



A STUDY OF ASSOCIATION OF LOW IRON STATUS AND FEBRILE SEIZURES IN CHILDREN AGED 6 MONTHS TO 60 MONTHS

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ABSTRACT **Background:** Febrile seizures are the most common type of childhood seizures. The peak incidence is at 18 months of age. Iron deficiency alters the development of the hippocampus, neurons, delayed myelin maturation, slowing of auditory and visual evoked potentials, impairment of energy metabolism, alteration in synaptic neurotransmitter which lessens the seizure threshold. These effects are aggravated during febrile episodes thereby increasing the risk of occurrence of febrile seizures. **Objective:** To know the association between low iron status with or without anemia and febrile seizures. **Results:** A total of 111 children with febrile seizures were taken into study. Among them, 68 children (61.1%) had low serum iron levels and 43 (38.7%) children had normal serum iron levels. Iron deficiency anemia was found in 46 (41.4%) of them. **Conclusion:** Low iron status even without the development of anemia increases the risk of febrile seizures through various nonhematological manifestations of iron deficiency.

KEYWORDS : Febrile, Iron, Ferritin, Seizures, Anemia

INTRODUCTION

Febrile seizures are the commonest type of childhood seizures, seen in 2 to 5% of neurologically normal children.¹ It is defined as a seizure that occurs with fever without CNS infection and dyselectrolytemia in children of age 6 to 60 months without previous history of afebrile seizures.²

About 46 to 66 % of children < 5 years are anemic and iron deficiency constitutes about 50 %. The most common presentation of iron deficiency is anemia.

The current study was done to find an association of low iron status and febrile seizures in children of age 6 m to 60 months by measuring serum ferritin, hemoglobin levels and analyzing the number of children with normal and low iron status and iron deficiency with or without anemia.^{3,4}

PATIENTS AND METHODS :

A hospital-based observational study was conducted at the Department of Paediatrics, Tertiary care Hospital, Government general hospital, Kakinada over a period of 18 months from 1st January 2020 to 30th June 2021.

STUDY POPULATION:

All infants and children between 6 months to 60 months age admitted to tertiary care hospital GGH Kakinada with febrile seizures.

INCLUSION CRITERIA:

All infants and children between 6 months to 60 months age with febrile seizures admitted to tertiary care hospital, GGH Kakinada.

EXCLUSION CRITERIA :

- Children with developmental delay
- CNS infection
- history of nonfebrile seizures
- Multisystem diseases
- Underlying malignancies
- Hemolytic anemias.

TABLE 1: HEMOGLOBIN LEVELS IN CHILDREN WITH FEBRILE SEIZURES

HEMOGLOBIN LEVEL	NO. OF CASES	PERCENTAGE	Mean HB
>11.5	26	23.4%	9.97 +/- 1.69 Gm/dl.

10-11.5	26	23.4%	
8.1 to 10	41	36.9%	
6.1 to 8	17	15.4%	
<6	1	0.9%	

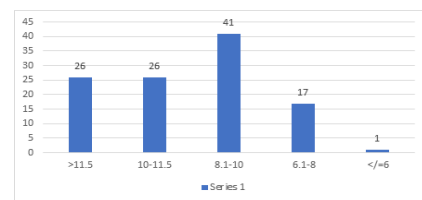


FIGURE 2:

- Among 111 children, according to hemoglobin values, 26 children (23.4%) had >11.5 gm/dl, 26 children had hb values between 10.1 to 11.5 gm/dl, 41 children had hb values between 8.1 to 10 gm/dl, 17 children had hb values between 6.1 to 8 gm/dl and 1 child had hb value of 6 gm/dl. The mean hemoglobin value was 9.9 +/- 1.69 gm/dl in this study.

Table 2: SERUM FERRITIN LEVELS IN CHILDREN HAVING FEBRILE SEIZURES

S.FERRITIN	No.Of cases	Percentage	Mean
Low (<30 ng/ml)	68	61%	29.6 +/-5.4 ng/ml
Normal (>30 ng/ml)	43	39%	

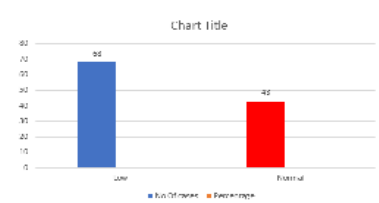


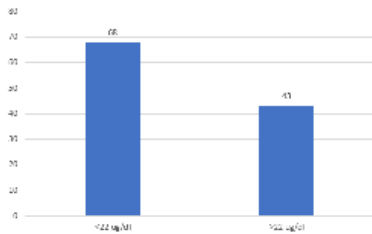
FIGURE 2:

Among the study population, 68 children (61%) had low s.ferritin levels, 43 children (39%) had normal s.ferritin levels. Mean s. ferritin levels in the current study was 29.6 +/- 5.4 ng/ml.

