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Screening of Anemia and Thalassemia among medical students: A study in Delhi NCR

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Abstract: The study was designed to screen medical students for anemia and beta thalassemia trait (βTT) using haematological parameters among medical students and advocate premarital counselling for thalassemia as they are the future healthcare providers. The study included 198 MBBS students. The demographic profile of students, Kuppuswamy's Socio-economic status, dietary habits was entered in a proforma. Anthropometric measurements (body mass index, waist hip ratio, physical fitness index) were taken using standard anthropometric techniques. Complete blood count was performed along with calculating discriminative indices for βTT. In students with indices favouring βTT, Hb A2 estimation was done by HPLC. Prevalence of anemia was found to be 12% with majority being females (66.7%). Microcytic hypochromic anemia was the most common type of anemia observed (70.8%). Correlation of dietary preference with anemia and the difference in WHR between anemic and non anemic students was found to be statistically significant however PFI and BMI did not show a significant correlation with anemia. Discriminative indices favoured βTT in 2 students, further confirmed on HPLC. Its important to advocate iron rich diet among adolescents. Continuous follow-up program and nutrition education can improve nutrition status. Thalassemia screening is important to create awareness in prevention of beta thalassemia.
Keywords: Thalassemia, Anemia, Screening, MBBS students, premarital screening.

INTRODUCTION

Nutritional anemia is a global health problem with an increasing incidence in developing countries[1]. It has been estimated that 30% of the global population suffers from iron deficiency anemia (IDA)[2]. According to WHO, anemia is an indication of malnutrition and is at its peak in South-East Asia[1].

Anemia during adolescence severely impairs the physical and mental development; weakens behavioral and cognitive development and decreases the work performance. It affects one's overall development. Adolescence is the most vulnerable period to anemia in human life as nutritional requirement is at its peak due to growth spurt [3]. It has been found that nutritional anemia is very much prevalent and largely undiagnosed among students in professional institutes [4]. Medical students are at high risk for anemia on account of irregular eating habits, skipping breakfast, studies overload, burden of clinical postings, hostel food and sedentary life-style[5]. Therefore, it is important to screen medical students as they are major and important part of the health care system.

The dictum 'Prevention is better than cure' holds true for most of the diseases, however, it is the only option for most of the genetic diseases including hemoglobinopathies. Hemoglobinopathies being a significant cause of morbidity and mortality, impose a great burden on global healthcare. Thalassemia is the most common among these with an overall prevalence of beta thalassemia approaching 3-4% in India[6].

Thalassemia can easily be prevented by awareness, education, screening, premarital genetic counselling and prenatal diagnosis. Screening medical students for anemia and thalassemia has an advantage as they being at the grassroot level form an important part of healthcare system, hence they will further help in creating awareness in the community. There have been few studies in literature on level of awareness

about thalassemia among medical students with variable results[7-9].

To distinguish between βTT and iron deficiency anemia (IDA), various discrimination indices derived from simple red blood cell (RBC) indices like RBC Count, Mean corpuscular volume (MCV), Mean corpuscular hemoglobin (MCH), red cell distribution width (RDW) have been advocated as a simple, rapid and reliable tool. Moreover, these do not impose additional cost so are useful for mass screening programs in resource poor developing countries like India[2,10-13]. The drawback of these indices is that they are not generally applicable to children, pregnant females and coexistent IDA and βTT[14]. Individuals with discrimination indices favouring βTT may then undergo confirmatory tests like high performance liquid chromatography (HPLC) which are costlier. This staggered approach helps to cutdown cost of screening for βTT in developing countries.

This study was designed to screen the medical students for anemia and beta thalassemia trait using haematological parameters with the aim to ascertain the incidence of anemia and βTT among medical students and advocate premarital counselling for thalassemia.

Advances in knowledge

- This study aimed at creating awareness among medical students about anemia and thalassemia as they are torchbearers of the society.
- To the best of the author's knowledge, there are no articles in the literature on correlation between WHR and PFI in anemics.
- This study revealed that the majority of anemics were females while microcytic hypochromic anemia was the most common type of anemia. Significant correlation of anemia with dietary preference and WHR was observed.

Application to patient care

- The study emphasises the importance of advocating nutrition education and continuous follow-up program to improve the nutrition status among adolescents.
- The premarital counseling in prevention of beta thalassemia needs to be endorsed as a significant step in prevention of beta thalassemia.

