IRON DEFICIENCY ANEMIA AS A RISK FACTOR FOR FEBRILE SEIZURE IN CHILDREN

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Abstract

Background: Febrile seizures are the most common type of seizures in children. It is prevalent in children aged between 6 months and 60 months, with an incidence of 2-5%. On the other hand, iron deficiency anemia is the most common hematologic disease of infancy and childhood with a period of incidence that coincides with the time of developing febrile seizures. Therefore, it is hypothesized that there is a possible association between this two conditions. The relationship between iron deficiency anemia and febrile seizures had been examined in several studies with conflicting results. This study was designed to elucidate this association. The purpose of this study was to determine the association between Iron deficiency anemia and febrile seizures in children. **Materials and methods:** In this case-control study 80 children with a diagnosis of febrile seizures, aged between 6 months and 60 months who were visited Pediatric ward and Pediatric outpatient department of Chattogram Medical College Hospital, Chattogram, during June 2012 to may 2013 were enrolled as cases. The control group consisted of 80 febrile children without seizure and were matched to the cases by gender and age. Iron deficiency anemia was diagnosed by hematologic investigations of hemoglobin value <11g%, serum ferritin value <30ng/mL and RDW > 15%. **Results:** A total 36 out of 80(45%) seizure cases had iron deficiency anemia whereas, 08 out of 80(10%) controls were found to have iron deficiency anemia. There was statistical significance of difference observed in two groups (p<0.001). Univariate risk factor analysis for control versus case showed odds ratio 7.364 (3.138 – 17.279) (95 % CI). The mean serum ferritin level of cases and controls were 43.01±29.77 and 72.36±38.66 (ng/mL) respectively (p<0.001). The mean value of HB%, MCV, MCH, and RDW% were also found significantly lower in the cases than controls (p<0.001). **Conclusion:** Iron deficiency anemia was more frequent among children with febrile seizures than those with febrile illness alone. The findings of this study suggest a positive association between iron deficiency and febrile seizures in children and screening for Iron deficiency anemia should be considered in children presenting with febrile seizures.

Key words

Febrile seizure; Iron deficiency anemia; Serum ferritin.

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Introduction

Febrile seizures are the most common seizures in children[1]. Their overall incidence is 2-5% of all children[1,2]. It may occur 25% of all children below five years of age[3]. In Bangladesh among hospitalized seizure patient (2 months to 12 years) 38% are due to febrile convulsion[4]. Recurrence rate of febrile seizures are 30 to 40%[5]. Children of age group 6 months to 5 years are usually affected. Age for peak incidence of febrile seizure is 14 to 18 months which overlaps with that of iron deficiency anemia which is from 6 to 24months[5,6]. Independent risk factors for febrile convulsions are height of temperature, first or second-degree relative with history of febrile and afebrile seizures, the number of fever episodes per year, maternal smoking and alcohol consumption

during pregnancy, and perinatal exposure to antiretroviral, developmental delay, infections (Influenza A, HHV-6, Metapneumovirus)[7,8]. Febrile seizures have a multifactorial pathogenesis[9]. Each single factor cannot explain seizure generation but the association of multiple factors different among individuals can trigger febrile seizures[10]. Complications like aspiration can occur during each episode of seizures. Febrile seizure episodes are frightening and agonizing to the parent and child and can cause psychological trauma to both[11]. Children with simple febrile seizure have approximately the same risk of developing epilepsy by the age of 7 years that is 1%, as does the general population. However, children suffering from complex febrile seizure, the risk of subsequent epilepsy increases 6 to 49%[7]. Complex febrile seizures may have approximately 2 fold long term increase in mortality probably secondary to coexisting pathology[8].

Iron deficiency anaemia is one of the most prevalent nutritional problem in the world today, especially in developing countries and it commonly occurs between the age of 6 and 24 months. In developing countries 46–66% of children under 4 years are anemic, with half attributed to iron deficiency anemia[10]. A recent study by the Institute of Public Health and Nutrition (IPHN) reported a high prevalence of anemia across all vulnerable groups, 46% among pregnant women, 64% among 6-23 months old children and 42% among 24-59 months old children[11-13].

