

Evaluation of Prevalence of Anemia and Its Sociodemographic Correlation among Undergraduate Medical College Students - A Cross Sectional Study

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Abstract Background: Anemia is a global health problem. Adolescents are particularly prone to develop nutritional anemia. Undergraduate Medical College students come under vulnerable group that suffer anemia. Anemia, particularly due to iron deficiency during adolescence, may impair the physical & mental development as well as behavioral & cognitive development. **Aims and objectives:** A cross sectional study was conducted to measure the prevalence of anemia among undergraduate Medical students, to categorize anemia into major types and to compare the socio-demographic factors related to anemia. **Material and methods:** Blood samples were collected from 100 undergraduate Medical College students and processed by automated cell counter for Complete Blood Count (CBC). Peripheral blood smears were examined. NESTROFT and Sickling Test were performed wherever necessary. Thalassaemia indices were calculated for suspected beta thalassaemia trait cases. A structured questionnaire was filled by each student. **Results:** The overall prevalence of anemia among undergraduate students was found to be 45 % with anemia being significantly more prevalent among female students as compared to males (OR, 11.8; 95%CI: 4.7-32.3, $p < 0.0001$). Microcytic hypochromic anemia constituted the most common type of anemia. Anemia was found to be significantly more prevalent in vegetarian students as compared to nonvegetarian students ((OR, 3.4; 95%CI: 1.45-8.32, $p = 0.0045$). **Conclusion:** A high prevalence of anemia was observed among undergraduate students. Anemia constitutes a health problem amongst undergraduate students. Hence, implementation of educational, awareness, screening and nutritional programs is warranted with special reference to adolescent age group.

Keywords: Undergraduate, adolescents, anemia, prevalence, NESTROFT

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1. Introduction

Anemia is a global health problem. Adolescents are particularly prone to develop nutritional anemia as appropriate nutritional requirements increase significantly during this period of life. Staying in hostels, skipping meals, clinical postings and long schedules in college and hospital, all put them at risk of developing anemia. Various sociodemographic factors like age, sex, social status, dietary habits, and infections have major influence on the development of nutritional anemia. Anemia, particularly due to iron deficiency during adolescence, may impair the physical, mental, behavioral & cognitive development. It may cause lack of concentration, irritability & impair academic performance of students. [1,2]

Hemoglobinopathies are reported to be common in central India, especially in Madhya Pradesh. The general incidence of thalassaemia trait & sickle cell haemoglobinopathy in India varies between 3-17% &

1-44% respectively. [3] Early detection may be useful for genetic counseling and screening of other family members.

Several studies have been conducted to evaluate prevalence of anemia among antenatal women and children, however, only a handful of studies have been conducted to address the problem of anemia among undergraduate Medical College students. Moreover, to the best of our knowledge, none of the studies have tried to categorize the types of anemia among undergraduate students.

2. Aims and Objectives

The present study was conducted with following aims and objectives:

- To measure the prevalence of anemia among undergraduate Medical College students.
- To categorize anemia into major types.
- To compare the socio-demographic factors related to anemia.

3. Material and Methods

A cross sectional study was carried out among undergraduate Medical College students of a Tertiary care Hospital of Central India over duration of two months. A total of 100 undergraduate medical students studying in the Medical College were enrolled for the study. Ethics approval was taken from Ethics Committee of the institute.

A written informed consent form was filled by each participant and blood samples were collected only from those students who volunteered for the same. A structured questionnaire was provided to each student to fill in details of age, gender, residence, socio-economic status, dietary habits and menstrual history.

Venous blood sample was collected in dipotassium EDTA vial. The sample was run on hematology autoanalyzer to calculate Hemoglobin, Red Blood Cell count, Red blood cell Indices including Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC) and Red Cell Distribution Width (RDW). Anemia cutoff was taken as hemoglobin (Hgb) <13 g/dL in males and <12 g/dL in females as per WHO recommendations. [4]

A peripheral blood smear (PBS) was prepared and stained with Leishman Stain in each case. [5] PBS of each participant was examined under microscope to evaluate the type of anemia. In case of microcytic hypochromic anemia, further categorization into iron deficiency anemia and beta-thalassemia minor was considered based on PBS findings, RBC count, RDW and red blood cell indices. Findings favouring beta Thalassemia trait included presence of a normal or slightly reduced haemoglobin concentration, presence of many target cells in the peripheral blood smear, elevation of the RBC count, reduction of MCV and normal red cell distribution width (RDW). In such cases, Thalassemia Indices including Mentzer's Index, Shine and Lal Index, England Frazer Index, Linear discrimination index was calculated and NESTROFT (Naked Eye Single Tube Red Cell Osmotic Fragility Test) was performed. [5]

