



Original Research

## Meningitis in Children Presenting With First-Time Fits And Fever

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### ABSTRACT

**Background:** Seizures are among the most common neurological crises that children experience. Medical professionals are concerned that meningitis may be the underlying reason when youngsters experience convulsions and fever. This study aimed to determine the frequency of meningitis in children presenting for the first time with seizures and fever at a tertiary care hospital in Peshawar.

**Materials & Methods:** This descriptive cross-sectional study was conducted over six months at the Pediatric Medicine Department, Khyber Teaching Hospital, Peshawar. The study used a non-probability consecutive sampling method to select 135 children, ages 1 month to 12 years.

**Results:** The study included 135 children with a mean age of 7.44 years (SD ± 2.7). Age-wise distribution showed the highest proportion (31.1%) in children aged 11–12 years. Males comprised 41.5% (n = 56), and females 58.5% (n = 79). Meningitis was confirmed in 37% (n = 50) of cases. Fever was documented in 48.1% of cases. There was a statistically significant correlation ( $p < 0.001$ ) between meningitis and the duration of symptoms, complicated seizures, and fever.

**Conclusion:** Meningitis is a serious medical issue that should be evaluated by medical professionals in children who are having their first seizures and fever, especially if they are young or have complicated seizure presentations. Meningitis may not show the classic symptoms, but a diagnosis can still be made in some situations.

**Keywords:** Meningitis, Children, Fits, Febrile, Seizures, Peshawar.

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## INTRODUCTION

In children, seizures are one of the most prevalent neurological conditions.<sup>1</sup> Between 4 and 10% of children will have at least one seizure episode in their first 16 years of life, with children under 3 years old having the greatest rate.<sup>2</sup> About 2% of visits to specialist pediatric emergency rooms and 1% of all ED visits are caused by seizures.<sup>3</sup> Convulsions associated with fever (CAWF) represent a frequent pediatric emergency worldwide.<sup>4</sup> Their etiology varies depending on age, geographical region, climate, and clinical presentation. In temperate regions, viral infections are a major cause, whereas in tropical countries, malaria is more prevalent. Nevertheless, bacterial infections continue to be significant contributors in both settings.<sup>5</sup> While the prevalence, clinical features, and outcomes of malaria and bacterial infections have been relatively well studied, there remains limited data on the role of viral infections in febrile seizures.<sup>6</sup>

Fever and seizures are common symptoms of infections of the central nervous system (CNS) in children, including encephalitis and meningitis.<sup>7</sup> Diagnostic hints may be offered by additional clinical findings, including Brudzinski's sign, Kernig's sign, neck stiffness, petechial rash, and reduced awareness.<sup>8</sup> However, meningeal symptoms in children under 12 months old may be weak or nonexistent, making the diagnosis more difficult.<sup>9</sup> Studies have shown that febrile seizures account for up to 53% of first-time seizure episodes in children under five years of age, while meningitis is the leading cause in children aged 6 months to 15 years, contributing to 33.6% of cases.<sup>10</sup>

In one study, first-time seizures were somewhat more common in males aged 6 months to 10 years than in females aged 11 to 15 years. According to another research, 232 (73.1%) of the 551 children, 317 (57.5%) of whom were between the ages of 6 months and 5 years, had seizures together with fever ( $p < 0.001$ ). 295 children (53.5%) who were later diagnosed with

meningitis had a fever and convulsions at the time of admission. CNS infections continue to be a major contributor to seizures and acquired epilepsy in developing nations.<sup>11</sup> Acute seizures are frequently caused by illnesses, including meningitis, viral encephalitis, and neurocysticercosis, and geographic circumstances affect the precise etiology.<sup>12</sup> These illnesses are frequently linked to higher rates of morbidity, death, and the onset of epilepsy later on.<sup>13</sup>