MATERIALS AND METHODS

This cross sectional study was conducted during a 3 month period (February to April 2017) among medical students at ESIC Medical College, Faridabad. Approval was obtained from Institutional ethics committee. All unmarried students of either gender who were willing to participate in the study were enrolled. Informed consent was obtained from all participants.

The study included a total of 198 students belonging to 1st and 2nd year MBBS. The demographic profile of students including gender, age, Kuppuswamy's Socio-economic status, dietary habits (vegetarian/non vegetarian) was entered in a proforma.

Anthropometric measurements were taken in the standing position using standard anthropometric techniques[15]. The participants wore light clothes without shoes, weight was measured on an electronic personal scale to the nearest 0.1 kg and height with a stadiometer to the nearest 0.1 cm. BMI was calculated as Weight/Height^2 (kg/m^2). Students were grouped on the basis of BMI cut off values recommended by WHO as underweight, normal, overweight and obese. The association of anemia with BMI was observed. WHO reference range:- Undernutrition : <18.5 kg/m^2; Normal : 18.5-24.9 kg/m^2; Overweight : 25-29.9 kg/m^2; Obese : >=30 kg/m^2[16].

Waist circumference (WC) was measured half way between the lower ribs and the iliac crest in a horizontal plane while hip circumference (HC) was measured at the level of greater trochanters. Waist hip ratio (WHR) was calculated as WC/HC. Based on WHR, students were categorized as obese when WHR >0.9 in males and >0.85 in females[17].

Physical fitness index (PFI) was calculated by using modified Howard step test. Subjects were required to step up and down on a 20 inches high platform at a rate of 30 steps/minute for 5 minutes or until exhaustion. Exhaustion was defined as when the subject cannot maintain the stepping rate for 15 seconds. Pulse rate was counted between 1to 1.5 minutes after completion of the test[18].

$$\text{PFI} = \frac{\text{Total duration of exercise in seconds}}{5.5 \times \text{post exercise 30 s pulse count}} \times 100$$

PFI score was graded as: <50 - poor; 50-80 – average and >80 - good (PFI).[19]

CBC parameters were taken including Hb, RBC, PCV, RDW, MCV, MCH, MCHC by Sysmex XN-1000 5 part hematology analyser and the results obtained were interpreted as per the WHO criteria. Anemia was established if the hemoglobin level was below the cut-off points as recommended by WHO. Anemia was further graded as mild, moderate and severe and typing of anemia as normocytic, microcytic and macrocytic was done.

Blood samples were collected from each medical student in EDTA vacutainers and run on automated haematology analyser. Values of haemoglobin, RBC Count, RBC indices- MCV, MCH and RDW were recorded. The discrimination indices to distiguish anemia and βTT were calculated as : Mentzer index (MCV/RBC; cut off<13), Shine and Lal Index

($MCV^2xMCH/100$; cut off <1530), Srivastava index (MCH/RBC; cut off <3.8), England and Fraser Index (MCV-5xHb-RBC-3.4; cut off <0) and RDW index (MCVxRDW/RBC; cut off <220). Peripheral blood smears were evaluated whenever required. In students with indices favouring βTT, Hb A2 estimation was done by HPLC. A cut off value of >3.5% was taken as positive for βTT.

OBSERVATIONS AND RESULTS

Out of 198 MBBS students, 112 were males (56.5%) and 86 were females (43.4%). The demographic profile of the study population is shown in Table I. The prevalence of anemia was found to be 12.1% (24/198), including 8 males (33.3%) and 16 females (66.7%) and the difference was statistically significant with p value 0.014 (Figure I). On grading anemia based on severity, most of the students (14/24) fell into mild anemia category (58.33%) followed by moderate anemia. Gender wise distribution of severity of anemia (according to WHO) among MBBS students was found to be statistically significant as shown in Figure II.

Based on the morphological classification of anemia, most of the students had microcytic hypochromic anemia (70.8%) followed by macrocytic anemia (25%) and normocytic normochromic anemia (4.2%). Anemia was compared with diet preference and was found to be more common in vegetarians (66.6%) which was statistically significant (Figure III).

On comparing various hematological and anthropometric parameters between male and female MBBS students, a statistically significant difference was observed in Hemoglobin, RBC count, PCV, MCH, MCHC along with waist hip ratio and physical fitness index (Table II).

