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Original Research Article

The prevalence of anemia among the tribal children from the western districts of West Bengal, India

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ABSTRACT

Background: Tribal population in West Bengal constitutes a significant proportion (5.1%) and the vulnerable group because of lower socio-economic status, poor literacy rate and malnutrition. The present study was conducted to evaluate hemoglobin level and prevalence of anemia among the tribal children from the western districts of West Bengal, India.
Methods: A cross-sectional study was conducted on school going (class I to class VIII) tribal children (≥5 to <13years) during March 2019 to February 2020. A complete blood count was done by automated blood cell counter and anemia was classified as per WHO criteria. They were also tested for markers of common nutritional anemias (serum ferritin, serum vitamin B12 and serum folate). Data entry and analysis was done on SPSS version 15. A p-value of <0.05 was considered statistically significant.
Results: Total 1, 010 tribal children were included with male:female=1:1.35. Among these, 46.34% (n=468) children had anemia. Among all anemic children 47.65% (n=223), 51.93% (n=243/468) and 0.42% (n=2) respectively had mild, moderate and severe anemia. There was a high prevalence (81.68%) of microcytic red blood cells in the total cohort; among anemic children, 53.94% have microcytosis while no macrocytosis was revealed. Among all grade anemias, iron, folate and vitamin B12 deficiency were found in 44.65% (n=209/468), 13.24% (n=62/468) and 25% (n=117/468) respectively.
Conclusions: The prevalence of anemia among tribal children of West Bengal is a matter of concern. The high prevalence of microcytic indices in non-anemic population highlights the dire need for screening for the causes of anemia in this population.

Keywords: Anemia, Tribal Children, West Bengal

INTRODUCTION

Hemoglobin (Hb), a metalloporphyrin present in red blood cells is a two-way transporter of gases, carrying oxygen from lungs to tissues and carbon dioxide from tissues to lungs. Anemia as defined by World Health Organization (WHO) is a condition in which the oxygen-carrying capacity of an individual is insufficient to meet the body's physiologic needs.[1] Any defect including the quantitative or qualitative in hemoglobin results in varying clinical severity. The prevalence of anemia is an important health indicator and in children is a serious concern as it can result in cognitive or behavioral impairment, delay in motor development, as well as increased morbidity and mortality from infectious diseases.[2]

The tribal population of the country, as per 2011 census, is 10.43 crore, constituting 8.6% of the total population; 89.97% of them live in rural areas and 10.03% in urban areas.[3] The fourth most populous state of India, West Bengal (WB) has a tribal population of approximately

5.1% of the total state population (9.13 crore).[4] Tribal communities are present in all the Districts of the State. Higher concentration of Tribal population is seen in the Districts like Darjeeling, Jalpaiguri, Alipurduar, Dakshin Dinajpur, Paschim Medinipur, Bankura and Purulia. Among the 40 ethnic groups notified as Scheduled Tribes in West Bengal, Toto, Birhor and Lodha have been notified as PVTGs (Particularly Vulnerable Tribal Groups) in terms of backwardness in different development indicators. BIRHORs and LODHAs are predominantly residing in the districts of Purulia and Paschim Medinipur respectively.[5] This section of the tribal community is considered the most backward, under privileged and deprived section of Indian society. In many of the districts including Bankura (10.4%), Bardhaman (6.4%), Birbhum (6.7%), Medinipur (8.3%) and Purulia (18.3%), situated in the western part of the state, the tribal population as per census 2001, exceeds ≥10% of the total district population.[6] Tribal children are a vulnerable population due to lack of social development, high illiteracy, rigid customs, inadequate food and health security, poor environmental conditions and a high prevalence of malnutrition.[7]

It is therefore crucial from the public health point of view to collect data regarding health and malnutrition including the prevalence of anemia and associated risk factors in these vulnerable communities to form the basis of preventive intervention programs. As per the National Family Health Survey (NFHS-3) report 2005-06, the prevalence of any anemia (Hb<11 g/dl) in children aged 6-59 months in India was 69.5%, with 2.9% having severe anemia (Hb<7 g/dl) and prevalence in WB was 61% with 1.5% children having severe anemia.2 When compared with NFHS-2 (1998-99), there was an increase in the prevalence of anemia in children, and the increase was primarily seen in rural areas, where it rose from 75% to 81% in the 2005-06 survey. With the availability of scarce data on the prevailing occurrence of anemia in tribal children, this study was undertaken to evaluate the magnitude and severity of anemia in tribal children of four western districts of West Bengal.

