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A Study of the Clinical Profile of Paediatric Patients Admitted to the Emergency Department With Febrile Seizures

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Abstract

Background: Febrile seizures (FS) are the most common neurological event in childhood, particularly among children younger than five years. Despite their predominantly benign nature, they are a significant cause of paediatric emergency department (ED) attendance. This study aimed to characterise the clinical and epidemiological profile of children admitted to the observation ward (OW) of the Vila Real Hospital ED with FS between January 2020 and December 2024, and to compare simple and complex FS.

Methods: A retrospective, descriptive study with an analytical component included 178 episodes in 126 children. Simple and complex episodes were compared with the chi-square, Fisher's exact, and Mann-Whitney U tests. Factors associated with complex FS were explored with logistic regression using Generalized Estimating Equations (GEE) to account for repeated episodes in the same child.

Results: Boys accounted for 57.9% of children; the mean age at presentation was 25.5 months (median 19), and the 12-17-month age group was the most represented. In all, 78.1% of episodes occurred between November and May, and of 163 classifiable episodes, 126 (77.3%) were simple and 37 (22.7%) complex; 15 atypical episodes were described separately, and most complex episodes were classified by recurrence within the same illness (27 of 37). Upper respiratory tract infection (URTI) was the most frequent associated diagnosis (71.3%), and a virus was identified in 21.9% of episodes. Complex FS was associated with a longer OW stay (median 17.2 vs 12.8 hours, $p = 0.007$), more frequent hospital admission (64.9% vs 7.1%, $p < 0.001$), and greater use of EEG, head CT, lumbar puncture, and diazepam. No factor was independently associated with complex FS in an exploratory multivariable model. About a quarter of children (26.2%) had more than one episode during the study period, more often when the first recorded episode occurred before 18 months (39.2% vs. 17.3%, $p = 0.008$).

Conclusions: These results align with published literature. Complex FS were associated with greater hospital resource utilisation and higher admission rates, and recurrence was more frequent in children with an earlier first episode.

Categories: Family/General Practice, Pediatrics
Keywords: complex seizure, epidemiology, febrile seizures, paediatric patients, retrospective observational study

Introduction

Febrile seizures (FS) are the most common neurological manifestation in childhood, with an estimated prevalence between 2% and 4% in children under five years of age, and they represent one of the most frequent causes of admission to the paediatric emergency department (ED) [1-3]. Peak incidence occurs between 12 and 18 months of life, and according to the internationally accepted definition, FS are convulsive episodes associated with a fever of 38°C or higher in the absence of central nervous system (CNS) infection, causal metabolic alterations, or a previous history of afebrile seizures in neurologically healthy children [1,2].

FS are classified as simple or complex. Simple FS are generalised, last less than 15 minutes, and do not recur within the same febrile illness; they represent 70-80% of cases. Complex FS have at least one of the following features: focal onset or signs, a duration of 15 minutes or longer, or recurrence within 24 hours or within the same febrile illness [3,4]. Febrile status epilepticus, a subtype of complex FS, is defined as a seizure lasting 30 minutes or longer, although a five-minute threshold is used operationally to start treatment [5]. Common risk factors include age between 12 and 18 months, high body temperature, viral infections (especially HHV-6, influenza A, and adenovirus), and genetic predisposition [6,7]. Diagnosis is clinical, and routine complementary investigations are not indicated in simple FS [2,3].

This study had two objectives. The descriptive objective was to characterise the clinical and epidemiological

profile of children admitted to the observation ward (OW) of the Vila Real Hospital ED with FS between January 2020 and December 2024; the analytical objective was to compare simple and complex FS and to explore clinical factors associated with complex FS.

Materials And Methods

Study design, location, and period

This work was a retrospective, cross-sectional, observational study with an analytical component: it was conducted at the ED and OW of Vila Real Hospital, Unidade Local de Saúde de Trás-os-Montes e Alto Douro (ULSTMAD), Vila Real, Portugal, and covered clinical records from January 1, 2020, to December 31, 2024.

