

# Prevalence of Anemia Among Tribal and Non-Tribal Male and Female College Students of Tripura: A Comparative Cross-Sectional Study

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**Abstract:** ***Background:** Anemia remains a significant public health challenge in India, affecting various demographic groups. Tripura, a northeastern state with a substantial tribal population, presents a unique socio-cultural and nutritional landscape. College students, a transitional demographic, are often overlooked in anemia surveillance. This study aimed to determine and compare the prevalence of anemia among tribal and non-tribal male and female college students in Tripura. **Methods:** A cross-sectional study was conducted among 400 college students (200 tribal, 200 non-tribal) aged 18-25 years from selected colleges in West Tripura district. Hemoglobin (Hb) levels were estimated using an autoanalyzer. Anemia was classified using World Health Organization (WHO) criteria. Data on socio-demographic factors, dietary habits, and menstrual history (for females) were collected using a pre-tested questionnaire. Statistical analysis was performed using SPSS version 25.0, employing Chi-square tests and logistic regression. **Results:** The overall prevalence of anemia was 48.5%. A significantly higher prevalence was observed among tribal students (59.5%) compared to non-tribal students (37.5%) ( $p < 0.001$ ). Female students had a higher prevalence (61.0%) than male students (36.0%) across both groups. The highest prevalence was found in tribal females (73.0%), followed by non-tribal females (49.0%), tribal males (46.0%), and non-tribal males (26.0%). Moderate anemia was the most common category. Factors significantly associated with anemia included tribal ethnicity (AOR: 2.4, 95% CI: 1.5-3.8), female gender (AOR: 2.8, 95% CI: 1.8-4.3), vegetarian dietary pattern, and low monthly family income. **Conclusion:** Anemia is a severe public health problem among college students in Tripura, with tribal students, particularly females, bearing a disproportionately higher burden. Targeted interventions, including nutritional supplementation, health education, and addressing socio-economic disparities, are urgently needed in this population.*

**Keywords:** Anemia, Tribal, Non-Tribal, College Students, Tripura, Hemoglobin, Prevalence

## 1. Introduction

Anemia, a condition characterized by a deficiency in the number or quality of red blood cells, is a global public health problem affecting an estimated 1.62 billion people worldwide (1). In India, anemia is a pervasive nutritional challenge, with national family health surveys consistently reporting high prevalence across all age groups, including adolescents and young adults (2). The National Family Health Survey-5 (NFHS-5) highlighted that 57% of women (15-49 years) and 25% of men (15-49 years) in India are anemic (3). The consequences of anemia in young adults include reduced physical capacity, impaired cognitive function, lowered immunity, and decreased academic and work performance, thereby hindering national development (4).

Tripura, a small hilly state in Northeast India, is characterized by a significant indigenous population. According to the 2011 census, tribal communities constitute approximately 31.8% of the state's population (5). These communities often face distinct challenges related to geographical isolation, socio-economic marginalization, limited access to healthcare, and unique dietary practices that may predispose them to nutritional deficiencies (6). While several studies have assessed anemia prevalence in tribal populations in other parts of India, data specific to Tripura, especially among the young adult population transitioning through higher education, is scarce.

College students represent a critical yet often neglected group. This period is characterized by continued

physiological and psychological transitions, increased nutritional demands, and lifestyle changes that can exacerbate nutritional deficiencies (7). Female students are at an even higher risk due to menstrual blood loss and socio-cultural dietary restrictions (8). The confluence of ethnicity, gender, and the transitional phase of college life makes this a pertinent group for investigation. Understanding the disparity in anemia prevalence between tribal and non-tribal students is essential for formulating equitable and effective public health strategies. Therefore, this study was conducted to determine the prevalence of anemia among tribal and non-tribal male and female college students in Tripura and to identify the associated factors.

