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THE PREVALENCE OF IRON DEFICIENCY ANEMIA IN CHILDREN BETWEEN 5 MOANTHS TO 6 YEARS WITH FEBRILE CONVULSION

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ABSTRACT

Background: The most prevalent form of seizure in children is febrile seizures. Several researches have looked at the link between iron deficient anemia and febrile seizures, with inconsistent findings. Iron deficiency anemia is a risk factor for febrile seizures, as iron has a crucial role in neurological development and function. **Objectives:** To determine the relationship between iron deficiency anemia and febrile seizure in children between 6 months to 6 years of age. **Patients and methods**: This prospective case-control study was carried out on children who visited the Al Salam Teaching Hospital's emergency room and outpatient clinics between October 2024 to April 2025 and were between the ages of five months and six years. Children were divided into two categories: case and control groups. The case group contained 80 patients (children with febrile convulsions), whereas the control group included 40 children (children without febrile convulsions). Hemoglobin (Hb), hematocrit, mean corpuscular volume, mean corpuscular Hb, mean corpuscular Hb concentration, serum iron, serum ferritin, total iron-binding capacity, and transferring saturation were measured in both groups. Children with atypical febrile seizures, signs of central nervous system infection, chronic neurodevelopment problems, previous diagnoses of other hematologic problems, bleeding or coagulation disorders, hematologic malignancy, iron supplementation, gastroenteritis, and very sick children were excluded from the study. **Results**: In this study, children with FS had higher rates of IDA, and this difference was statistically significant (P value < 0.05). There is no statistically significant difference between the two groups in terms of red blood cell (RBC) count in millions, MCHC. However, the case group showed significantly lower levels of Hb, MCV, Hct, and MCH compared to the control group (P value < 0.05). Additionally; there was a significant difference between the groups in terms of SI, TIBC, SF, and transferrin saturation (P-value < 0.05). **Conclusion**: Iron deficiency may have a significant risk factor for febrile convulsions. Iron status testing is suggested in children with FS. Early identification and treatment of iron deficiency may help avoid febrile seizures in children of this age range.

KEYWORDS: Febrile seizure Hemoglobin, Iron deficiency anaemia.

1- INTRODUCTION

According to WHO estimations, anemia is mostly brought on by iron deficiency. Globally, 1.76 billion individuals suffered from anemia in 2019 (prevalence of 23.67%).[1]

Febrile seizure (FS) is occurs in 2–5% of neurologically healthy children. FS is defined as a seizure associated with a febrile illness in the absence of central nervous system (CNS) infections or acute electrolyte abnormalities in 6–60-month-old children without previous afebrile seizures. Febrile seizures are further categorized into simple and complex forms. Complex FS is characterized as a seizure lasting more than 15 minutes that repeats within 24 hours, or a focal seizure.[2,3]

There are several etiological factors for febrile seizures, but iron deficiency has received a lot of attention.[4] Numerous neurotransmitters depend on iron for metabolism, and low iron levels result in decreased aldehyde oxidases and monoamines.[5] Furthermore, cytochrome C oxidase expression, a measure of brain metabolic activity, is downregulated in iron deficiency, has been shown to affect typical behavioral and developmental processes.[6,7]

At least one-third of the world's population suffers from iron deficiency. The most prevalent clinical sign of iron deficiency is anemia, although it can also impact other organs and systems.[8] Iron deficiency may be linked to thrombosis, breath-holding episodes, behavioral

abnormalities, cognitive dysfunction, psychomotor slowness, and pica.[9] These symptoms may be caused by the effects of iron deficiency in the developing brain and mechanisms like altered hippocampal neuron development, impaired energy metabolism, delayed myelin maturation, slowed visual and auditory evoked potentials, and changes in synaptic neurotransmitter systems like norepinephrine, dopamine, glutamate, γ-amino butyric acid, and serotonin. However, fever can exacerbate the detrimental consequences of iron deficiency on the brain.[10,12]

The aim of study is to determine the relationship between iron deficiency anaemia and febrile seizure in children between 6 months to 6 years of age.

2- PATIENTS AND METHODS

This prospective case-control study included 120 children aged 5 months to 6 years who visited Al Salam Teaching Hospital's outpatient clinics and emergency department between October 2024 and April 2025.

The children were categorized into two groups
1. The case group: It included 80 children with FS (first attack and recurrent FS.)
2. The control group: It included 40 febrile children but without seizures at the same age.

Following admission, all children underwent a comprehensive examination to rule out any previous history of epilepsy, developmental delay, neurological deficiency, CNS infection, or gastroenteritis. For all cases and controls, information on age, sex, body temperature at admission, cause of fever, duration between fever onset and convulsion, family history of febrile convulsion, and details of seizure history, including duration, frequency, and type of seizure (simple or complex), were recorded. Seizures lasting more than 15 minutes that occurred more than once in a 24-hour period or had focal characteristics were classified as complex, while tonic clonic seizures or tonic seizures lasting less than 15 minutes without focal symptoms and a brief postictal interval were classified as simple.

The following blood tests were performed to diagnose iron deficiency: serum ferritin level (SF) (measured using VIDAS, Henri-Bourassa West, Canada); serum iron level (SI); total iron-binding capacity (TIBC) (automated using Pictus 700, Budapest, Hungary); mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC); hemoglobin (Hb) level, haematocrit (Hct); and transferring saturation of children.