Presence of majority of significant values favoured Thalassemia trait: [6]

- 1) Mentzer's index=MCV/RBC (<13)
- 2) England Frazer Index=[MCV-RBC-(5XHb)-3.4] (NEGATIVE VALUE)
- 3) Shine and Lal Index= [MCV² X MCH/100] (<1530)
- 4) Linear discrimination index=[1.39(RBC)-0.3(RDW)-3.28] (POSITIVE VALUE)
- 5) RBC COUNT >5X10⁶/ul
- 6) Pearson's index =MCV<79fl
- 7) Besman's Index= RDW <=15.5

Other relevant tests like sickling test were performed if the peripheral blood showed sickle like cells and/or target cells. Any other significant finding related to WBCs and/or platelets was reported. Appropriate treatment and counselling regarding dietary habits was provided to those found anemic. Genetic counseling/further diagnostic tests were advised to those suggestive of haemoglobinopathy.

4. Data Analysis

The data was analyzed by SPSS Statistical software.

Prevalence was reported as a proportion with 95% CI. Comparison of socio-demographic variables and other variables was done by chi square and unpaired t test appropriately.

5. Results

A total of 100 students were included in the study, out of which 55 % were males and 45% were females. The age of students ranged from 18 to 24 years. 45 out of 100 students were found to be anemic, hence, the overall prevalence of anemia among undergraduate students was found to be 45 % (95% CI; 35.6-54.7).

Majority of females i.e. 34 (75%) (95% CI; 61.3-85.7) were anemic, while 11 (19.6%) of males were anemic. Anemia was found to be significantly more prevalent among female students as compared to males (OR, 11.8; 95%CI: 4.7-32.3, p<0.0001).

Out of 45 anemic students, 34(75%) had mild anemia and 11(25%) had moderate anemia, while none of the students had severe anemia.

The mean hemoglobin among anemic students was 10.3g/dl with standard deviation of \pm 0.84. The mean hemoglobin among non-anemic students was 13.9g/dl with standard deviation of \pm 1.37.

5.1. Peripheral Blood Smear Examination

Peripheral blood smear was examined in all cases and the results are shown in the Table 1. Among the anemic students, anemia was categorized based on RBC morphology on peripheral blood smear as well as correlation with red cell indices and other parameters. Different types of anemia found among male and female anemic students are shown in Table 2.

Table 1. Table showing peripheral blood RBC morphology of 100 cases

Peripheral blood film findings	Number of cases
Normocytic normochromic	69
Microcytic hypochromic	20
Macrocytic	09
Dimorphic	01
Normocytic hypochromic	01
Total	100

Table 2. Table showing peripheral blood smear findings of anemic students with male and female distribution

Types of anemia	Girls	Boys
Microcytic hypochromic anemia	18	02
Normocytic normochromic blood picture	09	05
Macrocytic anemia	05	04
Dimorphic	01	-
Normocytic hypochromic	01	-
Total	34	11

Microcytic hypochromic blood picture was seen in 20(44.4%) cases with mild to moderate anemia. It was found to be most common type of anemia overall and among female students. Smears showed mild to moderate anisopoikilocytosis, microcytic hypochromic RBCs, with presence of pencil cells, tear drop cells, elliptocytes and target cells. In mild cases of anemia, mild anisocytosis was seen with presence of normocytes and few microcytes.

Table 3. List of cases with findings favoring beta thalassemia trait. Thalassemia indices were calculated for these cases, NESTROFT was performed in all these cases

Serial number	MI	EFI	S&L	LDI	RBC	PEARSON INDEX	BI	SIGNIFICANT VALUES	NESTROFT	HPLC advised
1	20	21.08	2085.9	-2.5	3.82	76.8	15.3*	No	Negative	-
2	15.7	19.9	900.2*	-2.2	4.4	69.2*	17.1	No	Negative	-
3	12*	3.72	775.8*	-0.5	5.28*	63.4*	15.2*	yes	Positive	Positive
4	10.9*	-2.77*	685.7*	1.93*	5.37*	59*	8.5*	yes	Positive	Positive
5	21	14.8	3430.8	-3.3	3.45	75.2*	16.1	No	Negative	-
6	18.3	28.3	1090.8*	-3.3	4.07	74.6*	19.2	No	Negative	-
7	16.4	-2.5*	2166.1	0.5*	5.10*	84	10.9*	No	Negative	-
8	20.2	25.1	1751.1	-1.7	4.16	84.2	14.2	No	Negative	-

NESTROFT- Naked eye single tube red cell osmotic fragility test, MI-Mentzer's Index, EFI- England Frazer Index, S&L- Shine and Lal Index, LDI- Linear Discrimination Index, BI- Besman's Index

* Significant values favouring beta thalassemia trait.