METHODS

It was a cross-sectional study conducted over one year during the study period of March 2019 to February 2020 among tribal children in the age group of ≥5 to <13 years, residing in the geographical areas from the western districts of WB including Paschim Medinipur, Jhargram, Bankura, and Purulia. Children (studying in class I to VIII) were randomly selected from the primary and junior high schools in the above mentioned four districts and were included in the study. The ethical approval for the study was taken from the 'Institutional Ethical Committee'. Informed written consent was taken from the parents or legal guardian of the children. The exclusion criteria included were children suffering from known hematological or any other chronic disorder, taking any hematinic, received recent blood transfusion, not willing to participate or refused to give a blood sample.

An intravenous blood samples were collected in was collected in EDTA vacutainers (2 mL) and also in clot vacutainers (3 mL) from each subject and transported to the laboratory of the Institute for analysis under cool conditions within 3-5 hours of collection. A complete blood count (CBC) including Hb and red blood cell (RBC) indices was done by an automated blood cell counter (Sysmex KX-21; Sysmex Corporation, Kobe, Japan) that was calibrated with commercially available controls. The clotted blood sample is spun to separate the serum to be used for immunoassay for the markers of nutritional anemia (serum ferritin, serum vitamin B12 and serum folate). The tests were performed by Chemiluminescence immunoassay (CLIA) technique in Access 2 Immunoassay System (Beckman Coulter, Brea, California, USA). Anemia was defined and classified according to the WHO criteria: non-anemic (Hb≥11.5 g/dl), mild anemia (Hb 11-11.4 gm/dl), moderate anemia (Hb 8.0-10.9 gm/dl) and severe anemia (Hb <8.0gm/dl).1

Statistical analysis

Data entry and analysis was done on SPSS version 15 (SPSS Inc., 233 South Wacker Drive, 11th Floor Chicago, IL 60606-6412). Categorical variables were presented in number (n) and percentage (%) and continuous variables were presented as mean±SD (standard deviation) and median. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 1010 tribal children in the age-group of ≥5 to <13 years were included in this study with 429 boys and 581 girls (M:F=1:1.35). The Hb in the overall cohort varied from 5.8 to 15.4 g/dl; in females it was 5.8 to 13.9 g/dl while in the males it was 7.8 to 15.4 g/dl. The mean Hb±SD of the cohort was 11.54±0.89 and the median was 11.5 g/dl.

Table 1 shows the gender-wise distribution (prevalence) of anemia and its various grades. Overall, 46.34% (n=468/1010) children found to be anemic and the prevalence of anemia was more in males (47.32%; n=203/429) as compared to females (45.61%; n=265/581) in the cohort. When analyzed as per WHO grading of anemia, 51.93% (n=243/468) was found to have moderate anemia while 47.65% (n=223/468) had mild anemia and 0.42% (n=2/468) had severe anemia in the overall cohort. Out of 265 anemic females, 50.18% (n=133), 49.43% (n=131) and 0.37% (n=1) had mild, moderate and severe anemia respectively. In the male subgroup (n=203), 44.33% (n=90), 55.17% (n=112) and 0.49and (n=1) respectively had mild, moderate and severe anemia.

Table 1: Prevalence of different grades of anemia (as per who) in tribal children of West Bengal (n=1,010).

Parameters	All grades Anemia (Hb<11.5 g/dl); % (n)	Mild Anemia (Hb, 11-11.4 g/dl); % (n)	Moderate Anemia (Hb, 8.0-10.9 g/dl); % (n)	Severe Anemia (Hb <8 g/dl); % (n)
Male	Male= 47.32% (203/429)	44.33% (90/203)	55.17% (112/203)	0.49% (1/203)
Female	Female= 45.61% (265/581)	50.18% (133/265)	49.43% (133/265)	0.38% (1/265)
Total	Total= 46.34% (468/1010)	47.65% (223/468)	51.93% (243/468)	0.42% (2/468)

Table 2: Various grades of anemia across different age groups and gender prevalent in tribal children of West Bengal (n=468).