Patient recruitment

Patients were identified from nursing record books and clinical records in the SClínico software (SPMS - Serviços Partilhados do Ministério da Saúde, Lisbon, Portugal). Consecutive sampling included all eligible paediatric patients admitted during the study period; no formal sample size calculation was performed. Inclusion criteria were an age between one and 80 months, a convulsive episode associated with a fever of 38°C or higher, and no known neurological disease or prior epilepsy. Exclusion criteria were afebrile seizures, CNS infection (such as meningitis or encephalitis), metabolic alterations, and a prior history of epilepsy. The initial search yielded 221 episodes; after applying these criteria, 178 episodes in 126 children were included.

Data collection and outcomes

Data were extracted anonymously from electronic health records. Epidemiological variables were sex, age, and date and time of admission, while clinical variables were admission temperature, seizure type, duration of the first seizure, associated diagnosis, identified viral agent, personal and family history of FS, family history of epilepsy, prematurity, and developmental delay. Management and outcome variables were medication administered (including rectal diazepam), investigations performed (laboratory analysis, chest X-ray, electroencephalogram (EEG), head computed tomography (CT), brain magnetic resonance imaging, and lumbar puncture), length of stay in the OW, destination after the OW, and a later diagnosis of epilepsy within the study period.

An episode was classified as complex if it met at least one of the following criteria: duration of 15 minutes or longer, focal features, or recurrence within 24 hours or within the same febrile illness. An episode meeting none of these criteria was classified as simple. Episodes recorded in the database as atypical, mainly in children older than 60 months, were included in the descriptive analysis but excluded from the comparison of simple and complex FS and are described separately. Viral agents were recorded when identified by the tests performed at the clinician's discretion; the number of episodes tested was not recorded.

IRB/IEC details

Consent was waived by all participants in this study. The Comissão de Ética para a Saúde da Unidade Local de Trás-os-Montes e Alto Douro (CES) issued approval number 23, with reference to minute 3 of the CES meeting of April 15th, 2026. Because this was a retrospective observational study utilizing pre-existing clinical records, the requirement for written informed patient consent was explicitly waived by the committee. All patient data were anonymized and handled in accordance with the ethical standards of the institutional and national research committee and with the Declaration of Helsinki.

Statistical analysis

The unit of analysis was the episode; categorical variables are presented as absolute and relative frequencies, while continuous variables are presented as mean and standard deviation or median and interquartile range (IQR). Personal and family history variables are reported both per episode and per child at the first recorded episode.

Categorical variables were compared with the chi-square test with continuity correction, or with Fisher's exact test when any expected cell count was below 5. Continuous variables, which were not normally distributed, were compared with the Mann-Whitney U test, and associations between continuous variables were assessed with the Spearman correlation coefficient. To account for repeated episodes in the same child, associations between seizure type and outcomes were also estimated as odds ratios (OR) with cluster-robust standard errors, using Generalized Estimating Equations (GEE) with an independence working correlation and the child as the cluster.

Factors associated with complex FS were explored with multivariable logistic regression fitted by GEE as above. Seven candidate predictors were chosen a priori from the literature and entered simultaneously without stepwise selection: age, sex, admission temperature, personal history of FS, family history of FS, prematurity, and developmental delay. Results are reported as adjusted ORs with 95% confidence intervals (CI); discrimination was assessed with the area under the ROC curve (AUC) and collinearity with variance

inflation factors. As a sensitivity analysis, the comparisons and the model were repeated using only each child's first classifiable episode, with model calibration assessed by the Hosmer-Lemeshow test.

Recurrence was analysed at the child level, defined as two or more episodes during the study period. Missing data were not imputed: the duration of the first seizure was missing for 10 episodes (5.6%), and the associated diagnosis for nine episodes (5.1%), and analyses involving these variables used complete cases. All other variables were complete. Statistical significance was set at $p < 0.05$, and analyses were performed in Python 3.12.3 (Python Software Foundation, Wilmington, Delaware, USA) with SciPy 1.17.1 and statsmodels 0.15.0.

