

Original Research Article

Prevalence of iron deficiency anemia in children with febrile seizures referred to the pediatric clinic of Bu Ali Hospital in Ardabil during 2023-2024

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ABSTRACT

Background: Iron deficiency anemia is the most widespread and common nutritional disorder in the world, affecting about 30% of the world's population. In children, iron deficiency anemia is the most common blood disease during infancy and childhood. This study aimed to investigate the frequency of iron deficiency anemia among children with febrile seizures.

Methods: In this cross-sectional descriptive study, 270 children with febrile seizures participated. Ferritin, hemoglobin, and MCV indices were collected from the blood tests and children's records, coupled with demographic data and documented in checklists. SPSS version 24 was used to examine the data using both descriptive and analytical statistical techniques.

Results: Boys made up 53% of the children in the study. For 50.7% of children, upper respiratory infections were the most common cause of fever, and generalized seizures accounted for 64.8% of all seizures. 11.1% of children had aberrant MCV, while 17% had abnormal hemoglobin. Ferritin levels below 20 indicated that 9.6% of children were iron deficient. Thirty-seven percent of children were iron deficient based on ferritin indices below 20 and abnormal hemoglobin and MCV indices. The incidence of iron insufficiency was significantly correlated with age. The RBC, ferritin, MCV, and hemoglobin means of children who were healthy and those who were iron deficient differed significantly.

Conclusions: The findings of this study demonstrated that iron deficiency may be a risk factor for children to experience seizures after a fever. It is advised that future research be conducted with a larger sample size.

Keywords: Anemia, Infants, Iron deficiency, Seizure

INTRODUCTION

Two to five percent of children get febrile seizures, the most prevalent type of seizure disease in childhood.¹ The most typical onset period is six to sixty months. A positive family history, a fever higher than 38.5, the mother's smoking or alcohol use during pregnancy, and a history of hospitalization in the intensive care unit during infancy are all linked to an increased risk of febrile seizures, though the exact cause of febrile seizures is still

unknown. repeated febrile seizures can occur in subsequent fever episodes; in fact, between 30 and 50 percent of children will experience repeated seizures in later fever episodes.²

Given the comparatively high frequency of febrile seizures and the potential for recurrence, the stressful appearance of these seizures causes parents to become anxious and afraid, which leads to repeated trips to pediatric clinics and the expenditure of time, energy,

material resources, and moral considerations. The factors that contribute to the occurrence of febrile seizures must be identified in order to prevent them. Numerous theories have been put out to explain febrile seizures, such as a decreased seizure threshold brought on by fever, fluid retention and post-fever metabolic changes in the brain, temperature changes in the brain, and an increase in oxygen demand during fever. One of the things that can restrict the flow of blood to different tissues is anemia.³

About 30% of people worldwide suffer from iron deficiency anemia, making it the most prevalent and common nutritional condition in the world. The most prevalent blood condition among infants and young children is iron deficiency anemia.⁴

Iron is a micronutrient that practically every cell in the human body uses. In addition, iron is a cofactor for a number of bodily enzymes and is involved in DNA replication, hormone action, and neurotransmitter synthesis and activity. According to several research, children's and newborns' attention, alertness, and learning are impacted by iron deficiency anemia, or even iron deficiency without severe anemia.⁵

A study by Kadhemi et al demonstrated that there is unquestionably a link between iron supplementation insufficiency and febrile seizures, since iron deficiency anemia is more common in newborns with febrile seizures due to a greater reduction in serum ferritin.⁵

In a study, Habibian et al shown that iron can help children avoid post-febrile seizures, and that a lack of iron likely raises the threshold of neuronal excitation during fever.⁶

METHODS

Between April 2023 and September 2024, 270 children under the age of six who had febrile seizures and were admitted to Bu Ali Hospital in Ardabil participated in this descriptive cross-sectional study. Infants with definite febrile seizures entered in the study and infants with non-febrile seizures (other type of seizures) and also, infants with underlying diseases that impact the anemia status were excluded from the study. The sample size calculated by formula in 95% confidence interval and prevalence of Iron deficiency (15%) and the type one error 0.05. Ferritin and hemoglobin indices, white blood cell count, red blood cell count, MCV, and other laboratory indices were collected from the test sheet and children's file and entered into checklists after blood tests were performed on each child. Based on the goals of the study, the gathered data was statistically examined after being input into SPSS version 21 software. The data in the form of numbers, percentages, and tables were analyzed using descriptive statistical techniques, and the mean and standard deviation indices were computed.