Among the microcytic hypochromic cases, eight cases showed prominence of target cells and or relative erythrocytosis. Thalassemia indices were calculated for these cases and NESTROFT was done (Table 3). Two of these cases showed significant Thalassemia Indices and Positive NESTROFT (Figure 1). Test for sickling was also done in all these cases and was negative. The students were counselled and HPLC was advised in these cases. These were diagnosed as beta Thalassemia trait on HPLC with Hb A2 levels more than 4%. Further counselling was done for their condition, explaining future prospects and clinical significance.

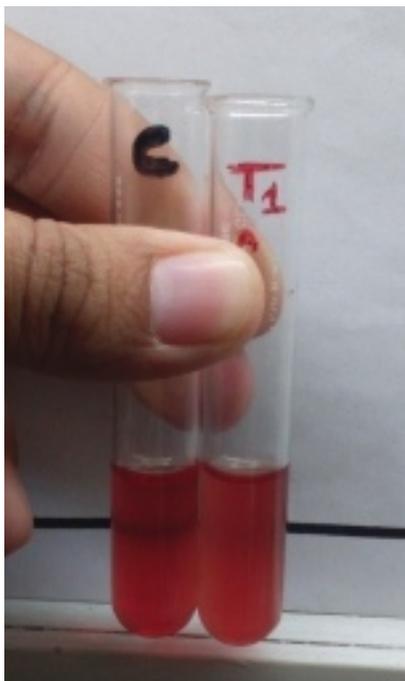


Figure 1. Showing a positive NESTROFT with invisible black line in case of beta thalassemia trait (Right) and a visible line in normal control(Left)

Macrocytic blood picture was seen in 09 cases (20%) of anemic students. This was the most common picture seen in boys. Smears showed moderate anisopoikilocytosis with presence of macrocytes, macroovalocytes, tear drop cells and normocytes. Hypersegmented neutrophils were also seen in some cases. Normocytic normochromic blood picture was seen in 14 cases (31%). These cases showed mild anemia. Normocytic hypochromic and dimorphic blood picture was seen in one case, each (2%).

6. Correlation with Sociodemographic Profile

Overall, anemia was found to be more common among hostellers (46%) as compared to day scholars (43%), however it was not found to be significant (OR, 1.09; 95%CI: 0.49-2.5, p=0.82). Majority of anemic girls were hostellers.

Anemia was found to be significantly more prevalent in vegetarian students as compared to nonvegetarian students ((OR, 3.4; 95%CI: 1.45-8.32, p=0.0045).

Macrocytic anemia was seen more commonly in boys having vegetarian only diet.

No significant correlation was seen with social status which was similar i.e. middle socioeconomic status for most of the students.

No significant relation was found with BMI (OR, 0.7; 95%CI: 0.13-3.2, p=0.46), menstrual irregularity and duration of blood flow ((OR, 1.2; 95%CI: 0.14-34.9, p=0.45).

7. Discussion

Iron deficiency is the most common and widespread nutritional disorder worldwide. The prevalence of iron deficiency varies greatly according to host factors like age, gender, physiological, pathological, environmental, and socioeconomic conditions. Anemia is particularly prominent in South Asia. In India, up to 88% of pregnant and 74% of non-pregnant women are affected. The prevalence rate among preschool children is usually similar to, or higher than, the rate among pregnant women. [7]

The prevalence of anemia in Madhya Pradesh among has been found to be 49.7% and 53.8% in urban and rural areas, respectively. Moreover, 21.4% to 27.4% of males and 66.3 to 69.9% of children have been found to be anemic. [8] However, data about the prevalence of anemia among adolescent age group has been lacking.

Adolescence or early adulthood is one of the most vulnerable periods in human life cycle when nutritional requirement increases due to growth spurt, hence, adolescents are prone to develop nutritional anemia. Only a handful of studies have been carried out to identify the prevalence and types of anemia among undergraduate medical students. In the present study, we have highlighted

the problem of anemia in undergraduate Medical College students and socio-demographic factors related to anemia.

We found out the overall prevalence of anemia to be 45% taking cut off haemoglobin for males as 13g/dl and for females as 12g/dl. Various other studies have reported anemia prevalence among undergraduate students to be as low as 23% to as high as 55.3%. [9,10] Findings similar to our study have been reported in several other studies. [11] Taking cut off haemoglobin value as 13g/dl for males could have been the reason for relatively higher anemia prevalence in our study.

