

ORIGINAL ARTICLE

Underweight as a Risk Factor for Nutritional Anaemia – A Cross-sectional Study among Undergraduate Students of a Medical College of Haryana

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Abstract

Background: Nutritional anaemia is the most common nutritional problem worldwide. Underweight and anaemia are associated and together constitute a serious problem in developing countries like India. **Aim & Objectives:** To estimate the prevalence of anaemia among medical students and determine its association with their body mass index (BMI). **Material & Methods:** Hemoglobin estimation was done in 140 MBBS students and anaemia status was determined by WHO criteria for anaemia. BMI was calculated and interpreted using cutoffs for Asian Indian population. Statistical analysis was done by Chi-square distribution and Binary logistic regression. **Results:** Overall prevalence of anaemia in students was 55.7% and 78.6% females compared to only 32.9% males were anaemic ($p < 0.001$). Gender was associated with both the severity of anaemia ($p = 0.028$) and BMI ($p = 0.036$). Prevalence of anaemia was significantly ($p = 0.007$) higher in underweight students (88.9%) compared to normal (54.2%) and overweight/obese (46%) students. However, no association was found between BMI and severity of anaemia ($p = 0.985$). **Conclusion:** Anaemia is significantly associated with nutritional status. Prevalence of anaemia is higher in underweight students compared to normal and overweight/obese students and management of both undernutrition and anaemia is critical for optimal results.

Keywords

Body Mass Index; Nutritional Status; Prevalence; Students; Overweight; Obesity; Anaemia; Hemoglobin;

Introduction

Nutritional anaemia is the most prevalent health problem globally and affects more individuals than

any other health problem at any given moment. (1) Iron-deficiency anaemia is the most common type of nutritional anaemia and is responsible for

approximately 50% of all anaemia. (2) It affects low, middle and high-income countries with significant effects on health and well-being, along with adverse impacts on their socioeconomic development. (3) Iron deficiency anaemia has an impact on psychological and physical development with adverse effects on cognitive and motor development along with fatigue, reduced work performance and low productivity. (4-7)

The worldwide prevalence of anaemia for all age groups was estimated to be around 32.9% in 2010. (8) In India as per NFHS 4 survey, almost one-fourth (23%) of men and more than half (53%) of women aged 15-49 years were anaemic during 2015-16. (9) Nutritional anaemia affects all age and sex groups in less developed countries like India. (10,11) Previous Indian studies conducted among college students have reported the prevalence of anaemia ranging from as low as 8% (12) to as high as 70.8%. (13) Previous studies carried out among college students reveal a significant association of anaemia with body mass index. (13-15) They reported a higher anaemia prevalence in underweight students compared to normal, overweight and obese students. However, few studies were unable to find any significant association of anaemia with BMI among college students. (16,17) Further iron deficiency anaemia is associated with impaired perception and learning difficulties resulting in declined academic performance among students. (7,18) Medical students have to go through vast curriculum and early anaemia detection and correction in them will have an impact on their success rates.

Aim & Objectives

1. To estimate the prevalence of anaemia among undergraduate medical students of a medical college
2. To determine the association of anaemia with body mass index

Material & Methods

Study Type: This was a cross-sectional type of study

Study Population: The study was conducted among undergraduate medical students.

Study Area: Department of Physiology and Community Medicine of Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, Ambala.

Study Duration: The study was carried out for a period of 3 months from April 2016 to June 2016.

Sample Size calculation: A sample size of 140 students was estimated by using anaemia prevalence of 71% from a study conducted among college students of North India (13) at 95% confidence level and absolute precision of 7.5%.

Inclusion Criteria: All the students willing to participate in the study.

Exclusion Criteria: Students not giving consent to participate in the study.

Strategy for collection: Data were collected from 140 (70 males and 70 females) first-year MBBS students of the college. A semi-structured questionnaire was designed to get details about general information, sign and symptoms of anaemia, and anthropometric measurements for calculation of body mass index. Haemoglobin levels were estimated with the help of Sahli's Haemoglobinometer.

