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Iron Status in Children Less Than6 Years Suffering from Febrile Convulsionsin Upper Egypt: A Case Control Study

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ABSTRACT

Background: Febrile seizures in pediatric, represent the most common seizure disorder during childhood and exist only in association with an elevated temperature. A youngster between the ages of six months and six years experiences it.Febrile seizure is a benign condition with excellent prognosis and with a recurrence rate of 20 to 30%.

Objective: This research aimed to evaluate the iron status of children aged 6 months to 6 years who were experiencing febrile convulsions in order to determine the effect of iron deficiency anemia in light of the high frequency of both conditions in children.

Methods: Fifty children with febrile seizures (patient group) and fifty healthy children of similar age and gender (control group) participated in this research. The study was carried out from June 2016 to June 2017, in the Outpatient Clinic and Pediatric Department of Aswan University Hospital. The children who underwent laboratory testing ranged in age from 6 months to 6 years.

Results: The current study reported that 56% of cases of febrile convulsions had iron deficiency anemia. Additionally, we discovered that, in contrast to controls, cases of febrile convulsions had lower blood levels of ferritin, hemoglobin, mean corpuscular volume, and mean corpuscular hemoglobin. We discovered that, in contrast to controls, patients with febrile convulsions had higher mean platelet count, total iron binding capacity, and red cell distribution width.

Conclusion: Iron deficiency anemia acts as a possible high-risk factor for development of febrile seizures in children aged from 6 months to 6 years.

Key words: Children, Febrile seizures, Iron deficiency anemia, Risk factor,Upper Egypt.

INTRODUCTION

The term febrile seizures (FS) refers to convulsions that are linked to an elevated body temperature of 38ºC or more in children who do not have an apparent central nervous system illness or an acute electrolyte imbalance[(1)].

FS represent the most common seizure disorders in childhood. It usually affects children between the ages of six months and six years[(2)]. FS reportedlyaffect 2–5% of the pediatric population [(3)].

The exact causeof FS is not known and it is a benign self-limited condition with excellent prognosis and with a recurrence rate of 20 to 30%. Both the parents and the kid may experience psychological trauma as a result of this distressing situation [(4)]. After a simple FS episode the risk to develop epilepsy is 2–3 %[(5)].

The most prevalent nutritional deficit in the world, iron deficiency anemia (IDA), is completely preventable and reversible[(6)].According to World Health Organization (WHO) estimates, between 500 million to two billion individuals worldwide suffer from anemia mostly brought on by iron deficiency. Up to 50% of preschoolers in certain impoverished nations, such as "Egypt," suffer from anemia, which is mostly brought on by an iron shortage[(7)].

Iron is a micronutrient used by roughly all the cells in the human body. In nerve cells iron is essential for the production of myelin and can change the amplitude and the threshold of neurons excitation and also iron is an important cofactor for the metabolism of brain neurotransmitters including norepinephrine, dopamine, gamma amino butyric acid (GABA),glutamate and serotonin[(8)].

The highest incidence of FS occurs between 14 and 18 months of age, which is similar to the 6 to 24 month range for iron deficient anemia[(9)].Regarding the high prevalence of IDA and FS and in children and unclear relationship between IDA and FS as some studies have concluded that IDA as a risk factor for the occurrence of FS [(10-12)].While, other studies did not confirm this relationship [(13-14)].Additionally, IDA may have a preventive impact on the development of FS, according to a few studies[(15-17)].

As the exact etiology for geographical variation can be explained by different genetic predisposition and the effect of environmental factors. The purpose of this research was to ascertain how IDA affects children's FS development in Upper Egypt.

PATIENTS AND METHODS

The research, which used a prospective comparative clinical design, was conducted from June 2016 to June 2017 at the Pediatric Department of Faculty of Medicine,Aswan University Hospital.

Patients: A total of 100 children of both sexes agedsix months to six years were enrolled in the study included 50 patients with historyoffebrile seizures attending in the Emergency Room in an acute attack of febrile

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seizure, or in Outpatient Pediatrics Clinic in Aswan University Hospital having an attack of febrile seizures (patients group) and Fifty age- and sex-matched, healthy kids served as the control group.

Inclusion criteria: Children of both sexes, aged from 6 months to 6 years and having FS.