Iron is a nutritional element not only needed for the synthesis of hemoglobin, but is also essential for enzymes likemonoamine oxidase, cytochrome, peroxidase and catalase, involved in neurochemical reactions and it is also important for neurological functioning. Such functions include neurotransmitter metabolism, myelin formation, and brain energy metabolism[5,10,14,16]. Iron deficiency has been associated with alterations in synaptic neurotransmitter systems including nor-epinephrine, dopamine, serotonin, glutamate and gamma-aminobutyric acid[7,15]. Low level of plasma ferritin–which occur in iron deficiency may lower the seizure threshold, as iron is important for the function and metabolism of various enzymes and neurotransmitters present in the central nervous system. Fever may worsen the negative effects of low plasma ferritin level on the brain, and therefore seizures can be triggered[7].

Clinically neurological symptoms like poor attention span, learning deficits, poor memory, delayed motor development, behavioral changes and breath holding attack caused by iron deficiency anemia are well known[5]. So question arises, is there a relationship between iron deficiency anemia and febrile seizures? It is possible that iron deficiency anemia may predispose to other neurological disturbances like febrile seizures in children and it is an easily correctable condition. Several studies with controversial results have attempted to evaluate the relationship between iron deficiency anemia and febrile seizures in different areas of the world found that iron deficiency anemia was less common in the febrile seizure group than the febrile seizure-free control group[16].

Despite several studies the risk factors for developing febrile seizure remain largely unknown. Keeping in view the prevalence of these two clinical entities as well as difference of opinion in available studies, the purpose of the present study was to determine the association between iron deficiency anemia and febrile seizures in children.

Materials and methods

This case control study was carried out in Pediatric ward and Pediatric outpatient department of Chattogram Medical College Hospital, Chattogram, Bangladesh during June 2012 to May 2013. Children aged between 6 months to 60 months fulfilled the study criteria of febrile seizure or any febrile illness (<3 days) without seizure were included in this study. Febrile seizure was classified as simple consists of a generalized tonic, tonic–clonic or atonic activity, lasting upto 15 minutes, and not recurring within 24hours. Complex has one of the following features: prolonged duration (>15 minutes) focal features, or seizure recurrence within a 24 hours period. Febrile status epilepticus - seizures lasting more than 30 minutes. The children were divided into two groups, cases and control each having a sample size of 84. The children having febrile seizures were comprised the cases while those having only febrile illness (<3 days) without seizures were the controls. The sampling technique was purposive.

Ethical clearance for this study was obtained from the Ethical committee, Chittagong Medical College, Chittagong. After getting informed written consent data were collected by pre defined questionnaire. Data were obtained by history, physical examination and drawing blood sample. Details of seizure history including type (Simple or complex) duration, nature (Focal or generalized) frequency, duration between initiation of fever and occurrence of seizure were taken from the cases. Previous history of febrile and afebrile seizure, family history (First degree relative) of febrile and afebrile seizure, iron supplementation therapy for previous 3 days were taken from both groups. Temperature was measured by Fahrenheit scale, weight (Kg) measured by CAMRY bathroom scale and Detectometer infant weighing scale and height (cm) measured by infantometer and Unicefstadiometer from both cases and controls. Nutritional status was determined by weight for height Z score. Demographic information was collected for cases and controls, including age and gender. Age (Month) was calculated from birth records. Cases and controls were selected in 1:1 ratio. A total 4 ml of blood was drawn, 2 ml of blood for measurement of HB%, MCV, MCH, MCHC, RDW% and estimated by HORIBAABX PENTRA DX 120 and 2 ml of blood for measurement of serum ferritin and estimated by Automated Chemiluminescent Immunoassay System. Blood sample was drawn from both cases and controls and send to nearby standard Laboratories, Chittagong for estimation. MCV, MCH, and MCHC were measured for exclusion of other types of anemia. Iron deficiency anemia was diagnosed by hematologic investigations of hemoglobin value <11g%, serum ferritin value <30ng/mL and RDW > 15%.

All the collected data were checked and verified. The data were compiled, analyzed and then tabulated according to key variables. Data were analyzed using SPSS-18 software, employing necessary statistical tools. Discrete variables were expressed as counts (%) and compared using the Chi-square tests. Continuous variables are expressed as mean and compared by means of the unpaired, two-sided t test. Odds ratios and 95% confidence intervals was calculated based on these models. Statistical significance was set at $p < 0.05$.

Inclusion criteria

i) Children with febrile illness <03 days
ii) Children with an age of 06 months to 60 months.

