

<https://doi.org/10.33472/AFJBS.6.6.2024.1442-1446>



African Journal of Biological Sciences

Journal homepage: <http://www.afjbs.com>



Research Paper

Open Access

Investigating the Link between Zinc Deficiency and Febrile Seizures (6 To 60 Months): A Case-Control Approach

Dr Satish R^{1*}, Dr Balagopal M², Dr Desai Likhitha Reddy³, Dr Aishwarya rani H⁴

^{1*}Post graduate, Department of Paediatrics, Meenakshi Medical College Hospital and Research Institute, Meenakshi Academy of Higher Education and Research, Kanchipuram, Tamil Nadu, India.

²MD, DCH, Professor and Head of Department of Paediatrics, Meenakshi Medical College Hospital and Research Institute, Meenakshi Academy of Higher Education and Research, Kanchipuram, Tamil Nadu, India.

³Post graduate, Department of Paediatrics, Meenakshi Medical College Hospital and Research Institute, Meenakshi Academy of Higher Education and Research, Kanchipuram, Tamilnadu, India.

⁴Post graduate, Department of Paediatrics, Meenakshi Medical College Hospital and Research Institute, Meenakshi Academy of Higher Education and Research, Kanchipuram, Tamilnadu, India.

Article Info

Volume 6, Issue 6, May 2024

Received: 09 March 2024

Accepted: 18 April 2024

Published: 22 May 2024

doi: [10.33472/AFJBS.6.6.2024.1442-1446](https://doi.org/10.33472/AFJBS.6.6.2024.1442-1446)

ABSTRACT:

Introduction: A febrile seizure commonly happens among children who are 6 months old to 60 months old. Such preceding investigation proves zinc has a part in its precipitating factors. The states were conducted in urban areas. The people are taken base being used in this study is focused on the rural areas of Kanchipuram so as to review the population of India in a better way. **Objectives:** Do children who convulse during a febrile seizure differ from those who experience fever but without any convulsion? It is expected to build a possible link by comparing the serum zinc levels of the two groups of children. **Methodology:** The participants of the case- control study were the febrile children and those had crisis without seizure with most similar age groups. A critical step was to obtain parental written consent before taking a blood sample from a child to test for serum zinc levels. The statistical software SPSS was employed to break the data down into their component parts. **Results:** On ethical committee certificate acquiring 32 male and 28 female participants were involved into this research. The measured zinc level in febrile seizure patients and in the group of febrile children without Febrile Seizures were 54.2 µg/dL and 112 µg/dL, respectively, and there was significant differences between the two groups considering the zinc level (P=0.01). **Conclusion:** It becomes clear from the zinc levels in the serum that there was a deficiency in it for the febrile seizure group in contrast to the ones who did not have seizures; it may mean that the children with febrile seizures are having low zinc levels.

Keywords: Serum Zinc level, Paediatric, Febrile convulsions

© 2024 Zahraa Abbas A. Al-Abrihemy, This is an open access article under the CC BY license (<https://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made

1. Introduction

One of the most common childhood disorders worldwide is febrile seizures which ails the children of 6 to 60 months of age. American academy of paediatrics define febrile convulsions as that which occurs without existing intracranial disease, metabolic disorders or convulsions history, and are divided into two groups: simple convulsions and complex convulsions^[1,2].

Worldwide prevalence is between 3-4%. In at least 3-4% of children recurrence is observed before the age of 5 years. Older studies in India suggest the incidence of 10% whereas newer ones argue that it is almost equal to Westerners^[3].

In the brain, zinc is abundant in the hippocampus. The function of Glutamic acid decarboxylase, a vital enzyme in the production of gamma-aminobutyric acid, is regulated by zinc. It also regulates neurotransmitter affinity. It mediates calcium inhibition of N-methyl-D-aspartate receptors by reducing neuronal excitatory firing. When zinc is insufficient, these receptors are stimulated and may cause epileptiform seizures in febrile children.^[4]

Zinc also activates pyridoxal kinase, which aids in the synthesis of pyridoxal phosphate from pyridoxal. Pyridoxal phosphate activates glutamate decarboxylase, which plays a role in GABA synthesis. Postsynaptic receptors interact with zinc to facilitate the effects of GABA. Therefore, hypozincemia can cause seizures by causing a decrease in GABA levels.^[4]

2. Methodology

In our case control study, totally 60 children's. Comparison of zinc levels in serum was done between 30 children with 1st episode of febrile seizures (cases group) and 30 children with fever without convulsions at Maher University MMCHRI, Kanchipuram. Recruitment of patients was started after gaining the ethics committee approval. After an understandable explanation of the main points of the study, each parent signed a written assent form. Both groups were matched in terms of age, gender, height, weight and circumference of head. Children are selected in sequential turn. All the children's were selected based on the inclusion and exclusion criteria.