Exclusion criteria: Any children with family history of epilepsy or any neurological problems, Iron therapy, congenital heart disease, chromosomal abnormalities, inborn errors of metabolism, chronic illness or children with acute bleeding (accident).

Methods: After patient's care-giver signs written approval consent.Detailed Full history was taken and full clinical and blood investigations were done for both patient and control groups. Laboratory investigations includedCBC,serum sodium & calcium.Specific investigations includeserum iron, serum ferritin, and total iron binding capacity.CT Brainimaging, Electroencephalogram (EEG) andlumbar puncture(LP) (in caseofcomplicatedfebrile seizures).A diagnosis of iron deficiency was made using the De Loughery TG criteria[18], which include a hemoglobin value of less than 11 g%, a mean corpuscular volume (MCV) of less than 70 fl, a Mean corpuscular hemoglobin (MCH)less than 27 pg and mean corpuscular hemoglobin concentration less than 32 gm/ dl, a red cell distribution width (RDW) of greater than 15%, a serum ferritin value of less than 7 ng/mL, serum iron < 50 µg/dl, and total iron binding capacity (TIBC) > 430 µg/dl..

Sample processing: From every patient 5 milliliters of venous blood were collected; 2 milliliters were placed on an EDTA tube for a full blood picture, and 3 milliliters were placed on a plain tube for an iron study (estimating TIBC, ferritin levels, and serum iron levels). Complete red blood cell indices evaluation (RBCs count, MCV, Hct, MCHC, MCH, and RDW) has been performed using an automated cell counter (Beckman Coulter DXH520). Serum Iron level, Ferritin level and TIBC have been estimated on automated Chemistry analyzer (Beckman coulter AU 480). Serum sodium level has been estimated on (Easylyte) ion selective electrode. All the laboratory tests were performed in Clinical Pathology Department, Aswan University, Egypt.

Ethical Considerations:For the purpose of taking part in the study, the patients' parents gave written informed consents. PediatricsDepartmentFaculty of Medicine, Aswan University and the Research Ethics Committee of the Aswan University authorized the research's conduct. The research was conducted on compliance with the Declaration of Helsinki, the code of ethics of the World Medical Association.

Statistical analysis

After being confirmed and coded by the researcher, the data were examined utilizing IBM-Statistical Package for Social Sciences (IBM-SPSS/PC/VER 21) analysis software. The distributional differences in the frequency of several risk variables between the two groups were compared utilizing the Chi square test. For normally distributed data, the mean variations in continuous variables between the two groups were tested utilizing the Student t-test.For non-parametric data, the median variations in continuous variables between the two groups were tested utilizing the Mann-Whitney test.For normally distributed data, a one-way ANOVA was computed to examine mean variations in continuous variables across groups.For non-parametric data, a Kruskall-Wallis test was computed to examine median variations in continuous variables between groups. The association between the most prevalent risk variables and the illness state was evaluated utilizing Spearman's Rank association Coefficient. Test findings were deemed significant when the p-value was ≤ 0.05.

RESULTS

Our results showed that there was insignificant variation between FS cases and controls as regards age (p = 0.944), weight (p = 0.185), the mean height (p = 0.663) and sex distributions. (p = 1.000**)** (Table 1).

Table (1): A comparison of demographic data between cases and controls

		Control (No.=50)	Case (No.=50)	P-value
Age in months	**(Mean ± SD)**	30.17 ± 18.34	29.74 ± 19.8	= 0.944
	(Median & Range)	27 (6 - 72)	24 (6 - 72)	
Weight in Kg	**(Mean ± SD)**	12.74 ± 4.02	11.69 ± 3.84	= 0.185
	(Median & Range)	12.5 (7 - 24)	11 (6 - 27)	
Length in Cm	**(Mean ± SD)**	85.60 ± 14.03	84.28 ± 16.11	= 0.663
	(Median & Range)	84 (65 - 120)	84.5 (54 - 120)	
Sex	**Male**	30 (60%)	30 (60%)	
	Female	20 (40%)	20 40%)	= 1.000

Regarding the distribution of risk factors, only 2%were unvaccinated. 30% of cases had malnutrition. Furthermore, 44% of cases had positive history for admission to NICU, 76% were full term and 24% were pre-term (table2).