Exclusion criteria

i) Children with developmental delay
ii) Children with hematological disorders like thalassemia, leukemia etc.
iii) Parents not consenting to the participation.

Results

Table I: Distribution of age, sex, height and weight in study groups

Variables	Case (n=80) Mean± SD		Control (n=80) Mean± SD	
Age (Months)	18.55± 6.60		18.70± 8.73	
Weight (Kg)	9.50± 1.07		9.57± 1.36	
Height (m)	78.05± 6.21		77.75± 7.21	
Sex	No.	%	No.	%
Male	64	80.0	64	80.0
Female	16	20.0	16	20.0

Table II: Distribution of variables associated with seizures among the cases (n = 80)

Variables		Frequency	Percentage (%)
Types of Seizure	Simple	40	50.0
	Complex	40	50.0
Duration of Seizure	≤ 15 Minutes	68	85.0
	16 – 30 Minutes	12	15.0
Frequency of Seizure	One time	52	65.0
	> One time	28	35.0
Time Between Fever & Seizure	≤ 12 Hours	64	80.0
	13 – 24 hours	12	15.0
	> 24 hours	04	5.0
Temperature During examination	≤ 102^{O} F	64	80.0
	> 102^{O} F	16	20.0
Total		80	100.0

Table III : Comparison of blood indices in cases and controls

Blood indices	Cases (n=80) Mean± SD	Controls (n=80) Mean± SD	p value
HB(%)	61.61±8.17	68.25±5.81	p<0.001(S)
HB (gm/dl)	9.86± 1.30	10.94± 0.94	p<0.001(S)
MCV(fl)	65.65±7.95	72.3±06.93	p<0.001(S)
MCH(pg)	20.52±3.36	23.14±2.76	p<0.001(S)
MCHC(gm/dl)	31.12±1.60	31.9±31.30	p=0.001(S)
RDW(%)	17.52±2.15	16.10±1.79	p<0.001(S)
SFerritin(ng/mL)	43.01±29.77	72.36±38.66	p<0.001(S)

S-Significant, HB-Haemoglobin, MCV-Mean Corpuscular Volume, MCH-Mean Corpuscular Haemoglobin, MCHC-Mean Corpuscular Haemoglobin Content, RDW-Red Cell Distribution Width.

Table IV: Distribution of risk factors among the study groups

Risk Factors		Study Groups		χ^2 test significance	Odd's Ratio (95% CI)
		Cases	Controls		
Family H/O Febrile Seizure	Present	20 (25.0)	12 (15.0)		1.889
	Absent	60 (75.0)	68 (85.0)	p =0.114(NS)	(0.85 – 4.18)
Family H/O Afebrile Seizure	Present	08 (10.0)	04 (5.0)		2.111
	Absent	72 (90.0)	76 (95.0)	p =0.230(NS)	(0.61 – 7.31)
Previous H/O Febrile Seizure	Present	28 (35.0)	06 (7.5)		6.641
	Absent	52 (65.0)	74 (92.5)	p <0.001(S)	(2.57 – 17.18)
Iron Deficiency Anemia	Present	36(45.0)	08(10.0)		7.364
	Absent	44(55.0)	72(90.0)	p < 0.001(S)	(3.138 -17.279)

NS-Not Significant, H/O- History of

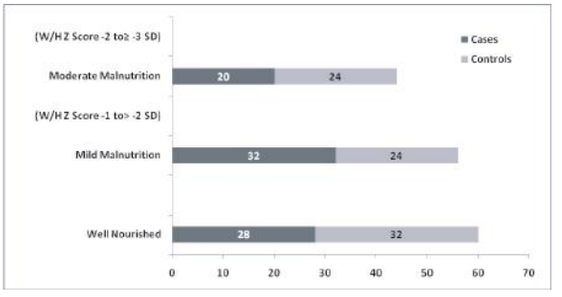

Fig 1: Distribution of nutritional status among the study groups

The study groups consisted of a total 160 children. Among them 80(50%) comprised the cases and 80(50%) comprised the controls. Table I shows the distribution of age, sex, height and weight in study groups.Among the cases 64(80%) were male and 16(20%) were female and among the controls 64(80%) were male and 16(20%) were female (p>0.05). The study groups were sexand age matched. The mean age of the cases and controls were 18.55±6.60 and 18.70±8.73 months, respectively (p>0.05), the mean weight of the cases and controls were 9.50±1.07(kg) and 9.57±1.36(kg) respectively (p>0.05) and the mean height of the cases and controls were 78.05±6.21(cm) and 77.75±7.21 (cm) respectively (p> 0.05).

