Original Article

Prevalence of anemia among the women of childbearing age belonging to the tea garden community of Assam, India: A community-based study

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ABSTRACT

Background: Anemia is a condition in which the number of red blood cells becomes insufficient to meet the body's physiologic needs. Anemia is one of the major public health problems in India. The aim of this study was to find the prevalence and determinants of anemia among the adult females of tea garden community of Assam. **Materials and Methods:** A community-based cross-sectional study was conducted among 770 numbers of adult females belonging to the tea garden community. For all the samples, complete blood count, abnormal hemoglobin variants screening by high-performance liquid chromatography (HPLC), serum iron level, total iron binding capacity (TIBC), and serum ferritin concentrations were determined. **Results:** Out of 770 patients, 19.7% were severely anemic. Hb S and β-thalassemia were the only hemoglobin types detected in the study. Hemoglobin type, mean corpuscular volume, TIBC, and serum ferritin level were the important determinants of anemia in the present study. **Conclusion:** To reduce the burden of anemia among the adult females of tea garden community, the females should be screened periodically, and appropriate measures should be taken.

Keywords: Cross-sectional study, high-performance liquid chromatography, prevalence, public health

Introduction

Anemia is a major health problem among the females of reproductive age in developing countries.[1] The World Health Organization global estimates of anemia prevalence averaged 56%, with a range of 35%–75% depending on geographic location.[2] In India, the prevalence of anemia is 52%.[1] Assam also reflects a similar scenario of the national average in the prevalence of anemia.[3] Previous studies conducted among tea garden workers of Assam show a high prevalence of anemia.[4–6] As per SRS 2007–2009 data, Assam is having the highest maternal mortality (380) of which tea garden community constitute the most.[7] Women of reproductive age are the most at risk for anemia.[8] The data of National Family Health Survey-3 shows that anemia is particularly high 55.3% in all women (15–49 years).[9] Therefore, it is important to assess anemia which is a risk for pregnancy-related complications, including greater risk for having a preterm delivery or low-birth-weight baby and also burdens the mother by increasing the risk of blood loss during labor and making it more difficult to fight infections.

The present study was carried out to get a clear idea of the different degree of anemia among the women of childbearing age of tea garden community of Assam and to find the role of different variables in the development of anemia.

Materials and Methods

Study design

This was cross-sectional study.

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Study population

The study population included women of childbearing age (15–44 years) from 7 randomly selected tea gardens of Dibrugarh, Assam who consent to participate in the study and fulfilled the inclusion criteria.

Study period

The study was conducted during 2015–2016.

Sample size

Considering 70% of women of childbearing age as anemic, with 3.5% margin of error and 95% confidence interval the required minimum sample size was 655. Taking 30% non-response rate and rounding up the sample size becomes 770.

Inclusion criteria

1. Women of childbearing age (15–44 years) belonging to the tea garden population of Assam.

Exclusion criteria

1. The individuals who did not give consent to participate in the study
2. The individuals who have blood transfusion history in last 3 months.

Data collection technique and tools

For sample collection, health camps were organized in the respective tea gardens. Before the survey, information and objectives of the survey were circulated in the selected tea gardens. All the study participants were made aware about the study before the collection of samples. During sample collection, details about the age, gender, educational status, ethnic origin, class in which studying, the name of the head of the family, information about the residential address, etc., were recorded by the study team in a predesigned questionnaire.[10] Qualified government medical practitioner (Allopathic) has supervised sanctity of data collection. The study has been approved by the Institutional Ethical Committee. Prior permission was obtained from the authorities of the respective tea gardens, and a written informed consent was obtained from all the participants before sample collection.

For the study of complete blood count, hemoglobinopathies, β-thalassemia (beta-thalassemia), serum ferritin, serum iron, and total iron binding capacity (TIBC) venous blood (3 ml) was collected from every participant in K3EDTA vials as well as in plain clot activator vials under aseptic condition. After collection, all the samples were transported to the laboratory in insulated packaging by maintaining refrigerated (+2°C to +8°C) condition with the help of gel packs. In the laboratory, serum was separated from the samples collected in clot activator vials by following standard laboratory procedure. A complete blood count of the individual blood samples was done in automated cell counter (SYSMEX XS-800i, Japan) using the standard procedure. For

screening of β-thalassemia and hemoglobinopathies cation exchanger high-performance liquid chromatography (HPLC)-based D10 Hemoglobin Testing System (BioRad Laboratories, USA) was used. A calibrated Dimension® RxL Max® integrated chemistry system (Siemens Healthcare, Germany) was used to measure serum iron and TIBC concentrations. Transferrin saturation was calculated by dividing the serum iron level by total iron-binding capacity and multiplied by 100.[11] Ferritin concentrations were determined by using IMMULITE® 1000 Immunoassay system (chemiluminescence method) (Siemens Healthcare, Germany).

