Original Article

Prevalence and Risk Factors of Iron Deficiency Anemia among the Tribal Residential Adolescent School Students of Odisha: A Cross-Sectional Study

Jyotiranjan Sahoo, Smaraki Mohanty, Sandhya Gupta[1], Sandeep K. Panigrahi, Sambedana Mohanty, Deepa Prasad[2], Venkatarao Epari

Departments of Community Medicine and [1]Physiology, Institute of Medical Sciences and SUM Hospital, Siksha 'O' Anusandhan Deemed to be University, Bhubaneswar, Odisha, [2]Chief of Programs, UNFPA, India

Abstract

Background: Globally, anemia is one of the biggest public health challenges. The highest prevalence of anemia is seen among adolescents. Tribal communities are especially at a disadvantage, with several studies documenting a high prevalence of anemia among tribal adolescents. We investigated the prevalence of anemia and its associated risk factors among the tribal residential adolescent school students in Odisha. **Material and Methods:** In a cross-sectional survey, the prevalence of anemia was estimated by spectrophotometry among adolescents of residential schools in three predominantly tribal districts of Odisha. The severity of anemia was defined as per the World Health Organization classification for adolescents. **Results:** The mean age of 953 subjects was 13.07 ± 1.48 years. The prevalence of anemia was found to be 37.3%. As per the World Health Organization classification, 19.9% had mild anemia, 16.3% had moderate, and 1% had severe anemia. Consumption of Iron Folic Acid (IFA) was associated with the level of hemoglobin at a statistically significant level. **Conclusion:** We found that the prevalence of anemia was lower than in similar studies conducted in other parts of the country. Despite poor coverage of beneficiaries with iron and folic acid at the national level, our study showed better compliance and was associated with a significantly higher level of hemoglobin among those who consumed IFA.

Keywords: Hemoglobin, IFA supplementation, nutritional status

Introduction

Globally, anemia is one of the biggest public health challenges having major health, economic, and social consequences.[1] As per the latest report of the National Family Health Survey 5, the prevalence of anemia has worsened in most of the states and union territories across India in the past half a decade.[2] Highest prevalence of anemia is seen among adolescents, as the nutritional requirements are the maximum during this time.[1,3] Adequate nutrition is important especially during adolescence as it is the period of rapid growth and poor nutrition can lead to impaired physical and mental ability with lifelong consequences.[4] The prevalence of anemia among the adolescents is reported to be high, with close to 50% of the surveyed population[5,6] being anemic, that commensurate with the findings of National Family Health Survey 5, where the prevalence of anemia in women (aged 15-19 years) is 59.1% and in men (aged 15-19 years) is 31.1% with urban and rural differences.[2]

The National Iron Plus Initiative was introduced to reduce the incidence and prevalence of iron deficiency anemia across all life stages including adolescents.[7] Under the framework of the National Iron Plus Initiative, Anemia Mukt Bharat has been designed to achieve the targets of the World Health Assembly of 50% reduction of anemia in women of reproductive age by 2025.[8] POSHAN Abhiyan (2018-2022) aims to reduce anemia prevalence of anemia among young children, adolescents, and women of reproductive age group by 3% per year.[9]

Access this article online

Quick Response Code:

Website: www.ijcm.org.in

DOI: 10.4103/ijcm.ijcm_453_22

Address for correspondence: Dr. Venkatarao Epari, Professor, Department of Community Medicine, Institute of Medical Sciences and SUM Hospital, Siksha 'O' Anusandhan Deemed to be University, Bhubaneswar, Odisha, India.
E-mail: e.venkata.rao@gmail.com

How to cite this article: Sahoo J, Mohanty S, Gupta S, Panigrahi SK, Mohanty S, Prasad D, *et al*. Prevalence and risk factors of Iron deficiency anemia among the tribal residential adolescent school students of Odisha: A cross-sectional study. Indian J Community Med 2023;48:562-6.