Results

Study population

The study included 178 episodes in 126 children: 73 boys (57.9%) and 53 girls (42.1%); 109 episodes (61.2%) occurred in boys. Mean age at presentation was 25.5 ± 15.3 months (median 19, IQR 15-34, range 4-77), and the 12-17-month group was the most represented (55 episodes, 30.9%). Of all episodes, 126 (70.8%) were simple, 37 (20.8%) complex, and 15 (8.4%) atypical. Table *1* summarises the baseline characteristics.

Variable	Episodes (N = 178)	Children, First Episode (N = 126)
Male sex, n (%)	109 (61.2)	73 (57.9)
Age, months, mean ± SD	25.5 ± 15.3	—
Age, months, median (IQR)	19 (15–34)	—
Boys, age, months, mean ± SD	27.2 ± 16.2	—
Girls, age, months, mean ± SD	22.8 ± 13.4	—
Admission temperature, °C, mean ± SD	38.84 ± 0.64	—
Simple FS, n (%)	126 (70.8)	—
Complex FS, n (%)	37 (20.8)	—
Atypical, n (%)	15 (8.4)	—
Personal history of FS, n (%)	67 (37.6)	20 (15.9)
Family history of FS, n (%)	26 (14.6)	17 (13.5)
Family history of epilepsy, n (%)	17 (9.6)	15 (11.9)
Prematurity, n (%)	14 (7.9)	9 (7.1)
Developmental delay, n (%)	38 (21.3)	21 (16.7)

TABLE 1: Baseline characteristics of the study population.

Percentages use all episodes (N = 178) or all children at their first recorded episode (N = 126) as the denominator. Personal history per episode includes earlier episodes recorded during the study.

FS: febrile seizure; SD: standard deviation; IQR: interquartile range

Seasonality, timing, and aetiology

Episodes peaked in December (n = 29) and January (n = 25), with the lowest counts in June and October (n = 7 each); 139 episodes (78.1%) occurred between November and May. Most admissions (107, 60.1%) occurred at night (18:00h-07:00h). The most frequent associated diagnoses were upper respiratory tract infection (URTI; 127, 71.3%), acute otitis media (20, 11.2%), and acute gastroenteritis (13, 7.3%); diagnoses could overlap, and nine episodes (5.1%) had no recorded diagnosis. At least one virus was identified in 39 episodes (21.9%), with 57 detections in total. The most frequent were enterovirus (n = 10), influenza A (n = 9, plus two untyped influenza A/B), SARS-CoV-2 (n = 7), adenovirus (n = 6), and respiratory syncytial virus (n = 6).

Classification of complex episodes

Of the 37 complex episodes, 24 were classified by recurrence alone, six by duration of 15 minutes or longer

alone, and three by both. The remaining four met neither criterion and were presumably classified by focal features, which were not recorded as a separate variable. Only nine complex episodes (24.3%) were therefore classified by duration.

Comparison of simple and complex FS

Table 2 compares the 126 simple and 37 complex episodes (114 children): age, sex, admission temperature, clinical history, viral identification, and later epilepsy did not differ between groups. The first seizure was longer in complex episodes (median 7.0 vs 3.0 minutes, $p < 0.001$), a difference that partly reflects the definition of complex FS. Neither temperature nor age correlated with seizure duration (Spearman $r = -0.021$, $p = 0.790$, and $r = -0.044$, $p = 0.568$; $n = 168$). Complex FS were associated with a longer OW stay (median 17.2 vs 12.8 hours, $p = 0.007$), fewer discharges home, and more frequent hospital admission (64.9% vs 7.1%) and outpatient referral (32.4% vs 10.3%). The associations with non-home discharge, EEG, head CT, lumbar puncture, and diazepam remained significant after accounting for repeated episodes in the same child (Table 2).