Among cases 28(35%) had no PEM, 32(40%) had mild malnutrition and 20(25%) had moderate malnutrition whereas, within controls, 32(40%) had no PEM, 24(30%) had mild malnutrition and 24(30%) had moderate malnutrition (p> 005). (Fig-1). There were 40(50%) simple and 40(50%) complex febrile seizure. Most of the children, 68(85%) had seizure duration ≤15 Minutes. A total 52 out of 80(65%) had one time seizure. Most of the children, 64(80%) develop seizure within ≤ 12 hours after initiation of fever, 64 out of 80(80%) had ≤ 102^0 F temperature during examination (Table II).

Table III shows the comparison of blood indices in cases and control. The mean hemoglobin percentage of cases and controls were 61.61±8.17 % and 68.25±5.81(%) respectively (p<0.001.) the mean hemoglobin level of cases and controls were 9.86±1.30 and 10.94±0.94(g/dl) respectively (p<0.001) the mean MCV of cases and controls were 65.65±7.95 and 72.30±6.93 (fl) respectively (p<0.001) the mean MCH of cases and controls were 20.50±3.36 and 23.24±2.76 (pg) respectively (p<0.001). The mean MCHC of cases and controls were 31.12±1.60 and 31.93±1.30 (g/dL) respectively (p<0.001) the mean RDW(%) of cases and controls were 17.52±2.15(%) and 16.10±1.79 (%) respectively (p = <0.001) and the mean serum ferritin level of cases and controls were 43.01±29.77 and 72.36±38.66 (ng/mL) respectively (p<0.001.)

As per table IV, a total of 20 out of 80 (25%) cases had family history of febrile seizure , 12 out of 80(15%) controls had family history of febrile seizure (p> 0.05) odds ratio 1.889 (95 % CI) a total of 08 out of 80 (10%) cases had family history of afebrile seizure, 04 out of 80(05%) controls had family history of afebrile seizure (p> 0.05) odds ratio 2.111 (95 % CI) 28 out of 80 (35%) cases had previous history of febrile seizure whereas, 06 out of 80(7.5%) controls had previous history of febrile seizure (p<0.001) odds ratio 6.641 (95 % CI). A total of 36 out of 80 (45%) cases had iron deficiency anemia whereas, 08 out of 80(10%) controls were found to have iron deficiency anemia (p<0.001) Odd's ratio 7.364(3.138 -17.279) ((95% CI).

Discussion

This hospital based case control study showed the mean age of the cases and controls were 18.55±6.60 and 18.70±8.73 months respectively. There were no significant difference regarding age between the cases and controls (p>0.05).This finding is consistent with other studies, as they found mean age of the cases 18.8 months and the controls 19.10 months[17]. Both cases and controls had a similar proportion of males (80% vs. 20%) and females (80% vs 20%) in this study.

In this study a total of 36 out of 80 (45%) cases had iron deficiency anemia whereas, 08 out of 80 (10%) controls were found to have iron deficiency anemia which was statistically significant (p<0.001). Univariate risk factor analysis showed odds ratio 7.364 (3.138 – 17.279) (95 % CI) that is iron deficiency anemia will be considered as a risk factor for developing febrile seizure. This result is similar to other studies[5,11,16]. A Meta-analysis of studies of iron deficiency and seizures in children reported 30.5% cases and 21.9% controls had iron deficiency (p<0.001)[18]. Another study reported a significantly higher rate of iron deficiency anemia among children with first febrile seizure (30%) than controls(10%)[16].

In the present study serum ferritin level was found significantly lower in the cases. The mean serum ferritin level of cases and controls were 43.01±29.77 and 72.36±38.66 (ng/ml) respectively (p<0.001).This finding is consistent with other studies[19,20,21]. The mean serum ferritin level in the cases were 29.5 mcg/L, much lower than the values in the controls (53.5 mcg/L) in that study (p<0.001). Similar observations were made in a study done where they found the mean serum ferritin level was significantly low in children with first febrile seizures (31.9±31.0 mcg/L) as compared to controls (53.9±56.5 mcg/L) (p=0.003)[9]. The findings of different studies suggest that reduction in serum ferritin level decreases seizure threshold. Although it is clear that ferritin, as an acute phase reactant, is increased during any febrile illness, fever was equally present in both groups, therefore, different serum ferritin levels between this groups cannot be attributed to fever alone. The differences between the results of the present study and the other studies were might be because of differences in sample size and using different patient age groups.