Table (2): Risk factors distribution among the studied cases of FS

Variable	Category	N = 50
Vaccination	• **No**	1 (2%)
	• **Yes**	49 (98%)
Malnutrition	• **No**	35 (70%)
	• **Yes**	15 (30%)
History of NICU Admission	• **No**	28 (56%)
	• **Yes**	22 (44%)
Gestational Age	• **Full-term**	38 (76%)
	• **Pre-term**	12 (24%)

Regarding seizures' characteristics,the majority of cases (80%), had generalized tonic clonic convulsion,while only 20% had generalized clonic convulsion. The median age of onset of seizures was 18.4 ± 14.2 months. Additionally, ictal period ranged between 5-15 minutes. Likewise, post-ictal period ranged between 2-15 minutes. On the other hand, mean of body temperatureduring fits was 39.3°C ± 0.5°C. About 19 cases (38%) had recurrence. Furthermore, 28 cases (56%) had positive history of febrile convulsion (Table 3).

Table (3): Features of the analyzed instances' seizures

Variable	Category	N = 50
Seizure Types	• **GC**	**10 (20%)**
	• **GTC**	**40 (80%)**
Onset of Seizure in months	• **Mean ± SD**	**18.42 ± 14.29**
	• **Median (Range)**	**12 (6 - 60)**
Ictal Period in Minutes	• **Mean ± SD**	**8.04 ± 3.43**
	• **Median (Range)**	**7.5 (5 - 15)**
Post-Ictal Period in Minutes	• **Mean ± SD**	**6.76 ± 4.21**
	• **Median (Range)**	**5 (2 - 15)**
Temperature	• **Mean ± SD**	**39.3°C ± 0.5**
	• **Median (Range)**	**39.5°C (38 - 41)**
Recurrence	• **No**	**31 (62%)**
	• **Yes**	**19 (38%)**
Family History of FS	• **No**	**22 (44%)**
	• **Yes**	**28 (56%)**

As regards infection types during Fits amongFS group,gastroenteritis (20%)and pneumonia (20%) were the most common types. Also, tonsillitis (16%), otitis media (16%), pharyngitis(8%),urinary tract infection and bronchitis (12%). Measles was the diagnosis in 4% of cases and lastly, hepatitis and septic arthritis occurred in 4% of cases (fig.1).

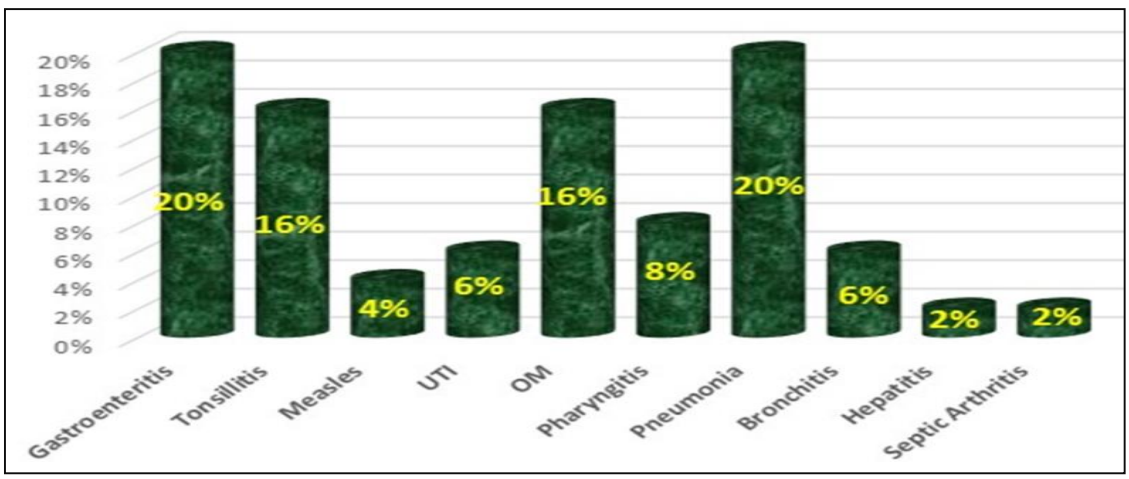


Figure (1): Distribution of infection type during fits of FS (n=50)

There were significantly lower levels of haemoglobin, HCT, mean MCV, MCHC in FS cases than in controls ($p < 0.001$). Additionally,substantially greater level of mean RDW and mean platelet count in FS cases than in controls ($p = 0.026$ and 0,001 respectively). On the other hand, there was no substantial variation between cases of FS and controls regarding mean WBCs count ($p = 0.133$) (Table 4).