Variable	Simple (n = 126)	Complex (n = 37)	Test, Statistic	p	Cluster-Adjusted OR (95% CI)
Age, months, median (IQR)	18.5 (14.0–30.0)	17.0 (15.0–29.0)	MW, U = 2518.5	0.458	—
Male sex, n (%)	76 (60.3)	21 (56.8)	χ^2 = 0.039	0.844	—
Temperature, °C, median (IQR)	38.8 (38.4–39.3)	38.8 (38.1–39.1)	MW, U = 2592.5	0.300	—
First-seizure duration, min, median (IQR)*	3.0 (2.0–5.0)	7.0 (4.0–13.0)	MW, U = 1037.5	< 0.001	—
Personal history of FS, n (%)	44 (34.9)	16 (43.2)	χ^2 = 0.531	0.466	—
Family history of FS, n (%)	20 (15.9)	4 (10.8)	χ^2 = 0.250	0.617	—
Family history of epilepsy, n (%)	12 (9.5)	3 (8.1)	Fisher	1.000	—
Prematurity, n (%)	13 (10.3)	1 (2.7)	Fisher	0.194	—
Developmental delay, n (%)	28 (22.2)	8 (21.6)	χ^2 < 0.001	1.000	—
Virus identified, n (%)	26 (20.6)	9 (24.3)	χ^2 = 0.064	0.800	—
Later epilepsy, n (%)	10 (7.9)	3 (8.1)	Fisher	1.000	—
OW stay, hours, median (IQR)	12.8 (5.4–17.9)	17.2 (11.0–21.9)	MW, U = 1645.5	0.007	—
Not discharged home, n (%)	22 (17.5)	29 (78.4)	χ^2 = 46.58	< 0.001	17.1 (6.7–44.0)
Hospital admission, n (%)**	9 (7.1)	24 (64.9)	χ^2 = 55.50	< 0.001	—
Outpatient referral, n (%)**	13 (10.3)	12 (32.4)	χ^2 = 9.14	0.003	—
EEG, n (%)	8 (6.3)	19 (51.4)	χ^2 = 38.72	< 0.001	15.6 (6.3–38.6)
Head CT, n (%)	8 (6.3)	15 (40.5)	χ^2 = 24.84	< 0.001	10.1 (3.6–28.1)
Lumbar puncture, n (%)	3 (2.4)	12 (32.4)	Fisher	< 0.001	19.7 (5.1–76.1)
Laboratory analysis, n (%)	111 (88.1)	37 (100)	Fisher	0.024	—
Rectal diazepam, n (%)	38 (30.2)	21 (56.8)	χ^2 = 7.65	0.006	3.0 (1.5–6.3)

TABLE 2: Comparison of simple and complex febrile seizure episodes.

OR: odds ratio, estimated by Generalized Estimating Equations (GEE) with the child as the cluster. *Duration missing for 10 simple episodes; the difference partly reflects the definition of complex FS. **Not mutually exclusive: seven complex episodes led to both admission and outpatient referral, and one to transfer to another hospital (counted as admission).

MW: Mann-Whitney U test; OW: observation ward; EEG: electroencephalogram; CT: computed tomography; FS: febrile seizure

Factors associated with complex FS

In the multivariable model (163 episodes, 114 children, 37 complex), no variable was significantly associated with complex FS (Table *3*). Discrimination was modest (AUC 0.65), and all variance inflation factors were at or below 1.09. The first-episode model (114 children, 27 complex) gave similar results, with AUC 0.66 and adequate calibration (Hosmer-Lemeshow χ^2 = 6.20, df = 6, p = 0.40). With about five events per variable, both models are underpowered and exploratory.

Variable	Adjusted OR, All Episodes (95% CI)	p	Adjusted OR, First Episode (95% CI)	p
Age (per month)	0.98 (0.95–1.01)	0.246	0.98 (0.94–1.02)	0.372
Male sex	0.87 (0.43–1.75)	0.689	1.31 (0.53–3.24)	0.566
Temperature (per °C)	0.76 (0.42–1.38)	0.366	0.65 (0.31–1.36)	0.249
Personal history of FS	1.59 (0.70–3.62)	0.267	2.38 (0.71–7.94)	0.158
Family history of FS	0.70 (0.21–2.32)	0.555	0.96 (0.27–3.38)	0.953
Prematurity	0.26 (0.03–1.96)	0.189	0.44 (0.05–3.89)	0.463
Developmental delay	0.89 (0.39–2.03)	0.779	0.93 (0.29–2.99)	0.909

TABLE 3: Multivariable logistic regression for complex febrile seizure.