Working Definition: Haemoglobin levels below 12 g/dl for girls and 13 g/dl for boys were used as cut-offs for diagnosing anaemia as per the WHO classification of anaemia. (19) The severity of anaemia was also graded as per WHO criteria with the haemoglobin level of 11-11.9 gm/dl for female and 11-12.9 gm/dl for male students labelled as mild anaemia, 8-10.9 gm/dl as moderate anaemia and less than 8 gm/dl as severe anaemia for both male and female students. (19) Height and weight of the students were measured to calculate BMI and evaluate their nutritional status using guidelines for Asian Indians. (20) According to these guidelines, individuals having BMI of $<18.0 \text{ kg/m}^2$ are Underweight, BMI of $18.0-22.9 \text{ kg/m}^2$ are normal, BMI of $23.0-24.9 \text{ kg/m}^2$ are Overweight and BMI of $\geq 25 \text{ kg/m}^2$ are Obese.

Ethical Approval: It was obtained from Institutional Ethical Committee of Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, Ambala, Haryana.

Consent: The data were collected from the subjects after assurance of confidentiality of the data and obtaining informed written consent from them.

Data Analysis: The data collected was analyzed by IBM SPSS Statistics for Windows, Version 20.0. Armonk, New York: IBM Corp. statistical software. Chi-square distribution was used and Odds ratios were calculated (with 95% confidence interval) for testing statistical significance. A p-value of less than 0.05 was considered statistically significant. Both the anaemia and body mass index were significantly associated with gender in our study. Hence, binary

logistic regression (Enter method) was applied and adjusted odds ratios were calculated to determine the association between anaemia and body mass index.

Results

The prevalence of anaemia among undergraduate medical students in the present study was 55.7%. Females had a higher prevalence of 78.6% compared to only 32.9% among males and the difference was statistically highly significant ($p < 0.001$). About two-thirds (64.1%) of anaemic subjects had mild anaemia and rest (35.9%) had moderate anaemia. None of the students had severe anaemia. 82.6% of males had mild anaemia compared to 56.4% females and the severity of anaemia was significantly ($p = 0.028$) associated with gender. (Table 1)

Majority of the female students were having haemoglobin below 12 gm/dl and none had above 14 gm/dl. Whereas, among male students, the majority of the students had haemoglobin above 12 gm/dl and none had below 10 gm/dl. Maximum proportion (44.3%) of female students had haemoglobin between 11-11.9 gm/dl and among male students, the maximum proportion (37.1%) had haemoglobin above 14 gm/dl. (Figure 1)

Around half (51.4%) of the students had normal BMI, whereas, 12.9% and 35.7% students were underweight and overweight/obese respectively. Female students were significantly ($p = 0.036$) more undernourished than male students as 18.6% females compared to only 7.1% males were underweight and 44.3% males compared to only 27.1% females were overweight/obese. (Table 1)

Prevalence of anaemia was higher in underweight students (88.9%) compared to normal (54.2%) and overweight/obese (46%) students and the difference was statistically significant ($p = 0.007$). However, no significant ($p = 0.985$) association was observed between severity of anaemia and body mass index. (Table 2)

Binary logistic regression revealed that females had significantly higher anaemia prevalence than males (adjusted odds ratio=7.258; $p < 0.001$). Anaemia was significantly more common in underweight students compared to those with normal BMI (adjusted odds ratio=7.073; $p = 0.021$) and overweight/obese students (adjusted odds ratio=0.128 and $p = 0.021$). (Table 3)

Majority of the anaemic students did not report common symptoms of anaemia. Fatigue was the

most common symptom reported by 34.6% anaemic subjects. All the symptoms had higher odds of presence among anaemic subjects than non-anaemic subjects, although the difference was statistically significant in fainting symptom only (OR=3.006, $p = 0.024$). Pallor was present in 55.1% of anaemic subjects compared to only 11.3% non-anaemic subjects (OR=9.653, $p < 0.001$). (Table 4)

Pallor was more common among underweight students (50%), than students with normal BMI (43.1%) and overweight/obese students (25%) and the difference was statistically significant ($p = 0.046$). Except for dyspnea all other symptoms of anaemia were more frequently reported by underweight students compared to normal and overweight/obese students although the differences were statistically not significant. (Table 5)

