ORIGINAL ARTICLE

Iron Deficiency Anemia: An Undermined Risk Factor in Children Presenting with Febrile Fits

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ABSTRACT

Objective: Objective was to uncover any hidden association between iron deficiency anemia and febrile fits.

Study Design: It was a randomized controlled trial.

Place and Duration of Study: This study was conducted at Pediatric Department, Ghurki Trust Teaching Hospital, Lahore, 12 months i.e 16-06-2022 to 15-06-2023.

Material and Methods: A total of 60 children presenting with febrile seizures and meeting inclusion criteria were enrolled after taking informed consents from parents and demographics were noted. A 3 ml blood sample was taken as per standard procedure for investigations and findings were recorded. The data was entered in SPSS version 25.0 for analysis. Confounding variables were controlled through exclusion.

Results: The mean age of children presenting with febrile fits was 2.26 ± 1.26 years. Gender-based analysis revealed higher prevalence of male participants (n=37) (61.7%), with male-to-female ratio of 1.61:1. The study found mean Hb of 10.1 ± 1.5 g/dl and mean serum iron level of 46.68±25.01 µg/L. Stratifying mean iron levels by age and gender further showed insignificant differences, with p-value > 0.05.

Conclusion: In conclusion, our study substantiates that iron deficiency anemia is a significant and potentially undermined risk factor in children with febrile fits, emphasizing the importance of targeted interventions and further exploration.

Key Words: *Febrile Seizures, Iron Deficiency Anemia, Hemoglobin Level, Serum Iron Level*.

INTRODUCTION

Febrile seizures, prevalent among children of less than 5 years of age, present multifaceted challenges in pediatric healthcare. Approximately 2-5% of children experience seizures before reaching the age of 5, accounting for a substantial 30% of total seizures in this age group.[1] This phenomenon is particularly pronounced in Asian populations, where incident is 8-10%.[2] Notably, 90% of children undergo their first febrile seizure by the age of 3, emphasizing the urgent need for a deeper understanding of the associated problems and potential risk factors.[3]

The pathogenesis of febrile seizures remains elusive, marked by a complex interplay of factors such as age, concomitant infection, fever, and

genetic predisposition.[4] Additionally, contributing factors include gender, developmental retardation, breastfeeding duration, maternal alcohol and smoking history, bacterial and viral infections, sudden elevated body temperature, family medical background, vaccinations, and deficiencies in essential minerals such as iron and zinc.[5,6] Iron deficiency anemia (IDA) adds another layer of complexity, with prevalence rates reaching 20.1% between 0 and 4 years and between 5 and 14 years, 5.9% in developed world while escalating to alarming levels of 39% to 48.1% in developing countries.[7,8]

The National Nutritional Survey of Pakistan reveals a disconcerting rise in the prevalence of nutritional anemia from 38% to 53.7% between 1977 and 2018, highlighting the persistent challenges in addressing this health concern.[9] However, the existing literature provides conflicting evidence regarding the association between iron levels and febrile seizures, further complicating our understanding. Fallah et al. (2013) reported significantly low mean serum iron levels (48.91 ± 22.96 µg/dl) in 48% of children presented with febrile seizures, while Razak et al. (2017) in India observed higher mean serum ferritin levels in children with febrile convulsions compared to healthy controls.[10,11]

Given the disparities in existing data, this study endeavors to provide clear-cut guidelines and bridges gaps in our understanding of the intricate relationship between febrile seizures and iron deficiency anemia. By unraveling these complexities, the study seeks to offer valuable insights for more effective interventions in pediatric care, ensuring the well-being of children navigating the challenges of febrile seizures and associated health complications. This nuanced exploration aims to contribute to the development of targeted strategies for prevention, diagnosis, and management in the context of febrile seizures among young children.