Independent t-test was used to examine the difference between the means of quantitative variables between the two groups, and chi-square test was used to examine the relationship between qualitative variables and the incidence of iron deficiency in children. The significance level in all analyses was considered less than 0.05.

RESULTS

In this study, 270 children less than 6 years of age with febrile seizures were studied. Most of the children, 66 (24.4%), were aged 1 year or younger. The age range of the children ranged from 6 months to 6 years. The mean age of the children was 3.2 years with a standard deviation of 1.7 years. Of the children studied, 53% were boys.

Table 1: Demographic and clinical information of studied infants.

Variables		N	%
Gender	Boy	143	53
	Girl	127	47
Fever reason	Upper respiratory infection	137	50.7
	Gastrointestinal infection	51	18.9
	Lower respiratory infection	39	14.4
	Urinary tract infection	43	15.9
Type of seizure	Generalize	175	64.8
	Focal	95	35.2
Hb	Normal	224	83
	Abnormal	46	17
MCV	Normal	240	88.9
	Abnormal	30	11.1
Both Hb and MCV	Normal	23	8.5
	Abnormal	247	91.5

Table 2: Incidence of iron deficiency in studied infants.

Indices	N	%
Healthy	187	69.3
Anemic iron deficiency	19	7
Non-anemic iron deficiency	64	23.7

Table 3: Descriptive indices of quantitative variables in studied infants.

Variables	Mean	SD	Min	Max
Age	3.21	1.743	1	6
WBC	8820.59	3606.097	3300	24400
RBC	4.4391	61030	3.02	8.00
HB	11.674	1.4102	8.5	14.8
MCV	80.039	8.6668	12.8	99.0
Ferritin	34.96	24.086	5	131

Table 4: Relationship between incidence of iron deficiency with quantitative variables in studied infants.

Variables		Iron deficiency		Health infants		P value
		N	%	N	%	
Type of seizure	Generalize	59	71.1	116	62.0	0.74
	Focal	24	28.9	71	38.0	
Age groups (years)	1-2	40	48.2	70	37.4	0.009
	2-4	28	33.7	48	25.7	
	4-7	15	18.1	69	36.9	
Gender	Boy	47	56.6	96	51.3	0.35
	Girl	36	43.4	91	48.7	
Fever reason	Upper respiratory infection	44	53.0	53	49.7	0.64
	Gastrointestinal infection	16	19.3	35	18.7	
	Lower respiratory infection	16	19.3	23	12.3	
	Urinary tract infection	7	8.4	36	19.3	

Table 5: Descriptive indices of quantitative variables in studied infants in two group with and without ID.

Variables		Mean	SD	P value
WBC	With ID	876.52	3829.677	0.85
	Healthy	8846.81	3512.645	
RBC	With ID	4.2748	0.54530	0.003
	Healthy	4.5120	0.62466	
Ferritin	With ID	13.96	4.275	0.001
	Healthy	44.28	23.387	
MCV	With ID	75.303	8.0424	0.001
	Healthy	82.137	8.1044	
HB	With ID	10.652	1.2555	0.001
	Healthy	12.127	1.2281	

The most common cause of fever in 50.7% of the children was upper respiratory infection and the type of seizure was generalized in 64.8%. 17% of the children had abnormal hemoglobin and 11.1% had abnormal MCV. Simultaneously, 8.5% of the children had abnormal MCV and hemoglobin (Table 1). 9.6% of the children were iron deficient based on ferritin less than 20. Based on ferritin indices less than 20, hemoglobin indices and abnormal MCV, 30.7% of children were iron deficient, of which 23.7% were non-anemic and 7% were iron deficient (Table 2). The mean hemoglobin in children was 11.67 with a standard deviation of 1.4 with a range of 8.5 to 14.8 (Table 3). The association between the incidence of iron deficiency with the type of seizure, cause of fever and gender was not significant, but it was significant with age (Table 4). There was a significant difference between the means of RBC, ferritin, MCV and hemoglobin among healthy and iron deficient children (Table 5).