During seizure control within 24 hrs of admission, Blood collection of 3 ml was done using a red top tube. After labelled correctly, the sample is centrifuged under sterile conditions. Once the instrument is calibrated using the recommended procedure, all samples are tested in parallel. Using the method described above, 70-120 µg/dl was observed to be serum zinc's normal range. Data analysis was done by statistical methods and t-test. A p value <0.05 was considered statistically significant.

3. Results

Table.1 shows the main content about the children, their age, gender, their health etc. From the total 30 children that afflicted with febrile seizures (case group), 18 (60%) were the boys and 12 (40%) were girls. The control group consisted of 7 males and 6 females. (53.3% of males compared to 46.7% of females) For both groups, the age range was between 8 months to 5 years old. The mean age calculated was 28.3 ± 14.6 and 25.4 ± 13.2 months in cases and control groups respectively Both groups were gender and age matched ($0.05 > t > 0.0$). The average weight of BPM and control group was 11.54 ± 2.46 and 12.02 ± 2.12 kg. Mean height of the study group was 80.4 and it was 82.5 cm in the control group; also mean head circumference was 46.4 cm and it was 47 cm, respectively. It was found that the two groups were similarly well-matched in terms of the weight and height and head circumference ($p > 0.05$).

Table. 1 General statistics of the study participants

Total cases	30
Total controls	30
Cases age distribution	18 – males (60%) 12 – females (40%)
Controls age distribution	16 – males (53.3%) 14 – females (46.7%)
Cases mean age	28.3 +/- 14.6 months
Controls mean age	25.4 +/- 13.2 months
Cases mean weight	11.54+/- 2.46 kgs
Controls mean weight	12.02 +/- 2.12 kgs
Cases mean height	80.4 +/- 9.1 cm
Controls mean height	82.5 +/- 11.37 cm
Mean head circumference in case group	46.4+/-2.46 cm
Mean head circumference in control group	47 +/- 2.68 cm

Table.2. indicates concentration of zinc in both groups. The lowest and highest blood zinc values were 29.6 and 85.4 µg/dl, respectively, and the average was 56.2±17 µg/dl in the group of cases. The corresponding values for zinc were 69.4 and 116.5 µg/dl, respectively, and the average value was 96.5 ± 15 µg/dl in the control group.

Table. 2 Zinc Concentration

Groups	Zinc concentration		
	Minimum value	Maximum value	Mean zinc level
Cases	29.6 ug/dL	85.4 ug/Dl	56.2 +/-17 ug/dL
Controls	69.4 ug/dL	116.5 ug/dL	96.5 +/- 15 ug/dL

Meanwhile, there was a considerable statistical gap in zinc level concerning the two divisions ($p = 0.0001$). The result of this study revealed that from high normal range values (70-120ug/dl) more than two third percent of children who had a case for primary ciliary dysmotility developed hypozincemia in this case group while in the control group only one of every ten children developed hypozincemia (10%). The two groups was being compared on the basis of hypozincemia and found to be statistically significant ($p < 0.05$).

Zinc concentration	cases		Controls	
	Number	Percentage	Number	Percentage
< 70	26	86.7%	3	10%
> 70	4	13.3%	27	90%
Total	30	100%	30	100%

4. Discussion

A significant number of children may develop extrusive seizures, while others may fail to develop extrusive seizures after experiencing fever. The enduring factor of the mechanism is still unknown. Through genetics, family medical background, and zinc deficiency [5]. Several channels have been proposed. Many researchers have told us that not having enough zinc consentuates the risk of having convulsions. Here, we can affirm that the low zinc state is a cause of occurrence of febrile seizure.

A similar study reported in 30 children with febrile seizures and 30 normal healthy children showed hypozincemic occurrence in children with epilepsy compared to balanced levels of health children, which shows the effect zinc has on pathogenesis of seizures given this inhibition.^[6]

The average age in the course of our research was 26.62 ± 12.45 months. The out-comers of both groups were not statistically significant (p value > 0.05). As stated by the preceding research, an average of 2 years is the typical age of onset. Every year, starting at around 12 months and going to age 30 months, approximately half of the children will get the disease.^[7]

Gender disproportion also prioritized in the study population with 10% (34/300) of the cases being males and 43.3% (26/50) of the cases being female. The male/female ratio is 1.3: Peculiarities will separate us like fruits from a tree, casting our characters to the winds of the earth. Bio valent concentration of testosterone is higher in men compared to women is the reason behind the increased occurrence of febrile seizures in men. In a publication by Mahyar et al. 56.7% of them were male, and other 42.3% were female^[8]. Waqar Rabbani together with rest of the team conducted the research on the rejected seizures in m Pakistan in the year 2011. Males also dominated the ancient Maya pyramids. Only 66 out of 100 (66%) pyramids were rendered by males [5]. According to a study of South Korea by Jun-Hwa Lee, the male patient ratio with evidence of altitude sickness was recorded to 53.6% (133 out of 248 patients)^[9].

