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## Correlation of serum ferritin levels and RBC indices in children with febrile seizures

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### Abstract

**Background:** Febrile seizures are the most common seizures that occur in 2 to 5% of neurologically healthy children in the age group of 6 – 60 months. There is an increased risk of febrile seizures in Children with iron deficiency anaemia. Iron deficiency anaemia is also associated with impaired neurocognitive functions. Our study compares the haematological parameters in children with febrile seizures.

**Methods:** The study is a prospective study conducted in a tertiary care hospital. Children admitted with first episode of febrile seizures in the age group of 6- 60 months were included in study group. Total of 50 children were enrolled in the study. Duration of study was one year. Haemoglobin levels, Red Blood Cell indices and serum ferritin were studied among the children and statistically analysed.

**Results:** The study showed that haemoglobin levels, RBC indices particularly Mean Corpuscular Volume (MCV) was low in 100% and Red Cell Distribution Width (RDW) was increased in 96% of children with low ferritin levels depicting iron deficiency anaemia, which in turn is a risk factor for febrile seizures.

**Conclusion:** The study concluded that among the RBC indices, RDW and MCV values well correlated with serum ferritin levels in detecting iron deficiency anaemia in children with first episode of febrile seizures.

**Keywords:** Febrile seizure, iron deficiency anaemia, serum ferritin, RBC indices

### Introduction

Febrile seizures are the most common type of seizures affecting 2 – 5 % of neurologically healthy infants and children. The most common age group is 6 – 60 months<sup>[1]</sup>.

Febrile seizures are more common among Asian population. About 5-10 % of Indian children are affected. The male to female ratio is 1.6: 1.8<sup>[2]</sup>. Some Korean studies showed annual prevalence of febrile seizures to be 6.92% which was found to be little higher than Worldwide prevalence of 2 to 5%<sup>[3, 4]</sup>. These are seizures that occur with a temperature of 100.4 °F or higher, that occur in the absence of any central nervous system infections or any metabolic abnormalities and without any prior history of afebrile seizures. A simple febrile seizures is usually tonic clonic lasting for less than 15 minutes and does not recur within a 24 hour period<sup>[1]</sup>. Children with simple febrile seizures have increased incidence of future epilepsy in the following conditions, fever less than 1 hour before onset of, onset of seizures before 1 year of age, multiple episodes of febrile seizures, positive family history of epilepsy and changes in electroencephalogram (EEG)<sup>[5]</sup>. Iron deficiency anaemia has been associated with increased risk of febrile seizures<sup>[1]</sup>. Iron is essential for neurotransmitter synthesis and myelination<sup>[6]</sup>.

Iron deficiency has been associated with poorer fine and gross motor skills, visual motor integration, language and intelligence quotient (IQ). There is higher incidence of anxiety depression, stress and attention disorders. There are various studies regarding correlation of Iron deficiency anaemia and febrile seizures. Kumari *et al* showed the association of iron deficiency anaemia and simple febrile seizures<sup>[7]</sup>. Ali O Koksali *et al* showed the relationship of low serum Ferritin levels and febrile seizures. The study concluded that even if serum Ferritin levels were normal during an acute attack of febrile seizures, Ferritin levels had to be checked later in order to prevent further episodes of febrile seizures<sup>[8]</sup>. Some studies showed low levels of serum iron and presence of anaemia serve a risk factor for febrile seizures<sup>[9]</sup>. In the present study we have studied the correlation of RBC indices and serum ferritin in detecting iron deficiency anaemia which is a risk factor for febrile seizures.

**Methods**

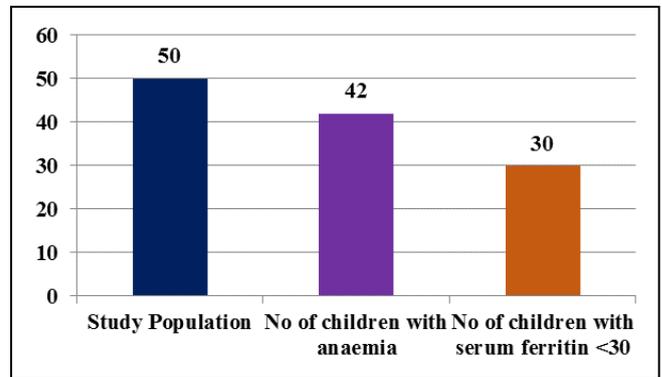
The current prospective study was carried out in a tertiary care hospital from September 2018 to September 2019. Fifty children with first episode of febrile seizures were included as study group. Children with history of previous seizures, developmental delay, other metabolic problems, intracranial infections, trauma are excluded from the study. Blood samples were collected from the children after getting informed consent from the parents. Children were analysed for Haemoglobin, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), red blood cell distribution width (RDW) and serum Ferritin. According to World Health Organisation (WHO), iron deficiency anaemia is defined as haemoglobin 10 to 10.9 as mild anaemia, 9.9 to 7 as moderate anaemia and < 7 grams as severe anaemia. In iron deficiency anaemia, the values of MCV & MCHC were < 73 femtolitres & < 24 pictograms / decilitre respectively. According to WHO, serum Ferritin levels < 12 indicates Iron deficiency anaemia, whereas in the presence of inflammation, levels < 30 were taken significant? Values were obtained and statistically analysed.