## 2. Materials and Methods

### *Study Design and Setting*

A community-based cross-sectional study was conducted from January 2026 to February 2026 among undergraduate college students in the West Tripura district. The district was chosen due to its mix of urban and rural colleges and a heterogeneous population of tribal and non-tribal students.

### *Study Population and Sampling*

The study population comprised apparently healthy students aged 18-25 years enrolled in undergraduate courses. Students with known chronic illnesses (e.g., thalassemia, sickle cell anemia, renal disease), those who had received a blood transfusion in the preceding three months, and pregnant female students were excluded.

The sample size was calculated using the formula  $n = Z^2pq/d^2$ , assuming an anticipated anemia prevalence of 50% ( $p=0.5$ ) for maximum sample size, a 95% confidence interval ( $Z=1.96$ ), and a 5% absolute precision ( $d=0.05$ ). The calculated sample size was 384, which was rounded up to 400 to account for non-response. A stratified random sampling method was employed. Students were first stratified by ethnicity (tribal and non-tribal) and then by gender. From each stratum, 100 students were randomly selected from the college enrollment lists, resulting in four groups: Tribal Male ( $n=100$ ), Tribal Female ( $n=100$ ), Non-Tribal Male ( $n=100$ ), and Non-Tribal Female ( $n=100$ ).

#### Data Collection

Data were collected through face-to-face interviews using a structured, pre-tested questionnaire. The questionnaire captured socio-demographic information (age, gender, ethnicity, family income, parental education), dietary habits (vegetarian/non-vegetarian, frequency of iron-rich food consumption), and menstrual history (for females). Anthropometric measurements (height, weight) were recorded. Following the interview, venous blood was collected via veinpuncture method under aseptic conditions. Hemoglobin (Hb) concentration was estimated immediately using an automated hematology analyzer (Yumizen H500 Horiba, SL 206YOXHO4761) which provides accurate, point-of-care results. Permission was sought from the respective college authorities. Written informed consent was obtained from all participating students. Ethical approval was obtained. The confidentiality of the data was strictly maintained.

#### Classification of Anemia

The WHO criteria were used to classify anemia based on Hb levels (g/dL) adjusted for gender and altitude (9):

Non-anemic: Male:  $\geq 13.0$ ; Female:  $\geq 12.0$

Mild Anemia: Male: 11.0-12.9; Female: 11.0-11.9

Moderate Anemia: Male: 8.0-10.9; Female: 8.0-10.9

Severe Anemia: Male:  $< 8.0$ ; Female:  $< 8.0$

#### Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were presented as frequencies, percentages, means, and standard deviations. The Chi-square test was used to compare proportions across groups. A  $p$ -value  $< 0.05$  was considered statistically significant. Binary logistic regression was performed to identify factors associated with anemia, and adjusted odds ratios (AOR) with 95% confidence intervals (CI) were calculated.

### 3. Results

#### Socio-demographic Profile

A total of 400 students participated, with an equal distribution across the four strata (100 each). The mean age of the participants was  $20.8 \pm 1.9$  years. A significantly higher proportion of tribal students (45.5%) belonged to low-income families (monthly income  $< ₹10,000$ ) compared to non-tribal students (18.5%) ( $p < 0.001$ ). Dietary habits also differed, with a higher prevalence of vegetarianism among non-tribal students (24.0%) compared to tribal students (12.0%) ( $p=0.002$ ).