Table 4: Comparative Analysis between cases and controls regarding CBC data.

		Case(No.=50)	Control(No.=50)	P-value
HB(g/dL)	**(Mean ± SD)**	10.11 ± 1.5	11.68 ± 1.6	**< 0.001***
HCT(%)	**(Mean ± SD)**	30.47 ± 4.1	34.48 ± 5.2	**< 0.001***
MCV (fl)	**(Mean ± SD)**	69.56 ± 8.2	76.36 ± 11.6	**= 0.001***
MCHC(g/dL)	**(Mean ± SD)**	31.31 ± 3.3	33.26 ± 2.4	**= 0.001***
MCH(pg/cell)	**(Mean ± SD)**	22.03 ± 4.9	24.58 ± 5.6	**= 0.017***
RDW(%)	**(Mean ± SD)**	17.31 ± 2.7	15.99 ± 3.2	**= 0.026***
Platelet(*10^9 /L)	**(Mean ± SD)**	434.8 ± 25.3	245.7 ± 12.9	**< 0.001***
WBCs(*10^9 /L)	**(Mean ± SD)**	10.06 ± 3.9	11.37 ± 4.3	**= 0.133**

The Mann Whitney-U test was utilized to compare the groups' median differences.
The Chi-square test was utilized to examine the variations in proportions among the groups.

There were significantly lower mean serum iron (52.18 ± 36.2) and mean serum ferritin level (158.5 ± 360.7ng/ml) in cases of FS than in controls ($p < 0.001$). Likewise, there was significantly higher TIBC (456.94 ± 194.5) in FS cases than in controls ($p < 0.001$). Number of cases with IDA was28 (56%) and positive family history was28 (56%) that were substantially greater in FS cases than in controls ($p < 0.001$) **(Table 5)**.

Table (5): Comparative analysis between cases and controls regarding iron status data and family history of having febrile seizures

		Case(No.=50)	Control(No.=50)	P-value
Serum Iron (µg/dL)	**(Mean ± SD)**	52.18 ± 6.2	91.62 ± 4.5	**< 0.001***
Serum Ferritin (ng/ml**)**	**(Mean ± SD)**	158.5 ± 36.7	281.39 ± 19.5	**< 0.001***
TIBC (µg/dL)	**(Mean ± SD)**	456.94 ± 94.5	350.18 ± 9.1	**< 0.001***
IDA	**No**	22 (44%)	42 (84%)	**< 0.001***
	Yes	28 (56%)	8 (16%)	
Family History of FS	**No**	22 (44%)	45 (90%)	**< 0.001***
	Yes	28 (56%)	5 (10%)	

In patients' group, there was no substantial variation between cases with IDA 28 (56%) and cases without IDA 22 (44%) as regards recurrence, family history of FS, age of onset of seizures, ictal period and post-ictal period durations ($p<$ 0.308, 0.540, 0.767, 0.158 and 0.831) respectively(Table 6).

Table (6): Comparative Analysis between cases regarding IDA status, Recurrence, family history and laboratory Investigations

		Without IDA(No.=22)	With IDA(No.=28)	P-value
Recurrence	**No**	15 (48.4%)	16 (51.6%)	= 0.308
	Yes	7 (36.8%)	12 (63.2%)	
Family History	**No**	10 (45.5%)	12 (54.5%)	= 0.540
FS	**Yes**	12 (42.9%)	16 (57.1%)	
Age of Onset/m	**(Mean ± SD)**	18.7 ± 14.6	18.2 ± 14.3	= 0.767
Ictal Period inminutes	**(Mean ± SD)**	7.3 ± 2.9	8.6 ± 3.6	= 0.158
Post-ictal Period	**(Mean ± SD)**	6.9 ± 4.3	6.7 ± 4.3	= 0.831

While the recurrence was significantly higher in cases with positive family history of FS ($p= 0.010$) (Table 7).