To date, although numerous studies have explored this topic globally, there is a lack of local data. This will be the first study conducted in this region to determine the frequency of meningitis in children presenting with first-time seizures associated with fever. The rationale behind this study lies in the fact that meningitis is one of the most serious and frequent causes of fever and seizures in children. If not diagnosed and managed promptly, it can result in severe complications and long-term disabilities. In some cases, seizures may be the only clinical manifestation of bacterial meningitis. Therefore, it is essential to consider meningitis as a potential diagnosis in such cases and to make informed decisions regarding lumbar puncture. Increasing awareness of the local prevalence of meningitis in children presenting with fever and first-time seizures will support pediatricians in early diagnosis, timely management, and evidence-based decision-making. Moreover, the findings from this study may help identify gaps in current clinical practice and guide future research in this important area. The study aim was to determine the frequency of meningitis in children presenting for the first time with fits and fever to the tertiary care hospital in Peshawar (Ref No. KTH/Paeds/2022/562 dated 25<sup>th</sup> June, 2022).

## MATERIALS AND METHODS

### Study Design, Setting, and Duration

This descriptive cross-sectional study was conducted in the Department of Pediatrics Medicine at Khyber Teaching Hospital, Peshawar,

over six months following approval from the hospital's ethical and research committee (Ref. No. KTH/Paeds/2022/562).

### Sample Size and Sampling Technique

A total of 135 children were included based on the WHO software for sample size calculation, keeping a 95% confidence level and an 8% margin of error, with an expected meningitis frequency of 33.6%. A non-probability consecutive sampling technique was used.

### Inclusion and Exclusion Criteria

Patients aged one month to 12 years, of both genders, presenting to the pediatric emergency or outpatient department with their first episode of seizures accompanied by fever lasting at least 24 hours were included. Patients with congenital CNS disorders (e.g., microcephaly, cerebral palsy, hydrocephaly), congenital blood or cardiac disorders, a history of head trauma, or those unwilling to participate were excluded to minimize bias.

### Data Collection Procedure

A thorough clinical assessment, including complete blood count and tests for glucose, electrolytes, urea nitrogen, creatinine, calcium, phosphorus, and magnesium, was conducted. Lumbar puncture was considered for children under 12 months, especially if immunization status was unknown. An electroencephalogram (EEG) was not routinely performed unless the seizure was complex, prolonged, or recurrent without fever. Neuroimaging (MRI or CT) was reserved for cases with suspected intracranial pathology. All demographic and clinical data were recorded in a pre-designed proforma.

### Data Analysis

Data analysis was performed using SPSS version 10, with mean  $\pm$  SD calculated for numerical variables and frequencies and percentages for categorical data. Chi-square tests were applied to assess effect modification, considering a p-value  $<0.05$  statistically significant. Results were presented in tables and graphs.

## RESULTS

### Demographic and Clinical Characteristics

The 135 children who were part of this study were both clinically and demographically. According to the age distribution, 12 children (8.9%) were between the ages of 1 month to 1 year, 27 (20.0%) were between the ages of 2-4 years, 22 (16.3%) were between the ages of 5-7 years, 32 (23.7%) were between the ages of 8 to 10 years, and 42 (31.1%) were between the ages of 11 to 12 years with Mean age was 7.44 years with standard deviation  $\pm$  2.7. This indicates a greater proportion of older children, especially those between the ages of 11 and 12. According to the gender distribution, out of the total n=79 (58.5%) were female and n=56 (41.5%) were male, indicating a small female majority. Distribution of fever among children was present in 65 (48.1%) and was absent in 70 (51.9%). Prolonged before presentation, 86 (63.7%) and 49 (36.3%) children experienced symptoms for a total of 24 hours. The children n=67 (49.6%) had seizures, whereas 68 children (50.4%) did not have seizures at the time of investigation. Meningitis was established in 50 individuals (37.0%).

