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Original Research Article

Prevalence of Anaemia and Role of Haemoglobinopathy as an Associating Factor among the Children Belonging to the Tea Garden Community of Assam, India

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ABSTRACT

Background: Anemia is highly prevalent in India and it is one of the major health problems among the children belonging to the tea garden community of Assam.
Aim: To study the prevalence of anaemia among the children belonging to the tea garden community of Assam.
Methods: Collected samples were tested for complete blood count by automated blood analyzer, serum ferritin by IMMULITE® 1000 immunoassay system, serum iron and TIBC concentration by Dimension® RxL Max® Integrated Chemistry System and haemoglobin variants by High-performance liquid chromatography. Transferrin saturation percentage (%) was calculated by dividing the serum iron level by TIBC and multiplied by 100. Generated data were analyzed by analysis of variance (ANOVA) and multiple regression analysis using SPSS 21.
Results: The overall prevalence of anaemia among the children belonging to the tea garden community of Assam was. Study showed HB disorders were the most important non nutritional factor for causing anaemia in the study population. The study also showed that MCV level and serum ferritin level were important indicators of anaemia. A statistically significant difference of mean haemoglobin level ($F= 17.782$; $P<0.0001$) was observed in different types of haemoglobin variants among the study population.
Conclusion: For this kind of populations cause of anaemia was not only because of iron deficiency and so other recommended tests should be performed before treatment.

Keywords: Haemoglobin Variants, Serum Ferritin, Serum Iron, TIBC.

INTRODUCTION

Globally anaemia is common and the most common cause of anaemia is deficiency of iron. [1] Anaemia is a public health problem associated with an increased risk of morbidity and mortality mainly in pregnant women and young children. [2,3] In clinical terms anaemia is an insufficient mass of RBCs circulating in the blood; in public health terms anaemia is defined as a haemoglobin concentration below the thresholds given by WHO, UNICEF, UNU. [4] Among numerous factors, nutritional (such as vitamin and mineral deficiency) and non-nutritional (such as infections and haemoglobinopathies) factors contribute to the onset of anaemia which leads to iron deficiency. [3] Like other developing countries, anaemia is a major public health problem in India. [5] Assam also reflects a

similar scenario of the national average in prevalence of anaemia. [5] Studies conducted reflect high prevalence of anaemia among tea garden workers of Assam. [6] Haemoglobinopathies one of the non-nutritional factors associated with anaemia is widely prevalent in this part of India. [7-11] Sickle cell haemoglobin (HB S) and β-thalassemia are also prevalent in Assam. [12,13] However, HB S is mostly confined to the tea garden communities of Assam. [10,11] The World Health Organization (WHO) has estimated that, globally, 1.62 billion people are anaemic, with the highest prevalence of anaemia (47.4%) among preschool-aged children; of these 293 million children, 89 million live in India. [14] The third National Family Health Survey (NFHS) 2005-2006 revealed that at least 80% of Indian children aged 12 to 23 months were anaemic. [15] Other factors, including folate and vitamin B12 and A deficiencies, malaria infection, hookworm infestation, and hemoglobinopathies, are also associated with childhood anaemia. [16-18] Haemoglobin concentration, mean cell volume (MCV), serum ferritin, transferrin receptor, zinc protoporphyrin are the five indicators selected to assess iron status. [19] Serum and plasma iron, total iron binding capacity (TIBC), transferrin saturation are also use as biochemical indicators for assessment of iron status.

The present study was undertaken to estimate the prevalence of anaemia and to find out the impact of haemoglobin disorder as an associating factor of anaemia among the children belonging to the tea garden community of Assam, India.

MATERIALS AND METHODS

The study was conducted in a tea garden of Dibrugarh district of Assam. A total of 230 children aged 6 months to 14 years were recruited in the study. The total child population of the tea garden was 750. Using finite population correlation for small target population (n=750) based on assumption and taking the prevalence of anemia as 70% at 5% relative precision and 95% confidence interval the required minimum sample size is 226. But in the present study, 230 children were included.

The whole study was approved by the institutional ethics committee. Blood samples were collected from each child after taking informed parental consent. In addition to parental consent, assent of children were taken where necessary. A predesigned questionnaire was used to get information on age, sex, ethnic origin, history of blood transfusion etc.

