

ANALYSIS OF INVESTIGATIVE WORKUP DONE AMONG CHILDREN HOSPITALIZED WITH FEVER WITH SEIZURES FOLLOWING UNIVERSAL IMMUNIZATION IN TAMIL NADU, 2023

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ABSTRACT

INTRODUCTION : The Universal Immunization Programme (UIP) provides free vaccines against 12 preventable diseases to children across India. Tamil Nadu has achieved high immunization coverage of 90.4%, according to the National Family Health Survey (NFHS). Monitoring Adverse Events Following Immunization (AEFI) is critical, with Tamil Nadu reporting 7,580 AEFI cases in 2020-2021, with around 0.2% of these involving serious adverse events. Fever with seizures, affecting 2-5% of children globally, may follow immunization, though they generally carry a low risk of long-term complications. Accurate diagnosis is crucial to prevent mismanagement. Hence, this study aims to assess investigative practices for fever with seizures post-immunization and identify areas for improvement. To estimate the proportion of children admitted with fever with seizures following routine immunization from January to December 2023 in Tamil Nadu and to assess the investigative work-up of children admitted with fever and seizures following routine immunization in Tamil Nadu

METHODS : This descriptive cross-sectional study uses secondary data of all cases of fever with seizures reported as AEFI in the SAFE-VAC portal in Tamil Nadu during 2023. The collected data were analyzed using Microsoft Excel and IBM SPSS version 29, with results presented in tables and graphs.

RESULTS: Most cases (42.9%) occurred in children aged 1 to 1.5 years, with 54.6% being male. The observed proportion of cases (4.97%) was lower than the expected rate of 10 AEFI cases per 100,000 doses. Haematological and metabolic screenings were commonly performed, while infectious disease tests and advanced imaging were underutilized, suggesting a need for more tailored diagnostic approaches.

CONCLUSION: The study provides insights into the epidemiology and investigative practices for post-immunization fever with seizures in Tamil Nadu. Although comprehensive diagnostic approaches were observed, there is room for standardization and improved protocol adherence.

KEYWORDS : Fever with seizures, Investigative workup, Post-vaccination seizures, Child Health

INTRODUCTION

Universal Immunization Programme (UIP) is a comprehensive vaccination program initiated in 1978 and expanded in 1985 to provide free vaccines against 12 vaccine-preventable diseases to all children across the country.^{1,2} The program aims to reduce morbidity, mortality, and long-term disabilities from these diseases. Under UIP, the government provides vaccination for diseases such as tuberculosis, polio, diphtheria, pertussis, tetanus, hepatitis B, Haemophilus influenzae type b, measles, rubella, Japanese encephalitis, and rotavirus diarrhea. Tamil Nadu has been a leader in implementing the Universal Immunization Programme. It has achieved a coverage rate of 90.4% for routine immunization, according to the National Family Health Survey (NFHS-

5). Tamil Nadu has also introduced newer vaccines, such as the rotavirus vaccine, into its immunization schedule ahead of the national rollout.³ Adverse Events Following Immunization (AEFI) are any untoward medical occurrences that follow immunization and do not necessarily have a causal relationship with the usage of the vaccine.⁴ These events can range from minor side effects, such as fever or pain at the injection site, to more serious adverse reactions.



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Major reactions of AEFI, although rare, can include severe allergic reactions like anaphylaxis, neurological disorders such as Guillain-Barré syndrome and seizures, and other serious complications requiring hospitalization. According to the World Health Organization (WHO), serious AEFIs occur in a small percentage of vaccine recipients and typically involve immediate medical intervention. The rate of serious AEFIs is generally low, with estimates indicating that about 0.1% to 0.5% of vaccinated individuals may experience these serious events. This statistic highlights that while minor side effects are more common, significant adverse reactions also occur.