Age group (years)	Gender	Mild anemia (Hb=11-11.4 g/dl); n (%)	Moderate Anemia (Hb 8.0-10.9 g/dl); n (%)	Severe Anemia (Hb<8 g/dl); n (%)	Overall prevalence (according to age across different age groups); n (%)	Overall prevalence (according to age group); n (%)
≥5 to <6	Male	4 (1.97%)	9 (4.43%)	1 (0.49%)	14 (6.89%)	21(4.48%)
	Female	2 (0.75%)	5 (1.89%)	0 (0.00%)	7 (2.64%)	
≥6 to <7	Male	18 (8.87%)	28 (13.79%)	0 (0.00%)	46 (22.67 %)	68 (14.52%)
	Female	6 (2.26%)	16 (6.04%)	0 (0.00%)	22 (8.31%)	
≥7 to <8	Male	11 (5.42%)	12 (5.91%)	0 (0.00%)	23 (11.33%)	47 (10.06%)
	Female	12 (4.53%)	12 (4.53%)	0 (0.00%)	24 (9.05%)	
≥8 to <9	Male	9 (4.43%)	16 (7.88%)	0 (0.00%)	25 (12.31%)	50 (10.68%)
	Female	16 (6.04%)	9 (3.40%)	0 (0.00%)	25 (9.43 %)	
≥9 to <10	Male	9 (4.43%)	12 (5.91%)	0 (0.00%)	21 (10.34%)	40 (8.56%)
	Female	10 (3.77%)	9 (3.40%)	0 (0.00%)	19 (7.16 %)	
≥10 to <11	Male	10 (4.93%)	10 (4.93%)	0 (0.00%)	20 (9.85%)	55 (11.75%)
	Female	19 (7.17%)	16 (6.04%)	0 (0.00%)	35 (13.23%)	
≥11 to <12	Male	15 (7.39%)	15 (7.39%)	0 (0.00%)	30 (14.78%)	85 (18.16%)
	Female	34 (12.83%)	21 (7.92%)	0 (0.00%)	55 (20.75%)	
≥12 to <13	Male	14 (6.90%)	10 (4.93%)	0 (0.00%)	24 (11.83%)	102 (21.79%)
	Female	34 (12.83%)	43 (16.23%)	1 (0.38%)	78 (29.43%)	
Total		Male = 90 (44.34%)	Male = 112 (55.17%)	Male = 1 (0.49%)	Male = 203 (43.45%)	468 (100%)
		Female = 133 (50.19%)	Female = 131 (49.43%)	Female = 1 (0.38%)	Female = 265 (56.55%)	

Table 3: Prevalence of microcytosis (MCV<80fL) in tribal children of West Bengal (n=1,010).

Parameters	MCV<80 fL); % (n)	Non-anemic (Hb≥11.5 g/dl));% (n)	All grades anemia (Hb<11.5 g/dl));% (n)
Male	84.84% (364/429)	46.15% (168/364)	53.85% (196/364)
Female	79.34% (461/581)	45.99% (212/461)	54.01% (249/461)
Total	81.68% (825/1,010)	46.06% (380/825)	53.94% (445/825)

Table 4: Prevalence of nutritional deficiency in tribal children of West Bengal (n=1,010).

Biochemical tests for nutritional anemia	Non-anemia (Hb ≥11.5g/dl); % (n)	All grades anemia (Hb<11.5 g/dl); % (n)	Mild anemia (Hb, 11-11.4 g/dl);% (n)	Moderate anemia (Hb, 8.0-10.9 g/dl);% (n)	Severe Anemia (Hb <8 g/dl); % (n)
Ferritin <30 ng/ml	36.34% (197/542)	44.65% (209/468)	43.04% (96/223)	48.14% (117/243)	100% (2/2)
Folate <4 ng/ml	16.9% (92/542)	13.24% (62/468)	12.55% (28/223)	14.4% (35/243)	0% (0/2)
Vitamin B12 <200 pg/ml	29.15% (158/542)	25% (117/468)	27.35% (61/223)	27.1% (66/243)	0% (0/2)