In the present study we found anemia prevalence among female students was significantly higher than in male students, with 75% of the female students and 19.6% of male students being anemic. In a similar study by done by Khan et al, prevalence of anemia was found to be 39% with preponderance among female students (56%) as compared to male students (22%). [11] Similar results have been observed in several other studies. [9,12]

Out of 45 anemic students, 34 (75%) had mild anemia and 11 (25%) had moderate anemia, while there were no students having severe anemia. Similar results were seen in other studies, which reported that most of students had mild anemia. [11,13,14]

We found anemia prevalence to be more common among hostellers as compared to day scholars, however, it was not found to be significant. Majority of anemic girls were hostellers. This could be due to low intake of proper diet among hosteller students, excessive intake of junk food and outside food, less calorie intake, improper diet schedule, skip meals. Similar results were shown in a study by Manjula VD et al who also found significant correlation of residential status with anemia. [15]

Anemia was found to be significantly more prevalent in vegetarian students as compared to nonvegetarian students (OR, 3.4; 95%CI: 1.45-8.32, $p=0.0045$). This reflected that dietary habits have direct relation to haemoglobin levels. Schill et al reported significant association of dietary habits on prevalence of anemia. [9] However, few studies did not find any significant association. [15]

We also found macrocytic anemia to be more common among boys especially those taking vegetarian only diet.

In the present study, no significant relation of anemia was found with socioeconomic status. This could be due to similar socioeconomic status of the students. Similar results were reported by Manjula et al and Saratha A et al. [15,16] However, significant relation was reported in several other studies. [11,13]

We did not find significant correlation with BMI. This could be due to majority of students having BMI in normal range. Different studies have however shown significant relation of underweight and anemia. Rubeena Bano et al found that majority (81.8%) of anaemic students were undernourished as per their BMI. Pandey et al reported that the prevalence of anaemia among underweight students (BMI below 18.5) was 60%, and normal (BMI 18.5-24.99) of 27.5% and overweight (BMI>25) have prevalence of 12.5%. [11,12,13]

In our study, we did not find significant association of anemia with menstrual irregularity and duration of blood flow. Manjula V D et al found even though menstrual irregularity was not a risk factor, duration of menstrual

flow more than five days and passing of clots during menstruation were found to be risk factors for anemia. [15] These results are against the result obtained by Saratha et al. [16]

We found out microcytic hypochromic anemia to be the most common type of anaemia (21%) followed by normocytic normochromic blood picture (14%) and macrocytic anemia (09%). Dimorphic blood picture and normocytic hypochromic blood picture was seen in 1% cases each. Beta thalassaemia trait was found in 2% students. Sickle cell anemia was observed in none of the students.

In one of the study done by Pujara et al, the overall frequencies of anemia, BTT and sickle cell anemia were 23%, 3.5% and 0.75% respectively. They also found efficiency of NESTROFT, Mentzer Index, Srivastava Index and Shine & Lal index for diagnosis of BTT to be 84.61%, 88.46%, 73.07% and 32.69% respectively. [10]

Evaluation of peripheral blood smear to categorize types of anemia is useful to direct further management. Students with anemia were advised to improve their dietary habits, including green leafy vegetables and iron rich foods, taking regular meals, not skipping breakfast. Students with moderate anemia were advised to take iron supplements. Students with positive NESTROFT were advised HPLC and counselled regarding their condition. These students were explained and counseled about future prospects and clinical significance of thalassaemia trait. The prevalence being higher among females, the results show that anemia constitutes a health problem among female Medical students. Staying in hostel is reflected upon dietary habits which have a significant reflection upon the prevalence of anemia.

To the best of our knowledge, this is the first study in which categorization of anemia based on peripheral blood smear findings and red blood cell parameters has been done. However, as our study was a single centre study including a small sample size, further multicentric study on a larger sample of Medical College students may be required to validate these findings. Implementation of educational, awareness, screening and nutritional programs with special reference to adolescent age group is warranted.

8. Conclusion

In the present study, we have highlighted the problem of anemia in undergraduate Medical College students and socio-demographic factors related to anemia. The overall prevalence of anemia among undergraduate students was found to be 45% with anemia being significantly more prevalent among female students as compared to males. Microcytic hypochromic anemia constituted the most common type of anemia.

A high prevalence of anemia was observed among undergraduate students. Anemia constitutes a health problem amongst undergraduate students. Implementation of educational, awareness, screening and nutritional programs with special reference to adolescent age group is warranted. This should be supported by programs for the prevention of anemia among adolescent girls through nutrition education and anemia prophylaxis.

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