Monitoring and investigating AEFI is crucial to ensure the safety and continued public confidence in vaccination programs. The World Health Organization (WHO) classifies AEFI into five categories: Vaccine product-related reaction, Vaccine quality defect-related reaction, Immunization error-related reaction, Immunization anxiety-related reaction, and Coincidental event. The National AEFI Surveillance Program monitors and investigates adverse events following immunization in India. During the financial year from April 2020 to March 2021, 36,306 AEFI cases were reported across India, with the majority being minor reactions. In Tamil Nadu, the state has a robust AEFI surveillance system, with 7,580 AEFI cases reported in 2020-2021, mainly consisting of minor reactions and 0.2% of these involving serious adverse events.^{5,6}

The AEFI cases are monitored and reported in the SAFEVAC (Surveillance and Action for Events Following Vaccination) portal that monitors and reports AEFIs in India. The portal serves as a centralized platform for healthcare providers to report any suspected adverse reactions to vaccines. The key features of this portal include Comprehensive data collection, real-time monitoring, Efficient investigation, and Public health decision-making.^{7,8} The cases reported in the portal will then be reviewed in the Causality assessment review meetings. The primary goal of these meetings is to determine whether the reported AEFI is likely to be related to the vaccine or immunization or if it is a coincidental event. This assessment is essential for maintaining public confidence in immunization programs and ensuring the safety and efficacy of vaccines. By conducting thorough and impartial causality assessments, India's AEFI surveillance system helps to identify and address any safety concerns associated with vaccines, ensuring that immunization programs remain safe and effective for the entire population.⁹⁻¹²

Fever with seizures are convulsions that occur in young children in association with fever, usually between the

ages of 1 month and 6 years. These seizures are often brief and are generally not associated with long-term neurological issues.¹³ They may be triggered by various factors, including infections and immunization. Globally, fever with seizures occurs in about 2-5% of all children, and the risk after immunization is generally low and studies consistently show that the benefits of vaccination far exceed these small risks.^{14,15} The data on fever with seizures specific to India is less documented than in Western countries. However, national estimates suggest the incidence aligns with global statistics, with a very small percentage of vaccinated children experiencing it.¹⁶

Fever with seizures is not frequently associated with downstream complications or severe neurologic diseases but still, some of them might need extensive investigations to rule out the other causes and prevent misdiagnosis.¹⁷ Fever with seizures can resemble serious neurological conditions like meningitis, encephalitis, or epilepsy, making diagnostic accuracy vital to ensure timely and appropriate treatment. Misdiagnosis or unnecessary investigations may lead to delayed care, increased healthcare costs, and undue family anxiety. Accurate diagnosis helps prevent missed serious cases and avoids over-treating benign conditions, ensuring optimal resource allocation and better clinical outcomes. While fever with seizures is common, research specifically focusing on those occurring post-immunization is relatively limited. This is significant because improper evaluation can impact individual clinical outcomes and public health strategies. Hence, this study would help assess the current practices of investigative workup among cases of fever with seizures and can help identify areas for improvement and standardization.

OBJECTIVES

1. To estimate the proportion of children admitted with fever with seizures following routine immunization from January to December 2023 in Tamil Nadu
2. To assess the investigative work-up of children admitted with fever and seizures following routine immunization in Tamil Nadu

METHODS

A Retrospective study using secondary data analysis was conducted among cases of fever with seizures reported as adverse events following immunization. The reported data during the year 2023 (January – December) were obtained from the Surveillance and Action for Events following Vaccination portal (SAFE-VAC). The database is based

on the data collected by the Immunization section in the Directorate of Public Health – Tamil Nadu from the medical facilities as a part of the National AEFI passive surveillance. The data was extracted from the case reporting form (CRF), the case investigation form (CIF), and the hospital records of all the cases reported as fever with seizures following immunization during 2023 through the SAFE-VAC portal. The study included all the hospitalized cases of seizures with or without fever following immunization from January 2023 to December 2023. The reported cases involving patients who left against medical advice (LAMA), and those classified as brought dead cases were excluded from the study. The Patient details, vaccine details, type of AEFI event, diagnosis, and hospitalization details were documented using a data extraction sheet and a checklist was developed for the investigations of febrile seizures as per IAP Standard Treatment Guidelines 2022 and Consensus Guidelines on Evaluation and Management of the Febrile Child in India.^{18,19} Official permission to conduct this study was obtained from the Director of Public Health and Preventive Medicine (DPH&PM), Tamil Nadu. The confidentiality and anonymity of the patient's information was maintained. The collected data were entered into Microsoft Excel software and analyzed using IBM SPSS software version 29.

RESULTS

In the study period spanning from January 2023 to December 2023, 119 cases of fever with seizures were reported to the state AEFI surveillance program.

