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# Etiological Composition Analysis of Infection-Related Febrile Seizures in Children

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## Abstract

**Objective:** To analyze the etiological composition of infection-related febrile seizures in children and provide guidance for clinical practice. **Methods:** A total of 495 children with febrile seizures who were admitted to the pediatric emergency department of Guangzhou Medical University Affiliated Women and Children's Medical Center (Zhujiang New Town Campus) from May 2024 to December 2024 were included in this study. Pharyngeal swab samples were collected for pathogen detection using PCR. The pathogens tested included *Chlamydia pneumoniae*, *Mycoplasma pneumoniae*, respiratory syncytial virus, adenovirus, bocavirus, rhinovirus, and human metapneumovirus. The pathogens were grouped according to their incidence rates, and analysis of variance (ANOVA) was performed. Multiple comparisons were conducted using the Student-Newman-Keuls (SNK) test and the Least Significant Difference (LSD) test. A p-value of less than 0.05 was considered statistically significant. **Results:** A total of 422 children tested positive for pathogens. After excluding cases with co-infections involving more than two pathogens, 355 positive cases were included in the study. The pathogens were categorized into three groups based on their incidence rates: the low-infection group (including *Chlamydia pneumoniae*, *Mycoplasma pneumoniae*, and respiratory syncytial virus) with 43 cases, the medium-infection group (including enterovirus, influenza virus, and parainfluenza virus) with 107 cases, and the high-infection group (including adenovirus, bocavirus, rhinovirus, and human metapneumovirus) with 205 cases. Analysis of the age distribution of cases in the low-, medium-, and high-infection groups showed statistically significant

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differences among the groups ($P < 0.05$). The age distribution of cases in different infection groups also showed statistically significant differences ($P < 0.05$). The majority of cases in each infection group were concentrated in the 1- to 6-year-old age range. The medium-infection group had a uniform distribution across different age groups, with no statistically significant differences ($P > 0.05$). Comparing the two time periods of May to August and September to December, the study found that the number of positive cases for respiratory syncytial virus, human metapneumovirus, and rhinovirus were 112 and 34, respectively, while the number of positive cases for influenza virus, parainfluenza virus, and adenovirus were 45 and 72, respectively. The differences between the two groups were statistically significant ($P < 0.05$), indicating that different viruses were prevalent in different seasons. **Conclusion:** The probability of febrile seizures caused by different viral infections varies. Empirical intervention and treatment can be provided for patients with febrile seizures based on the viruses that are prevalent in different seasons.

## Keywords

Febrile Seizure, Pathogen, Diagnosis

## 1. Introduction

Febrile seizures in children are one of the common pediatric emergencies, and their pathogenesis is not fully understood. The condition is mainly associated with inflammation, fever, immature brain development, genetic factors, and other elements. A minority of affected children may have an unfavorable prognosis, and recurrent seizures can pose risks to the children themselves and their families [1] [2]. Despite being a common condition, there is currently a lack of rapid and effective predictive diagnostic indicators. Improving diagnostic efficiency is crucial. Pediatric infections have distinct seasonal characteristics. By analyzing the pathogens of children with febrile seizures, high-frequency pathogens can be identified. In today's era of rapidly developing rapid testing, it is important to detect high-risk factors in a timely manner and to provide early prevention and intervention for children in high-risk age groups. This can help reduce the incidence of febrile seizures and avoid severe complications as much as possible, which has significant social importance. This article analyzes the clinical data of children with seizures admitted to the pediatric emergency department of Guangzhou Medical University Affiliated Women and Children's Medical Center (Zhujiang New Town Campus) from May 2024 to December 2024.

## 2. Subjects and Methods

### 2.1. Study Subjects

This study collected data from 495 children with febrile seizures who were admitted to the pediatric emergency department of Guangzhou Medical University Af-

filiated Women and Children's Medical Center (Zhujiang New Town Campus) from May 2024 to December 2024. Among them, 287 were boys and 208 were girls. The age distribution was as follows: 50 children were under 1 year old, 403 children were between 1 and 6 years old, and 42 children were over 6 years old. The study focused on the analysis of febrile seizure cases.