4 ml of blood was collected from each child by venipuncture. 2ml of it was kept in K3EDTA vials and other 2 ml kept in plain clot activator vials. After collection, all the samples were transported to the laboratory. Blood in clot activator vials were allowed to clot and then centrifuged following standard laboratory procedure to separate the serum. Complete blood count of each sample were done by automated complete blood analyzer (SYSMEX XS-800i, Japan), serum ferritin levels were detected in IMMULITE® 1000 immunoassay system (Siemens Healthcare, Germany), serum iron and TIBC concentrations were detected in Dimension® RxL Max® Integrated Chemistry System (Siemens Healthcare, Germany). Presence of haemoglobinopathy and β-thalassemia were detected by High-performance liquid chromatography (HPLC), using D10 Hemoglobin Testing System (BioRad Laboratories, USA). Transferrin saturation % was calculated by dividing the serum iron level by TIBC and multiplied by 100. [20]

Statistical Analysis

All the data were entered into SPSS 21. The data were compared by Analysis of Variance (ANOVA). Multiple regression analysis was used to determine factors influencing haemoglobin level. The factors (independent variables), haemoglobin type, serum iron, TIBC, serum ferritin were entered and the haemoglobin level (dependent variable) was entered as continuous variable. We used "Enter" option for regression analysis. Statistical significance was accepted as P<0.05.

RESULTS

During the study a total of 230 samples were collected from children in the age group of 6 months to 14 years. The study was carried out from January 2015 to February 2016 in a tea garden of Dibrugarh district of Assam.

The mean age of the study was 11.8±2.9 years. After analysis of all the blood samples it was found that 86.5% of the populations were anaemic. HB S and β-thalassemia were the only major haemoglobin types (Table.1**)** of this population.

Table 1: Showing Prevalence of HB Disorders In the Study Population

Age Group	HB AA	HB AS	HB SS	β- thalassemia trait	β - thalassemia major	HB S/ β-thalassemia	HB E/ β-thalassemia	Total
6-59 months	1	1	1	0	4	2	0	9
5-11 years	29	3	15	6	5	0	5	63
12-14years	116	27	7	7	1	0	0	158
Total	146	31	23	13	10	2	5	230

Compound heterozygotes like HB E/ β-thalassemia and HB S/ β-thalassemia were also detected during the study. The mean of haemoglobin [HB] and serum ferritin levels were quite different in all the samples that were confirmed for haemoglobinopathies and β-thalassemia (Table**.** 2).

Table 2: Mean ± SD of All the Parameters Detected In Different HB Types

HB type	HB (g/dl)	MCV (fl)	Serum Ferritin (ng/ml)	Serum Iron (µg/dl)	TIBC (µg/dl)	Transferrin saturation %
HB AA	10.2±2.4	81.3±14.4	44.7±80.7	60.8±32	469.2±114.1	15.1±14.7
HB AS	8.6±3.3	79.8±15.4	70.2±135.3	71.2±44.6	404±114.7	24.2±34.8
HB SS	7.1±2.3	80.9±7.7	294.2±333.1	54.5±16.7	443.2±141.4	14.2±7.9
β- thalassemia trait	8.6±3	74.2±12.1	19.2±29	63.7±46.1	553.3±167.6	14.5±12.8
β- thalassemia major	3.2±1.3	75.6±29.1	810±292.3	130.2±10.4	412.3±13.8	31.6±2.4
HB E/β- thalassemia trait	7.2±.0.2	69.2±12.4	1230.5±43.1	69±8.5	347.5±78.5	20.1±2.1
HB S/β- thalassemia trait	6.4±.1.6	71.2±4.5	500±707.1	95.5±37.2	379.8±53.6	25.1±9.5

Among the whole study group 6 individuals had splenomegaly and 22 had previous history of blood transfusion. The HB level was lowest in the β-thalassemia major samples and the serum ferritin levels were very high in HB E/ β-thalassemia followed by β-thalassemia major and HB S/ β-thalassemia samples. Severe anaemia cases were highest (13.9%) in the 12-14 years age group. In the whole study population prevalence of anaemia was quite high (Table. 3).

Table 3: Showing the Prevalence of Anaemia in the Study Population

Age Group	Normal	Mild	Moderate	Severe	Total
6-59 months	0	1	2	6	9
5-11 years	10	6	25	22	63
12-14 years	21	39	66	32	158
Total	**31**	**46**	**93**	**60**	**230**

Multiple regression analysis showed that HB types and serum ferritin levels were the most important factors for causing anaemia in the study group (Table.4 & Fig. 1).