Table 1: Age-wise & Gender-wise distribution of fever with seizure cases reported under AEFI surveillance in Tamil Nadu (January – December 2023)

S.No	Variable	Frequency (N = 119)	Percentage (%)
1.	Age-wise distribution		
	0 – 6 months	32	26.9
	6 months - 1 year	15	12.6
	1 year – 1.5 years	51	42.9
	1.5 years – 2 years	13	10.9
	> 2 years (up to 16 years)	8	6.7
2.	Gender-wise distribution		
	Male	65	54.6
	Female	54	45.4

Footnotes: the data in the table are represented in frequency (N) & percentage (%)

Most (42.9%) of the fever with seizure cases reported following immunization belonged to the age group of 1 year

to 1.5 years when compared to the rest of the age groups together with a majority of males at 54.6 % and females at 45.4% (Table 1).

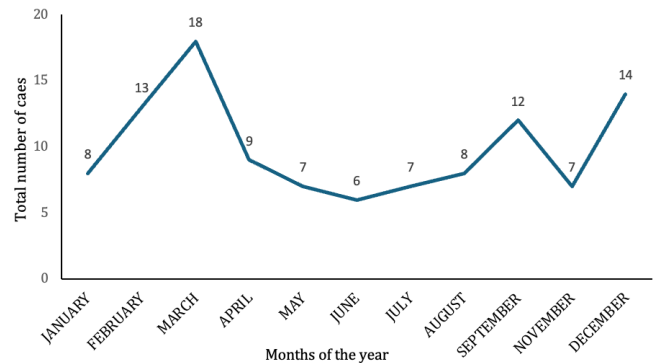
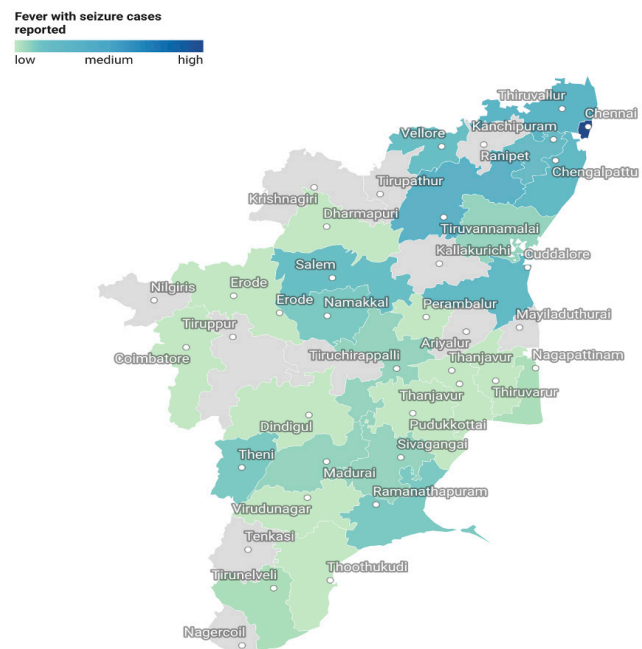


Figure 1: Month-wise trend of reported fever with seizure cases in Tamil Nadu during the year 2023

Figure 1 depicts a steady increase in the frequency of cases from January to March and a slight increase from August to September 2023. The observed cases of fever with seizure following immunization were 119 out of a total of 23,936,827 vaccination doses which when compared to an expected rate of 10 AEFI cases per 100,000 doses (equivalent to 2,394 cases), the observed proportion of fever with seizure cases is approximately 4.97% of the expected rate.



Footnotes: the data in the image are represented in frequency (N) (Low: < 10 cases, Medium: 10-25 cases, High: >25 cases)

Figure 2: District-wise distribution of fever with seizure cases reported in Tamil Nadu from January to December, 2023

Table 2: Frequency distribution of the vaccination details and adverse events of the reported fever with seizure cases in Tamil Nadu, 2023

S.No	Variable	Frequency (n)	Percentage (%)
1.	Place of vaccination		
	Outreach	61	51.3
	Government health facility	56	47.1
	Private health facility	2	1.7
2.	Source of vaccine supply		
	Government supply	117	98.3
	Private supply	2	1.7
3.	Duration between vaccination and the development of the first symptom		
	< 1 week	115	96.6
	> 1 week	4	3.4
4.	Duration between the development of symptom and hospitalization		
	Within 24 hours	103	86.6
	< 7 days	11	9.2
	> 7 days	5	4.2
5.	Place of hospitalization		
	Government	104	87.4
	Private	15	12.6
6.	Duration of hospital stay (days)		
	1 – 3	54	45.4
	4 – 6	39	32.8
	7 – 9	17	14.3
	> 10	9	7.6
7.	Outcome of the patient		
	Recovered completely	116	97.5
	Death	3	2.5

Footnotes: the data in the table are represented in frequency (N) & percentage (%)

Figure 2 illustrates the district-wise distribution of reported fever with seizure cases following universal immunization in Tamil Nadu during 2023. Overall, the distribution reflects varying intensities of reported cases across Tamil Nadu, with Chennai showing a notably higher number of incidents.