Statistical analysis

The data generated were computed and analyzed using SPSS 21 (IBM Corporation, U.S). The mean hemoglobin level across the study group, based on hemoglobin types, i.e., HbAA (normal hemoglobin), sickle cell homozygous (HbSS), HbAS (Sickle cell trait), β-thalassemia trait, β-thalassemia major was compared by analysis of variance. Multiple regression analysis was used to determine factors influencing hemoglobin level in a subset of women of childbearing age. The factors (independent variables), hemoglobin type, serum iron, TIBC, serum ferritin were entered, and the hemoglobin level (dependent variable) was entered as a continuous variable. We used "Enter" option for regression analysis.

Results

During the study, 770 individuals were screened. The mean (± standard deviation [SD]) age of the study individuals was 24.8 ± 7.3 years. The mean (± SD) hemoglobin level of the participants enrolled in the study was 9.6 ± 2.6 g/dl. Screening of the blood samples by cation exchanger HPLC-based D10 Hemoglobin Testing System (BioRad Laboratories, USA) indicates HbS was the widely prevalent variant hemoglobin in the present study. HbS and β-thalassemia were highly prevalent in the present study [Table 1]. Mean ± (SD) of Hb%, serum iron level, TIBC level, serum ferritin level, and mean corpuscular volume (MCV) levels are shown in Table 1. Within the studied population, 23.9% of samples had hemoglobinopathies and β-thalassemia. Severe anemia (Hb <8 g/dl) was observed in 8.4% of the study population. However, moderate (Hb 8–10.9 g/dl) anemia was detected in 91.6% of participants. Multiple regression analysis revealed that hemoglobin type, MCV, serum ferritin, and TIBC level were the important determinants of anemia among the tea garden community of Assam in the present study [Table 2]. The effect of various hemoglobin types on the levels of Hb is shown in Figure 1. In the present study, 7.9% of individuals had high levels of ferritin and 6.4% of individuals had low levels of ferritin. In the studied population, 31.8% of individuals were illiterate.

Discussion

Anemia is a major public health problem in India.[12] The present study revealed that anemia is one of the major health problems among the childbearing women of tea garden community of

Table 1: Descriptive information of the study population

Age group	Total number (%)	Hb%	Serum iron (µg/dl)	TIBC (µg/dl)	Serum ferritin (ng/ml)	MCV (fl)
HbAA	586 (76.1)	9.9±2.3	67.2±42.6	436.4±127.5	40.5±57.2	80.8±14.5
HbSS	21 (2.7)	6.9±2.3	53.3±22.8	387.8±98.9	323.2±370.6	81.9±9.2
HbAS	110 (14.2)	9.4±2.7	68.2±31.7	401.7±123.4	71±113.3	79.9±14.5
HbS/β-thalassemia	9 (1.1)	9.3±2.5	63.9±34.6	435.2±170.7	27.9±23.6	77.1±13.6
β-thalassemia trait	19 (2.4)	6.5±3.8	95.8±53.1	468.1±186.2	645.8±534.9	69.8±13.5
β-thalassemia major	25 (3.2)	6.9±2.7	81±49.5	320±72.3	133±48.1	70.6±13.8

TIBC: Total iron binding capacity; Hb: Hemoglobin; MCV: Mean corpuscular volume

Table 2: Determinants of hemoglobin level based on multiple linear regressions[a]

Model	Unstandardized coefficients		Standard coefficients	t	Significant	95.0% CI for B	
	B	SE	Beta			Lower bound	Upper bound
Serum ferritin	−0.005	0.001	−0.272	−5.457	0.000	−0.007	−0.003
MCV	0.014	0.005	0.126	2.692	0.007	0.004	0.024
Iron	−0.001	0.002	−0.015	−0.317	0.751	−0.004	0.003
TIBC	−0.279	0.001	−0.099	−2.142	0.033	−0.002	0.000
Hb type	−0.584	0.073	−0.121	−2.513	0.012	−0.326	−0.040

[a]Dependent variable: Hb (g/dl) for all samples. CI: Confidence interval; SE: Standard error; TIBC: Total iron binding capacity; Hb: Hemoglobin; MCV: Mean corpuscular volume
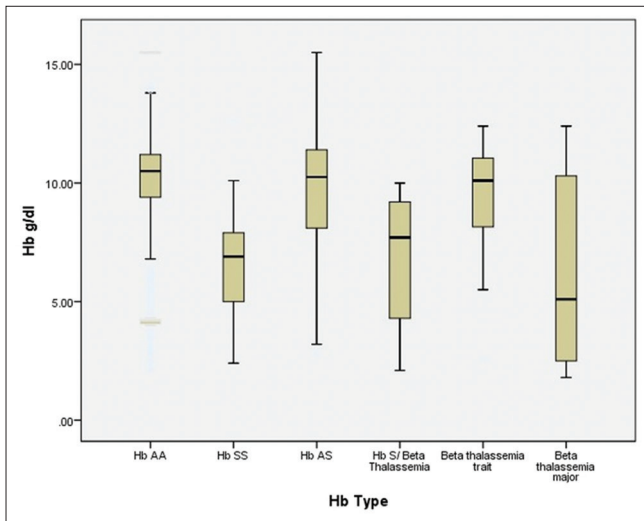