There was a statistically significant difference among anemic and non anemic students for various parameters including Hemoglobin, RBC count, PCV, MCV, MCH, MCHC, RDW along with waist hip ratio, however difference in Body mass index and PFI did not turn out to be significant (Table III).

Determinative indices for thalassemia profile were applied for all students and two students had their cut off values favouring thalassemia trait. So High Performance Liquid Chromatography (HPLC) was done for these two students. HbA2 value came out to be high of 6.2% in one student indicating beta thalassemia trait. However, on being called for HPLC sampling, the second student (on condition of anonymity) revealed that he was a known case of beta thalassemia major for which he underwent bone marrow transplantation 10 years back.

Table-I: Demographic profile of the study population (n=198)

Parameters		
Gender	Males	112(56.5%)
	Females	86(43.4%)
Age	<18yrs	8(4%)
	>18yrs	190(95.9%)
Body mass index (BMI)	Under weight (<18.5kg/m^2)	12 (6.06%)
	Normal (18.5-24.9 kg/m^2)	140 (70.70%)
	Over weight (25-29.9 kg/m^2)	35 (17.67%)
	Obese (>30 kg/m^2)	11 (5.55%)
Physical fitness index (PFI)	Poor (<50)	74(37.4%)
	Average (50-80)	123(62.1%)
	Good (>80)	1(0.5%)
Waist hip ratio (WHR)	Obese(Males : >0.90, Females : >0.85)	25(12.6%)
	Non obese	173(87.4%)
Kuppuswamy's socio economic status	Upper I	23(11.6%)
	Upper Middle II	139(70.2%)
	Lower middle III	32(16.2%)
	Upper lower IV	4(2%)
	Lower V	0

Table-II: Comparison of various parameters between male and female MBBS students

Red cell index	Males (Mean ± SD)	Females (Mean ± SD)	P VALUE
Hb	15.0 ± 1.496	13.2 ± 1.615	0.0001
RBC	5.1 ± 0.512	4.6 ± 0.48	0.0001
PCV	45.3 ± 3.59	40.3 ± 4.210	0.0001
MCV	88.8 ± 6.049	87.4 ± 6.98	0.17
MCH	29.5 ± 2.48	28.6 ± 2.87	0.016
MCHC	33.2 ± 0.978	32.6 ± 1.071	0.0001
RDW	13.7 ± 1.390	14.0 ± 0.930	0.061
BMI	23.1±3.64	22.3±4.21	0.155
Waist Hip ratio	0.8±0.04	0.8±0.06	0.003
PFI	54±6.70	50.2±5.30	0.0001

Table-III: Comparison of various parameters between anemic and non anemic MBBS students

Parameters	Anemic students	Non anemic students	P value
Hb	11.3±0.84	14.6±1.44	0.0001
RBC	4.3±0.34	5±0.53	0.0001
PCV	36±2.02	44.1±3.8	0.0001
MCV	83.0±8.4	88.9±5.84	0.003
MCH	26.2±3.35	29.5±2.34	0.0001
MCHC	31.4±1.26	33.1±0.83	0.0001
RDW	14.9±1.52	13.7±1.09	0.001
BMI	23.4±3.58	22.7±3.96	0.66
Under weight(<18.5kg/m^2)	2 (8.3%)	15 (8.6%)	
Normal (18.5-24.9 kg/m^2)	18 (75%)	119 (68.4%)	
Over weight (25-29.9 kg/m^2)	4 (16.6%)	30 (17.24%)	
Obese (>30 kg/m^2)	2 (8.3%)	10 (5.75%)	
WHR	0.7±0.05	0.9±0.05	0.006
PFI	50.2±6.23	52.6±6.55	0.24