All-episode model fitted using Generalized Estimating Equations (GEE) with cluster-robust standard errors (163 episodes, 114 children, 37 complex). First-episode model: standard logistic regression on each child's first classifiable episode (114 children, 27 complex).

Sensitivity analysis restricted to first episodes

In the 114 first classifiable episodes (87 simple, 27 complex), the longer OW stay ($p = 0.017$) and the higher rates of non-home discharge, EEG, head CT, lumbar puncture (all $p < 0.001$), and diazepam use ($p = 0.009$) in complex FS persisted. The difference in laboratory testing was no longer significant ($p = 0.571$).

Recurrence

Around 33 of 126 children (26.2%) had two or more episodes during the study period, accounting for 52 additional episodes; 25 children had two episodes and eight had three or more (maximum eight). Children with recurrence were younger at their first recorded episode (median 15, IQR 13-18, vs. 22, IQR 16-38 months; Mann-Whitney $p < 0.001$). Recurrence occurred in 20 of 51 children (39.2%) whose first recorded episode was before 18 months, compared with 13 of 75 (17.3%) aged 18 months or older (Fisher $p = 0.008$). A family history of FS (30.0% vs 25.5%, $p = 0.78$) and sex (27.4% of boys vs 24.5% of girls, $p = 0.84$) were not associated with recurrence. Recurrence rates were similar after a first simple episode (25 of 87, 28.7%) and a first complex episode (8 of 27, 29.6%). Among 31 children with two or more classifiable episodes, 14 had only simple episodes, nine had a simple episode followed by a complex one, eight had a complex episode followed by a simple one, and none had only complex episodes.

Later epilepsy and atypical episodes

Nine children (7.1%) received a diagnosis of epilepsy during the study period. The 15 atypical episodes occurred in 14 children aged four to 77 months, nine of them older than 60 months. None lasted 15 minutes or longer; two had a recurrence within the same illness, and seven did not end in discharge home.

Discussion

The findings of this study are consistent with the existing literature [1-4]: most FS episodes occurred in children without known neurological disease, with fever above 38°C, in the setting of viral URTI. Age did not differ between simple and complex FS ($p = 0.458$), suggesting that seizure complexity is not determined by age alone. The distribution of sex, age, and clinical history mirrors previous studies [3,8-13], which describe a slight male predominance and peak incidence in the second year of life [1,2]. Our male-to-female ratio of 1.4:1 (57.9% boys) is in line with Canpolat et al. [6] and Shrestha et al. [8]; the physiological mechanism for this difference remains debated.

Complex FS made up 22.7% of classifiable episodes, within the 20-25% reported in general paediatric overviews [1,3]. Most complex episodes in our cohort were classified by recurrence within the same illness rather than by prolonged duration, which explains why their mean first-seizure duration (11.5 minutes) was below 15 minutes. The longer duration of complex episodes is therefore partly a consequence of the definition and should not be read as an independent finding.

Complex FS was associated with longer observation, more admissions, and more neurological investigations, consistent with previous studies. Children with complex FS stayed longer in the OW, in line with recommendations that advocate a period of observation and, when indicated, further evaluation after a complex FS: the American Academy of Pediatrics [14], the Japanese Society of Child Neurology [15], and the Italian League Against Epilepsy [16]. These associations, however, may also reflect illness severity, institutional protocols, and individual clinician decisions, which a retrospective design cannot separate. Our

exploratory model did not identify any clinical factor independently associated with complex FS, but it was underpowered, so this finding should not be taken as evidence that no such factors exist.

