

Correlation between Iron Deficiency Anemia and Cognitive Achievement in School Aged Children.

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ABSTRACT

Background: Iron Deficiency Anemia (IDA) is the most prevalent hematologic disorder in childhood. Most correlational studies have found association between iron-deficiency anemia and poor cognitive functions in children, however sufficient studies were not found in Indian children. This study was planned to find effect of iron deficiency anemia on cognitive achievements in school aged children. **Methods:** Thirty children with iron deficiency anemia and 30 age and sex matched healthy controls underwent IQ testing by Wechsler Intelligence scale for children (WISC). Iron deficiency anemia was defined as Hb <11 gm% and Transferrin Saturation (TS) < 16%. **Results:** Mean IQ were found to be significantly low in Iron deficient anemic children (91.5±2.3) as compared to controls (97.5±3.2) (Value of unpaired T 0.066 significant at p<0.05). Performance IQ scores were lower (89±2.1) as compared to Verbal IQ scores (94±2.6) in iron deficiency anemia. **Conclusion:** This indicates that iron deficiency anemia affects the cognitive performance in school children.

Keywords: Iron deficiency anemia, Cognitive achievements, school children.

INTRODUCTION

Iron Deficiency Anemia (IDA) is the most common hematologic disorder in children. School going children are susceptible to IDA because of poor dietary intake and high iron requirement related to rapid growth.^[1] IDA results in various systemic manifestations i.e. impaired exercise capacity and functional alteration in small bowel & has been associated with behavioural and cognitive dysfunction in school going children. Alteration of behavior and cognitive performance is one of the most concerning consequences in children.^[1,3] Central nervous system iron decreases before restriction of red cell production, and, therefore the cognitive effects of IDA may precede the hematologic manifestation of anemia. Various studies have linked IDA with cognitive dysfunction in school going children have show positive correlation. The study aimed to determine the relationship between IDA and cognitive functions of school aged children.

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MATERIALS AND METHODS

The study was done at tertiary care hospital in Mumbai over the period of 2 years. Institutional ethics committee permission was obtained before commencement of the study. The subjects were apparently healthy children attending school clinical. Children were age and sex matched with equal Male Female ratio. Informed consent of the parents of healthy children between 6 to 11 yrs of age and without any evidence of chronic systemic illness was obtained. Complete Hemogram was obtained in all. Children with Hemoglobin (Hb) < 11 gm % were enrolled as cases (Anemic group). Children with Hb > 11 gm % were enrolled as controls (Non anemic group). Peripheral smear and stool examination was done in all children. IDA determined in all children by doing Serum Iron, Total Iron binding capacity (TIBC), Transferrin Saturation (TS).^[1] Iron deficiency was defined as Hb <11 gm% and Transferrin Saturation (TS) < 16%.^[2]

Intelligent Quotient (IQ) was calculated by clinical psychologist using Wechsler Intelligence scale for children (WISC).^[3] Test was administered in same order in all children and quantitative scores were obtained. Test scores of children with normal Iron status and Iron deficiency anemia were compared using Unpaired T test.

Correlation Coefficient between S. Iron and IQ scores obtained and compared for children with anemic and non anemic group for statistical analysis.

RESULTS

In our study 60 children, age and sex matched comprising 30 cases and 30 controls were enrolled. Out of these 83% of children had symptoms pertaining to anemia at presentation and 17% were asymptomatic. Worm infestation (63.33%) and pallor (30%) were the most common presenting symptoms.

Other tests such as peripheral smear (PS) and stool examination (SE) were done in all children. Abnormal PS in the form of hypochromia and microcytosis was seen in 56% of children with IDA. SE showed worm infestation in 40% of children with IDA.

The hematological parameters are as illustrated in [Table 1].

Table 1: Hematological parameters

Cases (n= 30) (Hb<11gm %)	Control (n= 30) (Hb>11gm %)	
TS (Serum Iron/TIBC)<16	TS<16	TS>16
100%	5%	45%

All these children were tested for cognitive function with WISC scale by the clinical psychologists. Results are depicted in [Table 2].

Table 2: IQ scales in Cases Vs Controls

IQ scale	Case (n=30)	Control(n=30)
	% of children	% of children
120-129 Superior	-	3.33%
110-119 High average	10%	26.66%
90-109 Average	33.33%	50%
80-89 Low average	16.66%	10%
70-79 Borderline	40%	10%
Mean Verbal IQ	94±2.6	98±3.6
Mean Performance IQ	89±2.1	97±2.9
Mean Full scale IQ	91.5±2.3	97.5±3.2

56.66% of case group had IQ scores below average whereas only 20% of children from control group had IQ scores below average. Statistical analysis to compare IQ scores in case and control group was significant. (Value of unpaired T test 0.066, significant at p<0.05). Mean IQ scores among the 2 groups were also comparable. Mean IQ were found to be significantly low in Iron deficient anemic children (91.5±2.3) as compared to controls

(97.5±3.2) (Value of unpaired T 0.066 significant at p<0.05). Performance IQ scores were lower (89±2.1) as compared to Verbal IQ scores (94±2.6) in iron deficiency anemia.