MATERIAL AND METHODS

This descriptive cross sectional study was conducted at Pediatric Emergency Department, Ghurki Trust Teaching Hospital, Lahore, after approval from hospital ethical review committee during a period of 12 months i.e 16-06-2022 to 15-06-2023. A sample size of 60 patients (1 to 5 year of age) was calculated by using 95% confidence level and absolute precision 0.06. Patients were enrolled using non-probability convenient sampling and after taking informed written consents from parents/guardians of the patients. Inclusion criteria of the study were children of both the genders with age between 1 year to five year presenting with febrile seizures. However, children with CNS infections as confirmed by CT-scan/ MRI of brain or lumber puncture and children having chronic seizure disorders were excluded from the study. Demographics were noted. A 3ml blood sample was taken as per standard procedure for investigation at hospital lab free of cost and findings were recorded. Iron deficiency anemia was labeled where Hb<10.5 g/dl for children <2 year age and Hb<11.5 g/dL in 2-5-year age with low serum iron. The normal level of serum iron was determined as >50 µg/dL for children over one year of age. Serum ferritin level was also measured but not taken as criteria due to its value as acute phase reactant too. All the data was entered in SPSS version 25.0. Numerical variables like age, mean hemoglobin level and serum iron level have been presented as mean and standard deviation whereas categorical variables like gender and age groups have been presented as frequency and percentage. Mean serum iron level has been stratified for age and gender to address effect modifiers and post-stratification independent sample t-test has been applied taking p-value ≤0.05 as significant.

RESULTS

The mean age of children presenting with febrile fits in this study was determined to be 2.26±1.26 years, (60% were < 2 years, 40% were between 2-5 years) encompassing a range spanning from 1 year to 5 years. A gender-based analysis revealed a higher prevalence of male participants (n=37, accounting for 61.7%), resulting in a male-to-female ratio of 1.61:1, as meticulously elucidated in table 1.1. Cause of fever was URTI in 60% (n= 36) of cases, GI infection in 30% (n=18) and other infections in 10% (n=6) of patients. Mean Hb level was 9.85 ± 1.9 g/dl. Serum iron levels showed mean level of 46.68 ± 25.01 µg/L, providing valuable insights into the iron status of the examined population, as encapsulated in table 1.2. Stratifying mean ferritin

levels 79.64 ± 65.22 with a p-value > 0.05 but not included in result compilation due to above mentioned reason. Among all the 60 children with febrile convulsions, 33 children (55%) were found to have IDA, while 27 children (45%) didn't have IDA.

TABLE 1.1: Baseline characteristics of study sample

Characteristics	Participants n=60 (%)
Age (years)	2.26 ± 1.26
1 year to ≤2years	36 (60.0)
>2 to 5 years	24 (40.0)
Gender	
Male	37 (61.7)
Female	23 (38.3)
Cause Of Fever	
URTI	36(60.0)
GI infections	18(30.0)
Others	6(10.0)

TABLE 1.2: Mean Hb and serum iron level in the study cohort and stratification on the basis of age and gender

Characteristics	Participants n=60 (100%)
Mean serum iron level	46.68 ± 25.01
	< 50 µg/L n=33 (55.0)
	>50 µg/L n=27 (45.0)
p – value	>0.05
Mean Hb level	9.85 ± 1.9 g/dL
1 to 2 years	9.5 ± 1.8
>2 to 5 years	10.2 ± 2.1
p-value	>0.05

DISCUSSION

Iron deficiency anemia, often overlooked in the context of pediatric health, emerges as a consequential risk factor in children experiencing febrile fits. Beyond its traditional association with fatigue and pallor, iron deficiency intricately intersects with neurological health.[1,12] The critical role of iron in cognitive development and neurotransmitter function accentuates its impact on the central nervous system. In cases of febrile illnesses, where the brain is subjected to heightened stress, insufficient iron levels may compromise the neurological threshold, potentially triggering seizures.[13] Acknowledging this nuanced relationship necessitates a paradigm shift in pediatric healthcare, urging a more comprehensive approach that not only addresses febrile fits but also scrutinizes and rectifies underlying iron deficiency. That is why this study was planned, aiming to unravel the intricacies of this connection and formulate targeted interventions for enhanced pediatric well-being.