Discussion

The overall prevalence of anaemia among medical students in the present study was estimated to be around 55.7%. Similarly, 55.3% and 53.2% subjects were found anaemic in studies conducted among college students in Bangladesh (21) and Pakistan (22) respectively. Roy PP and Gunturu VV (23) in their study from Ongole, Andhra Pradesh reported the prevalence of anaemia around 42% among students of a medical college. Other studies conducted among college students in India reported a variable prevalence of anaemia of around 15.6% by Rani NA *et al* (24), 30.2% by Pandey S and Singh A (15), 32% by Bano R *et al* (14) and 70.8% by Mehta K *et al* (13). Prevalence of anaemia was significantly higher ($p < 0.001$) among female students (78.6%) compared to males (32.5%). These findings are similar to results of a study by Mehta K (13) in which 75.5% females and 35.7% males were found anaemic and a study from Pakistan (22) that reported anaemia in 80.4% and 33.8% of females and males respectively. Other researchers have also reported significantly higher anaemia prevalence among females compared to males. (14,15,25) Regular menstrual losses and dietary habits to maintain thinness are the major contributors to higher anaemia prevalence among females.

In our study around two-thirds (64.1%) of the anaemic students had mild anaemia and one third had moderate anaemia (35.9%). Also, the severity of anaemia was significantly associated with gender ($p = 0.028$) as 82.6% anaemic males compared to 56.4% anaemic females had mild anaemia. A similar

trend was observed in a study carried out by Pandey S and Singh A (15) among medical students in a medical college, at Bilaspur, Chhattisgarh. They found that 69% and 31% of anaemic students had mild and moderate anaemia respectively and severity of anaemia was significantly associated with gender. Other researchers have also reported that mild anaemia is more frequent in students than moderate or severe anaemia. (13,14)

Only half (51.4%) of the students had normal BMI whereas 12.9% and 35.7% subjects were underweight and overweight/obese respectively. A similar trend in the BMI among college students was reported by previous studies. (14,15,23) However, Yadav SS *et al* reported normal BMI in 73.1% students and underweight in only 1.5% among undergraduate medical students. (26) The higher percentage of students with normal BMI in this study compared to our and other studies may be the result of using WHO cutoff for BMI not the cutoff for south-east Asian countries in the study. In the present study, a statistically significant association of BMI with gender in form of higher undernourishment among girls compared to boys is consistent with findings of previous studies. (15,26) However, a recent study has reported no significant gender difference in BMI among the college students. (27)

In our study, anaemia prevalence was significantly ($p=0.007$) higher among underweight students (88.9%) compared to normal (54.2%) and overweight/obese (46%) students. This is in concordance with findings of a study by Bano R *et al* (14) who found anaemia among 81.1% underweight students and 41.2% normal students. However, they reported anaemia in only 8.7% overweight/obese subjects in contrast to our findings. Other researchers have also reported significantly higher anaemia prevalence among underweight students than normal and overweight/obese subjects. (13,15) However, Saratha A *et al* (16) and Manjula VD *et al* (25) were unable to find any significant association of anaemia with BMI in their study among college students. Underweight women are more likely to have iron deficiency and iron deficient erythropoiesis reflected by low haemoglobin level and subsequent anaemia (28). In the present study, no significant association was observed between severity of anaemia and BMI which is consistent with findings of a study by Roy PP and Gunturu VV. (23)

Among various symptoms of anaemia, all of them were more commonly seen in anaemic students than

non-anaemic students but except fainting, none were statistically significant. Also, the presence of pallor among students was significantly associated with anaemia. Similar findings were reported in a study by Manjula VD *et al*. (25) Majority of the anaemic students in the present study did not report common symptoms of anaemia as most of them had mild anaemia which has usually a subclinical presentation. Except for dyspnea, all other symptoms reported were more frequently present among underweight students compared to normal and overweight/obese students. Presence of pallor was also significantly associated with the nutritional status which is in concordance with the association of anaemia with body mass index observed in our study. Thus improvement in the nutritional status can reduce the morbidity associated with anaemia.

Conclusion

Anaemia is a common nutritional problem among college students, especially among females. There is a significant association between nutritional status and anaemia as the prevalence of anaemia is more among underweight students than normal and overweight/obese students. However, the severity of anaemia is not associated with body mass index.

Recommendation

Since anaemia is one of the most common nutritional health problems in the adolescent age group, college students should be regularly screened for anaemia. Those found to be anaemic should be given treatment and encouraged to take treatment till their haemoglobin levels are in optimal range. As anaemia is associated with undernutrition, students should also be advised to maintain their body mass index within normal range. Anaemia leads to reduced work output, low productivity and learning difficulties which may result in declined academic performance among students and thus needs prompt treatment.