The following haematological tests were used to identify iron deficiency: SI less than 50 µg/dl, SF less than 12 µg/dl, TIBC greater than 400 µg/dl, transferring saturation less than 15%, MCV less than 74 fl, MCH less than 24 pg, MCHC less than 32%, and Hb less than 11 g/dl.[13,14]

The statistical package for the social sciences (SPSS) version 27 was used to enter and analyze the data. Frequency and percentage were used to express the nominal data. The Student's t-test was used to compare numerical data, which were presented as mean ± SD. P-values below 0.01% were regarded as highly significant, and P-values below 0.05% as just significant.

3 RESULTS

One hundred and twenty children were studied, 80 with FS in the case group and 40 as controls. Children with FS had a significantly higher frequency of IDA (P value < 0.05). As shown in table 3.1.

Table 3.1: Prevalence of iron deficiency anaemia among cases and controls.

Sex	cases		Controls		P-value
	n.	%	n.	%	
Iron deficiency anaemia	52	65	6	16	< 0.05
No iron deficiency anaemia	28	35	34	85	< 0.05

Table 3.2 shows comparison between laboratory characteristics of complete blood count in the two groups indicated no significant difference between the studied groups regarding red blood cell (RBC) count in millions, MCHC. The case group had significantly lower levels of Hb, MCV, and MCH compared to the control group (P value < 0.05). Additionally, the case group had highly significantly lower levels of Hct compared to the control group (P value < 0.01).

Table 3.2: comparison between the two groups regarding their hematological parameters.

Blood indices	Cases		controls		P-value
	Range	Mean ± SD	Range	Mean ± SD	
Hemoglobin (11-14 g/dl)	7.4-12.4	10.1±0.97	9.1-12.5	10.5±0.75	**0.011**
Hematocrit (33-42%)	24.3-34.4	29.1±1.8	27.9-35.1	32.2±1.51	**<0.001**
Red blood cells count (millions)	3.3-4.51	3.91±0.26	3.33-4.41	4.00±0.24	0.728
Mean corpuscular volume (74-89 fl)	68.2-84	73.9±8,8	72.5-88.6	79.9±7.2	**0.023**
Mean corpuscular hemoglobin (24-30 pg)	20.2-29.2	24.4±1.2	24.3-32,1	25.4±2.5	**0.018**
Mean corpuscular hemoglobin concentration (32-37%)	29.3-32.5	30.2±1.2	28.8-35.9	34.1±1.8	0.739

Table 3.3 shows comparison between laboratory characteristics of iron profile in both groups. The study found a significant difference in the levels of SI, TIBC, and transferrin saturation between the groups, in other word; the case group had lower levels of SI and transferrin saturation than the control group, but had higher levels of TIBC (P-value < 0.05). The case group had significantly lower SF levels compared to the control group (P < 0.01).

Table 3.3: Comparison between the two group regarding their serum iron, serum ferritin, total iron-binding capacity, and transferrin saturation.

Variable	Cases		Controls		P-value
	Range	Mean ± SD	Range	Mean ± SD	
Serum iron (50-120 µg/dl	28-80	49.9 ± 9,3	39-95	56.2 ± 9.1	**0.021**
Serum ferritin (12-149 µg/dl	3-45	20.4 ± 9,5	9-67	33.5 ± 20,1	**0.003**
Total iron binding capacity (112-400 µg/dl	95-600	377 ± 140.6	180-500	298.1 ± 94.7	**0.029**
Transferrin saturation (20-25%)	4.2-31.1	16.1 ± 8.9	9.4-36.2	20.5 ± 9.8	**0.038**

4 DISCUSSION

The most prevalent type of seizures in children are febrile seizures.[15] It may have an impact on the standard of family life and make parents anxious.[16] These impacts show as physical, psychological, and behavioral symptoms. It may have a number of adverse effects in life that are caused by parents' lack of appropriate awareness about febrile seizures.[17]

In this study, 65% of cases with febrile seizure have IDA while only 16% of control have IDA. This suggests that iron deficiency could be a significant risk factor for febrile seizures, which is comparable with Alok Khanna et al who found that the incidence of IDA in patients with FSs (48%) as compared to controls (22%).[18] Moreover; the mean haemoglobin level and haematocrit which are markers of iron deficiency anaemia, found in this study to be significantly lower in febrile seizure group compared with control group, in contrast to Abdul-Kareem M. Ali.[19] and Alok Khanna et al.[18] studies. However; further researches are needed to confirm this relationship. Furthermore, the study consistently found that children experiencing febrile seizures tend to have lower Mean Corpuscular Volume and Mean Corpuscular Hemoglobin levels compared to control groups without seizures. These findings confirm the potential link between iron deficiency and febrile seizures. As the MCV indicates the average size of red blood cells, while MCH measures the average amount of hemoglobin in each red blood cell. Khanna et al[18] and S Ghosal[19] showed comparable results.

On the other hand; regarding iron studies, the study found that lower serum iron and transferrin saturation levels were found in the febrile seizure group, while TIBC (Total Iron Binding Capacity) was higher. Additionally, serum ferritin levels were significantly lower in the febrile seizure group compared to the control group. These findings add more confirmation to the potential link between iron deficiency and febrile seizures, as lower levels of iron, transferrin saturation, and ferritin are all indicators of iron deficiency. This is in agreement with Savitri Kuntari et al meta-analysis findings.[20]

5 CONCLUSION

Based on the result of this study, iron deficiency may have a significant risk factor for febrile convulsions. Iron status testing is suggested in children with FS. Early identification and treatment of iron deficiency may help avoid febrile seizures in children of this age range.

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