**Table 1: Demographic and Clinical Characteristics of Children Presenting with First-Time Seizures and Fever (n = 135).**

Parameter	Categories	Frequency n = 135 (%)
Age Groups	1 month – 1 year	12(8.9%)
	2 – 4 years	27(20.0%)
	5 – 7 years	22(16.3%)
	8 – 10 years	32(23.7%)
	11 – 12 years	42(31.1%)
Gender	Male	56(41.5%)
	Female	79(58.5%)
Fever	Present	65(48.1%)
	Absent	70(51.9%)
Duration of Disease	12 hours	49(36.3%)
	24 hours	86(63.7%)
Fits	Present	67(49.6%)
	Absent	68(50.4%)
Meningitis	Present	50(37.0%)
	Absent	85(63.0%)

The cerebrospinal fluid revealed no meningitis in 85 children (63.0%), as shown in Table 1. These results give a thorough picture of the research population and the distribution of important clinical characteristics that are necessary for diagnosing meningitis in children who have fever and seizures for the first time.

#### Association of Meningitis with Gender

The connection between certain clinical factors, such as gender and fever, and meningitis. None of the female patients had meningitis, whereas 50 (89.3%) of the 50 children who were diagnosed had the illness. There were 79 (100%) female children and 6 (10.7%) male children among the 85 children who did not have meningitis. This implies that there is a significant correlation between meningitis prevalence in the population under study and male gender. Regarding the fever relationship, none of the 50 children with meningitis were afebrile, and all of them (76.9%) had fever at presentation. Fever was present in 15 (23.1%) of the children without meningitis, but not in 70 (100%) of them. According to these results, fever was a significant presenting symptom in instances of meningitis. These findings are verified by the statistical analysis. The correlation between meningitis and fever was 85.520, whereas the correlation

between meningitis and gender was 112.0, according to the chi-square test. Both associations were highly significant, with p-values of < 0.001 as shown in Table 2. This demonstrates that the incidence of meningitis in this group of children was statistically significantly correlated with both male gender and fever.

#### Association of Meningitis with Duration

The correlation between meningitis and two clinical factors: the length of illness and seizure frequency. Just n=1 (2.0%) of the 50 children with meningitis presented to the hospital after 24 hours, whereas 49 (98.0%) exhibited symptoms for 12 hours or less. On the other hand, all 85 (100%) of the children in the group without meningitis appeared after 24 hours, and none of them did so within 12 hours. This is a clear correlation between meningitis and shorter symptom duration. Likewise, there was a significant correlation between meningitis and seizure activity. Just 1 (1.5%) of the children with confirmed meningitis did not exhibit seizure activity, whereas 49 (72.1%) did. The majority, 66 (98.5%), did not have seizures, but 19 (27.9%) exhibited seizures among individuals without meningitis. These findings are supported by the statistical analysis. Both the meningitis and seizure activity associations had chi-square values

**Table 2:** Association of Meningitis with Gender and Fever in Children Presenting with First-Time Seizures and Fever (n = 135).

Meningitis Status	Fever Absent	Fever Present	Gender (Female)	Gender (Male)	Total n (%)
Absent	70 (100%)	15 (23.1%)	79 (100%)	6 (10.7%)	85 (63.0%)
Present	0 (0%)	50 (76.9%)	0 (0%)	50 (89.3%)	50 (37.0%)
Total	70 (51.9%)	65 (48.1%)	79 (58.5%)	56 (41.5%)	
p-value	< 0.001		< 0.001		135 (100%)
Chi-square ( $\chi^2$ )	85.520		112.0		

**Table 3:** Association of Meningitis with Duration of Illness and Presence of Seizures (n = 135).

Meningitis	Fits (No)	Fits (Yes)	Duration (24 hrs)	Duration (12 hrs)	Total
Yes	1 (1.5%)	49 (72.1%)	1 (2.0%)	49 (98.0%)	50 (37.0%)
No	66 (98.5%)	19 (27.9%)	85 (100%)	0 (0%)	85 (63.0%)
Total	67 (49.6%)	68 (50.4%)	86 (63.7%)	49 (36.3%)	
p-value	< 0.001		< 0.001		135 (100%)
Chi-square ( $\chi^2$ )	72.065		130.8		

of 72.065 and 130.8, respectively, for the length of illness and meningitis associations. With  $p < 0.001$ , both associations were statistically significant, as shown in Table 3. These findings suggest that children with seizures and those who show early signs have a markedly increased risk of meningitis.