All patient data were screened based on the discharge diagnosis from the emergency department or the discharge diagnosis after admission to the inpatient ward. The basic criteria included fever with axillary temperature ≥38˚C and the occurrence of convulsive seizures (common indicators of convulsive seizures include loss of consciousness, pale or cyanotic skin, frothing at the mouth, respiratory distress, staring or rolling back of the eyes, and generalized or focal muscle spasms). Exclusion criteria: (1) Patients with a previous diagnosis of epilepsy that is not well-controlled; (2) Patients with seizures caused by central nervous system infections, genetic metabolic diseases, hypoglycemia, metabolic disorders, autoimmune encephalitis, acute poisoning, or intracranial space-occupying lesions; (3) Patients with congenital malformations or congenital heart disease and other congenital diseases. Enroll patients and collect detailed medical history: gender, age of onset, clinical manifestations, associated symptoms, precipitating factors, past medical history, personal history, special perinatal history, growth and development, and family history. Additionally, perform the following tests: complete blood count, blood gas analysis, electrolyte analysis, blood glucose, blood ammonia, cardiac, hepatic, and renal function tests, and pharyngeal swab pathogen tests (for pathogens such as *Chlamydia pneumoniae*, *Mycoplasma pneumoniae*, respiratory syncytial virus, enterovirus, influenza virus, parainfluenza virus, adenovirus, bocavirus, rhinovirus, and human metapneumovirus). Conduct cerebrospinal fluid examination, pathogen testing, cranial MRI, and electroencephalogram (EEG) as well. The pharyngeal swab pathogen testing is conducted based on a screening system for common pediatric infectious diseases established by this medical institution. The specimens are collected by clinical physicians of our department and sent to the laboratory department of this institution for execution. The relevant implementation standards and quality control are all carried out in accordance with standard protocols. Informed consent is obtained from the patients or their guardians before sampling. Lumbar puncture is performed based on the duration of fever, fever peak, mental status, positive physical examination findings, abnormal imaging changes, and treatment response. It is conducted only after obtaining parental consent and signing an informed consent form.

## 2.2. Statistical Methods

Data analysis was performed using SPSS version 17.0 software. Analysis of variance (ANOVA) was conducted based on the incidence rates. For comparisons among multiple groups, the Student-Newman-Keuls (SNK) test and the Least Significant Difference (LSD) test were used. A p-value of less than 0.05 was considered to indicate statistical significance.

## 3. Results

### 3.1. Pathogen Distribution

In this study, 422 cases tested positive for pathogens. After excluding cases with co-infections involving more than two pathogens, a total of 355 positive cases were included in the analysis. Based on the incidence rates, the pathogens were categorized into three groups: the low-infection group (including *Chlamydia pneumoniae*, *Mycoplasma pneumoniae*, and respiratory syncytial virus) with 43 cases, the medium-infection group (including enterovirus, influenza virus, and parainfluenza virus) with 107 cases, and the high-infection group (including adenovirus, bocavirus, rhinovirus, and human metapneumovirus) with 205 cases (see Table 1). Analysis of the age distribution of cases in the low-, medium-, and high-infection groups showed statistically significant differences among the groups ($P < 0.05$). The age distribution of cases in different infection groups also showed statistically significant differences ($P < 0.05$). The majority of cases in each infection group were concentrated in the 1- to 6-year-old age range. The medium-infection group had a uniform distribution across different age groups (see Table 2).