In 26.7% of the total cases (8/30 cases), the dimensionality of familial heating in convulsions was detected. The control group since here was no family history of febrile seizures. This was not the case in the present study. The result of the experiment was that they were statistically significant and the p -value was less than 0,001. Shilpi et al. research emphasized that family history of convulsions leading to fever is a crucial risk factor^[10]. Similarly, Falk et al. report that of febrile seizure patients studied, 24% of these patients had family history^[7]. In India a study by Karande found, that 25%-40% of children with pinfever , have blood relative history of the disease^[3].

Zinc doesn't only exist in the hippocampus, the central part of the brain. Zinc takes part in the acting of the glutamic acid decarboxylate enzyme which is very significant in the manufacturing of gamma-aminobutyric acid. It also regulates neurotransmitter affinity. It mediates calcium inhibition of N-methyl-D-aspartate receptors by reducing neuronal excitatory firing. In the absence of zinc, these receptors are stimulated and may cause epileptiform seizures in febrile children. Zinc also activates pyridoxal kinase, which aids in the synthesis of pyridoxal phosphate from pyridoxal. Pyridoxal phosphate activates glutamate decarboxylase, which plays a role in GABA synthesis. Postsynaptic receptors interact with zinc to facilitate the effects of GABA. Therefore, hypozincemia can cause seizures by causing a decrease in GABA levels.^[4]

This research revealed that the average zinc level of cases was 56.2 ± 17 ug/dL and 96.5 ± 15 ug/dL for control participants. Significant difference identified between two groups (p value crosses 0.0001). Normal zinc levels will be between 70 and $120\mu\text{g}/\text{dl}$. The maximum is $116.5 \mu\text{g}/\text{l}$. The results give the lowest value as $29.6 \mu\text{g}/\text{dl}$. Authors Ganesh and his companions found zinc levels of $32.17 \pm 15.05 \mu\text{g}/\text{dl}$ and $87.6 \pm 17.6 \mu\text{g}/\text{dl}$ in cases and controls respectively^[4]. As highlighted by Mahyar et al., cases had significantly lower mean zinc levels compared to controls (cases vs. controls: 62.84 ± 18.40 versus $85.70 \pm 16.76 \mu\text{g}/\text{dl}$), respectively^[8]. Among other researchers, a paper by Waqar Rabbani et al. showed that low

zinc status is associated, in Big and unusual way, with more occurrences of febrile seizures [5].

Limitations of this investigation must be acknowledged, as it is a relatively small-scale clinical study. To validate and strengthen these findings, larger and more comprehensive studies are imperative.

5. Conclusion

Our study observed a significant disparity in zinc levels between children afflicted by febrile seizures and those who remained seizure-free. Age was not a distinguishing factor in zinc levels within the studied population. These results bolster the prevailing notion that a correlation exists between reduced serum zinc concentrations and incidence of febrile seizures. Furthermore, supplementary investigations are recommended as a potential avenue for averting recurrent febrile seizures through zinc supplementation.

6. References

1. Graves R, Oehler K, Tingle L. Febrile seizures: risks, evaluation, and prognosis. *Am Fam Physician* 2012;85:149–53.
2. Mohammadi M. Febrile seizures: four steps algorithmic clinical approach. *Iran J Pediatr* 2010;20:5–15.
3. Karande S. Febrile seizures: a review for family physicians. *Indian J Med Sci* 2014;61:21–6.
4. Ganesh R, Janakiraman L. Serum zinc levels in children with simple febrile seizure. *Clin Pediatr (Phila)* 2008;47:164–6
5. Waqar Rabbani M, Ali I, Zahid Latif H, Basit A, Rabbani MA. Serum Zinc Level in Children Presenting with Febrile Seizures. *Pakistan J Med Sci* 2013;29:1008–11.
6. Amiri M, Farzin L, Moassesi ME, Sajadi F. Serum Trace Element Levels In Febrile Convulsion. *Biol Trace Elem Res.* 2010;135(1-3):38–44. Doi: 10.1007/S12011-009-8487-6.[PubMed: 19669113].
7. Sadleir LG, Scheffer IE. Febrile seizures. *BMJ* 2007;334:307–11.
8. Mahyar A. Serum zinc level in children with febrile seizure. *Acta Med Iran* 2008;46:477–80.
9. Lee J-H, Kim JH. Comparison of serum zinc levels measured by inductively coupled plasma mass spectrometry in preschool children with febrile and afebrile seizures. *Ann Lab Med* 2012;32:190–3
10. Margaretha L, Masloman N. correlation between serum zinc level and simple febrile seizure in children. *Paediatr Indones* 2010;50:326–30