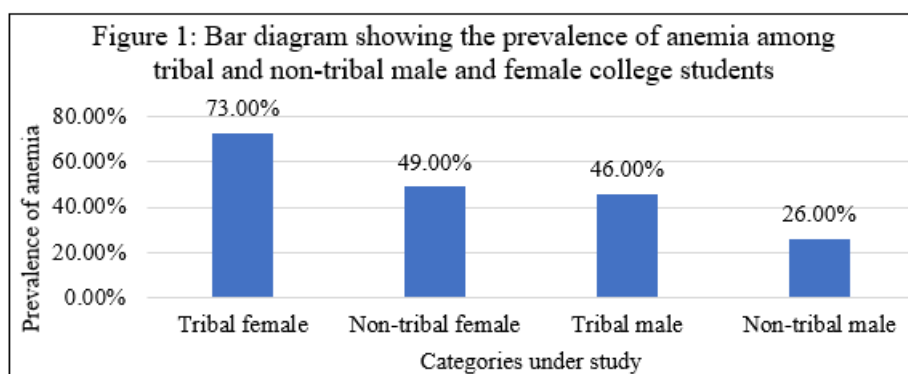
#### Prevalence of Anemia

The overall prevalence of anemia among the college students was 48.5% (194/400). The prevalence was significantly higher among tribal students (59.5%) compared to non-tribal students (37.5%) ( $\chi^2 = 19.7$ ,  $p < 0.001$ ). Female students had a significantly higher prevalence (61.0%) than male students (36.0%) ( $\chi^2 = 25.3$ ,  $p < 0.001$ ).

**Table 1:** Prevalence of Anemia by Ethnicity and Gender

Group	Tribal (N=200) n (%)	Non-Tribal (N=200) n (%)	Total (N=400) n (%)	p-value
Male	46 (46.0%)	26 (26.0%)	72 (36.0%)	0.003
Female	73 (73.0%)	49 (49.0%)	122 (61.0%)	$< 0.001$
Total	119 (59.5%)	75 (37.5%)	194 (48.5%)	$< 0.001$

The highest prevalence was observed in tribal females (73.0%), followed by non-tribal females (49.0%), tribal males (46.0%), and non-tribal males (26.0%) (Figure 1).



**Figure 1:** Bar diagram showing the prevalence of anemia among tribal and non-tribal male and female college students

#### Severity of Anemia

The distribution of anemia severity is presented in Table 2. Moderate anemia was the most common category across all

groups. Notably, severe anemia was observed in 2.5% of the total anemic population, all of whom were tribal females.

**Table 2:** Distribution of Anemia Severity Among Anemic Students (N=194)

Severity	Tribal Male (n=46) n (%)	Tribal Female (n=73) n (%)	Non-Tribal Male (n=26) n (%)	Non-Tribal Female (n=49) n (%)	Total (N=194) n (%)
Mild	12 (26.1%)	18 (24.7%)	11 (42.3%)	17 (34.7%)	58 (29.9%)
Moderate	34 (73.9%)	49 (67.1%)	15 (57.7%)	32 (65.3%)	130 (67.0%)
Severe	0 (0.0%)	6 (8.2%)	0 (0.0%)	0 (0.0%)	6 (3.1%)

#### Factors Associated with Anemia

Binary logistic regression analysis revealed that tribal ethnicity (AOR: 2.4, 95% CI: 1.5-3.8), female gender (AOR: 2.8, 95% CI: 1.8-4.3), low monthly family income (< ₹10,000) (AOR: 1.9, 95% CI: 1.2-3.1), and a vegetarian dietary pattern (AOR: 1.6, 95% CI: 1.1-2.4) were significantly associated with higher odds of anemia. Among females, irregular menstrual cycles (AOR: 2.1, 95% CI: 1.3-3.4) and a history of heavy menstrual bleeding (AOR: 2.5, 95% CI: 1.5-4.2) were also significant predictors.

