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Hemoglobin and Hematocrit values in diagnostic of different forms of Anemia and their relation with Essential Minerals (Iron and ferritin)

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Abstract: Anemia is a widespread problem among children in many parts of the world, and it is often associated with some trace elements like Iron, Ferritin and other trace elements, Anemia is a global health issue that has significant consequences for individual health and socioeconomic development. The deficiency of Iron and certain trace elements which are not only involved to causing hypochromic microcytic anaemia however also intricate the high absorption of other minerals. Moreover it delayed the many essential metabolic steps like heme biosynthesis. The cross-sectional study was carried out among the 160 students with anemic condition; children's health status was collected through questionnaire & blood samples. The samples were collected from boys and girls of schools children having age 10-16 years, divided in two age groups. The blood analysis of anemic subjects were carried out, including blood complete picture, serum iron and serum ferritin level. The result reveals that the deficiency of hemoglobin and indices, serum iron and serum ferritin levels clearly declined in anemic groups. It showed that positive correlation between Fe with ferritn, with negative impact on hematological parameters.

Keywords; Anemia, Hemoglobin, Iron, Red blood cell, hematocrits, IDA

1. INTRODUCTION

Hemoglobin concentration below the WHO recommended limit i.e. 13g/dL in man and 12 g/dL in women is considered as anemia and is a significant public health problem with major consequences for human health and socio-economic development *(WHO/UNICEF/UNU 2001)*. The World Health Organization (WHO) estimates that about 200 million public on the earth may be ill with anemia, around 50% cases are attributable toward iron deficit. There are more individuals with iron deficiency than any other medical condition at any given moment worldwide (*World Health Organization 2008*). The School going children in developing countries have mostly the complain of laziness and less attention in study found due to the anemia and iron deficiency and their cost incorporate retard psychomotor growth, impaired cognitive role, In addition to growth alteration (Semba *et al ; 2002*, Nokes *et al., 1998)*.Numerous studies have acknowledged the mainly health consequences of anemia, the outcomes of anemia included physical growth and work performance,susceptible status, cognitive performance and morbidity from various infections (Richard *et al.,2006)*.Significant population groups like adult males and elderly are not captured in most of the national prevalence available data. The deficiency of trace elements usually causes certain type of anemia (especially hypochromic microcytic). The deficiency of iron may increase the absorption of cadmium & lead and also cause the anemia (hypochromic microcytic). When the level of these trace elements are high in hypochromic microcytic anemia`s patients led to cause the worse condition of anemia. In thalassemia patients the hypochromic microcytic anemia result to impaired the synthesis of globin chain which may decrease the synthesis of hemoglobin, causing hypochromia and microcytosis. It is estimated that 1.5% of population carries beta-thalassemia gene. Anemia is a result of deficiency of sufficient iron which is essential for the synthesis of hemoglobin, this hematological condition mostly seen in children and infants. It is estimated that 30% of population is effected from iron deficiency anemia. This condition mostly seen in developing countries. World health organization defines the criteria of anemia that Hemoglobin level less than 11g/dl *(World Health Organization 2001)*. World health organization also defines the different categories of anemia, In mild class of anemia the Hemoglobin level is 10 to 10.9 g/dl, while in moderate condition the level of Hemoglobin is about 8-9.9 g/dl whereas in sever amenia Hemoglobin (Hb) level is less than 8g/dl *(World Health Organization 2001)*.

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2. MATERIALS AND METHODS

This study has been carried out on 160 school going children of different school situated in Hyderabad, both gender had been included in this study boys and girls divided into 2 groups based on age. Blood samples were taken after informed consent forms were signed by the parents of the students and sample size was calculated by using online software Openepi calculator, with 95% confidence level. 10 ml blood samples were collected from students who had signed informed consent form with sterilized disposable syringe, the sample were transferred in appropriate tube labeled with numbers and the samples were stored at -40C. the samples were divided into 02 tubes, In first tube EDTA was added and this tube was used for estimation of hematological parameters (e.g. red blood cell (RBC) count, Haemoglobin (Hb), mean corpuscular Haemoglobin, haematocrit, mean corpuscular volume) by using Celttac auto analyzer. While second tube was used for estimation of serum iron and serum ferritin on Hitachi 911 autoanalyzer and Elecsys 1010 respectively. The Roche reagent kits were used for estimation of iron and ferritin.