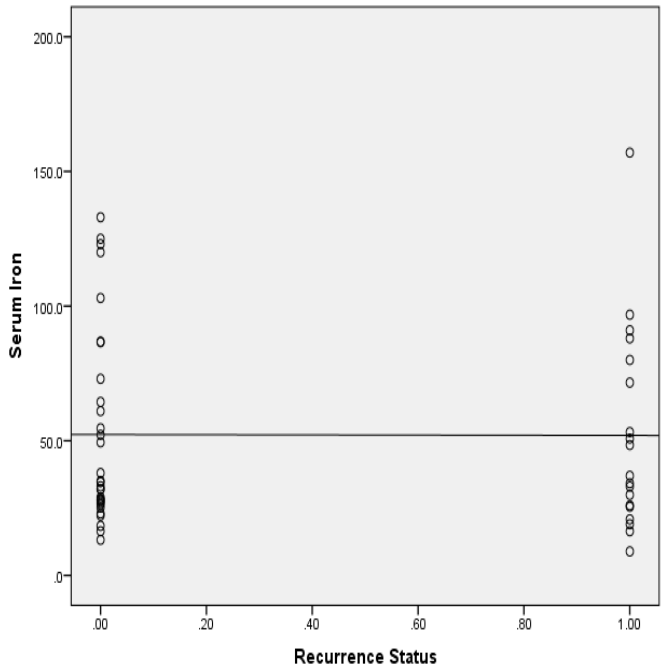
Table (7): Relationship between cases of FS with and without recurrence and family history of FS

		Family history of seizures		P-value
		No (N=22)	Yes (N=28)	
Recurrence	**No**	18 (81.8%)	13 (46.4%)	**= 0.010***
	Yes	4 (18.2%)	15 (53.6%)	

There was non-significant minimal negative correlation ofrecurrence with serum iron level (r = -0.004, p > 0.05). Also there was non-significant minimal negative correlation ofrecurrence ratewithserum ferritin level (r = -0.053, p = 0.359).Unlikely there was non-significant minimal positive connection of recurrence rate with TIBC (r = 0.025, p > 0.05) (Table 8 and figures 2, 3 and 4).

Table (8): Correlations between iron status data among recurrence cases (n=50**)**

	Recurrence	
	Rho	**P-value**
Serum Iron	-.004	= 0.488
Serum Ferritin	-.053	= 0.359
TIBC	.025	= 0.430



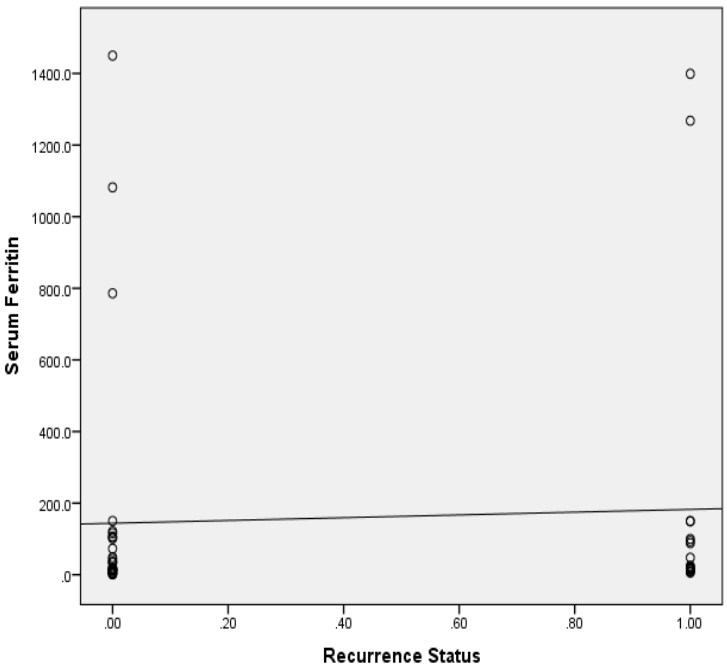
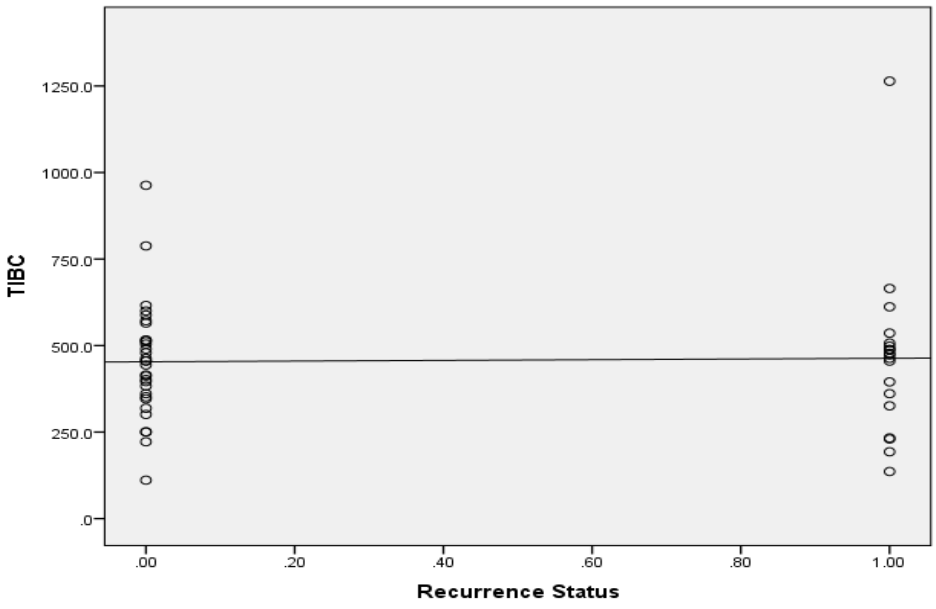


