Original research article

Assessment of zinc and iron serum levels in children with febrile seizures

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Abstract
Aims and Objectives: The goal of this study is to predict zinc and iron levels in the serum of children experiencing febrile seizures. In order to evaluate these parameters alongside those of children with fever but no convulsions.
Methods: Patients between the ages of 6 months and 5 years old (6-60 months) who met the inclusion criteria and visited the paediatric out-patient department or were admitted to the Department of Paediatrics, Siddhartha Medical College, Vijayawada, Andhra Pradesh, India with fever were included in the study over a period of December 2021 to November 2022.
Results: Cases had a mean age of 22.62 12.45 months, whereas controls were a median of 23.14 15.58 months. There was no discernible change (p-value > 0.05). Males accounted for 54% (27) while females accounted for 46%. (23). The ratio of male to female controls was 1.17:1, with 33 male and 17 female controls (66% male/34% female). P-value > 0.05 indicates lack of statistical significance. The average body temperature of the patients and the healthy volunteers was 101.61 1.31°F and 101.17 0.86°F, respectively. There was no statistically significant difference (p-value > 0.05) between the two groups.
Conclusion: In comparison to febrile children without seizures, those who did experience them had considerably lower iron and zinc levels. As comparison to older children, infants and toddlers had significantly lower levels of serum iron. Zinc levels are generally stable across the lifespan. Seizures were 68.3 times more likely to occur in people with low Iron and Zinc levels.
Keywords: Seizures, zinc levels, iron levels, temperatures

Introduction

One of the most common paediatric crises seen around the world is febrile convulsions. The age range for febrile seizures is between 6 months and 5 years. In the absence of intracranial infection, metabolic instability, or history of afebrile seizures, the American Academy of Pediatrics defines febrile convulsions as seizures that can be either simple or complex [1, 2].

Febrile convulsions occur in 3-4% of the world's population on average. It occurs at roughly the same rate in every region. An estimated 3-4% of children will experience an episode before the age of 5. Around 10% is reported by some research to be the incidence rate in India. However new research shows that the incidence is about the same as in the West [3].

The cause of febrile convulsions was unknown at the time. Convulsions caused by heat and genetic predisposition were among the many postulated explanations. However, the pathophysiology is still unclear. Developmental delay, NICU stays longer than 30 days, a family history of febrile convulsions, viral infections and iron and zinc deficits have all been suggested as potential causes of febrile seizures [1, 4].

The hippocampus, a part of the brain, contains a high concentration of zinc. Glutamic acid decarboxylase is a key enzyme in the biosynthesis of -aminobutyric acid, and its activity is regulated by zinc. Neurotransmitter affinity is likewise controlled by this mechanism. Therefore, it mediates calcium inhibition on N-methyl-D-aspartate receptors, thereby decreasing excitatory discharge in neurons. Epileptiform discharges in children with fever have been linked to zinc deficiency when these receptors are triggered.

Moreover, pyridoxal kinase is activated by zinc, which aids in the conversion of pyridoxal to pyrioxal phosphate. Glutamic acid decarboxylase, an enzyme critical in GABA production, is stimulated by pyridoxal phosphate. Zinc facilitates GABA activity by interacting with postsynaptic receptors. Thus, decreased GABA levels cause seizures in hypozincemia [5].

Iron has a crucial role in brain metabolism. It's also useful for regulating the metabolism of neurotransmitters. An iron deficiency contributes significantly to the onset of febrile seizures [6]. In the

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West, scientists investigated the connection between low zinc levels and febrile convulsions. Yet, there are hardly any researches conducted in India. In this research, we hypothesise that low levels of Zinc and Iron may increase susceptibility to developing febrile seizures.

Material and Methods

Participants in the study ranged in age from six months to five years (6-60 months), attended the paediatric out-patient department or were admitted to the Department of Paediatrics, Siddhartha Medical College, Vijayawada, Andhra Pradesh, India from a period of December 2021 to November 2022, and were considered to meet the inclusion criteria. The study group included fifty patients who had febrile seizures and fifty patients who had fever but no seizures.