## DISCUSSION

In this study, the prevalence of meningitis in children who had their first seizure episode during a fever attack was assessed. The findings, which indicated that 37.0% of the 135 children analyzed had meningitis, highlight the necessity of diagnosing a central nervous system infection in children who exhibit fever and convulsions. In resource-constrained areas where vaccination rates are low and medical treatment is delayed, the present study confirms earlier research that identified meningitis as the predominant cause of seizures in children with fever. Patients who have complex seizures in addition to diminished awareness or early indications of sickness require careful consideration of early therapeutic decisions regarding lumbar puncture. These clinical characteristics have a substantial statistical association with meningitis, according to the study's findings, making them important indicators of infection of the central nervous system.

There is an established correlation between seizures and meningitis, with reports of 12–27% of cases.<sup>14</sup> Since the implementation of universal vaccination against bacterial infections, the risk of BM in a child with a fever has decreased; nonetheless, this remains a significant worry for any child exhibiting FS, particularly in countries with poor immunization rates.<sup>15</sup> According to our study's findings, children with FS had a 1.6% incidence of BM and a 4.5% frequency of both bacterial and aseptic meningitis. These findings are comparable to those of Ehsanipour et al, who found that among children with FS aged 6

months to 5 years, 3.6% had meningitis and 1.6% had BM.<sup>16</sup>

Furthermore, among patients with FS aged 3 months to 5 years, Al-Eissa's study in Saudi Arabia revealed a 3.5% prevalence of meningitis and a 1.5% frequency of BM.<sup>16</sup> According to Casasoprana et al (2013), among children under 18 months old with a first FS in France, the prevalence of BM was 1.9%.<sup>17</sup> According to Ghotbi and Shiva, out of 254 individuals with fever and seizures, 4.7% had meningitis. Children with FS had greater incidences of meningitis, according to several studies.<sup>16</sup> In China, Owusu-Ofori et al, reported a 10.2% prevalence of BM in infants with FS, while in Tunisia, Tinsa et al, observed a 10% rate in children under a year old with FS.<sup>18</sup> This may be because meningitis is more common in these groups. Children who experienced their first fever and seizure episode in Nepal had a 4.5% BM and a 17% meningitis rate, according to Joshi Batajoo et al.<sup>19</sup> These findings could be partially explained by research on children who experienced their first episode of FS, which may be more closely linked to meningitis.

The findings of other investigations, however, varied significantly. Following the adoption of universal vaccination, Carroll and Brookfield found that children with uncomplicated FS had a 0.23% rate of BM.<sup>20</sup> According to Kimia et al, children with complicated FS had a 0.9% BM rate. In another study, they found that children aged 6–18 months who experienced their first incident of simple FS did not have any incidents of BM.<sup>21</sup> Similar outcomes were seen by Shaked et al, for children aged 6–12 months who had the first uncomplicated FS.<sup>22</sup> A larger coverage area of immunization against prevalent bacterial infections that cause infant meningitis in these groups may be the cause of the results.

Gender and meningitis did not significantly correlate, according to our research. This is concurrent with previous research. According to several FS studies, meningitis is more prevalent in

younger children. Although children younger than 18 months had a higher prevalence of meningitis in our sample, this difference was not statistically significant. One possible explanation for this might be that not all FS patients had LPs completed, and many of those who did not have LPs were elderly. Furthermore, our investigation was carried out on a broader age range than most previous studies, which have mostly involved children as young as five. None of our BM patients had meningeal irritation symptoms, which is similar to Joshi-Batajoo and Laditan AA. This suggests that meningitis in younger patients is not ruled out by the absence of these symptoms.<sup>19</sup> In this respect, doctors should not depend exclusively on physical indicators. According to our findings, most kids with meningitis exhibited complicated seizure characteristics.