Figure 1: Box and Whisker plot showing hemoglobin level among the study population according to their hemoglobin type

Assam. Among numerous factors, nutritional (such as vitamin and mineral deficiency) and nonnutritional (such as infections and hemoglobinopathies) factors contribute to the onset of anemia which leads to iron deficiency.[13] Among the hemoglobin variants, sickle cell hemoglobin (HbS) is mostly confined to the tea garden communities of Assam.[14,15] β-thalassemia is also prevalent in this community.[6] In this study, 18.9% of the population were severely anemic. To classify anemia WHO cutoff had been applied.[16]

One of the major findings of this study was the role of HbS and β-thalassemia as an important nonnutritional determinant of anemia among the study population. Earlier studies showed the prevalence of β-thalassemia in Assam.[17,18]

HbAA (normal hemoglobin) – In the present study, 76.1% of the participants were with normal hemoglobin variants. All the

participants had moderate anemia. Some of the participants of this group had iron deficiency anemia. Lower serum ferritin level indicates iron deficiency as the main cause of anemia. There was wide variation in the range of serum ferritin values among this group varying from 4.2 to 350 ng/ml.

Anemia among the women with normal hemoglobin may be influenced by nutritional deficiencies. Another study done in adolescent girls living in slums of Ahmedabad shows a significant association between fathers occupation, the habit of tea consumption with food, the habit of green leafy vegetable consumption, and body mass index.[19]

Nutritional anemia is one of the major public health problems in India affecting almost 70% of children and 56% among ever-married women.[20] The ICMR study also revealed the high magnitude of undernutrition and infectious diseases among tea garden population of Assam.[21]

HbS (sickle hemoglobin) – in this study, 2.7% of the population suffered from sickle cell homozygous (HbSS). All the participants of this group had severe anemia. An increase in ferritin levels combined with an increase in transferrin saturation usually is a sign of iron overload.[22-24] Chronically transfused iron overloaded patients with sickle cell homozygous (HbSS) have significantly higher mortality than less transfused HbSS patients without iron overload, as well as age and race-matched normal controls.[25,26] Normal ferritin concentrations vary by age and sex. Concentrations are high at birth, rise during the first 2 months of life, and then fall throughout later infancy.[27] However, normal or elevated levels of serum ferritin do not indicate adequate iron stores necessarily, particularly in populations exposed to recurrent infections.[28,29] Nearly 14.2% of the studied population had HbAS (Sickle cell trait). All of them had moderate anemia. Nearly 1.1% of the studied population had HbS/β-thalassemia (Sickle cell-beta thalassemia). All of them had moderate anemia.

β-thalassemia – β-thalassemia syndromes are the result of insufficient (β+) or absent (β0) production of β-globin chains. Their molecular causes are β-globin gene mutations. In this study, 3.2% of the population had β-thalassemia major and 2.4% had β-thalassemia trait. All of them had severe anemia. β-thalassemia major is hereditary hemolytic anemia which is treated with multiple blood transfusions.[30] However, iron overload is a major complication suffered by β-thalassemia major patients due to multiple blood transfusions. Studies suggested that greater iron absorption and lower utilization in β-thalassemia major resulted in large increases in body iron that exceeds iron-binding capacity.[31-33]

In India, 8.19% population distributed in different states has tribal population.[34] The tribal population is vulnerable population, in terms of social development, isolating dwelling places in difficult terrain, rigid customs and beliefs, illiteracy, and separation from non-tribal population exposes them to many health and social issues.[35] In this group of the population, anemia has a number of consequences which includes reducing in working capacity and impaired immunity.[2,36] It has also a direct impact during pregnancy since 50% of anemic cases during pregnancy starts at the time of conception.[2] This study indicated the importance to improve the iron status of this population and the need for planning intervention programs that would increase the health condition of these women.

Anemia is one of the most common nutritional deficiency disorders.[1,37] The high prevalence of mild, moderate and severe anemia demands a due emphasis on iron and folic acid supplementation and health education on the consumption of iron-rich foods, to bring down the prevalence of anemia among the women of the reproductive age group of this particular population.

As the prevalence of anemia among this population was found higher than the national average more focused attention and better coverage is needed.

Limitation of the study

The sampling was done from the women of childbearing age from 15 to 44 years.

Future directions of the study

In this community-based study, we can further explore the other nutritional factors and infections that might be related to anemia.

Conclusion

This kind of the study shows the clear picture of the health of the general population. The present study indicates the need for a further comprehensive study to determine the role of hemoglobin type as an associating determinant of anemia in this part of India. The study also shows that before starting treatment all anemic patients should be properly investigated for the cause and type of anemia. Anemia is a major problem among

the women of childbearing age belonging to the tea garden community. To overcome these problems, new innovative and cost-effective methods should be developed for the fortification of food of these populations. Awareness programs should be organized for these people about the fortification of food as well as the importance of iron for females.

Conflicts of interest

There are no conflicts of interest.

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