In order to prevent bias, the study did not include children with atypical febrile seizures, intracranial infections, taking Zinc and iron supplements, or with electrolyte and metabolic abnormalities. Both the cases and the controls gave their written consent. The digital thermometer's readings were converted to Fahrenheit. The examinations of these children's brains have all come back clean. All patients had a full blood count taken. A red vial containing 3-5 ml of blood was withdrawn from the patient's peripheral vein. The serum was centrifuged off and then frozen at -20 degrees Celsius until the zinc and iron levels could be determined. Stanes laboratory in Coimbatore used Atomic Absorption Spectroscopy (Agilent Technologies 200 series AA) to determine zinc and iron concentrations.

Parents' socioeconomic position was gathered through questions about their occupation, monthly income, and level of schooling. The modified Kuppuswamy scale was used to classify the socioeconomic status of the participants in this study.

Inclusion Criteria

- Babies and young children up to the age of 5.
- A seizure follows a high temperature by no more than 24 hours.
- Epileptic convulsions throughout the body.
- There was no lasting cognitive impairment.

Exclusion Criteria

- Seizures associated with a fever are atypical.
- Infected brain tissue in children who have already been diagnosed.
- Treatment-related zinc and iron supplementation in young patients.
- There has been a shift in the electrolyte equilibrium.
- Disorders of metabolism that run in families.
- Damage to the brain's structure.
- Children suffering from cerebral palsy, intellectual disability, or other neurodegenerative conditions.

Results

Table 1: Characteristics of patients in both groups

	Febrile seizures (n=50)	Fever without seizures (n=50)	p-value
Sex (male: female)	1.17:1		
Male	27	33	>0.05
Female	23	17	
Mean age (in months)	22.62 ± 12.45	23.14 ± 15.58	>0.05
Nutritional status			
Normal	40	40	1.00
Grade I malnutrition	10	10	
Grade II malnutrition	Nil	Nil	
Grade III malnutrition	Nil	Nil	
Grade IV malnutrition	Nil	Nil	
Family history of febrile seizures	11	0	0.002
Mean temperature	101.61 ± 1.31	101.17 ± 0.86	>0.05
Socio economic status			
Upper	1	1	0.782
Upper middle	9	6	
Middle	5	7	
Upper lower	11	15	
Lower	24	21	
Duration of seizure			
<5mins	40		
5-10mins	10		
10-15mins	0		

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One hundred patients were used in the study and were randomly assigned to one of two groups. Fifty children presented to the emergency room or were admitted as inpatients with febrile seizures and fifty children with similar symptoms but no seizures served as controls. There are similarities and differences between the two groups that are outlined in Table 1. Both groups were comparable in age and nutrition.

Table 2: Diagnosis in cases and controls

	Cases (n=50)		Controls (n=50)	
Diagnosis	**Number of patients**	**Percentage**	**Number of patients**	**Percentage**
ARI	35	70%	27	54%
Age	7	14%	10	20%
Viral Fever	7	14%	12	24%
UTI	1	2%	1	2%
Total	50	100%	50	100%

Seventy percent (35/50.0) of the patients in the study group had an acute respiratory infection, whereas 14% (7/50) each had AGE and viral fever. UTI occurred in 2% of patients (1/50). The ARI rate among the controls was 54% (27/50). Twelve out of fifty of the controls, or 24 percent, developed a viral fever. Ten out of fifty of the controls (20%) were old. A urinary tract infection affected 2% of the placebo group (1/50). (Table 2).

Table 3: Age distribution of cases and controls

	Cases (n=50)		Controls (n=50)	
Age Group (months)	**No. of Patients**	**Percentage**	**No. of Patients**	**Percentage**
≤ 24 MONTHS	37	74%	33	66%
>24 MONTHS	13	26%	17	34%
TOTAL	50	100%	50	100%

Around three-fourths (37 of 66) of the patients were younger than 24 months old, whereas about a quarter (13 of 66) were older than 24 months old. Among the total number of controls (33), 66% are children younger than 24 months old, while 34% are children older than 24 months old (Table 3).

Table 4: Mean age in cases and controls

	Cases (n=50)	Controls (n=50)
Mean	22.62	23.14
Standard deviation	12.45	15.58

Cases had a mean age of 22.62 12.45 months, whereas controls were a median of 23.14 15.58 months. There was no discernible change (p-value > 0.05). (Table 4).

Table 5: Gender distribution of cases and controls

	Cases (n=50)		Controls (n=50)	
Gender	**No. of Patients**	**Percentage**	**No. of Patients**	**Percentage**
Male	27	54%	33	66%
Female	23	46%	17	34%
Total	50	100%	50	100%

Males accounted for 54% (27) while females accounted for 46%. (23). The ratio of male to female controls was 1.17:1, with 33 male and 17 female controls (66% male/34% female). The p-value is greater than 0.05, indicating that there is no statistically significant difference between the groups (Table 5).