3. RESULTS ANS DISCUSSION

This cross-sectional study was carried out on 160 students with anemic condition of different schools situated Hyderabad. This study include both Sax of different age group, the students have been divide in to two groups, 10-16 years and 14-16 years. The anemia were classified into 03 different classes, moderate anemic, mild and Sever anemia, **(Table 1)** shows the percentage of severity of anemia of school going children, 15(9.375%) of boys showed moderate anemia of age group 10-13 while 18(11.25%) of mild anemia and 7(4.375%) of severe anaemia respectively, whereas percentage of moderate, mild, and sever anemia in girls of age group 10-13 was 15(9.375%),the prevalence of anemia was high in girls with age group 14-16 was 21(13.12%) having severity of amenic condition, this is due to the low intake of diet ,whereas low sever condition have been seen in age group 10-13 with 7(4.375%),11(6.875%),11(6.875%) respectively.

Table:1 Haemoglobin levels to diagnose the level of anaemia of different age groups

Boys			
Age group	**Moderate**	**Mild**	**Sever**
10-13	15(9.375%)	18(11.25%)	7(4.375%)
14-16	14(8.75%)	9(5.625%)	17(10.62%)
Girls			
10-13	15(9.375%)	11(6.875%)	11(6.875%)
14-16	07(4.375%)	12(7.5%)	21(13.12%)

Table:2 Mean values of different hematological parameters and serum Iron, ferritin level in school Boys of Hyderabad.

Boys	**Moderate**	**Mild**	**Sever**
HB%	8.87±0.479	11.157±0.763	6.933±0.837
HCT	30.37±3.783	36.62±2.342	26.208±3.145
RBC	4.30±0.858	4.894±0.488	3.648±0.71
MCV	66.25±7.019	72.851±6.278	66.629±9.29
MCH	18.76±3.118	22.277±2.734	18.037±4.136
MCHC	28.1±2.566	30.52±1.603	26.479±2.955
FE	36.78±18.336	61.11±32.690	60±66.547
Ferritin	16.75±8.543	23.418±13.547	49.337±109.81

(Table 2) described the Mean and standard deviation value of red blood cell (RBC) count, Haemoglobin (Hb), mean corpuscular Haemoglobin, haematocrit, mean corpuscular volume, Ferritin and Iron level of boys having different severity level of amenia. The level of HCT, RBC and MCHC, shows low in sever type of anemia, while MCV value was high in Mild type anemia.

(Table 3) described the Mean and standard deviation value of red blood cell (RBC) count, Haemoglobin (Hb), mean corpuscular Haemoglobin (MCHC), haematocrit, mean corpuscular volume Iron (Fe) and Ferritin level of girls having different severity level of amenia. The level of Hb, HCT and MCH were high in Mild type of anemia in girls whereas the level RBC and MCHC, shows low in sever type of anemia. Association between mean values of different hematological parameters, serum iron and serum ferritin in anemic were calculated (Table 2).

Table:3. Mean values of different hematological parameters and serum Iron, ferritin level in school going girls of Hyderabad and adjoin area.

Girls	Moderate	Mild	Sever
HB%	9.21±0.591	10.39±0.243	6.746±0.781
HCT	31.42±3.077	52.21±72.141	23.48±2.617
RBC	4.62±0.632	4.83±0.661	3.46±0.684
MCV	69.17±8.011	70.23±12.58	70.21±12.314
MCH	20.56±2.356	21.9±3.478	20.74±4.344
MCHC	29.58±2.015	30.37±5.361	28.53±2.629
FE	42.11±18.058	31.65±21.157	40.93±17.798
Ferritin	29.16±27.761	22.97±24.554	30.10±20.241

The **(Table 4)** shows positive correlation between Fe with ferritn, copper and shows negative impact on all parameters including hematological parameters.