In our study, maximum S. Iron concentration obtained was 235 and minimum was 24. A graph plotted of S. Iron Vs IQ scores is shown [Figure 1]. As seen from the graph there was linear association between S. Iron and IQ scores i.e. as the level of S. iron increases the IQ also increases proportionately.

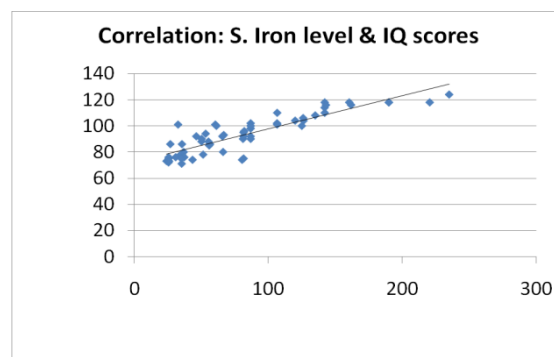


Figure 1: Serum Iron level and IQ score

Correlation coefficient among S. Iron and IQ scores was 0.91(significant at p <0.05) and shows statistically significant positive association amongst these two parameters.

DISCUSSION

Iron deficiency (ID) is a major public health problem affecting more than 2000 million persons worldwide. India continues to be one of the countries with very high prevalence. National Family Health Survey (NFHS-3) reveals the prevalence of anemia to be 70-80% in children. Prevalence of anemia in India is high because of low dietary intake, poor availability of iron and chronic blood loss due to hookworm infestation and malaria. While anemia has well known adverse effects on physical and cognitive performance of individuals, the true toll of iron deficiency anemia lies in the ill effects on maternal and fetal health.^[4] Iron is an essential nutrient for not only the normal growth, health, and survival of children, but also for their normal mental and motor development and cognitive functioning. Iron deficiency with anemia (IDA) is associated with significantly poorer performance on psychomotor and mental development scales and behavioural ratings in infants, lower scores on cognitive function tests in preschool children, and lower scores on cognitive function tests and educational achievement tests in school-age children.

In present study, we evaluated data from a small representative sample of school aged children who attended hospital for minor complaints, may be pertaining to IDA itself. All the children in anemic

group had Iron deficiency. The mean IQ score of anemic group was 91.5 ± 2.3 whereas for non-anemic group it was 97.5 ± 3.2 . IQ scores were proportionate to the S. Iron levels in anemic as well as non-anemic children. Three children from non-anemic/control group had ID but the number was too small to be commented upon. The statistical analysis of the data revealed that there is significant correlation between IDA and cognitive achievements in school children. Several studies have studied the effect of iron deficiency on cognitive performance.^[4,5] [Table 3].

5. Catherine Nokes, Claire van den Bosch, Donald A.P. Bundy; The effects of iron deficiency and anemia on mental and motor performance, educational achievement, and behaviour in Children, An Annotated Bibliography; A report of the International Nutritional Anemia Consultative Group, September 16–17, 1996.

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Table 3: Studies examining the effects of iron deficiency anemia on cognition.

Observational studies (Title)	Authors
Short-term effects of treatment for ID/IDA on performance	Webb and Oski, 1973
Extended supplementation (2–8 month)	Seshadri and Gopaldas, 1989, study 1
Extended supplementation (2–8 month) Pollitt et al., 1985 (35)	Soemantri et al., 1985; Seshadri and Gopaldas, 1989, (Studies 2,3,4)

Various studies suggested that IDA is causally associated with less than optimal behavior in preschool children as well as lower cognitive achievements amongst school aged children and iron therapy results in improvement in performance of behavioural and cognitive tests. In most of the studies conducted for association IDA and cognitive achievements, diagnosis of iron deficiency was based on 3 laboratory parameters of iron status. They were TS, Free Erythrocyte Protoporphyrin (FEP) and S. Ferritin. However, we did not have the facilities to test FEP and S. Ferritin hence we considered the child to be iron deficient if TS was less than 16%.^[2]

CONCLUSION

Iron deficiency is present much before clinical and biochemical Iron deficiency anemia. The developing brain is susceptible to effects of iron deficiency. Hence, early identification and treatment of Iron deficiency is important for improving cognitive performance in children.

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4. http://www.whoindia.org/en/Section6/Section324_1467.htm