**Table 1.** Number of cases with different pathogen infections.

| Virus | Number of Cases |
|---|---|
| *Chlamydia pneumoniae* | 7 |
| *Mycoplasma pneumoniae* | 13 |
| Respiratory Syncytial Virus | 23 |
| Enterovirus | 26 |
| Influenza Virus | 37 |
| Parainfluenza Virus | 43 |
| Adenovirus | 44 |
| Bocavirus | 46 |
| Rhinovirus | 57 |
| Human Metapneumovirus | 58 |
| Two or More Pathogens Positive | 60 |

**Table 2.** Patient counts by age group in each infection group.

| Age Group (y) | LOW | MID | HIG |
|---|---|---|---|
| <1 | 5 | 29 | 16 |
| 1 - 6 | 26 | 44 | 112 |
| >6 | 12 | 34 | 67 |

### 3.2. Comparison of Pathogen Distribution in Different Time Periods

In this study, the research subjects were grouped according to time and season, with comparisons made between the periods of May to August and September to December. The findings revealed that during the two time periods of May to August and September to December, the number of positive cases for respiratory syncytial virus, human metapneumovirus, and rhinovirus were 112 and 34, re-

spectively. Meanwhile, the number of positive cases for influenza virus, parainfluenza virus, and adenovirus were 45 and 72, respectively. The differences between the two groups were statistically significant ($P < 0.05$), indicating that different viruses are prevalent in different seasons.

## 4. Discussion

Febrile seizures are a common cause of seizures in children, predominantly occurring in children aged between 6 months and 5 years, with a higher incidence in boys [3]. Approximately 30% - 40% of patients with febrile seizures experience recurrence. Factors such as a family history of seizures, past medical history, and age of onset are closely associated with the recurrence of febrile seizures. Repeated episodes of febrile seizures may affect the child's cognition and memory and may also increase the risk of secondary epilepsy. In severe cases, it may lead to the death of the child. The pathogenesis of febrile seizures is caused by a combination of multiple factors and heterogeneity. It is currently mainly related to the immaturity of the central nervous system in infants and young children, increased excitability of the central nervous system mediated by inflammation, genetic factors, ion channel mechanisms, and neurotransmitter dysregulation [4]. Inflammatory markers refer to various chemical substances involved in the inflammatory response, among which IL-1, IL-6, TNF-*α*, and PCT are the most common pro-inflammatory factors that participate in inducing fever and other acute-phase inflammatory responses [5]. This study found that viruses in the high-infection group (adenovirus, bocavirus, rhinovirus, and human metapneumovirus) also showed higher systemic inflammatory responses in clinical manifestations, such as elevated body temperature and heart rate, and lethargic mental status, especially in infants and young children, who may present with sepsis-like symptoms. This could be due to the vigorous immune response triggered during the viral infection process, leading to the release of inflammatory cytokines and causing systemic inflammatory response syndrome. Therefore, during the prevalence of certain viruses, empirical treatment can be administered based on clinical manifestations. Intravenous immunoglobulin can be used to suppress the inflammatory response, preventing rapid deterioration of the condition and avoiding severe complications. Additionally, by analyzing the pathogens of febrile seizures in different time periods (similar to seasons), this study found that different viruses are prevalent in different seasons. The incidence of febrile seizures caused by the same virus varies in different seasons, and the clinical manifestations of febrile seizures caused by the same virus also differ in different seasons. This suggests that different viral infections lead to different levels of inflammatory cytokines, which are highly correlated with clinical manifestations [6].

## 5. Conclusion

Therefore, pathogens are an important factor in determining the levels and severity of inflammatory responses. Especially during the outbreak of a particular virus,

mutations in gene expression sites are inevitable, leading to changes in transmissibility and virulence. This, in turn, triggers systemic inflammatory responses, induces the release of various cytokines, and leads to a range of clinical complications, with febrile seizures in children being one of them. This study has identified some patterns, but since the annual viral epidemic cycles vary, further research and analysis are needed in this area.

## Authors' Contribution

Shushan Nie contributed to data collection and manuscript draft. Guangming Liu carried out statistical analysis. Yanhuan Mao and Chengdong Kang for clinical quality control. Qiang Wang contributed to editing the manuscript. MuSheng Li contributed to the study design and review of the manuscript. All authors read and approved the final manuscript.

## Data Availability Statement

All data generated or analysed during this study are included in this published article.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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