Table 6: Temperature in cases and controls

	Cases (n=50)	Controls (n=50)
Mean	101.61	101.17
Standard Deviation	1.31	0.86

The average body temperature of the patients and the healthy volunteers was 101.61 1.31°F and 101.17 0.86°F, respectively. The p-value for the difference between the two groups was greater than 0.05, indicating that it was not statistically significant (Table 6).

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Table 7: Family History of Febrile Seizure

	Cases (n=50)		Controls (n=50)	
Family H/O Febrile Seizure	**No. of Patients**	**Percentage**	**No. of Patients**	**Percentage**
Present	11	22%	0	0%
Absent	39	78%	50	100%
Total	50	100%	50	100%

Table 8: Family History of Febrile Seizure Actual Values

Actual Values			
Family H/O Febrile Seizures	**Case**	**Control**	**Total Patients**
Present	11	0	11
Absent	39	50	89
Total	50	50	100

Table 9: Family History of Febrile Seizure Expected Values

Expected Values			
Family H/O Febrile Seizures	**Case**	**Control**	**Total Patients**
Present	5.5	5.5	11
Absent	44.5	44.5	89
Total	50	50	100

Table 10: Chi Test p-value

Chi Test p-value	0.002
Chosen significance value	0.05

There was a history of febrile seizures in the family in 22% of the patients (11/50). The control group did not have a history of febrile seizures in their family. This difference between the groups was statistically significant (p=0.002) (Table 7, 8,9,10).

Table 11: Socio Economic Status

	Cases (n=50)		Controls (n=50)	
Socio Economic Status	**No. of Patients**	**Percentage**	**No. of Patients**	**Percentage**
Upper	1	2%	1	2%
Upper Middle	9	18%	6	12%
Middle/Lower Middle	5	10%	7	14%
Lower/Upper Lower	11	22%	15	30%
Lower	24	48%	21	42%
Total	50	100%	50	100%

Table 12: Socio Economic Status Actual Values

Actual Values			
Socioeconomic Status	**Case**	**Control**	**Total Patients**
Upper	1	1	2
Upper Middle	9	6	15
Middle/Lower Middle	5	7	12
Lower/Upper Lower	11	15	26
Lower	24	21	45
Total	50	50	100

Table 13: Socio Economic Status Expected Value

Expected Values			
Socioeconomic Status	**Case**	**Control**	**Total Patients**
Upper	1	1	2
Upper Middle	7.5	7.5	15
Middle/Lower Middle	6	6	12
Lower/Upper Lower	13	13	26
Lower	22.5	22.5	45
Total	50	50	100

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Table 14: Chi Test p-value

Chi Test p-value	0.782
Chosen significance value	0.05

In the vast majority of these instances (48%), those with lower socioeconomic class were the primary demographic, followed by those with higher lower (22%), upper middle (18%), lower middle (10%) and upper (2%) demographics. 42% of the controls were from the Lower socioeconomic group, followed by 30% from the Upper lower, 14% from the Lower medium, 12% from the Upper middle, and 2% from the Upper social economic group. There was no statistically significant difference between the two groups (p = 0.782). (Table 11, 12, 13, 14).

Table 15: Nutritional status

	Cases (n=50)		Controls (n=50)	
Nutritional Status	**No. of Patients**	**Percentage**	**No. of Patients**	**Percentage**
Normal	40	80%	40	80%
Grade (I)	10	20%	10	20%
Grade (II)	0	0%	0	0%
Grade (III)	0	0%	0	0%
Grade (IV)	0	0%	0	0%
Total	50	100%	50	100%

A majority (40) of the cases were considered to be at a healthy weight, whereas 20% (10 instances) were considered to have grade-I malnutrition. In the control group, eighty percent (40) had adequate nutrition and twenty percent (10) had severe malnutrition. There is no statistically significant difference between the two groups (p-value = 1.00). (Table 15).