Table: 4 a Pearson's Correlation between Fe and other parameters.

	HB%	*HCT*	*RBC*	*MCV*	*MCH*	*MCHC*	*FE*	*Ferritin*
HB%	**1**							
HCT	**0.268111**	**1**						
RBC	**0.673621**	**0.29178**	**1**					
MCV	**-0.30789**	**-0.69974**	**-0.5921**	**1**				
MCH	**0.188495**	**-0.0861**	**-0.58119**	**0.449153**	**1**			
MCHC	**0.43702**	**0.027486**	**-0.24869**	**-0.0234**	**0.825069**	**1**		
FE	**0.087106**	**0.247749**	**0.065542**	**-0.20783**	**-0.0271**	**0.036223**	**1**	
Ferritin	**0.216065**	**0.120007**	**-0.06234**	**-0.18658**	**0.317062**	**0.492776**	**0.739563**	**1**

Concerning the hematological parameters, nearly all values were significantly lower among the all anemic subjects. Anemias may be classified based on their etiology; hematological parameters are valuable in the morphologic classification of anemias. Although worldwide there is economic and scientific growth but more than a quarter of the world's residents remains anemic.

We observed in this research, that the serum iron level in girls was lower with mild anemia than other subjects group whereas the Fe level in boys was lower with moderate anemia. In another study in Thailand revealed that the ratio of anemia among schools children was as high as 31% (Nguyen VAN Nhien *et al.,* 2008). About half of this burden was a result of iron deficiency anemia. Intake of sufficient iron in diet develops physical and mental performance, work productivity, and well-being, impaired scholastic performance and even long-term child outcomes. Among children, iron may improve cognitive, psychomotor, and physical development (Sebahat *et al.,* 2007). However, iron alone or with combination can reduce only 40-60% of the anemia however large a proportion of anemia is unresponsive to supplementation.

Anemia is described as a decrease in the number of red blood cell (RBC) below the standard range (Greer *et al.,* 2008). The fundamental health issues of anemia remained unresolved, affecting the health and working capacity of billions of people globally. In most cases anemia is caused by the deficiency of iron, which is often related to deficiency of folate and or deficiency of vitamin B12 (Milman, 2011). Andrew Hall, in his research work found that boys with age group 12-14 were more anemic than the girls (boys 50% while girls 40%). According to the research of Andrew Hall some anemia may also cause from the infection by worms and deficiency of micronutrients such as Fe (Andrew *et al.,*2000). The iron deficiency is most significantly contributing to the onset of anemia, Iron deficiency anemia (IDA) has often been andused as synonymous to anemia, and the anemia is considered to be a proxy for IDA (De Benoist *et al,* 2008). The iron deficiency is most significantly contributing to the onset of anemia, IDA has often been used as synonymous to anemia, and the anemia is considered to be a proxy for IDA (De Benoist *et al.,*2008). Multiple researches have documented very astonishing health impacts of anemia, i.e. higher chances of child and of maternal mortality due to intense anemia (Bothwell *et al.,* 1981; Scholl and Hediger, 1994). The documents published by WHO shows the negative impacts of IDA on body growth and intellectual development of children and also the physical performance of adults, in particular their work productivity (WHO, 2001). Iron (Fe) deficiency also maximizes the absorption of heavy metals like lead (Pb) (WHO, 2001). Enzymes require Fe that is vital for functioning of cell and plays an important part of carrying oxygen through the proteins like hemoglobin and myoglobin. Its importance can be judged from the fact that very specialized proteins are being developed for efficient extracellular transport (transferrin) and intracellular storage (ferritin) of Fe (Deugnier *et al.,*2008). When Fe is exported to plasma from the enterocytes through ferroportin-1 (Fpn1), it is rapidly oxidized to Fe3+ form by hephaestin and bound to transferrin (McKie *et al.,*2002).

4. CONCLUSION

The positive correlation was seen between Fe with ferritn, and shows negative impact on all parameters including hematological parameters. Concerning the hematological parameters, nearly all values were significantly lower among the all anemic subjects; hematological parameters are valuable in the morphologic classification of anemias.

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