The mean age of children presenting with febrile fits in our study was 2.26 ± 1.26 years, providing a specific insight into the demographic characteristics of this cohort. Interestingly, when juxtaposed with findings from other studies, notable variations emerge. Addil et al. (2021) reported a lower mean age of 1.44±0.98 years in a Pakistani population, while Alok et al. (2020) documented a substantially higher mean age of 27.16 ± 16.65 months in India.[14,15] Another study by Razak et al. (2017) in India reported an intermediate mean age of 22.86 ± 12.86 months.[11] These discrepancies highlight the heterogeneity in age distribution among populations experiencing febrile fits. This variability could be attributed to genetic factors, environmental influences, or variations in healthcare practices across regions. The observed mean age in our study offers a unique perspective on the age dynamics of febrile fits within the specific population under investigation.

A gender-based analysis within our study unveiled a higher prevalence of male participants, with 37 individuals representing 61.7%. This resulted in a male-to-female ratio of 1.61:1. This observation aligns with the findings of previous studies, reinforcing a consistent pattern of male dominance in the manifestation of febrile fits. Addil et al. (2021) reported a comparable prevalence of males at 58.9%, while Alok et al. (2020) observed 61.33% male participants, and Shah et al. (2016) documented a male prevalence of 58.61%.[14-16] The recurrent theme of a higher incidence of febrile fits in males across multiple studies suggests a potential gender-specific susceptibility or response to factors triggering febrile seizures. Further exploration of these gender-based differences could contribute to a more nuanced understanding of the underlying mechanisms and risk factors associated with febrile fits.

In the present study, a noteworthy observation of a low mean serum iron level, measured at 46.68 ± 25.01 µg/L, was documented in 55% of children experiencing febrile fits. This finding aligns with the outcomes reported by Fallah et al. (2013),

who identified a significantly low mean serum iron level (48.91 ± 22.96 µg/dl) in 48% of children with febrile seizures.[10] Similarly, Alok et al. (2020) reported a mean serum ferritin level of 39.54 ± 24.55 ng/ml, instead of iron which was also significantly lower than controls. In another investigation by Zahra et al. (2019), 34.61% of cases exhibited iron deficiency anemia, contrasting with 22.91% in the control group.[15,17] Shah et al. (2016) conducted a case-control study in India, establishing a significant association (p-value < 0.001) between iron deficiency anemia and simple febrile seizures.[16] Fallah et al. (2013) further demonstrated that children with febrile seizures had significantly lower hemoglobin levels, serum iron levels, and serum ferritin levels than healthy children.[10] Contrasting results were reported by Razak et al. (2017) in India, where children with febrile convulsions displayed higher mean serum ferritin levels compared to healthy controls, with no significant difference noted (87.50 ± 37.04 vs. 80.78 ± 35.43; p-value = 0.205).[11] These conflicting findings emphasize the ongoing debate within the existing literature on the association between low iron levels and febrile seizures. The implications of these varied outcomes underscore the complexity of the relationship between iron status and febrile fits. While some studies support a significant association between iron deficiency and febrile seizures, others present inconclusive findings. This underscores the need for further research to elucidate the nuanced interplay between iron levels and febrile fits, with potential implications for targeted interventions and management strategies in pediatric care.

Limitations: This study includes a small sample size (60), introducing potential bias. Retrospective data collection may lead to recall bias. The single-center design and specific demographics limit generalizability. Comprehensive understanding warrants larger, multicenter studies.

CONCLUSION

In conclusion, our study substantiates that iron deficiency anemia is a significant and potentially undermined risk factor in children with febrile fits, emphasizing the importance of targeted interventions and further exploration.

Conflict of interest: Nil

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