**Results**

Fifty children with febrile seizures were enrolled in the study. The mean age group in the study group was 23.96 months. The study included 35 male and 15 female children. Mean serum Ferritin values were 24.8 ± 9.2, 22.8 ± 14.8, 32.2 ± 19 in the age group of 6-12 months, 13-36 months, 37-60 months respectively. Mean MCV values were 63.2 ± 6.8, 16.1 ± 1.5 was the mean RDW values. Based on WHO classification, mild anaemia was seen in 58% of children and moderate anaemia was seen in 42% of children in the study group. Microcytic hypo-chromic anaemia was present among 84% of the children in study group. Out of fifty children in the study group, 42 children had anaemia. Thirty children out of the 42, had low serum ferritin levels as shown in Table 1 & Fig 1. Among those 30 children, 96% of children had increased RDW, 100% of children had low MCV which depicted iron deficiency anaemia. Only 70% and 46% of children had low MCH & MCHC respectively as depicted in Table 2 & Fig 2. Among the RBC indices, MCV and RDW values has a positive correlation with the serum ferritin levels in children with anaemia who had low Ferritin levels. Hence MCV and RDW can be used as a indirect marker for serum Ferritin levels.

**Table 1:** Children with anaemia and low Ferritin levels

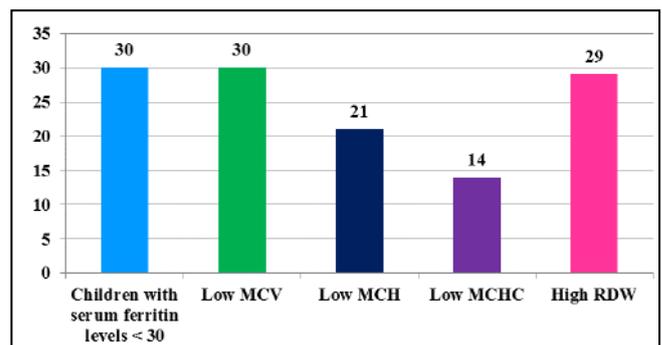
Study Population	50
No of children with anaemia	42
No of children with serum ferritin <30	30



**Fig 1:** Children with anaemia and low Ferritin levels

**Table 2:** Comparison of serum Ferritin levels with RBC indices

Children with serum ferritin levels < 30	30(60%)
Low MCV	30 (100%)
Low MCH	21(70%)
Low MCHC	14(46%)
High RDW	29(96%)



**Fig 2:** Comparison of serum Ferritin levels with RBC indices

**Discussion**

This study was conducted to reach a conclusion regarding diagnosis of iron deficiency anaemia with RBC indices particularly MCV & RDW without serum Ferritin levels and starting iron supplements in order to decrease the incidence of febrile seizures.

Our study showed that the RBC indices particularly MCV and RDW well correlated with serum ferritin to diagnose iron deficiency anaemia in children with first episode of febrile seizures. In this study, MCV was low and RDW was high in all children with low Ferritin levels. The P value of MCV and RDW in the study group was <0.0001 which was statistically highly significant. P value of serum ferritin was 0.0001 which was also significant. Many studies have showed this type of correlation. S. Ghoshal *et al* showed that MCV, MCH, MCHC and serum Ferritin were low in children with febrile seizures. RDW was not studied. P values of MCV, MCH, MCHC and serum Ferritin were <0.0001, which was statistically significant<sup>(10)</sup>.

Mohamadreza Modaresi *et al* studied Hb, MCV, MCH, MCHC & Serum Ferritin, among children with febrile seizures. They found that Mean Ferritin level, Hb, MCH were significantly low in children with febrile seizures.

In contrast to the above study, our study showed statistically significant low values of MCV, RDW and serum Ferritin levels. About 100% and 96% of children with low serum Ferritin had low MCV and high RDW respectively. Our study showed that MCV and RDW are correlating with serum ferritin in detecting iron deficiency anaemia. Children with low MCV and high RDW can be started on iron therapy to decrease the incidence of febrile seizures in the age group of 6 to 60 months <sup>[11]</sup>.

El Shafie *et al* in their study showed low MCV, MCH & serum Ferritin in their study group. Compared to our study, which also showed low serum ferritin & MCV in the study group, the above study did not entail regarding RDW which was increased in our study <sup>[12]</sup>. Shailaja potdar *et al* concluded that serum ferritin and Haemoglobin were significantly low and RDW was high in children with febrile seizures which is on par to our study <sup>[13]</sup>. Yousefichaijan P *et al* also showed similar results as our study with low MCV and serum ferritin. RDW was not studied <sup>[14]</sup>. There are studies in contrast to the present study. Fallah *et al* studied Haemoglobin, serum Ferritin RBC indices in children with febrile seizures. There was no correlation between MCV and serum ferritin levels. Serum Ferritin was lower in the children with febrile seizures, while MCV was not significantly low in this group <sup>[15]</sup>.

AL Saha *et al* in their study, followed up values of CBC, RBC Indices & serum ferritin children with febrile seizures. Hb, serum Ferritin & MCH were significantly low compared to other parameters. This is in contrast to our study where MCV and RDW were significantly low in children with low serum Ferritin levels <sup>[16]</sup>. One finding which stood unique to our study is that among the RBC indices, RDW was significantly increased in all cases of febrile seizures with low serum Ferritin levels. But many studies have not included RDW in their evaluation. P Singh *et al* in their study showed RBC indices were not significant enough to prove iron deficiency anaemia among children with febrile seizures which was also in contrast to our study <sup>[17]</sup>.

The limitations of our study was only a small population of children were included in the study. The study group was not from the general population but only from hospital population.

### Conclusion

We studied serum ferritin and RBC Indices in children with febrile seizures. MCV was low in 100% of children and RDW was high in 96% of children with low serum ferritin levels, which shows a positive correlation between MCV, RDW and serum Ferritin levels. Hence in conditions where serum ferritin could not be done, MCV and RDW can be used as an indirect marker of low serum ferritin levels. It could be suggested to start iron supplements to children with low MCV and RDW in the age group of 6 to 60 months to decrease the incidence of febrile seizures in these children. However a large population needs to be studied to prove it.

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