Table 16: Mean values of all investigations in cases and controls

	Cases		Controls		
Investigations	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**	**p-value**
Sr. Iron	51.4	37.0	82.3	18.6	<0.0001
Haemoglobin	10.6	0.9	11.6	0.8	<0.0001
MCV	68.7	6.3	76.5	6.5	<0.0001
MCHC	33.1	1.4	33.6	1.1	0.0629
MCH	22.8	2.4	26	2.6	<0.0001
RDW	16.1	1.6	14.3	1.5	<0.0001
Sr. Zinc	49.8	38.6	92.2	33.5	<0.0001

The average amounts of zinc in the blood of patients and healthy people were 49.8 38.6 and 92.2 33.5 g/dl, respectively. Overall, zinc levels were somewhat low. Assuming a 95% confidence interval, the p-value for t = 5.8539 is less than 0.0001. It was quite crucial. The lowest Zinc concentration in the blood was 14 g/dL. Maximum Zinc Concentration: 126 g/dL (Table 16).

Serum iron levels were significantly different between the two groups, with patients having lower levels (514 37) and controls having higher levels (82.3 18.6 g /dl). The average serum iron levels of the patients were significantly lower than those of the controls. The significance level is 0.0001 at a 95% confidence interval of t = 5.2719. The results were substantial enough to be recorded in the statistics. Iron levels ranged from 13 g/dL in the lowest instance to 67.4 g/dL in the highest (Table 16).

Cases had a mean haemoglobin level of 10.6 0.9 gm/dl, while controls had a mean of 11.6 0.8 gm/dl. The significance level was extremely high, with a t-value of 0.0001 (95% confidence interval: t = 5.74) indicating this. Having a haemoglobin level of 8.6g/dL is the lowest ever recorded. The highest level of haemoglobin was 12.2 g/dL. (Table 16).

Cases had a mean MCV of 68.7 6.3 fl, while controls had a mean MCV of 76.5 6.5 fl. With a 95% confidence interval and a t-value of 6.062, the probability of an outcome being chance is less than 0.0001. It was quite crucial. The minimum MCV value was 52.8 fl, while the maximum MCV value was 82.8 fl (Table 16).

The average MCHC concentration was 33.1% 1.4% in the case group and 33.6% 1.1% in the control group. It was found that there was no statistically significant difference between the two groups (P-value is 0.0629). Average MCHC was 30.4%, with a high of 34.6%. (Table 16).

Cases had mean MCH levels of 22.8 2.4pg, while controls had mean MCH levels of 26 2.6pg. The 95% confidence interval for the significance of the value of t = 6.4332 is 0.0001. It was quite crucial. The minimum MCH concentration was 18.2pg, and the maximum was 24.6pg (Table 16).

The average RDW for both cases and controls was 16.1% 1.6%, with cases having a somewhat higher value than controls. The 95% confidence range for the value of t, which is 6.321, yields a p-value of 0.0001. It was quite crucial. RDW reached a maximum of 20.8%. Maximum RDW value was 21%;

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minimum was 15%. (Table 16).

Table 17: Mean values of all investigations in <24 months age group

	Cases		Controls		
Investigations	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**	**p-value**
Sr. Iron	47.09	33.3	80.6	21.07	<0.0001
Haemoglobin	10.4	0.7	11.5	0.8	<0.0001
MCV	68.11	5.5	74.5	6.7	<0.0001
MCHC	32.9	1.4	33.4	1.1	0.098
MCH	22.6	2.3	25.3	2.7	<0.0001
RDW	16.3	1.6	14.6	1.68	<0.0001
Sr. Zinc	49.8	38.6	92.2	33.5	<0.0001

Table 18: Mean values of all investigations in >24 months age group

	Cases		Controls		
Investigations	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**	**p-value**
Sr. Iron	63.5	45.05	85.3	12.57	0.067
Haemoglobin	11	1.32	11.8	0.58	0.032
MCV	70.2	8.2	80.2	4.2	<0.0001
MCHC	33.5	1.4	33.7	1.1	0.544
MCH	23.3	2.5	27.3	1.4	<0.0001
RDW	15.4	1.5	13.6	0.65	<0.0001
Sr. Zinc	49.6	42.1	99.7	35.7	<0.001

The mean serum iron and other red cell indices levels were significantly lower in the 24 month age group compared to the >24 month age group (Tables 17 and 18). Mean values of haemoglobin, MCHC and iron for those older than 24 months were not significantly different from one another. The mean serum zinc levels were considerably lower (p0.0001 and p0.001, respectively) in the 24 month and >24 month age groups.