Table 4: Determinants of Haemoglobin Level Based On Multiple Linear Regressions

Model	Unstandardized coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence interval of B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
HB type	-.609	.113	-.386	-5.378	.000	-.833	-.386
MCV	.005	.008	.033	.585	.559	-.011	.021
Serum Ferritin	-.004	.001	-.390	-5.400	.000	-.005	-.002
Serum Iron	.014	.007	.228	1.884	.061	.000	.028
TIBC	-.002	.001	-.114	-1.568	.119	-.005	.001
Transferring Saturation%	-.023	.014	-.185	-1.633	.104	-.050	.005

Dependent variable: HB (g/dl) for all samples

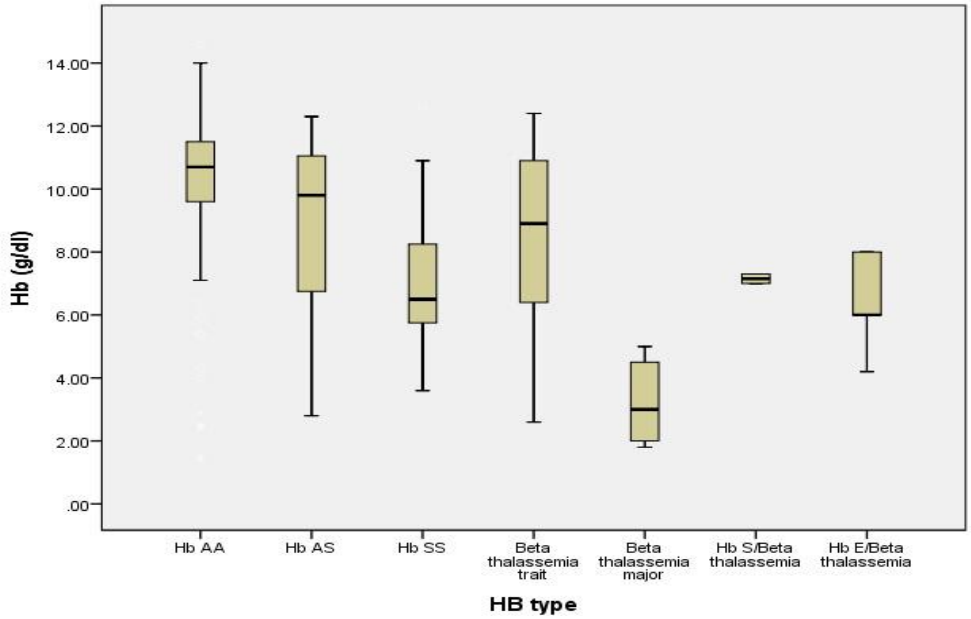

Fig. 1: Box and Whisker Plot Showing Haemoglobin Level in the Study Population

A statistically significant difference of mean haemoglobin level (F=17.782; *P*<0.0001) and serum ferritin level (F= 53.664; *P*<0.0001) were observed in different types of haemoglobin variants among the study population.

DISCUSSION

The present study was carried out to find the determinants that cause anaemia among the children belonging to the tea garden community of Assam. The study showed that anaemia was a major health problem among the children of the tea garden community of Assam. The overall prevalence of anaemia in the study population was 86.5%. The percentage was slightly higher than the National Family Health Survey (NFHS-3) of 2011 which showed the prevalence of anaemia as 70-80% in children. During the study we made the following observations: (1) HB levels were associated with prevalence of Haemoglobinopathies and β-thalassemia (2) HB levels were also associated with serum ferritin levels. In the study, for assessment of body iron status serum ferritin, serum iron and TIBC tests were performed. The cut off levels for serum ferritin had been used as per WHO recommendation. [4] There is a close relationship between the total amount of stored iron and the serum ferritin concentration in normal individuals. [21] A high concentration of serum ferritin level was found during iron overload, but there were other causes as well. [1] The study showed that HB concentration and serum ferritin levels were important indicators for assessment of iron status of the body. Among the whole study group 13% of the cases had low serum ferritin level. Within these low serum ferritin level cases 8.3% had HB AA genotype. In 33.9% of the samples the serum iron levels were low and out of which 26.1% belongs to the HB AA genotype. These results showed that HB disorders were not the only cause of anaemia among the children of tea garden community of Assam.

CONCLUSION

Very minimum studies had been done on iron deficiency anaemia (IDA) and its coexistence with haemoglobin disorders in the children belonging to the tea garden community of Assam. So this study will give an idea on the present status of anaemia among the children belonging to the tea garden community of Assam.

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