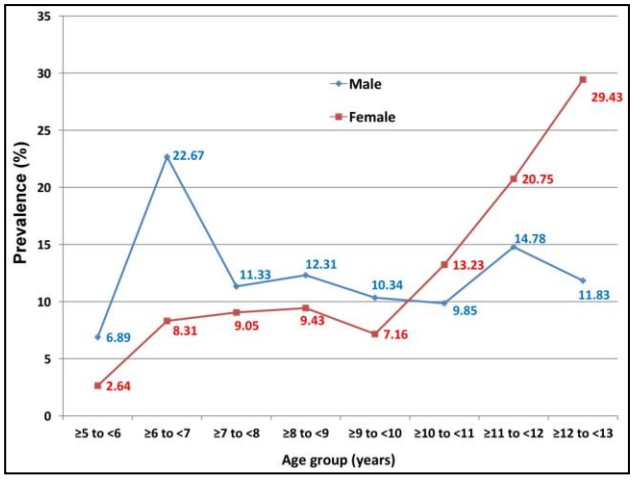

Figure 1: Trends in prevalence of anemia in different age groups in tribal children of both sexes in West Bengal.

The distribution of the prevalence of anemia in different age groups among males and females are shown in Table 2 and Figure 1. The prevalence of anemia in males was maximum (22.67%) in the age group of ≥6 to <7years, while in females (29.43%) it was seen in the age group ≥12 to <13years. The prevalence of anemia in females surpasses that of males by ≥10 to <11 years of age. The maximum prevalence in males was seen at age group≥6 to 7 years as moderate anemia (13.79%) while in female maximum prevalence was seen after ≥11 years of age as mild (12.83%) and moderate anemia (16.23%). When analyzing the RBC indices in the cohort (n=1010), there were 825 (81.68%) children were having microcytosis (MCV <80fL), in which 53.94% (n=445) were anemic and 46.06% (n=380) were non-anemic (Table 3). In subgroup analysis in male children (n=429) the prevalence of microcytosis in anemic children was 53.85% (n=196) and while in female cohort (n=581) it was 54.01% (n=249).

Table 4 depicts the prevalence of iron, folate and Vitamin B12 deficiency among non-anemic and in various grades of anemic groups. The prevalence of iron deficiency defined as serum ferritin <30ng/ml, 1 was higher in anemic group (44.65%) compared to non-anemic group (36.34%). Also, the prevalence increases with the grade of anemia with severe anemia showing 100% iron deficiency, while it was 48.14% in moderate and 43.04% in mild anemic group. The prevalence of folate and Vitamin B12 deficiency was higher in non-anemic group compared to anemic group and no children with severe anemia found to have any of two deficiencies.

DISCUSSION

Anemia and its clinical consequences affect upto one-fourth of the world's population (1.62 billion people worldwide), especially pre-school children (47.4%), pregnant (41.8%), and non-pregnant (30.2%) women.8 As per NFHS-4 survey (2015-16), the prevalence of anemia in children aged 6-59 months (Hb<11g/dl) of rural India was found to be 59.5% (28% of children had mild anemia, 29% had moderate anemia and 2% had severe anemia), while in WB it was 53.7%.[9] Various studies had reported the prevalence of anemia in a tribal population ranging from 51% to 91.4% in different states of India.[10-14]

The present study was the first initiative on the estimation of Hb level and prevalence of anemia in tribal children from the western districts of WB. The prevalence of anemia in tribal school-going children (studying in class I to VIII) in these four districts were found to be 46.34%, that is as per to the prevalence (54.51%) reported in tribal population (n=88; mean age of 33.37 years) from the northern districts of WB.[10] The present study found that anemia in both male and female children in tribal school-going children is equally prevalent, with a lack of severe anemia in all age groups. In the anemic cohort, there was a predominance of moderate anemia in both male and female groups and a lack of severe anemia that also matches with the reported prevalence in tribal children aged 6-12 years from government schools of villages in Rajasthan.[15] Although the present study revealed that the prevalence was more in male children (47.32%) but other reported studies from different regions of India had shown an overall higher prevalence in females.[9-12] When prevalence of anemia was analyzed as per the age of the cohort, female surpasses the male population at 10 years of age showing the higher prevalence in adolescent females. This can be related to the physiological changes in males during adolescence (testosterone surge) and blood loss in females related to menarche.