Fig. (2): correlation between recurrence and**Fig.(3):** Serum ferritin levels and recurrence are serum iron levelscorrelated.



Figure(4): Correlation between TIBC levels and recurrence

There was substantially lower mean serum iron leveland serum HB in cases with simple FS and complicated FS compared to controls ($p < 0.001$).There was significantly lower mean serum ferritin level in cases with simple FS compared to controls ($P < 0.036$). There was insignificantly lower mean serum ferritin value in cases with complicated FS compared to controls. In addition, there was statistically significant higher TIBC in cases with simple FSand complicated FS than incontrols (p=0.001).However, There was statistically insignificant lower mean serum iron and mean serum ferritin value in cases with complicated FS compared to cases with simple FS(P =0.258 and 0.702) (Table 9).

Table (9): Comparative analysis between FS (simple and complicated) cases and controls regarding iron status

	Cases with simple FS(No.=40)	**Cases with complicated FS (No.=10)**	**Controls (No.=50)**	**P-value**
Serum Iron (µg/dL)	55.4 ± 7.9 P_1= 0.258	39.3 ± 5.3 **P_2< 0.001**	91.6 ± 4.5 **P_3< 0.001**	**0.001***
Serum Ferritin (ng/ml**)**	150.7 ± 32.4 P_1 = 0.702	189.9 ± 46.1 P_2= 0.364	281.4 ± 19.5 **P_3 = 0.036**	**0.001***
TIBC (µg/dL)	419.4 ± 34.1 **P_1 < 0.001**	607.1 ± 31.5 **P_2 < 0.001**	350.2 ± 9.1 **P_3 = 0.027**	**0.001***
HB (g/dL)	10.3 ± 1.4 P_1 = 0.068	9.3 ± 1.5 **P_2 < 0.001**	11.7 ± 1.6 **P_3 < 0.001**	**0.001***

P1 (simple vs complicated)./ P2 (Complicated vs control)./ P3 (Simple vs Control).
FS cases had significantly higher mean calcium level (10.90 ± 0.4) compared to controls (10.45 ± 0.6). In contrast there was insignificant difference between cases of FS and controls concerningsodium level (p = 0.392)(Table 10).

Table (10): Comparative Analysis between cases and controls regarding serum electrolytes "Na & Ca"

		Case (No.=50)	**Control(No.=50)**	**P-value**
Ca (mg/dl)	**(Mean ± SD)**	10.90 ± 0.4	10.45 ± 0.6	**= 0.006***
Na (mEq/l)	**(Mean ± SD)**	138.7 ± 5.8	136.9 ± 6.8	= 0.392

Cases presented withacute FS had non-significant higher mean serum level of iron,ferritin andTIBCcompared to cases with past FS (p value = 0.582, 0.228 and 0.872respectively) **(**Table 11).