#### 4. Discussion

With a significant difference between tribal and non-tribal populations, this study offers important insights into the high prevalence of anemia among Tripura's college students. According to the WHO categorization, the overall prevalence of 48.5% suggests that anemia is a serious public health issue in this population (10). This frequency highlights the underappreciated health needs of this population and surpasses various national estimates for young adults reported in some recent research (11). Tribal students had a much greater prevalence (59.5%) than non-tribal students (37.5%), which is consistent with the larger national narrative of health inequities experienced by indigenous groups (12). This discrepancy could be caused by a number of things. Our study found that a greater percentage of tribal students were from low-income households, which has a direct influence on dietary diversity and availability to nutrient-dense foods, especially foods high in iron, such as meat, poultry, and green leafy vegetables (13). The observed dietary patterns—a greater frequency of non-vegetarianism among tribal students (88%) may seem nutritionally beneficial, but meat consumption is frequently uncommon and the diet is primarily cereal-based with low iron absorption (14). Anemia may also result from persistent blood loss and malabsorption caused by underlying problems such as inadequate sanitation and restricted access to treatment in tribal regions (6). The gender disparity observed, with females having nearly double the prevalence of males (61.0% vs. 36.0%), is consistent with global and Indian data (1,3). This is mostly explained by physiological iron loss during menstruation, which is exacerbated in some groups by early marriage, early motherhood, and nutritional discrimination based on gender (15). It is concerning to note that tribal women had the highest prevalence (73.0%), indicating a gender and ethnicity-related intersectional vulnerability. Since severe anemia is linked to higher morbidity and can be fatal, particularly in the setting of future pregnancies, the fact that it only occurs in tribal females (6 out of 6 instances) is a crucial discovery (16). Despite being more prevalent in non-tribal populations, the link between vegetarian eating habits and anemia emphasizes the difficulty of guaranteeing sufficient iron intake from plant-based sources, which contain non-heme iron with reduced bioavailability (17). The necessity of gynecological evaluation as part of anemia care is shown by the strong

correlation between heavy menstrual bleeding and irregular periods and anemia in females (18).

*Comparison with Other Studies:* Our findings are comparable to a study by Bharati et al. (2019) in West Bengal, which reported a higher prevalence of anemia among tribal adolescents than among non-tribal adolescents (19). Similarly, a study in Maharashtra by Patil et al. (2021) found a high prevalence of anemia in college-going girls, with tribal girls being most affected (20). However, our study provides a more comprehensive picture by including both male and female students from tribal and non-tribal backgrounds within a single setting in Tripura, a region with limited prior data.

#### 5. Strengths and Limitations

The strengths of this study include its comparative design, adequate sample size, and the use of a validated standard laboratory-based hematology measurement. However, limitations include the cross-sectional design, which precludes establishing causality. The study was conducted in one district, limiting generalizability to the entire state. Additionally, we did not assess for specific etiologies of anemia like iron deficiency, vitamin B12 deficiency, or thalassemia traits, which are prevalent in certain tribal groups (21). Finally, social desirability bias might have influenced responses to dietary questions.

#### 6. Conclusion

This study reveals an alarmingly high prevalence of anemia among college students in Tripura, with tribal students, especially females, constituting the most vulnerable group. The findings underscore a significant health inequity that requires immediate and targeted public health action. The multifactorial nature of anemia, involving socio-economic status, dietary practices, and gender-specific factors, necessitates multi sectoral public health interventions.

#### 7. Recommendations

- *Screening and Treatment:* Mandatory annual hemoglobin screening for all college students, with free iron-folic acid (IFA) supplementation and treatment for those diagnosed with anemia, as per the National Iron+ Initiative guidelines (22).
- *Nutritional Interventions:* Strengthening mid-day meal programs in colleges to ensure iron-rich, diversified meals. Promoting the consumption of locally available iron-rich foods through nutrition education campaigns, especially within tribal communities.
- *Health Education:* Conducting awareness programs focusing on the causes and consequences of anemia, the importance of dietary diversity, deworming, and menstrual hygiene management.

- *Addressing Underlying Determinants:* Policy-level interventions aimed at improving the socio-economic conditions of tribal communities and ensuring equitable access to healthcare.

Addressing anemia in this young, productive age group is not only a matter of health equity but also a crucial investment in the future workforce and overall development of Tripura.