The mean HB level of cases and controls were 9.86±1.30 and 10.94±0.94(gm/dl) respectively (p<0.001), the mean MCH of cases and controls were 20.50±3.36 and 23.24±2.76 (pg) respectively (p<0.001) and the mean RDW % of cases and controls were 17.52±2.15 and 16.10±1.79 (%) respectively (p<0.001). The level of MCV and MCHC were also found lower among cases than controls and the differences were statistically significant (p<0.001). This findings were consistent to other studies[19,20].

There were 40 (50%) simple and 40 (50%) complex febrile seizure. Most of the children, 68 (85%) had seizure duration ≤15 Minutes, 52 out of 80(65%) had one time seizure, most of the children, 64 (80%) develop seizure within ≤12 hours after initiation of fever and 64 out of 80(80%) had $\leq 102^0$ F temperature during seizure. This findings were almost similar to other studies[3,19,22]. A total of 20 out of 80 (25%) cases had family history of febrile seizure whereas, 12 out of 80(15%) controls had family history of febrile seizure. There were no significant difference in the two groups (p>0.05), odd's ratio 1.889 (95 % CI). 08 out of 80 (10%) cases had family history of afebrile seizure whereas, 04 out of 80(05%) controls had family history of afebrile seizure which was not significant (p> 0.05)), odd's ratio 2.111 (95 % CI). Studies found family history of febrile seizure in 26% cases and 13% controls and family history of afebrile seizure in 23.4% cases and 11% controls which was almost similar to the present study[11, 19]. A total 28 out of 80 (35%) cases had previous history of febrile seizure whereas, 06 out of 80(7.5%) controls had previous history of febrile seizure which was significant (p<0.001) odd's ratio 6.641 (95 % CI). Family history of febrile seizure, family history of afebrile seizure and previous history of febrile seizure are known risk factor for febrile seizure, but in this study only previous history of febrile seizure were found statistically significant.

Nutritional status of the children can influence the Iron deficiency. It was observed that among cases 28(35%) had no PEM, 32(40%) had mild malnutrition and 20(25%) had moderate malnutrition whereas, within controls, 32(40%) had no PEM, 24(30%) had mild malnutrition and 24(30%) had moderate malnutrition. There was no significant difference of nutritional status between the cases and controls (p>0.05), that is cases and controls were

nutritionally matched. Therefore it appears that Iron deficiency anemia has been found significantly higher in febrile seizure was not due to nutritional influence among two groups.

The findings of this study suggest a positive association between iron deficiency and febrile seizures in children and screening for Iron deficiency anemia should be considered in children presenting with febrile seizures. Early detection and timely correction of iron deficiency anemia may prevent febrile seizures in children. However, the sample size in this study was not enough for a definite conclusion and therefore, a prospective multi centre study with large sample sizes should be needed.

Limitations

As it was a hospital-based study the result of association may be different from a community setting. It is deficient in not being able to account for some confounding factors leading to iron deficiency anemia like lead poisoning. More over sample size was small and duration of study was short.

Conclusion

The present study showed that Iron deficiency anemia was significantly higher in children suffering from febrile seizures than febrile children without seizure. So there was strong association between Iron deficiency anemia and febrile seizure in children. Serum ferritin level was also found significantly lower in the cases, suggested that a low ferritin level may have an important role in children for developing febrile seizures. Therefore, this study suggested that screening for iron deficiency should be regarded in children presenting with febrile seizure and oral supplemental iron therapy may be given to the children with febrile seizures who have iron deficiency anemia to prevent the recurrence of febrile seizure attacks. However, the sample size in this study was not enough for a definite conclusion and therefore, a multicentre study with more cases and a sufficient follow-up period is needed.

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Contribution of authors

MSA- Conception, acquisation of data, critical revision and final approval.
RS-Design, drafting and final approval.
MRK-Acquisation of data, analysis, critical revision and final approval.
AKMZU-Design, drafting and final approval.
KN-Interpretation of data, analysis, critical revision and final approval.
MAK-Design, drafting and final approval.

