

Review

## Childhood Febrile Seizures: Overview and Implications

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This article provides an overview of the latest knowledge and understanding of childhood febrile seizures. This review also discusses childhood febrile seizure occurrence, health services utilization and treatment costs. Parental reactions associated with its occurrence and how healthcare providers can assist parents with dealing effectively with this potentially frightening and anxiety-producing event are also discussed.

Key words: childhood febrile seizure, parental reaction, anxiety, health services utilization, parental education

### 1. Introduction

Although the occurrence of febrile seizures in childhood is quite common, they can be extremely frightening, emotionally traumatic and anxiety provoking when witnessed by parents. During the seizure, the parent may perceive that their child is dying [1;2], but fortunately the vast majority of febrile seizures are benign. Rarely have febrile seizures caused brain damage [3] and with the exception of developing countries, there are no documented cases of febrile seizure-related deaths on record [4]. There have been numerous reviews and updates which have explored the natural history, treatment and subsequent outcomes of febrile seizures [5]. In addition, several articles have addressed the immediate parental reaction to this occurrence [1;6-11], and one has addressed parental reaction over time [10]. In this article, we provide a brief overview of childhood febrile seizures and explore the potential parental reactions to febrile seizures from physiological, emotional, and behavioral perspectives. We also include a review of health services utilization and the treatment costs of children experiencing febrile seizures, an aspect that has not been considered to any depth in relation to childhood febrile seizures.

### 2. Febrile Seizures Defined

Febrile seizures have defined by The International League Against Epilepsy (ILAE) as "a seizure occurring in childhood after one month of age, associated with a febrile illness not caused by an infection of the central nervous system, without previous neonatal seizures or a previous unprovoked seizure, and not meeting criteria for other acute symptomatic seizures [12]. Febrile seizures are classified as either simple or complex. Simple febrile seizures consist of a brief (lasting less than 10 minutes) tonic-clonic convulsion which occurs only once within a 24-hour period. There are no focal features and it resolves spontaneously [13].

Conversely, complex febrile seizures are prolonged (greater than 10-15 minutes), focal, or multiple (recurrent within the same febrile illness over a 24-hour period). While the majority of febrile seizures are simple (70-75%) [14], 9-35% of febrile seizures are complex [15].

### 3. Natural History

Approximately one-half million febrile seizure events occur per year in the US [16]. Most febrile seizures occur between 6 months and 36 months of age, peaking at 18 months [15]. The incidence of febrile seizures is between 2-5% [17], with at least 3% to 4% of all children in North America experiencing at least one febrile seizure before the age of 5 years [18]. The occurrence of a child's first (initial) febrile seizures has been associated with: first or second-degree relative with history of febrile and afebrile seizures [19], day care attendance [20;21], developmental delay [19;21], Influenza A viral infection [18;22], Human herpesvirus-6 infection [23;24], Metapneumovirus [25], and iron deficiency anemia [26]. Other exogenous circumstances that have been identified as predicting an increased risk of initial febrile seizures include difficult birth, neonatal asphyxia, and coiling of the umbilical cord [27]. Children with febrile seizures and the exogenous conditions previously listed are likely to have affected family members, and have a risk of recurrence of seizures on  $\geq 5$  occasions [27].

The risk of initial febrile seizures has also been studied after receipt of pediatric vaccinations such as diphtheria-tetanus-whole cell pertussis (DTP) [28;29] and Measles, Mumps and Rubella (MMR) [30;31]. Studies by Barlow and associates (2001) and Walker and colleagues (1988) found a 4-fold increase in the risk of febrile seizures within 1-3 days of receipt of DTP vaccination. With regard to MMR vaccination, the risk of febrile seizures increases by 1.5 and 3.0 fold, with the peak occurring 1-2 weeks after vaccination [30;32]; an additional 25-34 febrile seizures have been

estimated to occur per 100,000 doses of MMR administered [30].