#### Area of conflict

No conflict

#### Funding

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#### References

- [1] World Health Organization. (2021). The global prevalence of anaemia in 2019. Geneva: World Health Organization.
- [2] International Institute for Population Sciences (IIPS) and ICF. (2021). National Family Health Survey (NFHS-5), India, 2019-21: India. Mumbai: IIPS.
- [3] Ministry of Health and Family Welfare. (2021). National Family Health Survey-5 (NFHS-5) Factsheet. New Delhi: Government of India.
- [4] Haas, J. D., & Brownlie, T. (2001). Iron deficiency and reduced work capacity: a critical review of the research to determine a causal relationship—the Journal of Nutrition, 131(2), 676S–690S.
- [5] Census of India. (2011). Primary Census Abstract: Tripura. Office of the Registrar General & Census Commissioner, India.
- [6] Basu, S., & Saha, A. (2017). Health status of tribal communities in India: A review. Journal of Family Medicine and Primary Care, 6(3), 487–493.
- [7] Ahmed, F., Khan, M. R., & Banu, C. P. (2019). Anemia and its associated factors among university students in Bangladesh. BMC Public Health, 19(1), 1068.
- [8] Shaka, M. F., & Wondimagegne, Y. A. (2018). Anemia, a moderate public health concern among adolescents in South Ethiopia. PLoS ONE, 13(7), e0199467.
- [9] World Health Organization. (2011). Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. Vitamin and Mineral Nutrition Information System. Geneva: WHO.
- [10] World Health Organization. (2008). Worldwide prevalence of anaemia 1993-2005. Geneva: WHO.
- [11] Rakesh, P. S., & Surekha, A. (2022). Prevalence of anaemia among young adults in India: A systematic review and meta-analysis. Indian Journal of Public Health, 66(1), 52-59.
- [12] Xaxa, V. (2016). Health and health care of tribal populations in India. Economic and Political Weekly, 51(25), 47-54.
- [13] Rao, K. M., Balakrishna, N., Laxmaiah, A., et al. (2019). Diet and nutritional status of tribal population in India. Indian Journal of Medical Research, 149(4), 487–496.
- [14] Thankachan, P., Walczyk, T., Muthayya, S., et al. (2007). Iron absorption in young Indian women: the interaction of iron status with the influence of tea and ascorbic acid. The American Journal of Clinical Nutrition, 85(2), 461-466.
- [15] Bharati, S., Pal, M., & Bharati, P. (2018). Determinants of nutritional status of pre-school children in India. Journal of Biosocial Science, 50(3), 369-386.
- [16] Kumar, A., & Chauhan, S. (2022). Severe anaemia among adolescent girls and women of reproductive age in India: A growing concern. Journal of Health Management, 24(1), 112-123.
- [17] Pawlak, R., Berger, J., & Hines, I. (2018). Iron status of vegetarian adults: a review of the literature. American Journal of Lifestyle Medicine, 12(6), 486-498.
- [18] Mansour, D., Hofmann, A., & Gemzell-Danielsson, K. (2021). A review of clinical guidelines on the management of iron deficiency and iron-deficiency anemia in women with heavy menstrual bleeding. Advances in Therapy, 38(1), 201-217.
- [19] Bharati, S., Pal, M., & Bharati, P. (2019). Anemia among adolescent girls in West Bengal, India: A cross-sectional study. Journal of Biosocial Science, 51(4), 554-570.
- [20] Patil, S. S., & Kakade, S. V. (2021). A cross-sectional study of anemia among college-going girls in rural Maharashtra. Journal of Family Medicine and Primary Care, 10(2), 786-791.
- [21] Colah, R. B., Mukherjee, M. B., & Ghosh, K. (2015). Sick cell disease in India: A perspective. Indian Journal of Medical Research, 141(5), 509-511.
- [22] Ministry of Health and Family Welfare. (2013). Guidelines for Control of Iron Deficiency Anaemia. Adolescent Health Division, Government of India.