Received: 27-05-22, **Accepted:** 26-04-23, **Published:** 14-07-23

Tribal communities are especially at a disadvantage, both economically and socially, and often excluded from proper education. Their typical socio-cultural beliefs, food, and dietary patterns with inadequate consumption of nutrients often lead to undernutrition including anemia.[10] Several studies have documented high prevalence of anemia among tribal adolescents.[8,11–13] Odisha is one among the top few states in the country with a large (23%) and highest varieties of tribal population.[14]

It has been noted that adolescents in the nonresidential schools have significantly higher proportion of worm infestations, diarrhea, and vitamin deficiencies.[15] To ensure development of the tribal communities, the concept of residential schools was conceptualized, which provide education along with nutritious food.[16]

In the backdrop of two major schemes launched with a lot of ambition, but neither addressing tribals specifically, despite the tribal community has a natural disadvantage, the scheduled caste and scheduled tribe department of the Government of Odisha took an initiative to detect and treat cases of anemia among the tribal school students. We investigated the prevalence of anemia and their associated risk factors among the tribal residential adolescent school students in Odisha.

Methods

Study setting, participants, and design: This cross-sectional study was conducted during January to July 2019, as a part of a project to validate a hand-held device for hemoglobin estimation, published previously.[17] Students of residential schools of three predominantly tribal districts namely Keonjhar, Kandhamal, and Rayagada constituted our study universe.[18] These districts were chosen in priority by the Government of Odisha owing to their poor health indicators.[19]

Sample size: Sample size was calculated based on the reported prevalence of anemia of 50% to 90% in India among adolescents.[1] Considering the lower prevalence of 50% with a margin of error of 3.5% at 95% confidence interval, a total of 775 subjects were adequate from a total of 61,981 students in three districts to provide an estimate of prevalence of anemia with sufficient power.

Sampling method: Sample from each district was chosen based on population proportionate to the size from a total of 61,981 enlisted students from three districts (Data obtained from SCSTRTI, Government of Odisha, unpublished). Eight schools from each of the three districts were selected randomly. Sample and site selection from each district was done beforehand and was informed to the concerned school for smooth execution. List of students (from 5th to 10th class) in each of the selected school was obtained and the sample from each class in the school was drawn using probability proportionate to the size method. During the school visit, students were chosen randomly from each class using their class roll numbers.

Data collection procedure: The team, comprising of a doctor, a laboratory technician, a staff nurse, and an attendant, were trained on all the relevant procedures (data collection on basic demographic profile, counselling before blood collection, venipuncture procedure, recording of the results, quality check, postprocedural observation for any untoward event, and biomedical waste handling). A structured questionnaire was used to collect relevant information. A minimum of 2 mL of blood was collected through venipuncture in EDTA containing vacutainers following standard guidelines. The blood sample was transported in cold boxes to the institute's NABL-accredited laboratory and tested within 24 hours for hemoglobin estimation by the gold standard method using spectrophotometry technique to detect Slauryl sulfate (Sysmex XN 3000: manufactured by Sysmex GmBH). The biomedical waste generated and segregated at the site was transported back to the institute for appropriate disposal.

Severity of anemia was defined as per the World Health Organization (WHO) classification for adolescents[20]: severe anemia – Hb level below 8 g/dL; moderate anemia – Hb level 8 to 10.9 g/dL; mild anemia – 11 to 11.4 (for 5 to 11 years), 11 to 11.9 (for 12 to 14 years), and 11 to 12.9 (for males >15 years).

The age of the subject was ascertained either from the school register or the birth certificate if available.

If a child has consumed IFA for 15 days regularly, till 2 months back, was considered as 'Yes'. Consumption of IFA and other relevant information like history of deworming, hospitalization, malaria, bloody diarrhea, and sickle cell disease was ascertained from the participant/parent/records/school authority. Deviation in frequency (of menses beyond 24–38 days) and/or the amount based on subjective perception was considered as menstrual irregularity.[21] Hand washing practice was evaluated by asking whether the pupil washed his/her hands before having food.

Statistical Methods: Continuous variables were expressed as mean and standard deviation, and categorical variables as percentage. Chi-square test was used to compare the proportions and student's *t*-test to compare means. Multivariable linear regression analysis was used to find association of risk factors with level of hemoglobin. The analysis was performed using SPSS software version 27.0 (IBM Corp., Armonk, NY) licensed to the institute. A *P* value of <.05 was considered as statistically significant.

Ethical approval: Prior permission was obtained from the institutional ethical committee wide letter no. DMR/IMS.SH/SOA/180166 dated February 22, 2019. A written informed consent was obtained from the legally accepted representative and head of the school before the enrollment. For children aged less than 12 years, verbal assent was obtained before enrollment. Findings of the hemoglobin estimation were shared with appropriate advice to the subjects.