Table 19: Duration of seizure

Duration of seizure	No of patients	Percentage
<5mins	40	80%
5-10mins	10	20%
>10mins	0	0%

Table 19 shows that eighty percent of seizures (forty out of fifty) lasted less than five minutes, while twenty percent (ten out of fifty) lasted more than five. The mean zinc levels in the 5-10 minute group were significantly lower than those in the 5minutes group. The 5-minute group had significantly lower mean iron and red cell indices than the 5- to 10-minute group. The p-value for the lack of a difference between the groups was significantly greater than 0.0001.

Table 20: Odds ratios

		Cases	**Controls**	**Total**	
Only low Iron	Present	6	4	10	Odds ratio: 1.568 Relative risk: 1.227 p-value: 0.507
	%	60%	40%	100%	
	Absent	44	46	90	
	%	48.9%	51.1%	100%	
Total	Count	50	50	100	
	%	50%	50%	100%	

		Cases	**Controls**	**Total**	
Only low zinc	Present	4	7	11	Odds ratio: 0.534 Relative risk: 0.704 p-value: 0.343
	%	36.4%	63.6%	100%	
	Absent	46	43	89	
	%	51.7%	48.3%	100%	
Total	Count	50	50	100	
	%	50%	50%	100%	

		Cases	**Controls**	**Total**	
Both low zinc and iron	Present	37	2	39	Odds ratio: 68.30 Relative risk: 4.45 p-value: <0.0001
	%	94.9%	5.1%	100%	
	Absent	13	48	61	
	%	21.3%	78.7%	100%	
Total	Count	50	50	100	
	%	50%	50%	100%	

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Low levels of Iron and Zinc were associated with a 68.3-fold (p0.0001) increased risk of febrile seizures in the study population. The hazard ratio is 4.45. The relative risks are 0.704 for low zinc and 1.227 for low iron intake, respectively. Neither one made a big difference.

Discussion

One of the most common paediatric crises seen around the world is febrile convulsions. A child can get febrile seizures anywhere between the ages of 6 months and 5 years [4, 7]. Febrile convulsions occur in 3-4% of the world's population on average. It occurs at roughly the same rate in every region. An estimated 3-4% of children will experience an episode before the age of 5. Around 10% is reported by some research to be the incidence rate in India. Nonetheless, current studies show that the incidence is about the same as in the western population [3]. Febrile convulsions can occur in some children with fever, but not in others. Insight into the underlying mechanism is lacking at now. Genetic predisposition, a history of febrile convulsions in the family, and an iron and zinc deficit were among the postulated causes [8]. Several studies have linked an iron or zinc deficit to an increased likelihood of convulsions. Specifically, we hypothesised that low levels of Zinc and Iron could increase the risk of developing febrile convulsions.

1) Mean age in months

In this analysis, the average participant age was 22.62 12.45 months. Two groups did not differ statistically (p-value > 0.05). According to research done in Chennai, the average age was 23.80 months [5]. In 2006, Mahyar *et al*. conducted a case control study comparing children with febrile convulsions to children who were otherwise healthy. Mean age was 27.13 15.72 months [9] in this study. An further study (Farah *et al*., 2009) found a mean age of 21.2511.53 [10]. In Pakistan, Waqar Rabbani *et al*. found a mean age of 23.9714.45 months [8]. Between August and November of 2009, Ihsan kafadar *et al*. The researchers determined that the typical patient was 16 months old [11]. The average onset age across studies has been shown to be 18 months. There is a peak incidence between 12 and 30 months of age (affecting about 50% of children) [4].

2) Sex

Males accounted for 54% (27/50) of the cases in the research, while females made up 46% (23/50). Overall, there were 1.17 males for every female. Fever-induced convulsions affect males more often than females. According to research conducted by Farah *et al*. [61], only 40% of patients were female while 60% were male. Ganesh *et al*. [5] report no evidence of a male-dominated population. Mahyar *et al*. [9] found that there were 57.7 percent males and 42.3 percent females. Researchers Al- Zwaini *et al*. [12] found that the male-to-female ratio ranged from 1.11 to 4. The 2011 case control research by Waqar Rabbani et al. was performed in Pakistan. About 66% of the youngsters surveyed were boys [8]. Study results from Korea by Jun-Hwa Lee *et al*. [13] found that of 248 cases, 115 (46.4%) were female.