DISCUSSION

The present study showed that the prevalence of total iron deficiency (anemic/non-anemic) in the children studied was 30.7%, of which 7% of these children had anemic iron deficiency and 23.7% had non-anemic iron deficiency, which was lower than the studies conducted by Bateni and Tatala et al by 53.7% and 50%,

respectively, but higher than the study by Hall et al by 18.7%. The difference in the results of some studies with the present study may be due to different dietary habits and their awareness.⁷⁻⁹ It is also important to note that the rate of anemic iron deficiency in children with febrile seizures in this study was 7%, which was lower than similar studies conducted in this field.^{1,10,11}

In the present study, the mean levels of hemoglobin and MCV, ferritin, and RBC among children with iron deficiency were significantly lower than those without iron deficiency, indicating that the lower the levels of these indicators in children's bodies, the higher the risk of iron deficiency. Similar to the present study, various studies have shown that there is an inverse relationship between age and the prevalence of iron deficiency anemia, meaning that the prevalence of iron deficiency decreases with increasing age. Iron deficiency anemia usually begins at this age and, if not controlled and treated, can occur in adolescence among school-age children. Therefore, it is essential to pay attention to young children, such as the children in the present study, in terms of anemia, to improve nutritional status.^{1,9}

In this study, the prevalence of iron deficiency anemia was the same in boys and girls, which was in agreement with the findings of Derakhshan and Abedini et al, and

also with the study of Wong et al, who concluded that iron deficiency anemia is more common in boys and girls in the age group of infancy and puberty, respectively, but at other ages, the prevalence of this disorder is the same in both sexes, and it can be said that these two sexes require the same level of special attention.¹²⁻¹⁴ In this study, the incidence of iron deficiency in children with focal seizures was 28.9% and 72.1% lower than in generalized seizures, respectively, but the relationship between focal and generalized seizure types and the occurrence or absence of iron deficiency was not significant. In the study by Karbasi et al, the association between the type of focal seizure and the incidence of iron deficiency among the children studied was significant, such that in children with simple focal seizures, it was 37.5% lower than in children with generalized focal seizures with 66.7%.

However, due to the difference in seizure type in the two studies, it was not possible to compare the results of the studies.¹⁵

In the present study, among children with FS, hemoglobin levels, serum iron levels, and serum ferritin levels were lower than in the healthy group of children. However, iron deficiency (48% versus 28%) and iron deficiency anemia (22% versus 10%) were higher in children with FS, which was consistent with other studies.¹⁶⁻¹⁸ However, in the study by Zareifar et al in Shiraz, Iran, iron deficiency as a serum ferritin level below 20 ng/dl was more common in children with FS (56.6% versus 24.8%) and on the other hand, hemoglobin levels were lower in febrile children without seizures than in FS.¹⁰ However, in three other studies in Iran, serum iron and plasma ferritin were higher in FS than in febrile children without seizures.¹⁹⁻²² In several studies from Iran, iron deficiency anemia was less common in children with FS compared with febrile children without seizures.^{19,21} In the Kobrinsky study in Fargo, iron deficiency was less common among children with febrile seizures, but hemoglobin, hematocrit, and MCV were higher. The authors suggested that iron deficiency anemia may protect children from FS.²² In the study by Talebian et al in Kashan, Iran, the risk of FS in anemic children was lower than in non-anemic children.²³ The prevalence of iron deficiency anemia in FS children and febrile children without seizures was not significantly different in three other Iranian studies.²⁴⁻²⁷ Possible explanations for these differences are differences in age, dietary habits, geographical area, sample size, and control group.

CONCLUSION

There is lack of awareness and inadequate knowledge. According to the results of this study, iron deficiency and iron deficiency anemia were more common in children with febrile seizures, and it seems that iron deficiency is an important risk factor for the development of febrile seizures. Assessment of iron status in children with febrile seizures is recommended.

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