Recurrence is common after a first FS: about 30% of children have a further episode, and the risk rises with each recurrence [1,13]. The best-established risk factors are younger age at onset and a first-degree family history of FS [1,13]. In our cohort, 26.2% of children had more than one episode during the study period, and recurrence was more than twice as frequent when the first recorded episode occurred before 18 months. A family history of FS was not associated with recurrence, possibly because of small numbers (20 children with a positive family history). Recurrent episodes did not follow a fixed pattern: 17 of 31 children with recurrence had both simple and complex episodes, in either order, so a first simple episode did not predict that later episodes would also be simple.

A family history of FS was present in 13.5% of children, supporting a genetic contribution. Familial studies report a family history of FS in 10% to 46% of affected children, and twin concordance is about three to four times higher in monozygotic than in dizygotic pairs (0.62 vs 0.16 in a community-based twin study) [17,18]. Most cases are thought to follow polygenic or multifactorial inheritance, whereas autosomal dominant transmission with reduced penetrance has been described in some large families [17]. Family history was not associated with seizure type in our cohort, suggesting that history alone cannot reliably predict whether a child will present with a complex seizure.

Nine children (7.1%) were diagnosed with epilepsy during the study period, with similar episode-level rates after simple and complex FS. Larger cohorts report a higher risk of later epilepsy after complex FS [1,2], and our follow-up was too short and too limited to detect it. Developmental delay, a recognised risk factor for later afebrile seizures [1], was recorded in 16.7% of children and did not differ between groups.

Episodes were concentrated between November and May (78.1%), mirroring the seasonal circulation of respiratory viruses and the predominance of URTI as the associated diagnosis. A virus was identified in 21.9% of episodes, with enterovirus, influenza A, and SARS-CoV-2 the most frequent; because testing was at the clinician's discretion, this is a minimum estimate. SARS-CoV-2 was among the most frequent agents, reflecting the study period: older cohorts analysed in landmark reviews [2,12] predate the COVID-19 pandemic, whereas our findings agree with recent observations by Gonçalves et al. [7]. This suggests that SARS-CoV-2 has joined influenza A and enterovirus among the viral triggers of FS, consistent with the neurotropic potential of SARS-CoV-2 and the neurological involvement reported in children after infection [19].

Study limitations

This study has several limitations. First, its retrospective, single-centre design precludes causal inference and depends on the completeness and accuracy of clinical records. Second, the cohort was hospital-based and included only children admitted to the OW, so referral and selection bias are likely, and the proportion of complex FS may not reflect the community. Third, 52 of 178 episodes came from children with more than one episode; we addressed this non-independence with cluster-robust methods and a first-episode sensitivity analysis, but residual effects cannot be excluded. Fourth, the multivariable model had about five events per variable and is underpowered. Fifth, recurrence and later epilepsy were captured only within our hospital and the study period, so both are probably underestimated, especially for children first seen in 2024. Sixth, viral testing was not systematic, and the number of episodes tested was not recorded. Finally, focal features were not recorded as a separate variable, and daycare attendance, a plausible exposure to viral infections, was not collected. Despite these limitations, the study contributes to the characterisation of FS in the local paediatric population: it supports a structured clinical approach, appropriate caregiver education, and the avoidance of unnecessary investigations in children with typical presentations.

Conclusions

In this paediatric ED cohort from 2020 to 2024, FS occurred mainly in boys in the second year of life and during the colder months. Most episodes were simple and benign. Complex FS, most often defined by recurrence within the same illness, was associated with greater hospital resource utilisation and higher admission rates. An exploratory, underpowered model identified no clinical factor independently associated with complex FS. About a quarter of children had more than one episode, more often when the first episode occurred before 18 months, and simple and complex episodes could follow each other in either order. Identifying complex FS early allows closer monitoring and appropriate management, and recognising children at higher risk of recurrence supports targeted caregiver education in both primary care and paediatric practice.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Andreia S. Sá

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Drafting of the manuscript: Andreia S. Sá

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Supervision: Maria V. González

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Comissão de Ética para a Saúde da Unidade Local de Trás-os-Montes e Alto Douro (CES) issued approval Number 23, Minute 3 of the CES Meeting of April 15th, 2026. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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