3) Aetiology of fever

Seventy percent (28/50 instances) of the people in the study group had an acute respiratory infection, followed by 14% (four cases) with acute gastroenteritis and 14% (four cases) with viral fever. In 2010, Margareta *et al*. found that acute respiratory infection was the most commonly reported cause of hospitalisation. Sixty percent of the cases, according to research by Tomoum *et al*. [14]. Waqar Rabbani *et al*. [8] observed that upper respiratory tract infection is the most common cause, accounting for 24% of cases. According to research by Jun-Hwa Lee *et al*. [13], acute tonsillo pharyngitis is the most common cause of illness.

4) Degree of temperature as a risk of seizures

The degree of temperature increase appears to be a potential risk factor for the onset of seizures. In the current study, the average body temperature of the patients was 101.61 1.31°F, while that of the controls was 101.17 0.86°F. There was no statistically significant difference (p-value > 0.05) between the two groups. The study by Ganesh *et al*. [5] found that the mean temperature of the patients was 102 degrees Fahrenheit and the controls were 101.4 degrees Fahrenheit. The average body temperature of both patients and controls, as measured by Margareta *et al*. in 2009, was 39.01 0.56 °C [14]. Cases had a mean temperature of 38.30.9 °C, while controls had a mean temperature of 36.50.3 °C, as reported by Jun-Hwa Lee *et al*. It was determined to have statistical significance [13]. In Egypt, Hassan *et al*. discovered that the average body temperature of both patients and controls was 390.5 °C [15].

5) Family history of febrile seizures

In 22% of cases (11/50), a family history of febrile convulsions was found. For example, in the current study's control group, nobody had ever experienced a febrile seizure in the family before. This statistically significant difference between the two groups was found to have a p-value of 0.001.

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Margareta *et al*. conducted a study showing that a history of febrile seizures within the family is a significant risk factor [14]. Researchers Sadleir *et al*. found that in a quarter of kids who had febrile seizures, there was a history of the condition in the family [4]. Twenty-five to forty percent of febrile convulsion children had a family history of febrile convulsions, according to research by karande *et al*. conducted in India [3]. Hassan *et al*. analysed forty cases of febrile seizures in Egyptian children and forty cases of childhood fever. Thirty-five out of forty (87.5%) of the patients had a history of febrile convulsions in their family [15]. Of the patients studied by Ihsan kafadar *et al*. [12], 44.4% had a positive h/o for a history of febrile convulsions in the family.

6) Role of Zinc

The hippocampus, a part of the brain, contains a high concentration of zinc. Glutamic acid decarboxylase is a key enzyme in the biosynthesis of -aminobutyric acid, and its activity is regulated by zinc. Neurotransmitter affinity is likewise controlled by this mechanism. Therefore, it mediates calcium inhibition on N-methyl-D-aspartate receptors, thereby decreasing excitatory discharge in neurons. The stimulation of these receptors in zinc shortage may lead to epileptiform discharges in infants with fever [5].

Moreover, pyridoxal kinase is activated by zinc, which aids in the conversion of pyridoxal to pyrioxal phosphate. Glutamic acid decarboxylase, an enzyme critical in GABA production, is stimulated by pyridoxal phosphate. Zinc facilitates GABA activity by interacting with postsynaptic receptors. Thus, decreased GABA levels cause seizures in hypozincemia [5].

The current investigation found that the mean serum zinc levels of the patients and controls were 49.8 38.6 and 92.2 33.5 g/dl, respectively. A statistically significant (p0.0001) gap was found between the two groups. Zinc levels between 65 and 120 g/dl were considered normal. The highest level was 126 g/dl. The lowest reading was 14 g/dl. The average levels of zinc in patients and healthy people were 32.17 15.05 and 87.6 17.6 g/dl, respectively, according to a study by Ganesh *et al*. [5]. Mahyar *et al*. [9] found that the mean levels of zinc in patients and controls were 62.84 18.40 and 85.70 16.76 g/dl, respectively. Recent research by Waqar Rabbani *et al*. [8] suggests that low zinc levels may contribute to the onset of febrile convulsions. The median levels of zinc were 53 and 93 g/dl in the patients and controls, respectively, in a research by Hassan *et al*. Zinc levels were not significantly different between patients and controls in a research conducted in Turkey by Ihsan kafadar *et al*. [11] (110.4935.03 g/dL vs. 107.1221.66 g/dL).