Disclosure

All the authors declared no competing interest.

References

1. Dinesh Y, Jagdish C. Iron Deficiency: Beyond Anemia. Indian J Pediatr. 2011;78:65-72.

2. Jayasri S, Katherine AW, Ingrid ES. Febrile seizures. Australian Family Physician. 2005; 34(12):1021-1024.

3. Hoque M, Ali CMH, Zaman MS, Ahmed ASMNU, Hossain MM, Begum JA et al. Risk Factor For Recurrent Febrile Convulsion. Journal of Bangladesh College of Physicians and Surgeons. 2004;22(2):49-52.

4. Khan MK, Hassanuzzaman M, Quddus ASMR. Evaluation of admitted cases of convulsion in pediatric ward of medical college. The ORION Medical Journal. 2007; 28:490-491.

5. Sherjil A, Zaheer US, Sohail S, Rabia A. Iron deficiency anemia-a risk factor for febrile seizures in children. J Ayub Med Coll Abbottabad. 2010;22(3):71-73.

6. Robert JB, Patricia KD. Treatment of Children With Simple Febrile Seizures: The AAP Practice Parameter. PEDIATRIC NEUROLOGY. 2000;23(1):11-17.

7. Ariana Canuto,Idaciniglio. Febrile seizure. Wikipedia.2012. FebileSiezures-il flipper e la nuvola-diff.

8. Bidabadi E, Mashouf M. Association between iron deficiency anemia and first febrile convulsion: A case–control study. Seizure. 2009;18:347–351.

9. LeelaKumari P, Kc Nair M, Nair S M, Lalithakailas, Geetha S. Iron deficiency as a risk factor for simple febrile seizures a case control study. Indian pediatrics. 2012;49(1):17-19.

10. Mohammad AM, Kliegman, ST.Geme, Stanton, Schor, Behrman. Febrile Seizures. Nelson's Text Book of Pediatrics. 19th ed. Philadelphia:Saunder-Elsevier. 2011;2017-2019.

11. Institute of Public Health Nutrition. Ministry of Health and Family Welfare.Government of the Peoples Republic of Bangladesh. National Strategy for Anaemia Prevention and Control in Bangladesh. 2007;13.

12. Bangladesh Nutritional Surveillance Project Bulletin No. 6. The Burden of Anemia in Rural Bangladesh The Need for Urgent Action. April 2006.

13. Keith j. Collard. Iron Homeostasis in the Neonate. PEDIATRICS. 2009;123(4):1208-1214.

14. Pisacane A, Renato S, Nicola I, Angelo C, Paolo R, Alfonso D, et al. Iron deficiency anemia and febrile convulsions: Case-Control Study in Children under 2 years. BMJ. 1996;313-343.

15. Michael V Johnston. Iron Deficiency, Febrile Seizures and Brain Development. INDIAN PEDIATRICS. 2012;49:13-14.

16. Kobrinsky NL, Yager JY, Cheang MS, Yatascoff RW, Tenenbein M. Dose Iron deficiency raise the seizure threshold? J Child Neurol. 1995;10(2):105-117

17. Hartfield DS, Tan J, Yager J, Rosychuk RJ, Spady D, Haines C et al. The Association Between Iron Deficiency and Febrile Seizures in Childhood. Clinical Pediatrics. 2009;48(4):420-426.

18. Amirsalari S, Keihani DZ, Ahmadi M, Sabouri A, Kavemanesh Z, Afsarpeyman S et al. Relationship between Iron deficiency anemia and febrile seizures. Iran J Child Neurology. 2010;4(1):27-30.

19. Saleh F, Ajlouni AL. Febrile convulsion in children. Neurosciences. 2000;5(3):151-155.

20. Khalid N.Abdurrahman, AkremM.Al-Atrushi. The association between iron deficiency anemia and first febrile seizure: A case control study. Duhok Medical Journal. 2010;4(1):60-64.

21. Richard I, Samson G, Thomas NW, Tuda O, Sophie U, Gregory F. Iron Deficiency and Acute Seizure: Results from Children Living in Rural Kenya and a Meta-Analysis. PLoSONE. 2010;5(11):1-9.

22. Salehiomran MR, Tamaddoni A, Nasehi MM, Babazadeh H, Alizadehnavaei R. Iron status in febrile seizure: A case control study. Iran J Child Neurology. 2009;39-42.