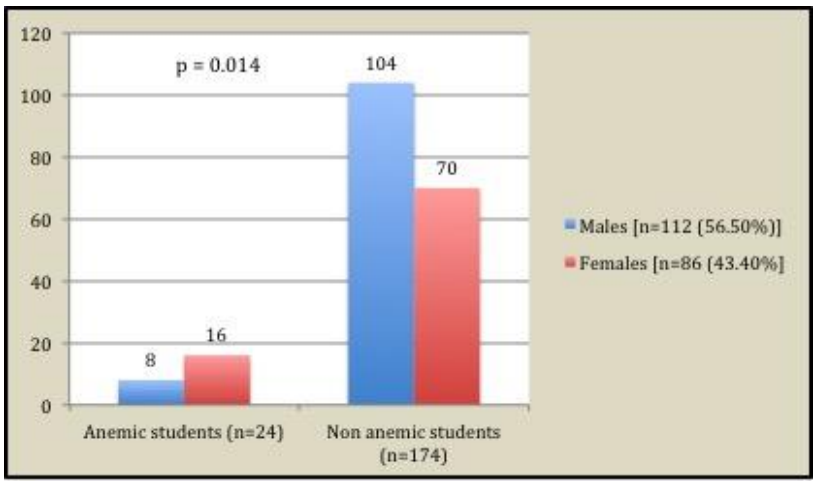

Fig-1: Gender wise distribution of anemia among MBBS students (p=0.014)

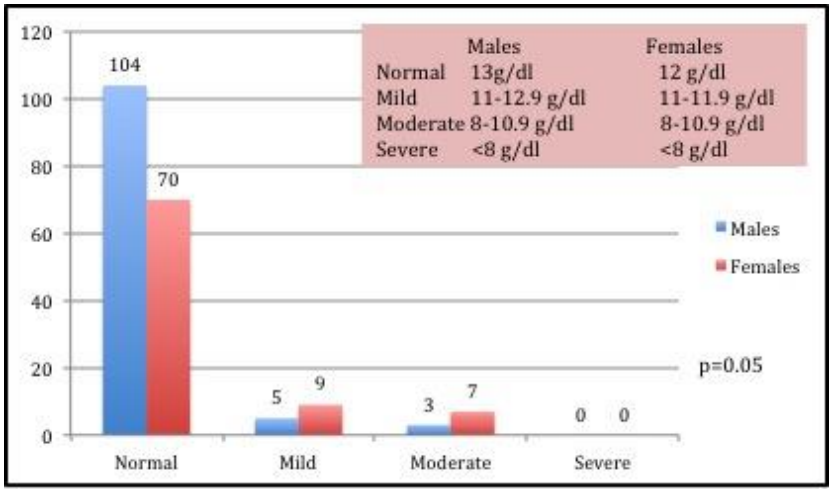

Fig-2: Gender wise grading of severity of anemia (WHO criteria) (p=0.05)

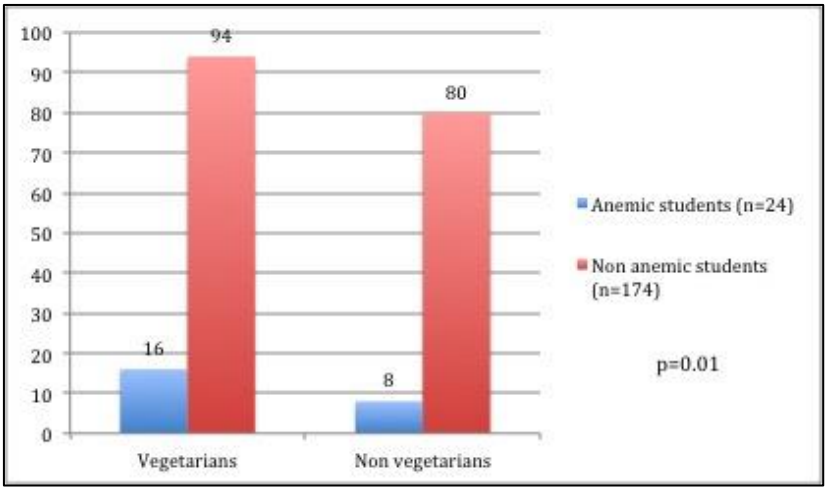

Fig-3: Correlation between diet preference and anemia (p=0.01)

DISCUSSION

Anemia is one of the most prevalent health issues globally. According to WHO, two billion people are suffering from anemia world-wide. Out of which, half of the cases are due to iron deficiency [20]. It is one of the major health problems in both developing and developed countries. India is one of those countries with highest prevalence of anemia [21]. Anemia is of major concern due to its detrimental effects on physical development work and productivity of adults.