Febrile seizures frequently recur. Although febrile seizure usually occur as single, isolated incidents, the recurrence rate is 30% overall [33], and increases to 50% if the initial febrile seizure occurs in a child under one year of age [34]. Of those who experience a second febrile seizure, the risk of recurrence increases 2-fold [35;36]. Predictors of recurrent febrile seizures include: a history of focal, prolonged, and multiple seizures [37;38], Influenza A viral infection [39], family history of febrile seizures [36], onset of febrile seizure <12 months of age [40], temperature <40°C (<104 °F) at time of seizure [41], and a history of complex, initial febrile seizures [42]. A low proportion (2-4%) of children who experience at least one febrile seizure event [4;43], go on to develop recurrent afebrile seizures (epilepsy) [16;44].

#### **4. Febrile Seizure Evaluation and Management**

While febrile illnesses in infants and children account for 10-20% of all pediatric, emergency room visits [45], up to one percent of these visits involve pediatric seizure patients [46;47]. Eighty percent of those pediatric seizure patients are diagnosed with febrile seizures, and 20% are diagnosed with afebrile seizures [48-50]. Seizures of any type are usually a manifestation of a number of underlying pathologic conditions to differentiate between them, careful history taking, physical examination, and laboratory work-up are usually required. EEG's and neuroimaging studies should be performed as dictated by clinical suspicion, as routine ordering of neuroimaging studies and EEG's have been found to have limited value. Abnormalities on EEG do not predict the occurrence of future seizures [51] or the subsequent development of epilepsy [17]. Practice guidelines have recommended that lumbar punctures be strongly considered in children experiencing their first simple febrile seizure, particularly if < 18 months of age [15;20;52;53] In the case of first simple febrile seizure, prophylactic antipyretic or anticonvulsant therapies are not recommended to reduce the recurrence rate [54;55]. As to the short-term treatment of ongoing febrile seizures, anticonvulsants such as Phenobarbital and Diazepam have been found to reduce the reoccurrence of febrile seizures, but not subsequent development of epilepsy [56].

#### **5. Health Services Utilization and Treatment Costs of Children with Febrile Seizures**

There are few data available regarding health services utilization and treatment costs of children experiencing febrile seizure events. The majority of studies evaluating health services utilization and treatment costs have been in children diagnosed with epilepsy [57-62]. The costs to initially evaluate and treat febrile seizures depend on the clinical work-up indicated by clinical suspicion.

In 2003, Freeman detailed the cost of evaluating

an initial afebrile seizure in the emergency room (US \$3057) and concluded that less testing is needed in the ER following this occurrence [63]. Two studies have indicated that children with febrile seizures do not consume excess health care resources. In a matched case-control study, 75 children experiencing their first febrile seizure were age-matched with 150 febrile and 150 afebrile controls. It was concluded that children with febrile seizures had nearly identical rates of subsequent hospitalization when compared with age-matched controls [18]. A secondary analysis of this same data set was undertaken, and it was found that children with a known family history of febrile seizures at the time of study entry had 24% fewer physician visits [64]. In contrast, children experiencing their first febrile seizure had 45% more physician visits when they knew of a relative with afebrile seizures than those with negative family histories. Thus, it appears that knowledge of a family history of febrile seizures is correlated with reduced office visits.

#### **6. Parental Reaction and Response to Febrile Seizures in Children**

Parental reaction and response to febrile seizure occurrence in children can comprise physical, psychological, and behavioral manifestations. Common physical symptoms experienced by parents following their child's febrile seizure include dyspepsia [65], anorexia [1], and sleep disruption [1;8;9;65]. Psychological reactions experienced by parents include fear of reoccurrence [8], fear of subsequent development of epilepsy [1], apprehension, and excessive anxiety and worry about low-grade fevers [66].

The occurrence of febrile seizures can potentially disrupt the familial quality of life and the parents may experience anxiety and fear whenever a child develops a fever. These parents may also perceive that somehow the child is now "vulnerable" or unusually susceptible to medical or developmental problems [18]. The full term to describe this perception is referred to as the "vulnerable child syndrome", which includes a compilation of behaviors that are thought to develop as a result of this excessive parental anxiety [67;68]. These parents experience increased anxiety and fear [68] whenever a child develops a fever [8;9]. As a result, this heightened parental fear of fever and febrile seizures can have series negative consequences on daily family life [1;4], parental behavior [4;69] and parent-child interactions [68;70;71]. As a consequence of this perceived "vulnerability", it would seem intuitive that the caregiver would seek medical attention for their child more frequently, as this was repeatedly found in previous parent-perceived child vulnerability studies involving general pediatrics and premature infants [70;72-74]. But to the contrary, as noted earlier in two studies [18;64], children experiencing febrile seizures did not utilize a higher rate of resources compared with age-matched controls.