Table 3: DISTRIBUTION ACCORDING TO S. IRON LEVELS IN CHILDREN HAVING FEBRILE SEIZURES

Table 3

S. iron	No. of cases	Percentage
<22 ug/dl	68	61%
>22 ug/dl	43	39%



Among 111 children, 68 children had low s.iron levels and 43 children had normal s.iron levels. Mean iron value in this study was 39.7 +/- 31.3.

Table 4 : IRON DEFICIENCY IN CHILDREN HAVING FEBRILE SEIZURES

Table 4

	No. of cases	Percentage
With iron deficiency	68	61%
Without iron deficiency	43	39%

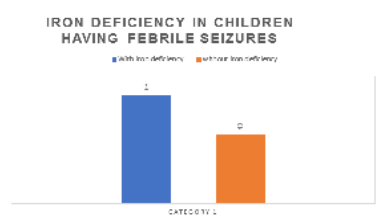


FIGURE 4

Among 111 children, 68 children (61%) had iron deficiency and 43 children (39%) had no iron deficiency.

Table 5 : IRON DEFICIENCY ANEMIA IN CHILDREN HAVING FEBRILE SEIZURES

TABLE 5

	No. of cases	Percentage
With iron deficiency anemia	46	41.4%
Without iron deficiency anemia	65	58.6%

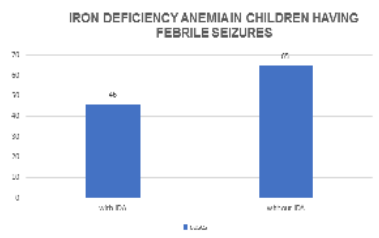


FIGURE 5

In the current study among 111 children, 48 children had IDA and 65 children had no iron deficiency anemia.

DISCUSSION

DEFINITION

The ILAE had defined febrile seizures as ' seizures that occur with febrile illness, without CNS infection or metabolic imbalances, and that occur without prior history of afebrile seizures in children more than 1 month of age. The National Institute of Health (NIH) Consensus Conference had defined Febrile seizures as ILAE except that a febrile seizure is an event usually occurring between 3 m to 5 yrs of age.

CLASSIFICATION

Febrile seizures are of two types, simple febrile seizures, and complex febrile seizures. simple febrile seizure is an isolated, brief, and generalized usually tonic-clonic type, lasting for a duration of <15 min, and does not recur within 24 hours.

A complex febrile seizure is focal/generalized type, multiple (>1 episode), or prolonged, lasting for > 15 minutes duration and recurs within 24 hr. Febrile status epilepticus is defined as a febrile seizure lasting > ½ hour duration.

Hemoglobin levels and febrile seizures.

Nadia Waheed et al ¹⁰ had done a cross-sectional study and found mean hemoglobin value in children who are having febrile seizures was 11.7+/- 1.38 gm/dl and found no association between IDA and febrile seizures.

Kumar TB et al ¹² had done a prospective case-control study and the mean hemoglobin was 9.8 gm/dl. Kunwar Bharat et al ¹¹ had done a prospective control study and found a mean hemoglobin value of 10.86 +/-1.23 gm/dl in cases and 12.72+/- 1.33 gm/dl controls

Study	Mean hemoglobin
Nadia Waheed et al ¹⁰	11.7+/- 1.38 gm/dl
Kumar TB et al ¹²	9.8 gm/dl
Kunwar Bharat et al ¹¹	10.86 +/-1.23 gm/dl
Current study	9.9 +/-1.6 gm/dl

Compared to other studies hemoglobin levels in children who are having febrile seizures in the current study were around 9.9 gm/dl.

Serum ferritin values

According to S.ferritin levels, 68 children (61%) had low s.ferritin levels, 43 children (39%) had normal s.ferritin levels. The average S.ferritin level in the study population was 29.6 +/-5.4 ng/dl. Iron deficiency in the current study did not vary statistically significantly according to gender and age (p value>0.05).

Azhar S Daoud et al ⁸ did a case-control study and found that ferritin levels were significantly lower in cases than in controls. Whether iron supplementation prevents febrile seizures further is not known as there is no follow-up in the current study. Comparable to other studies current study also showed low ferritin levels in more children who are having febrile seizures. Serum ferritin levels in children who are having febrile seizures can be affected during febrile illness because it is an acute phase reactant and in febrile illness, ferritin levels can increase mask the previous low levels.