In the present study, the prevalence of anemia was found to be 12% (24/198). On the contrary most of the studies in the literature found a much higher prevalence compared to our study. Bano *et al.* [22] found a prevalence of 32% among medical students, Verma *et al*. [23] found overall prevalence of anemia in college youths from the rural background to be 43.76% while Shill *et al.* [24] observed an even higher prevalence of 55.3% among university students in Bangladesh. A lower prevalence in our study could be explained by the better dietary habits or higher proportion of non-vegetarians.

Anemia affects all the socio-economic classes, however it is more prevalent among females than males because of unequal distribution of health resources. In the present study, anemia was predominantly found in females (66.7%;16/24) similar to the studies by several other authors[1,5,25]. Increased testosterone concentration which is associated with increased concentration of erythropoietin and hemoglobin, may be the reason for less prevalence of anemia among male students[5]. Along with poor dietary habits, menstrual blood loss and lack of awareness of iron deficiency and nutritional status may be the cause of higher prevalence among females in developing countries like India. Thereby, anemia can be prevented by improving food habits, lifestyle and providing awareness about harmful effects of anemia among students. Inculcating healthy food habits among medical students will be very beneficial in creating awareness among them as they are future health providers of the society.

In the present study, on grading anemia based on severity, it was found that majority had mild anemia (60%), similar to the findings of Mehta[3], Sultan[21] and Verma *et al*.[23] However, Joglekar *et al.* [26]

found high incidence of moderate anemia followed by mild anemia though the study was conducted among girls students only. The high prevalence of mild anemia followed by moderate anemia, thereby emphasize on supplementation of iron and folic acid along with health education on consumption of iron rich foods so as to bring down the incidence of anemia in the Indian society.

Maximum students were suffering from microcytic hypochromic anemia (70.8%) in the present study which is in concordance with Sultan *et al*.[21] Iron deficiency is the most common cause of microcytic anemia. The human body maintains iron hemostasis by recycling its stores, however conditions like pregnancy, menstruation, gastrointestinal bleed and decrease iron intake in diet severely affects the balance. Therefore repleting iron stores are very important in order to correct anemia.

There was a significant correlation of diet preference with anemia (vegetarians vs non vegetarians; 66.7% vs 33.3%) in our study. Similar to our observations, Mehta [3] found that among the 70% anemic students, most of them were vegetarians, reflecting the relationship between type of diet and magnitude of anemia. Thereby indicating that diet of the college students is not adequate for their iron need leading to anemia among them. On the contrary, Shill *et al*. [24] found no significant correlation with the diet preference.

In the present study there was no correlation of body mass index with the anemia in contrast to study by various authors who found anemia to be more prevalent among underweight students[3.5,24]. Nutritionally inadequate diet increases the prevalence of anemia while unhealthy eating practices like fast food consumption, common among students now-a-days, affects BMI and also contributes to anemia.

Waist circumference reflects intra-abdominal fat mass. And is related to cardiovascular diseases in adults. In the present study there was a statistically significant difference in WHR between anemic and non anemic students however PFI does not any significant difference. To the best of our knowledge, we did not come across any article in the literature where the correlation between WHR and PFI were studied with anemia.

The frequency of in India is variable. It has been reported from <1% to 17% with an average of 3.3% with certain communities like Muslims, Sindhis, Cutchi, some tribals etc having 8-10% prevalence of β thalassemia trait[6,27]. In the present study, the discriminative indices favoured βTT in 2 out of 198 students. However, one of them turned out to be a known case of thalassemia major, treated by BMT while the other one was confirmed as βTT by HPLC.

Although HPLC is the method of choice for thalassemia screening, but the limitation is the high cost and non-availability at the periphery. In resources deprived countries like India, we need to device a staggered approach for screening of thalassemia so as to pose minimal economic burden on the health sector. Proposed approach is initial screening of CBC parameters and calculation of discriminative indices for βTT. If favoring βTT, then HPLC should be done for confirmation. Moreover, it needs to be highlighted that this screening should be carried out premaritally so as to prevent the future occurrence of thalassemia. Premarital screening is the single most efficient and cost effective strategy for the control of thalassemia.

CONCLUSIONS

There is need to advocate iron rich diet among adolescents. Continuous follow-up programme and nutrition education can improve the nutrition status. Screening medical students for anemia and thalassemia has an advantage as they being at the grassroot level form an important part of healthcare system, hence they will further help in creating awareness in the community. The premarital counseling in prevention of beta thalassemia needs to be endorsed.

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