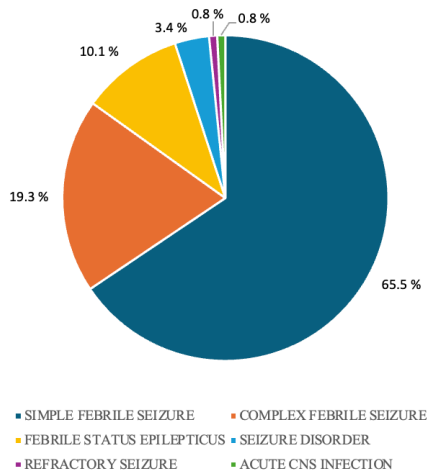


Figure 2: Distribution of Types of Seizure Diagnoses Among Children Hospitalized with Fever and Seizures Following Universal Immunization in Tamil Nadu – 2023

The highest proportion of vaccinations occurred

through outreach programs (51%), followed by vaccinations at Government Health Facilities (47%) and Private Health Facilities (2%). Among the fever with seizure cases reported following immunization, the majority source of vaccine supply was the government (98.3 %). Most cases (96.6%) developed symptoms within the first week after vaccination, while only 3.4% exhibited symptoms more than a week later. Regarding hospitalization, 87.4% of cases were treated at Government Facilities, and 12.6% received care at Private Health Facilities. Nearly 86.6% of the cases were hospitalized within 24 hours of symptom onset. Regarding hospital stays, most children (45.4%) were discharged within 1 to 3 days. About 32.8% required a hospital stay of 4 to 6 days, while 14.3% needed hospitalization for 7 to 9 days. Extended hospitalizations were less common, with 7.6% of cases requiring stays of more than 10 days. Of the total cases, 116 children (97.5%) fully recovered, but unfortunately, 3 cases (2.5%) resulted in death. The three deaths were categorized under causality classification Category C, indicating that they were due to coincidental underlying or emerging conditions, or conditions caused by factors unrelated to the vaccine. The specific diagnoses associated with these cases included status epilepticus, refractory seizures, and sepsis.

Almost 14% percent of children had a prior history of similar reaction events, while the majority, 85.7 % of children, had no such history. Almost none of the children had a history of allergies, while 1.7% were unaware of their allergy status. A proportion of children had a pre-existing illness (10.9%), had experienced an acute illness within 30 days before vaccination (5.9%), had a known family history of disease (5.0%), were on concomitant medication at the time of vaccination (4.2%), and had been hospitalized in the 30 days preceding vaccination (1.7%).

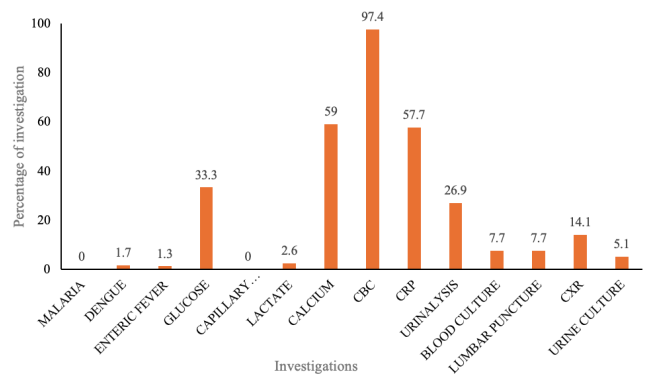


Figure 3: Distribution of Investigations Performed in Simple Febrile Seizure Cases Among Hospitalized Children Following Universal Immunization in Tamil Nadu, 2023