When evaluating nutritional deficiency as cause of anemia, iron deficiency was pronounced among anemic group compared to folate or vitamin B12 deficiency. Several studies have shown the significance of lower socioeconomic status, including family income, food habits and literacy rate as a contributor to nutritional anemia in the tribal population.[12,16,17] A very recent study conducted among Santal Adivasi Children from Birbhum District in West Bengal found a high prevalence of malnutrition (height-for-age, 51.9% and weight-for-age, 49.2%) and anemia (73.3% with Hb<10 g/dL,) suggesting malnutrition as the main cause of anemia in tribal children.[18] Chowdhury et al conducted a study on undernutrition in Santal (the third largest tribe in India) children (aged 5-12 years) of Puruliya District of West Bengal and reported the prevalence of undernutrition among Santal children as follows: stunting (17.9%), underweight (33.7%) and wasting (29.4%); prevalence of stunting and wasting (21.7% and 35.8%) was higher in girls in comparison to boys (stunting-13.8% and wasting-22.7%).[19] As per the NFHS-4 survey, tribal children have an increased risk of death, high prevalence of anemia, stunting, and wasting as compared to non-Adivasis.[9] The

present study also found high prevalence of iron, folate and vitamin B12 deficiency in the tribal children cohort, suggesting nutritional assessment at regular intervals is still the clinical need. As per the census 2011 in India, there was a definite improvement in the literacy rates of tribes from only 8.54% in 1961 to 63.1% in 2011.[20] However, even in 2011, male literacy rate (71.70%) was far better than the female literacy rate (54.40%) and therefore there is an urgent need for focus on tribal education and inclusive growth.[21]

Hemoglobinopathies including thalassemias are among the major causes of anemia in this part of the country. Various studies have reported the prevalence of various hemoglobinopathies in west Bengal ranging from 6 – 11.46%.[22-24] Amongst these, the most recent study by Maji SK24 showed the prevalence of β-thalassemia trait and Hb E traits in 7.23% and and 2.77% of the population studies in rural areas of Paschim Midinipur (West Midnapore) and Jhargram Districts of West Bengal. When mean corpuscular volume (MCV) was evaluated in the whole cohort, 81.68% (n=825/1,010) were found to have microcytic RBCs (MCV<80fL) while 53.94% (n=445/825) of the children with anemia of any grade had shown microcytosis. This high prevalence of microcytosis in non-anemic children (46.06%; n=380/825) can be explained by the reported high prevalence of hemoglobinopathies (11.46%) in this region.[24] The high prevalence of microcytic indices in tribal children suggests the need for screening and counseling for hemoglobinopathies in this vulnerable group to curtail the prevalence of hemoglobinopathies and their consequences. There was no macrocytic anemia (MCV >100fL) found in this cohort.

Anemia has multifactorial causes involving complex interaction between nutrition, infectious diseases, and other factors, and this complexity presents a challenge to effectively address the population determinants of anemia. Reduction of knowledge gaps in research and policy and improvement of the implementation of effective population-level strategies will help to alleviate the anemia burden in low-resource settings.[17]

Limitation

This study is being unable to evaluate the other causes of anemia in tribal children of WB. Also successful implementation of screening programs to rule out hemoglobinopathies in the population is the unmet need. However, this data can be used as baseline information to plan further studies to know the various causes of anemia in tribal children and to make health policy to prevent them.

CONCLUSION

The tribal population constitutes a significant population of various districts of West Bengal. They are among the vulnerable population to develop malnutrition and hence nutritional anemia. The prevalence of anemia was found to be high among tribal children of both sex reveled in this study is a matter of concern. The higher prevalence of microcytic RBCs and the causes of anemia other than nutritional anemia were not fully explored in this study and can be considered to be taken up in the future for well-designed studies in a large scale in this underprivileged population. It can be further suggested that there is an unmet need for definite operational research and community-based micro-level studies to detect the measures to be taken to improve the existing nutritional supplementary activities to prevent nutritional causes of anemia.

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