (2023) demonstrated that inflammatory biomarkers can provide information for distinguishing simple and complex febrile seizures, although individual markers may not consistently demonstrate sufficient discriminatory capacity. The present finding is consistent with this broader interpretation because lymphocytosis showed a descriptive tendency toward KDK without establishing a statistically significant association. Clinical interpretation should therefore avoid treating lymphocyte elevation as an independent predictor of complex febrile seizure classification.

Taken together, the three hematological parameters showed different patterns in relation to febrile seizure classification. Leukocytosis demonstrated the largest descriptive difference, with KDK accounting for 70.0% of children with elevated leukocyte counts, whereas neutrophil status showed almost identical KDK proportions between the normal and neutrophilia groups. Lymphocytosis showed an intermediate descriptive pattern, with KDK occurring in 60.0% of affected children. Despite these differences, the reported p-values indicate that none of the three hematological parameters reached the 0.05 significance threshold. The findings suggest that the inflammatory response may be involved in the clinical context of febrile seizures without necessarily determining whether an individual episode meets the criteria for KDS or KDK. Söğütlü and Altaş (2024) reported that composite inflammatory indices may provide greater predictive information than isolated leukocyte subtypes, supporting the interpretation that relationships between inflammation and seizure phenotype are biologically complex. A similar perspective is provided by Hosseini et al. (2022), whose systematic review and meta-analysis identified a relationship between inflammatory responses and febrile seizures but also indicated heterogeneity across studies. The absence of significant associations for individual hematological parameters in this study may therefore reflect the multifactorial nature of febrile seizure classification.

From a clinical perspective, the hematological findings indicate that laboratory parameters should complement rather than replace clinical assessment in children with fever-associated seizures. Leukocyte, neutrophil, and lymphocyte counts can assist clinicians in evaluating the underlying inflammatory or infectious condition, but the present results do not support their use as standalone indicators for distinguishing KDS from KDK. The classification of febrile seizures remains primarily dependent on clinical characteristics, including seizure duration, focality, and recurrence within the same febrile illness (Ferretti et al., 2024). The stronger associations identified in this study for age, body temperature, and previous seizure history suggest that these clinical characteristics may provide greater discriminatory value than isolated hematological measurements. Laboratory findings nevertheless remain clinically relevant because infection and inflammation may contribute to the physiological conditions under which febrile seizures occur. Erdede et al. (2023) highlighted the potential usefulness of inflammatory biomarkers in the broader assessment of febrile seizure phenotypes, while Söğütlü and Altaş (2024) suggested that combined inflammatory indices may warrant further investigation. Future studies involving larger samples and additional biomarkers, such as C-reactive protein and neutrophil–lymphocyte ratio, may provide a more comprehensive assessment of the relationship between systemic inflammation and febrile seizure classification.

CONCLUSION

This study involved 35 children with febrile seizures who presented to the Emergency Department of Harapan Anda Islamic General Hospital. Children aged 6–24 months constituted the largest age group, accounting for 20 participants (57.1%), while male children comprised 21 participants (60.0%). A total of 22 children (62.9%) had a body temperature of ≥38°C, and 19 children (54.3%) had a previous febrile seizure history. Laboratory findings were most frequently characterized by leukocytosis and lymphocytosis. Regarding seizure classification, 19 children (54.3%) experienced complex febrile seizures (KDK), whereas 16 children (45.7%) experienced simple febrile seizures (KDS). These findings indicate that KDK was slightly more prevalent than KDS among children presenting with febrile seizures in the study setting.

Bivariate analysis demonstrated statistically significant associations between age, body temperature, previous febrile seizure history, and febrile seizure classification. Children aged 6–24 months had higher odds of KDS, whereas children with a body temperature of ≥38°C had higher odds of KDK. Children with a previous febrile seizure history also had higher odds of KDK than those without previous seizure history. Gender, leukocyte count, neutrophil count, and lymphocyte count were not significantly associated with febrile seizure classification. The findings indicate that age, body temperature, and previous febrile seizure history were the main factors associated with the classification of febrile seizures in this study. These factors may provide useful clinical information for healthcare professionals when conducting early assessment and monitoring of children with febrile seizures in the emergency department. Further studies with larger samples and additional inflammatory biomarkers are needed to strengthen the evidence regarding factors associated with febrile seizure classification.

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