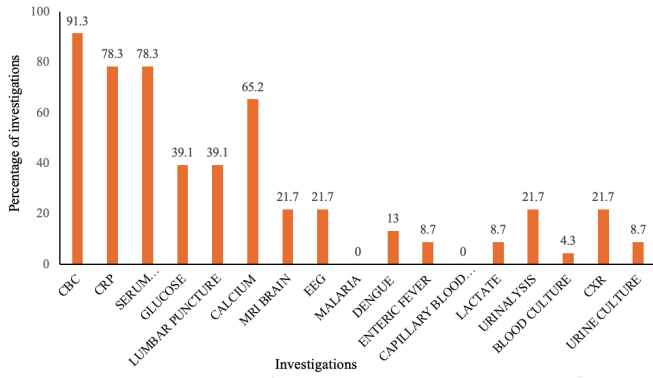


Figure 4: Distribution of Investigations Performed in Complex Febrile Seizure Cases Among Hospitalized Children Following Universal Immunization in Tamil Nadu, 2023

Table 3: Frequency distribution of investigations performed in febrile status epilepticus and other diagnosis among hospitalized children following Universal Immunization in Tamil Nadu, 2023

S.No	Investigations	Febrile Status Epilepticus (n = 12)	Others (n = 6)
1.	CBC	12 (100)	6 (100)
2.	CRP	8 (66.7)	5 (83.3)
3.	Serum electrolytes	11 (91.7)	5 (83.3)
4.	Glucose	3 (25)	3 (50)
5.	Lumbar puncture	5 (41.7)	3 (50)
6.	Calcium	11 (91.7)	5 (83.3)
7.	MRI brain	3 (25)	3 (50)
8.	EEG	3 (25)	1 (16.7)
9.	Malaria	0	0
10.	Dengue	0	1 (16.7)
11.	Enteric fever	0	1 (16.7)
12.	Capillary blood gas	0	1 (16.7)
13.	Lactate	1 (8.3)	4 (66.7)
14.	Urinalysis	4 (33.3)	2 (33.3)
15.	Blood culture	1 (8.3)	3 (50)
16.	Chest X-Ray	2 (16.7)	3 (50)
17.	Urine culture	2 (16.7)	0

Footnotes: the data in the table are represented in frequency (N) & percentage (%) (Other diagnoses include seizure disorder, Refractory seizure, and Acute CNS infection)

The majority, 65.5%, were diagnosed with simple febrile seizures. Complex febrile seizures accounted for 19.3% of cases, while febrile status epilepticus was observed in 10.1%. Seizure disorder was noted in 3.4% of the children. Both refractory seizures and acute CNS infections were rare, each contributing to 0.8% of cases.

Figures 3 and 4 represent the distribution of investigations performed in cases of simple and complex febrile seizures among hospitalized children following universal immunization. The frequency distribution of investigations performed in febrile status epilepticus and other diagnoses are represented in Table 3 which shows the most performed investigations and the least performed investigations.

Table 4: Range of investigations performed in fever with seizure cases according to their diagnoses in Tamil Nadu, 2023

S.No	Diagnosis	No. of investigations	Frequency (N)	Percentage (%)
1.	Simple febrile seizures (n = 78)	0 - 5	11	47.8
		6 - 10	12	52.2
		Total	23	100
2.	Complex Febrile Seizures (n = 23)	0 - 5	11	47.8
		6 - 10	12	52.2
		Total	23	100
3.	Febrile Status Epilepticus (n = 12)	0 - 5	7	58.3
		6 - 10	5	41.7
		Total	12	100
4.	Others (n = 6)	0 - 5	1	16.7
		6 - 10	4	66.7
		> 10	1	16.7
		Total	6	100

Footnotes: the data in the table are represented in frequency (N) & percentage (%) (Other diagnoses include seizure disorder, Refractory seizure, and Acute CNS infection)

Table 4 depicts, that in simple febrile seizures, 92.3% of the cases had undergone up to 5 investigations and the remaining 7.7% of the cases had about 6 – 10 investigations performed to find out the focus of fever. Whereas in the case of complex febrile seizures and febrile status epilepticus the percentage of investigations was almost equally split between both ranges. The category with the remaining diagnosis had the majority of cases undergo about 6 – 10 investigations.