Table (11): Comparative Analysis between cases presented with acute FS andcases presented with past history of FS cases with IDA regarding iron status data.

		Acute FS (No.=16)	**FS in the past (No.=12)**	**P-value***
Serum Iron (µg/dL)	**(Mean ± SD)**	59.32 ± 3.7	43.38 ± 0.2	= 0.582
Serum Ferritin (ng/ml**)**	**(Mean ± SD)**	61.79 ± 1.8	27.66 ± 3.6	= 0.228
TIBC (µg/dL)	**(Mean ± SD)**	487.42 ± 10.3	451.90 ±8.3	= 0.872

DISCUSSION

Recurrent febrile seizures may be predicted by a variety of independent risk factors, including genetics, gender, age, fever, family and developmental history,type and duration of the seizure, multiple seizures, perinatal exposure to antiretroviral drugs, and history of maternal drinking and smoking during pregnancy [18].Thus, the purpose of our research was to determine if IDAand FS in children under the age of six in Upper Egypt are related.

The diagnostic thresholds for iron deficiency that were used in the current investigation [18] included1. Hb level < 11g/dl., 2. MCV < 70 fl, 3. MCH < 27pg. 4. MCHC <32gm/dl, 5. RDW >15%, 6. Sr. Iron < 50 µg/dl, 7. TIBC > 430 µg/dl, 8. Sr. Ferritin < 7 ng/l.

As regards socio-demographic characteristics our study revealed that the mean age of the febrile convulsions cases were younger compared to the controls but that relation was statistically insignificant. This is in agreement with **Boshra*etal*.**[19] that studied IDA as a risk factor for simple FS and found that cases also were younger than controls. However our results disagree with**Kumari*et al*.** [20]who studied ID as a risk factor for FS and found that control group was younger than case group and that difference may be due to different sample size or different age group of the two studies.

According to the gender there was insignificant difference between cases and controls. This is in line with **Khan*et al.*** [21]who studied association between IDAand FS and revealed that cases of males were 58% and cases of femaleswere 42%. Also,this agrees with **Evi*et al*.** [22]who reported that there was evidence that there are gender differences in seizure susceptibility; men are more prone to temporal lobe-like seizures because of elevated testosterone levels. Gender differences in cell proliferation, differentiation, and survival have been linked to the involvement of hormones in neurogenesis, according to research on gender differences in febrile seizures.

According to the possible risk factors of febrile convulsions in our study firstly regarding the malnutrition we found about (30%) of FS cases were malnourished. This is in line with **Kumari*et al*.** [20]who found that the percentage of malnourished children among their febrile seizures cases were 40.3%. But, this is in disagreement with **AbdElrehim*et al.*** [7]who found that eighty percent of the children with febrile seizures were malnourished.This discrepancy may be attributed to the fact that proper central nervous system (CNS) development, aging, and functioning depend on a sufficient nutritional status. When it comes to brain development, micronutrients, such as iron, should be taken into account not only for the organ's growth but also, in particular, for the synthesis of crucial cellular components like proteins and nucleic acids in tandem with neurogenesis and gliogenesis, glial cell and neuron migration, and cellular differentiation. Malnutrition is known to have a negative impact on the maturation and functional development of the nervous system. Therefore, malnutrition may disrupt a few of these phases of a child's brain development [23].

According to receiving routine vaccination schedule, we found that 98% of cases were vaccinated. This is in agreement with**Kumari*et al*.** [20]who found that 82% of studied cases of febrile seizures were vaccinated for age. Because of the relation between vaccination and infection that may cause febrile illness or febrile seizures studying of vaccination history is important among the studied cases.

As regards history of NICU admission we found that 44% of FS cases had been admitted in NICU in neonatal period.This is in agreement with **Gupta*et al*.** [24]who found that 30% of studied FS cases had been admitted to NICU in neonatal period. But, this is in disagreement with**Tu*et al*.** [25]who studied FS susceptibility in preterm children and found that children born preterm have a greater rate of febrile seizures than full-term babies and this can be explained by that hypoxic-ischemic and infections are commonin preterm newborns throughout the prenatal, perinatal, and postnatal phases, which raises the likelihood of neurodevelopmental abnormalities in preterm infants. Additionally, the use of prenatal and postnatal corticosteroids during a lengthy stay in the intensive care unit (NICU) owing to serious lung difficulties has been linked to an elevated risk of FS in children who were born extremely preterm[26].IDA is also more common in preterm and low-birth-weight infants. The amount of iron that these newborns' bodies keep is less than that of bigger, full-term babies [27].