Comparable findings were made by Ham, Medwid, and Casasoprana, who discovered that children with uncomplicated FS and a normal physical examination had a very low risk of developing encephalitis or BM.<sup>23</sup> According to Rossi *et al*, a complex seizure may be a crucial indicator of meningitis in infants less than three years old who do not exhibit any neurological symptoms.<sup>24</sup> According to Najaf-zadeh *et al*, the prevalence of BM was 0.6% in children with complicated FS and 0.2% in those with simple FS. According to Al-Eissa, every meningitis patient exhibited complicated seizure characteristics.<sup>25</sup> Results from other trials have been comparable. Children with the initial complicated FS had a low incidence of BM, according to Kimia *et al*, although most meningitis patients.<sup>21</sup> Almost all of the BM patients in our research experienced their first FS attack when compared to those without meningitis. Our findings resemble those of Ehsanipour *et al*.<sup>16</sup> Childhood FS attacks may occur often in children with a genetic susceptibility. Furthermore, seizure is a presenting symptom of meningitis that occurs in almost 25% of young children. Therefore, in all febrile

individuals with seizures, the absence of prior FS may raise suspicions that meningitis may be involved.

Patients with meningitis experienced impaired awareness much more frequently in our research. The findings of a few additional investigations have been comparable. When comparing patients with FS and lethargy, Owusu-Ofori found that the rate of BM was 4.5%, but the rate for patients with FS and neck stiffness was 34.6%.

This could be because the study had patients as young as 15 years old, and meningeal symptoms, including stiff necks, are more noticeable in this age range. Antibiotic pretreatment and the incidence of meningitis in our patients did not significantly correlate. Ghotbi and Shiva discovered that among kids with FS, previous antibiotic usage is a risk factor for meningitis.<sup>26</sup> According to Casasoprana *et al*, an LP should be taken into consideration when children with FS have previously received antibiotic medication.<sup>23</sup> These findings diverge from ours, which could be because our community's feverish youngsters are receiving more antibiotics than is necessary. As it can conceal the symptoms of meningitis, the American Academy of Pediatrics has released recommendations that state that an LP is an option in the evaluation of children who arrive with fever and seizures who have already received antibiotic treatment. The choice to do an LP is, in fact, up to the physician and is dependent on the kind and length of antibiotic administered.

The study we conducted had limited limitations. It is possible that some patients with aseptic meningitis (without strong clinical evidence) were overlooked since not all patients had LPs completed. Therefore, rather than mentioning the meningitis frequency for all patients (19 of 681 [2.79% [95% CI 1.7-4.3]]), we reported the frequency based on instances in which LP was performed (19 of 422 patients [4.5% CI 2.9-6.9]).



## CONCLUSION

According to our research, children who presented with FS did not have a significant incidence of bacterial meningitis. Although meningitis is more prevalent in kids with FS younger than 18 months, complicated seizure symptoms, the initial FS episode, or reduced awareness appear to be important risk factors for meningitis, and an LP should be considered in these cases. Meningitis can still occur even if there are no symptoms of meningeal irritation, particularly in younger children.

**Disclosures:** The Authors report no conflict of interest.

**Ethical Review Board Approval:** Approval was taken from the IRB committee of Khyber Teaching Hospital, Peshawar (Ref. No. 562).

**Human Subjects:** Consent was obtained from all patients/participants in this study.

**Conflicts of Interest:** None.

**Data Availability Statement:** For data sharing, interested researchers can contact the corresponding authors.

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### **AUTHORS CONTRIBUTIONS**

<b>Sr.#</b>	<b>Author's Full Name</b>	<b>Intellectual Contribution to Paper in Terms of:</b>
1.	Naveed Ullah	1. Study design and methodology, manuscript drafting and approval.
2.	Bibi Hajira	2. Paper writing, critical review, and manuscript approval.
3.	Hina Imtiaz	3. Data collection, analysis and manuscript approval.
4.	Izzah Rahim	4. Analysis of data and interpretation of results and manuscript approval.
5.	Abdul Hameed	5. Literature review and referencing and manuscript review and approval.
6.	Muhammad Kashif	6. Editing and quality insurance, drafting and manuscript approval.