The most performed investigations in Simple febrile seizures were complete blood count (97.4%), serum calcium (59%), and C-reactive protein (57.7%). However, investigations for malaria, dengue, enteric fever, and capillary blood gas were among the less frequently performed investigations. For complex febrile seizures, CBC was performed in 91.3% of cases, while CRP and serum electrolytes were each assessed in 78.3%. Lumbar punctures and glucose tests were conducted in 39.1% of cases. In febrile status epilepticus, CBC was done in all cases (100%), with serum electrolytes and calcium also evaluated in 91.7%. Other investigations included lumbar punctures in 41.7%. In cases such as refractory seizures and acute CNS infections, CBC was conducted in all patients, with serum electrolytes and calcium assessed in 83.3%. These findings reflect the tailored clinical approach to investigations based on the specific seizure type following vaccination.

DISCUSSION

The Assessment of investigative work up in children hospitalized with fever and seizures following immunization in Tamil Nadu reveals several significant findings, which align with and add to the existing literature on adverse events following immunization. Of the 119 cases, 54.6% were male, while 45.4% were female. This male predominance is consistent with other studies on febrile seizures post-immunization, such as the work by Hall et al., which found

a higher incidence of febrile seizures in males following measles, mumps, and rubella (MMR) vaccination.²⁰ Macartney et al conducted a study that found that febrile seizures occur in approximately 4-5 cases per 100,000 doses of the MMR vaccine, which aligns closely with the observed rates in this study.²¹ However, a European study by Schink et al in 2014 has reported higher rates, particularly with the MMRV vaccine, where febrile seizures can occur in up to 9 per 100,000 doses, suggesting regional and vaccine-specific variability. The observed month-wise trend in this study is consistent with findings from a study conducted by Schink et al with peaks aligning with the circulation of seasonal viruses like influenza, which may exacerbate post-vaccination febrile responses.²²

The majority of the vaccines (98.3%) were administered through government sources, sources reflecting the dominant role of public healthcare in delivering immunization services in Tamil Nadu. The strong reliance on public healthcare is indicative of a well-organized Universal Immunization Programme (UIP), which has been effective in increasing vaccination coverage. Similar studies in Andhra Pradesh and Madhya Pradesh reported 95% and 96.7% reliance on public healthcare, respectively, highlighting a national trend.^{23,24} The majority of cases (96.6%) experienced symptom onset within a week of vaccination, a typical timeframe for post-vaccine reactions, aligning with Kulkarni et al. (2018), who found that over 90% of AEFI cases occurred within the first week.²⁵ In contrast, Macartney et al. (2016) noted a slightly broader window of up to 14 days, possibly due to differences in immune response or underlying health conditions among populations. A significant portion of children were admitted to government hospitals (87.4%), with most hospitalized within 24 hours of symptom onset. The median hospital stay was 1-5 days for 71.4% of cases, resulting in a high recovery rate of 97.5%. This favorable outcome can be attributed to timely medical interventions and the effective management of febrile seizures, similar to findings by Verbeek et al.²⁶

Bansal et al. (2020) found that 85% of children recovered within three days, contrasting with our findings, particularly for those hospitalized for 6-10 days.²⁷ The differences in recovery times may be influenced by factors such as the severity of the seizures and associated complications, which could vary based on healthcare access and available treatments. However, Roy et al. (2021) in West Bengal noted that 70% of children were discharged within five days, closely aligning with our results, reinforcing the notion that effective management can lead to quick recoveries.²⁸ Variations

in hospitalization duration may stem from the severity of febrile seizures and differences in regional healthcare systems' ability to deliver rapid diagnostic and therapeutic interventions. Additionally, clinical guidelines for managing post-vaccination febrile seizures may differ by region, contributing to these discrepancies in treatment outcomes. Yavuz et al. (2020) reported that among 300 children with febrile seizures, 60% had simple febrile seizures, 25% had complex febrile seizures, and 5% had febrile status epilepticus, suggesting a similar distribution pattern as compared to our findings.²⁹

Our findings show a high prevalence of complete blood count investigations, which aligns with common clinical guidelines advocating for initial screening in febrile children to rule out hematological causes of fever. This high percentage suggests that physicians prioritize identifying potential infections or hematologic conditions that could contribute to febrile episodes. Calcium levels were assessed in 59% of the children. This aligns with previous literature emphasizing the need to evaluate electrolyte imbalances, especially in cases where the clinical picture suggests potential metabolic derangements. In summary, the investigative practices for simple febrile seizures in this study highlight a significant reliance on hematological and metabolic screening, while underutilizing tests for infectious diseases like malaria and dengue. This suggests a need for more comprehensive protocols to ensure appropriate investigations in cases of febrile seizures, particularly in populations at risk for these infections.