According to the distribution of infection type during the first fit among the studied cases, we found that gastroenteritis and pneumonia occurred in 40% of cases. This is consistent with **Sreenivasa*et al.*** [28]who studied the role of IDA in FS in children and found that 75% of cases had gastroenteritis and pneumonia. But, these results are against **Srinivasa and Reddy**[29]who listed gastroenteritis as a last infection to cause febrile seizures.

According to the characteristics of FS our study revealed that 80% of cases of FS had generalized tonic clonic convulsions, while only 20% had generalized clonic type. This agrees with **Anup*et al.*** [30]who revealed that 90% of cases of febrile seizures had generalized tonic clonicconvulsion and that is in agreement with the criteria of simple febrile seizures that is approved by **American Academy of Pediatrics**[31].

In our study we found thatmean body temperature of FS cases during seizures was 39.5°C, which isin agreement with **Boshra*et al*.** [19] who found that 39.3

°Cwas a mean body temperature of febrile seizures cases during seizures.In contrast, **Jang*et al.*** [30]revealed that 38.7 °Cwas a mean body temperature of febrile seizures cases during seizures. This difference can be explained by different locality of the studies.

In our study we found that HB, HCT,MCV, MCH and MCHC were substantially lower in cases of FS than in controls. These results showed that, the incidence of iron deficiency as one of microcytic hypochromic anemias was found in highest proportion inFS patients. Iron deficiency may raise a child's risk of febrile seizures since iron is necessary for the proper operation of many enzymes and neurotransmitters found in the central nervous system.This in agreement with **Momen*et al.*** [32]who found also that HB, HCT, MCV and MCH were lower in cases of FS in comparison with controls. But this is in disagreement with **Yousefichaijan*et al.*** [33]who found that when comparing the FS group to the control group, all of these markers were greater in the former.This difference may be due to different time of collection of samples and may be due to the different nutritional habits. The distinction may also be explained by the function of iron, which is a necessary component of various neurotransmitters. Therefore, in the event of IDAand low serum iron, there may be a reduction in the number of neurons upon stimulation, which will lower the incidence of seizures.

Furthermore, we discovered that the mean RDW of FS patients in the present research was much greater than that of controls. This agrees with **Singh *et al.*** [34]whofound statistically insignificant higher RDW in cases than in controls.

In the current study we found that 80% of cases were of simple type (typical) and 20% of total cases were complex (atypical),which represented complicated seizures that were in need to do further investigations such as EEG, CT, or LP.

In the current study we found that the mean duration of the ictal period was 8 minutes. Likewise, post-ictal mean was 6 minutes. This is in agreement with the criteria of simple febrile seizures that are approved by **American Academy of Pediatrics**[31]**.**

Our study revealed that IDA cases had a higher mean ictal period compared to those without IDA.That agrees with **Gupta*et al.*** [24]who concluded that iron deprivation may play a role in the pathogenesis of FS and increasing the period of ictal state. Also we reported that the median age of onset of first attack of FS was 18 months. This is consistent with **Sreenivasa*et al.*** [28]who concluded that the mean age of onset of first attack of FS was 18 months. But these results are in disagreement with **Boshra*et al.*** [19]who revealed that the age at which the first episode of febrile seizures began was 24 months. The rationale was that anemia and iron deficiency are common in children under 24 months of age.

Moreover, we found that IDA cases had a lower mean age of onset of first convulsion compared to those without IDA. This result may be due to the role of iron in protection of neurons cells of the brain.

Conclusion: According to the research, low blood iron levels may contribute to the pathophysiology of febrile seizures, particularly complex seizures, and iron deficiency anemia may be a risk factor that predisposes children to febrile seizures.S**o**any children of FS should be screened for iron deficiency anemia at an early stage after first febrile fit and every child with FS and having IDA should be given therapeutic iron supplementation. Also we need further prospective studies to assess whether febrile seizures can be prevented with iron supplementation or not.

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- **Competing interests:** None.

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