Results

A total of 968 students participated in the study. After data cleaning, 953 subjects were chosen for the final analysis (data

of 15 students were excluded owing to missing or incomplete information or wastage of blood sample). The mean age of students was 13.07±1.48 years. Males constituted 54.4% of the students. Almost equal proportion of students from 6th to 9th class participated. Lesser participation was observed from class 5th (fewer number available in the class) and class 10th (ongoing board examinations). Prevalence of anemia was found to be 37.3%. As per WHO classification, 19.9% had mild anemia, 16.3% had moderate, and 1% had severe anemia.[20]

Univariate analysis of association of risk factors with the prevalence of anemia is shown in Table 1. We observed that 86.4% of subjects were consuming IFA tablet and 91.6% of the students had consumed antiparasitic tablet for helminthic infections in the past three months under the government program, as confirmed from the students. Menstrual irregularities among female subjects was 9.5%. More than half (56.3%) of the students had unsatisfactory hand washing practices.

Those students who consumed IFA regularly, practiced handwashing (before food and after using toilet) at satisfactory level and those who had not been hospitalized in the last 6 months had higher level of hemoglobin compared to their counterparts at statistically significant level. However, in multivariable regression analysis [Table 2], only consumption of IFA was associated with the level of hemoglobin at statistically significant level.

Discussion

The challenge of rapid growth and development during the period of adolescence coupled with menstrual blood loss among females and diets with poor bioavailability of iron especially in the low and middle income countries has categorized adolescents as vulnerable group by the WHO. Thus identification of the priority groups especially in the vulnerable communities is recommended through national anemia surveys.[20] We conducted a tribal residential school-based survey of prevalence of anemia among adolescents in the three tribal dominated districts of Odisha.

While the literature is scanty on anemia among the tribal adolescents across the country, to the best of our knowledge, this is the first ever study to document the same in Odisha. We found that the prevalence of anemia was 37.3%, which is lower than similar studies conducted in other parts of the country.[8,11–13] However, several other studies conducted

Table 1: Risk factors associated with anemia

Risk factor	*n* (%)	Mean Hb% ± SD	*P*
Consumption of IFA			0.005*
Yes	823 (86.4)	12.48±1.68	
No	130 (13.6)	12.07±1.49	
Deworming in last 6 months			
Yes	873 (91.6)	12.11±1.52	0.255
No	80 (8.4)	12.32±1.54	
Required hospitalization in last 6 months			
Yes	15 (1.6)	11.39±2.52	0.028*
No	938 (98.4)	12.24±1.44	
Suffered from malaria in last 6 months			0.706
Yes	15 (1.6)	11.98±1.13	
No	938 (98.4)	12.12±1.53	
Suffered from bloody diarrhoea in last 6 months			0.287
Yes	23 (2.4)	11.80±2.89	
No	930 (97.6)	12.14±1.47	
Previously diagnosed sickle cell disease			0.093
Yes	10 (1.0)	12.12±1.51	
No	943 (99.0)	12.94±1.91	
Use footwear during outdoor activities?			
Yes	671 (70.4)	12.23±1.44	0.179
No	282 (29.6)	12.09±1.55	
Handwashing before food and after toilet			
Satisfactory	416 (43.7)	12.25±1.40	0.005*
Unsatisfactory	537 (56.3)	11.97±1.65	
Having sign and symptoms of worm infestation			
Yes	61 (6.4)	11.81±1.67	0.087
No	892 (93.6)	12.15±1.51	
Suffering from menstrual irregularities (*n*=352)			
Yes	91 (9.5)	11.51±1.72	0.465
No	261 (27.5)	11.65±1.42	

Table 2: Multivariable regression analysis of risk factors contributing to the level of Hb among tribal school going students (*n*=953)

Multiple *R*	R^2	Adjusted			Standard
0.108	0.012	0.009			1.5186
ANOVA table	**Sum of square**	**Mean of square**	**Df**	***F***	**Significance**
Regression	26.036	8.679	3	3.763	0.011
Residual	2188.471	2.306	949		