Among children with complex febrile seizures, high rates of complete blood counts (91.3%), C-reactive protein (78.3%), and serum electrolytes (78.3%) were noted, indicating a focus on identifying infections and metabolic disturbances; however, lower rates of advanced imaging (MRI at 21.7%, EEG at 21.7%) suggest these are reserved for atypical cases, aligning with American Academy of Pediatrics guidelines.³⁰ In cases of febrile status epilepticus, a more aggressive diagnostic approach was taken, with 100% undergoing CBC and 91.7% serum electrolytes; lumbar punctures were performed in 41.7% of cases, reflecting concerns for central nervous system infections. Conversely, the low rates of malaria and dengue investigations raise concerns in endemic areas. The other diagnoses such as refractory seizures and acute CNS infections showed similarly high CBC utilization (100%), but lower lumbar puncture (50%) and MRI (50%) rates suggest selective diagnostic strategies. Overall, the emphasis on basic metabolic and infectious evaluations underscores their significance in pediatric seizure management, while the

lower utilization of advanced imaging in specific populations highlights the need for tailored diagnostic approaches.

The regional distribution of cases showed that a substantial portion was from Chennai (26.05%), with fewer cases from other districts. This is consistent with patterns of healthcare access and reporting, where urban areas tend to have better surveillance and healthcare infrastructure, leading to more reported cases.³¹

LIMITATIONS

This study, while robust in its scope, has limitations in terms of its retrospective design and reliance on secondary data. There may be underreporting of milder cases or incomplete documentation of investigations. Future studies could benefit from a prospective design and could aim to include a more detailed breakdown of vaccine types associated with febrile seizures. The study was conducted in a specific region, which may limit the applicability of the findings to other areas with different healthcare systems, or demographic characteristics.

CONCLUSION

This study offers valuable insights into the epidemiology of febrile seizures following immunization in Tamil Nadu. The management of fever with seizures in children following universal immunization necessitates a comprehensive diagnostic approach, as evidenced by the investigation patterns observed in this study in Tamil Nadu. The investigative approach was largely appropriate, although there is room for standardization and adherence to guidelines in specific investigations. These findings reinforce the safety of vaccines, with a high recovery rate.

CONFLICT OF INTEREST

None

REFERENCES

1. Lakshmi, J. K., Nair, M., Tripathy, J. P., Harries, A. D., Hariharan, R., Abejirinde, I. O. O., ... & Rao, S. (2019). Universal immunisation programme in India: the wheels have turned, but can the job be finished? *BMJ Global Health*, 4(Suppl 4), e001569.
2. Ministry of Health and Family Welfare. (2022). Universal Immunization Programme (UIP). Retrieved from [https://main.mohfw.gov.in/organisation/departments/department-health-and-family-welfare/universal-immunization-](https://main.mohfw.gov.in/organisation/departments/department-health-and-family-welfare/universal-immunization-programme-uip)

[programme-uip](https://main.mohfw.gov.in/organisation/departments/department-health-and-family-welfare/universal-immunization-programme-uip)

3. Parashar, U. D., Bresee, J. S., & Glass, R. I. (2013). The global burden of diarrhoeal disease in children. *Bulletin of the World Health Organization*, 91(3), 146-146A.
4. World Health Organization. (2013). Causality assessment of an adverse event following immunization (AEFI): user manual for the revised WHO classification. World Health Organization.
5. Directorate of Public Health and Preventive Medicine. (2021). Annual Report 2020-2021. Government of Tamil Nadu.
6. Ministry of Health and Family Welfare. (2021). National Adverse Events Following Immunization (AEFI) Surveillance Program: Annual Report 2020-2021. Government of India.
7. Ministry of Health and Family Welfare, Government of India. SAFEVAC Portal.
8. <https://safevac.mohfw.gov.in/>
9. National Health Mission, Government of India. Adverse Events Following Immunization (AEFI). <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9970920/>
10. World Health Organization. Adverse Events Following Immunization (AEFI). <https://pubmed.ncbi.nlm.nih.gov/30026925/>
11. Ministry of Health and Family Welfare, Government of India. National AEFI Surveillance and Response Operational Guidelines. <https://mohfw.gov.in/sites/default/files/Revised%20AEFI%20Guidelines%20Execute%20Summary.pdf>
12. World Health Organization. Causality Assessment of Adverse Events Following Immunization (AEFI). <https://pubmed.ncbi.nlm.nih.gov/30026925/>
13. Patel N, Ram D, Swiderska N, Mewasingh LD, Newton RW, Offringa M. Febrile seizures. *BMJ*. 2015;351:h4240.
14. Vestergaard M, Obel C, Henriksen TB, Christensen J, Madsen KM, Ostergaard JR, et al. The Danish National Hospital Register is a valuable study base for epidemiologic