#### **7. Implications**

The occurrence of childhood febrile seizures are

common; thus parents and caregivers should be provided information about them. Instructions and parental education should be specific, written in lay

terms, tailored to their language and culture and address the following (See Table 1):

**Table 1:** Febrile Seizure Information and Education

Clinical Information	Clinical Education
What is a febrile seizure?	Febrile seizures are convulsions brought on by a fever in infants or small children. Most febrile seizures occur within the first 24 hours of an illness/fever. Febrile seizures may last from a few seconds to more than 15 minutes.
The link between fever and febrile seizures (FS) in children.	Febrile Seizures occur in 3% -5 % of otherwise healthy children 6-60 months of age. It is debated by experts whether it is the quickness of the rise in temperature or the height of the temperature which triggers the seizure. The seizure is often the first sign of a fever.
What may happen to the child during the febrile seizure?	During a febrile seizure, a child may lose consciousness or responsiveness, shake and move limbs on both sides of the body. The child becomes rigid or has twitches in only a portion of the body, such as an arm or a leg, or on the right or the left side only. The child may vomit or pass urine.
What measure(s) should be taken or avoided during the febrile seizure event.	<b>Do stay calm.</b> Focus your attention on bringing the fever down. Insert rectal acetaminophen (Tylenol) (if available). Apply cool washcloths to the forehead and neck. Sponge the rest of the body with lukewarm (not cold) water. Loosen any restrictive clothing. <b>Don't</b> try to hold or restrain the child or stop the seizure movements. Don't try to force anything into his mouth to prevent him from biting his tongue as this increases the risk of injury. Move the child only if in a dangerous situation. Remove any objects that may injure him.
What <b>does not</b> happen to the child's brain during a febrile seizure?	There is no evidence that simple febrile seizures (<10 minutes) cause death, brain damage, epilepsy, mental retardation, a decrease in IQ, or learning difficulties.
The likelihood of reoccurrence.	A third of children will have another febrile seizure with a subsequent fever. Of those who do, about 1/2 will have a 3 <sup>rd</sup> seizure. If there is a family history, if the first seizure happened before 12 months of age, or if the seizure happened with a fever below 102, a child is more likely to have >1 febrile seizures.
When to consult a healthcare provider, when to call 911 and when take the child directly to an emergency room (ER).	1. Children should consult a healthcare provider as soon as possible after the first febrile seizure. 2. Call 911 if the seizure lasts more than a few minutes. 3. Contact a healthcare provider or go to the ER if any other symptoms occur <b>before</b> or <b>after</b> the seizure: nausea, vomiting, rash, tremors, abnormal movements, problems with coordination, drowsiness, agitation, confusion, sedation, etc.
What may occur during the healthcare provider's evaluation and/or testing of the child	Blood and urine tests may be examined to detect infections. Typically, a full seizure workup including an EEG, head CT, and lumbar puncture (spinal tap) is not warranted.
What are the possible sequelae of febrile seizures?	Injuries caused by falling or bumping into objects. Biting oneself Pneumonia secondary to fluid aspiration. Injury from prolonged or complicated seizures. Medication side effects related to the treatment and prevention of seizures (if prescribed). Complications if a serious infection, such as meningitis caused the fever. Seizures unrelated to fever (afebrile seizures) Parental perception of increased child vulnerability to medical or developmental problems.
What treatments may be prescribed (i.e anticonvulsants), when they are indicated, and possible adverse effects.	The list of epilepsy medications used depends on clinical plan devised

## 8. Summary

Childhood febrile seizures, although primarily benign, can be frightening and anxiety-provoking events for parents and caregivers. It is important that health care providers understand potential parental misconceptions, anxieties and fears about fever and febrile seizures so that they may allay those fears effectively. The healthcare provider also needs to assess parental reactions to the occurrence of febrile seizure and to determine the coping patterns utilized as well as to detect any disruptions in parent-child interactions. Additional studies are needed to evaluate the costs of treatment for initial febrile seizures as well as health services utilization.

## Conflict of interest

The authors have declared that no conflict of interest exists.

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