Variables in the equation

Variables	Unstandardized Coefficient		Standardized Coefficients	*t*	*P*	95% Confidence Interval	
	B	SE	*B*			Lower Bound	Upper Bound
(Constant)	11.945	0.339		35.262		11.280	12.610
Consuming IFA	0.363	0.146	0.082	2.492	0.013*	0.077	0.649
Hospitalization	-0.160	0.100	-0.052	-1.600	0.110	-0.356	0.036
Handwashing	0.024	0.027	0.029	0.884	0.377	-0.029	0.077

**P* significant at <0.05; B, Beta coefficient; SE, Standard error

among the general adolescent population in the country, especially in the rural areas show a wide variation in the prevalence of anemia.[5,6,16,22,23] Although there has been controversies regarding the cut-off used to define anemia,[24] and there are methodological differences in estimation exist, still anemia remains as a significant public health challenge despite the rolling of several sponsored programs.[8] Despite poor coverage of beneficiaries with iron and folic acid at the national level,[7] our study showed better compliance and was associated with significantly higher level of hemoglobin among those who consumed IFA. Similar findings have been reported earlier by other researchers where supplementation of oral iron has been successful in increasing the mean hemoglobin level,[25] especially when provided by peer educators.[26] Several other risk factors, although were not associated with the level of hemoglobin at a significant level in our study, they do play a major role in preventing the development of anemia.[27] To have a comprehensive approach, recommendations have been issued by the WHO[20] and several national programs.[7]

This study was a maiden effort to document the prevalence of anemia in a vulnerable population of Odisha. No previous studies have documented the burden along with risk factors of anemia in tribal adolescent children in Odisha. Using a robust method of estimation of hemoglobin in this study validates the findings.

Conclusion

Anemia among the tribal students was relatively lower in this population, and consumption of IFA emerged as one of the important associated factors. Although other factors were associated at a statistically insignificant level, still it requires a holistic approach considering both nutritional and non-nutritional factors.

Limitations

All classes could not be represented equally; lower number of students from higher classes in the study might have influenced the mean hemoglobin level and affects the association between menstrual irregularities and anemia.

Ethical approval

Prior permission was obtained from the institutional ethical committee wide letter no. DMR/IMS.SH/SOA/180166 dated February 22, 2019. A written informed consent was obtained from the legally accepted representative and head of the school before the enrolment. Findings of the hemoglobin estimation were shared with appropriate advise to the subjects.

Financial support and sponsorship

Department of Scheduled Caste and Scheduled Tribe and Research Institute, Government of Odisha, India wide letter no. 264 dated 22.01.2019.

Conflicts of interest

There are no conflicts of interest.

References

1. World Health Organization. Prevention of iron deficiency anaemia in adolescents. Role Wkly Iron Folic Acid Supl 2011;50. Available from: https://apps.who.int/iris/handle/10665/205656. [Last accessed on 2023 May 10].
2. National Family Health Survey. National Family Health Survey, India. 2018. p. 1–735. Available from: http://rchiips.org/nfhs/NFHS-5Reports/NFHS-5_INDIA_REPORT.pdf. [Last accessed on 2021 Oct 13].
3. UNICEF. Adolescent nutrition | UNICEF India. 2018. Available from: https://www.unicef.org/india/what-we-do/adolescent-nutrition. [Last accessed on 2021 Oct 13].
4. Hoddinott J, Alderman H, Behrman JR, Haddad L, Horton S. The economic rationale for investing in stunting reduction. Matern Child Nutr 2013;9(S2):69–82.
5. Johnson AR, Baburajan C, Sulekha T. Anaemia among adolescents: A community-based study using cluster sampling in villages under Sarjapur Primary Health Centre, Bangalore urban district. Indian J Health Sci Biomed Res KLEU 2020;13:244–9.
6. Kamble B, Gunjan M, Sumit J, Singh S, Jha D, Singh S. Prevalence of anaemia among school going adolescent girls attending Test, Treat and Talk (T-3) camp under Anaemia Mukt Bharat in Delhi. J Family Med Prim Care 2021;10:898-903.
7. Kapil U, Kapil R, Gupta A. National Iron Plus initiative: Current status & future strategy. J Med Res 2019;150:239-47.
8. Bhatia V, Sahoo DP, Parida SP. India steps ahead to curb anemia:

Anemia Mukt Bharat. Indian J Community Health 2018;30:312–6.
9. Paul VK, Singh A, Sneha Palit D. Poshan abhiyaan: Making nutrition a jan andolan. Proc Indian Natl Sci Acad 2018;84:835–41.
10. Rokade S, Mog M, Mondal NA. Nutritional status among tribal women in Maharashtra, India: Spatial variations and determinants. Clin Epidemiol Glob Health 2020;8:1360–5.
11. Chauhan S, Kumar P, Marbaniang SP, Srivast S, Patel R. Prevalence and predictors of anaemia among adolescents in India: An exploration from Understanding the lives of adolescents and young adults survey. Res Square 2021. doi: http://dx.doi.org/10.21203/rs. 3.rs-476555/v1.
12. Bhise RM, Wadekar KB, Tarpe VC. Prevalence of anemia in the children of tribal ashram schools in Ahmednagar district of Maharashtra. Int J Dev Sustain 2013;2:298–305.
13. Rao V, Aggrawal M, Yadav R, Das S, Sahare L, Bondley M, *et al*. Intestinal parasitic infections, anaemia and undernutrition among tribal adolescents of Madhya Pradesh. Indian J Community Med 2003;28:26–9.
14. Census 2011. Scheduled Tribe (ST) Data – Census 2011 India. Census 2011. 2021. Available from: https://www.census2011.co.in /scheduled-tribes.php. [Last accessed on 2021 Nov 05].
15. Yadav A, Rawat S, Patil P. A comparative study of the nutritional status of adolescents in residential and non-residential tribal secondary schools. Indian J Public Health Res Dev 2021;12:28–32.
16. Devara R, Deshmukh D. Impact of nutritious meals on the nutritional status of the tribal students: A comparison between centralized kitchens (Annapurna) and regular kitchens in government tribal residential schools from two Districts of Maharashtra, India. Indian J Public Health 2017;61:233–8.
17. Sahoo J, Epari V, Panigrahi SK, Prasad D, Bhola RK, Mohanty S, *et al*. Challenges in detection of adolescent anaemia : Validation of Point-of-Care Device (Mission ® plus) for haemoglobin measurement among tribal residential school children of selected districts of Odisha, India. Indian J Community Med 2021;46:680–4.
18. Dash L. The State of Tribal Health in Odisha. The tribal tribune. 2018. Available from: https://www.etribaltribune.com/index.php/volume-5/mv5i3/the-state-of-tribal-health-in-odisha. [Last accessed on 2022 Dec 15].
19. Thomas D, Sarangi BL, Garg A, Ahuja A, Meherda P, Karthikeyan SR, *et al*. Closing the health and nutrition gap in Odisha, India: A case study of how transforming the health system is achieving greater equity. Soc Sci Med 2015;145:154–62.
20. World Health Organization (WHO). Nutritional Anaemias : Tools for effective prevention. 2017. p. 7. Available from: https://www.who.int/publications/i/item/9789241513067.
21. Zeru AB, Gebeyaw ED, Ayele ET. Magnitude and associated factors of menstrual irregularity among undergraduate students of Debre Berhan University, Ethiopia. Reprod Health 2021;18:1–8.
22. Chandrakumari A, Sinha P, Singaravelu S, Jaikumar S. Prevalence of anemia among adolescent girls in a rural area of Tamil Nadu, India. J Family Med Prim Care 2019;8:1414-7.
23. Reshmi PS, Takalkar AA. Prevalence of anemia in adolescent girls and its association with certain demographic variables: Our experience from rural Telangana. Int J Community Med Public Health 2020;7:1007.
24. Sachdev HS, Porwal A, Acharya R, Ashraf S, Ramesh S, Khan N, *et al*. Haemoglobin thresholds to define anaemia in a national sample of healthy children and adolescents aged 1–19 years in India: A population-based study. Lancet Glob Health 2021;9:e822–31.
25. Kapil U, Kapil R, Gupta A. Prevention and control of anemia amongst children and adolescents: Theory and Practice in India. Indian J Pediatr 2019;86:523–31.
26. Shah SP, Shah P, Desai S, Modi D, Desai G, Arora H. Effectiveness and feasibility of weekly iron and folic acid supplementation to adolescent girls and boys through peer educators at community level in the tribal area of Gujarat. Indian J Community Med 2016;41:158–61.
27. Siva PM, Sobha A, Manjula VD. Prevalence of anaemia and its associated risk factors among adolescent girls of central Kerala. J Clin Diagn Res 2016;10:LC19–23. doi: 10.7860/JCDR/2016/20939.8938.