- research in febrile seizures. *J Clin Epidemiol.* 2006;59(1):61-66.
15. Duffy J, Weintraub E, Hambidge SJ, Jackson LA, Kharbanda EO, Klein NP, et al. Febrile seizure risk after vaccination in children 6 to 23 months. *Pediatrics.* 2016;138(1):e20160320.
16. Shankar P, Raghunath CN, Kalra V. Febrile seizures in Indian children: prevalence and risk factors. *J Pediatr Neurosci.* 2014;9(1):17-21.
17. Aaberg KM, Gunnes N, Bakken IJ, Lund Søråas C, Berntsen A, Magnus P, et al. Incidence and prevalence of childhood epilepsy: a nationwide cohort study. *Pediatrics.* 2017;139(5):e20163908
18. Indian Academy of Pediatrics. Guidelines for management of febrile seizures. *Indian Pediatr.* 2022;59(5):325-332.
19. Mahajan P, Batra P, Thakur N, Patel R, Rai N, Trivedi N, Fassel B, Shah B, Lozon M, Oteng RA, Saha A, Shah D, Galwankar S. Consensus Guidelines on Evaluation and Management of the Febrile Child Presenting to the Emergency Department in India. *Indian Pediatr.* 2022;59(8):675-688.
20. Hall JG, et al. Risk of febrile seizures after MMR vaccination: A population-based study. *Journal of Pediatrics.* 2020.
21. Macartney K, McRae J, Buttery J, Crawford N, Gold M, Marshall H, et al. Febrile seizures following measles and varicella vaccines in young children in Australia. *Vaccine.* 2016;34(37): 5272–5278. doi: 10.1016/j.vaccine.2016.07.019.
22. Schink T, Holstiege J, Kowalzik F, Zepp F, Garbe E. Risk of febrile seizures and other adverse events after simultaneous vaccination with measles, mumps, rubella, and varicella: A systematic review. *Vaccine.* 2014;32(29): 3144–3151. doi: 10.1016/j.vaccine.2014.04.032.
23. Jain R, Shrivastava AK, Gupta A. Adverse events following immunization surveillance and vaccine supply analysis in Andhra Pradesh. *Indian J Public Health.* 2020;64(2):162-6
24. Rajendran P, Singh V, Kumari S. Role of public healthcare in routine immunization coverage: Insights from Madhya Pradesh. *J Trop Pediatr.* 2021;67(4)
25. Kulkarni V, Agarkhedkar S, Kulkarni P, Ganjare M, Bhattad V, Dhotre K. Adverse events following immunization: Surveillance in pediatric population. *Indian J Public Health.* 2018;62(1):9-14.
26. Verbeek NE, et al. Long-term outcome of febrile seizures. *European Journal of Pediatrics.* 2016.
27. Bansal S, Singh R, Gupta N, et al. Duration of hospital stay and clinical outcomes in children with febrile seizures post-immunization. *Indian Pediatr.* 2020;57(9):815-819.
28. Roy A, Nandi S, Das A. Adverse events following immunization: hospital admission, duration of stay, and outcomes in a tertiary care hospital in West Bengal. *J Clin Diagn Res.* 2021;15(3)
29. Yavuz A, Ceylan G, Erbatur S, et al. Epidemiological and clinical features of febrile seizures: a multi-center study in Turkey. *Seizure.* 2020;75:78-83. doi:10.1016/j.seizure.2019.11.007.
30. American Academy of Pediatrics, Subcommittee on Febrile Seizures. Febrile seizures: guideline for the neurodiagnostic evaluation of the child with a simple febrile seizure. *Pediatrics.* 2011;127(2):389-394.
31. Patel V, Parikh R, Nandraj S, et al. Assuring health coverage for all in India. *Lancet.* 2015;386(10011):2422-2435.