S. iron levels.

Out of 111 children, 68 children had low s.iron levels and 43 children had normal s. iron levels. In the current study, more number of children had low s. iron levels.

From the above hematological parameters, iron deficiency was seen in 68 children (61%) out of which 46 children (41.4%) had iron deficiency anemia.

In the current study out of 111 children who are having febrile seizures, according to age and gender-wise distribution of iron deficiency, in 6m – 12m, age group 13 males and 7 females had iron deficiency, in 13m-24m age group 20 males and 10 females had iron deficiency, in 25m-36m age group 5 males and 4 females had iron deficiency, in 49m-60m age group 2 males and 1 female had iron deficiency.

In the current study, Iron deficiency state was more common than iron deficiency anemia in children who are having febrile seizures.

Iron deficiency can be controlled by increasing the intake of absorbable iron and controlling infestations and infections that lower hemoglobin levels. Health programs initiated by the government play a key role in preventing iron deficiency and worm infestations.

Iron Intake can be increased by

- a) Fortification of commonly consumed foods with iron.
- b) Increasing the bioavailability of iron in the diets.
- c) Providing iron through medicinal supplementation.

Anemia mukt Bharat is an initiative laid down by the government to

reduce anemia by 3% per year. Biweekly iron (20 mg elemental iron) folic acid (100 ugs) supplementation is given to children aged 6m – 5 years under this program. Such programs can prevent iron deficiency anemia especially for children belonging to low socioeconomic status.

Pisacane et al⁵ had done a case-control study with 146 cases and 293 control, with the age of 6-24 months, reported that significant higher rate of iron deficiency anemia in children with 1 st febrile seizure than control (odd's ratio=3.3, 95% CI of 1.7-6.5).

Kumari et al¹³ had done a study that showed significant association between iron deficiency and simple febrile seizures. The crude odds ratio was 5.34 (CI 3.27- 8.73, P<0.001) and adjusted

The odds ratio in the logistic regression analysis was 4.5 (CI 2.69- 7.53, P<0.001).

A study done in Canada found that children who are having febrile seizures had iron deficiency twice as much as those without febrile seizures (OR, 1.84; 95% CI, 1.02-3.31), but significant difference was not seen in the proportion of anemia between the two.

Vaswani et al⁷ had done a study in which the mean serum ferritin level was low in children with 1st febrile seizures (31.9 µg/l) as compared to controls (53.9 µg/l) (P=0.003) which was significant

However, no significant difference was noted in the mean hemoglobin values of cases (9.4 ± 1.2 g/dL) and controls (9.5 ± 1.0 g/dL) or in the mean value of MCV (P=0.89) and MCH (P=0.71).

Another study conducted by Ravi Bhatia et al⁹ showed that among 27 cases, 18 cases Hb level below 10.5 gms. 18 cases had low serum ferritin level. 12 cases had low MCV levels.

In Majumdar R et al¹⁴ 83 studies mean Hb, MCV and MCH was 8.92 g%, 67.03 fl, 30.66 pg/dl respectively which was significantly low in cases compared to control.

Papageorgiou et al¹⁵ had done a case-control study and found that low serum ferritin was more seen in cases than in controls. In contrast, Amirjalali et al¹⁶ and Bidabadi et al⁶ reported that there was no significant association between iron deficiency and febrile seizures.

In the current study, iron deficiency state was seen in a maximum number of children who are having febrile seizures than iron deficiency anemia.

Ferritin is an acute-phase reactant that can interfere in identifying the association of iron status on febrile seizures. In the current study, ferritin levels were taken at the time of illness and may be elevated falsely. Serum ferritin and iron levels were decreased in a maximum number of children who are having febrile seizures depicting an iron deficiency state. In the current study, iron deficiency state was not always associated with iron deficiency anemia.

Hence low iron status even without the development of anemia increases the risk of febrile seizures through various nonhematological manifestations of iron deficiency.

Conclusions and summary

- A Maximum no. of children who are having febrile seizures have low iron status.
- Mean hemoglobin levels in children who are having febrile seizures was 9.9 +/-1.6 gm/dl.
- Mean s. ferritin levels in children who are having febrile seizures was 29.6 +/-5.4 ng/dl.
- Iron deficiency state was more seen in children who are having febrile seizures than iron deficiency anemia.
- Iron deficiency did not vary significantly according to age and gender.
- Low iron status rather than IDA was more associated with children who are having febrile seizures.
- National programs like Anaemia mukt Bharat can help in improving the iron status of children.
- Screening of children who are having febrile seizures for iron deficiency and supplementing them with iron can be beneficial.

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