7) Role of iron

Iron has a crucial role in brain metabolism. It's also useful for regulating the metabolism of neurotransmitters. An iron deficiency contributes significantly to the onset of febrile seizures [6]. Combinations of the following parameters were used to diagnose iron deficiency: haemoglobin levels below 11 g/dl, mean corpuscular volume below 70 fl, mean corpuscular haemoglobin concentration below 31%, mean corpuscular cystatin concentration below 23 pg, serum iron below 65 g/dl, relative diffusion width above 15%, and serum ferritin below 12 ng/ml.

The current investigation found that the mean Iron levels of the patients and controls were 51.4 37.0 and 82.3 18.6 g/dl, respectively. Cases with iron levels below 13 g/dl were rare. Cases reached a peak of 67.4 g/dl. There was a statistically significant contrast between the two groups. Pisicane *et al*. found that compared to controls, patients had considerably lower mean serum iron levels [6]. The average amount of iron in the blood was found to be quite a little lower in leelakumari *et al's* study [6]. Hassan *et al*. [15] found that the median serum iron level in patients was 34 g/dl, while in controls it was 129 g/dl. Results from an Iranian study by Fallah *et al*. indicated that serum iron levels in patients and controls, respectively, were 48.91 22.96 and 75.13 35.57 g/dl. Ghasem *et al*. found that the average levels of iron in both cases and controls were 40.88 22.16 and 43.18 23.35 g/dl. However, there was no statistically significant difference between the groups [16].

The average haemoglobin levels in the patients and controls in the current investigation were 10.6 0.9 and 11.6.1 0.8, respectively. In these cases, the lowest haemoglobin count was 8.6 g/dl. The highest haemoglobin level was 12.2 g/dl. A statistically significant (p0.0001) gap existed between the two groups. The mean haemoglobin levels were substantially lower than in the control group, according to the research by Pisicane *et al*. Leelakumari *et al*. found that both patients and controls had mean haemoglobin levels of 9.4 1.2 gm/dL and 9.5 1.0 gm/dL, respectively. In this investigation, no discernable variation was seen [6]. Hartfield *et al*. found no statistically significant difference between the two groups (11.7 vs. 11.6) [17].

Cases had a mean MCV of 68.7 6.3, while controls averaged 76.5 6.5. A statistically significant (p0.0001) gap existed between the two groups. The range of MCV values was from 82.8 fl to 52.8 fl. Hartfield *et al*. [17] report considerably reduced mean MCV levels when compared with controls (76.6 vs. 77.8). Leelakumari, *et al*. found that while the mean MCV was decreased, it was not statistically significant [6]. Ghasem *et al*. [16] did a study in Iran and discovered that the median mean corpuscular volume (MCV) for both patients and controls was 78.147.35 fl.

The average MCHC concentration was 33.1% 1.4% in the case group and 33.6% 1.1% in the control group. Non-significance in statistical analysis (p-value 0.062). Ghasem *et al*. [16] determined that the average MCHC was 31.461.76 and 31.781.24%.

Cases had mean MCH levels of 22.8 2.4, while controls had mean MCH levels of 26 2.6. This statistically significant difference between the two groups was found to have a p-value of 0.001. The red cell index was shown to be low compared to controls by leelakumari *et al*. [6].

Both cases and controls had higher than average RDWs, with mean values of 16.1 1.6 and 14.3 1.5, respectively. By comparing patients and controls, the average RDW levels were considerably higher in cases (p 0.0001). When compared to controls, Leelakumari *et al*. showed that mean RDW values were considerably greater [6]. Hartfield *et al*. found that the median RDW levels for both cases and controls were 14, while the median RDW levels for controls were 13.9. Hassan *et al*. reported that the mean RDW levels of patients and controls were 16.8 1.3 and 12.7 1.1, respectively. There is a discernable difference [15] according to the statistics.

Zinc, haemoglobin, MCV, MCHC, MCH and RDW were also analysed and compared between the 24 month and > 24 month age groups. Serum zinc levels were found to be nearly same across the two groups. The mean levels of Iron, MCV, MCHC and RDW were all significantly lower in the younger age group than in the older age group.

Low Iron and Zinc levels increased the risk of developing febrile seizures. There was no greater danger if they had low levels of Iron or Zinc compared to the controls.

Conclusions

Both iron and zinc stores were significantly depleted in feverish children who had seizures compared to febrile children who did not. Much lower levels of serum iron were found in infants and toddlers than in older children. Zinc mean levels do not vary significantly with ageing. For those with low levels of both Iron and Zinc, the probability of having a seizure increased by a factor of 68.3.

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