Limitation of the study

The study was conducted in one medical college and thus the results may not be generalized to medical students of Haryana or India.

Relevance of the study

The study consolidates the fact that prevalence of anaemia is high among medical students, especially among females. Underweight students are more predisposed to anaemia and require management of both undernutrition and anaemia for best results.

Anaemia is associated with learning difficulties and deterioration of academic performance. Thus medical students who have to cover vast curriculum requires prompt treatment if they are anaemic to improve their success rates.

Authors Contribution

ZAK: Concept and Design, data analysis and interpretation of data, drafting and reviewing for intellectual content and final approval; TK: Concept and Design, Acquisition of data, revising and final approval; AB: Drafting, Reviewing and final approval; SJA: Reviewing and final approval; SS: Reviewing and final approval.

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Tables

TABLE 1 ASSOCIATION OF ANAEMIA, ITS SEVERITY AND BODY MASS INDEX WITH GENDER

	Total	Males	Females	p value
Anaemia (n=140)				
Present	78 (55.7%)	23 (32.9%)	55 (78.6%)	<0.001**
Absent	62 (44.3%)	47 (67.1%)	15 (21.4%)	
Severity of anaemia (n=78)				
Mild	50 (64.1%)	19 (82.6%)	31 (56.4%)	0.028*
Moderate	28 (35.9%)	4 (17.4%)	24 (43.6%)	
Severe	0 (0%)	0 (0%)	0 (0%)	
Body Mass Index in kg/m² (n=140)				
<18.0 (Underweight)	18 (12.9%)	5 (7.1%)	13 (18.6%)	0.036*
18.0–22.9 (Normal)	72 (51.4%)	34 (48.6%)	38 (54.3%)	
≥23 (Overweight/Obese)	50 (35.7%)	31 (44.3%)	19 (27.1%)	

* Statistically significant; ** Statistically highly significant

TABLE 2 ASSOCIATION OF ANAEMIA AND ITS SEVERITY WITH BODY MASS INDEX

Anaemia	Underweight	Normal	Overweight/Obese	p-value
Anaemia (n=140)				
Present (n=78)	16 (88.9%)	39 (54.2%)	23 (46.0%)	0.007*
Absent (n=62)	2 (11.1%)	33 (45.8%)	27 (54.0%)	
Severity of anaemia (n=78)				
Mild (n=50)	10 (62.5%)	25 (64.1%)	15 (65.2%)	0.985
Moderate (n=28)	6 (37.5%)	14 (35.9%)	8 (34.8%)	

* Statistically significant

TABLE 3 BINARY LOGISTIC REGRESSION ANALYSIS OF GENDER AND BODY MASS INDEX WITH ANAEMIA

Variable	Crude Odds Ratio (95% C.I. #)	p-value	Adjusted Odds Ratio (95% C.I. #)	p-value
Gender				
Males	Ref.	<0.001**	Ref.	<0.001**
Female	7.493 (3.511-15.991)		7.258 (3.277-16.075)	
Body mass index				
Normal	Ref.		Ref.	
Underweight	6.769 (1.449-31.619)	0.015*	7.073 (1.342-37.261)	0.021*
Overweight/Obese	0.721 (0.349-1.487)	0.376	0.907 (0.401-2.051)	0.815

Confidence Interval; * Statistically significant; ** Statistically highly significant

TABLE 4 ASSOCIATION OF VARIOUS SIGNS AND SYMPTOMS WITH ANAEMIA

Signs/Symptoms	Anaemic (n=78)	Non-anaemic (n=62)	Odds ratio (95% C.I. #)	p value
Palpitation				
Present	11 (14.1%)	5 (8.1%)	1.872 (0.614-5.705)	0.265
Absent	67 (85.9%)	57 (91.9%)		
Dyspnea				
Present	8 (10.3%)	6 (9.7%)	1.067 (0.350-3.254)	0.910
Absent	70 (89.7%)	56 (90.3%)		
Fainting				
Present	19 (24.4%)	6 (9.7%)	3.006 (1.119-8.073)	0.024*
Absent	59 (75.6%)	56 (90.3%)		
Fatigue				

Present	27 (34.6%)	13 (21.0%)	1.996 (0.925-4.306)	0.076
Absent	51 (65.4%)	49 (79.0%)		
Pallor				
Present	43 (55.1%)	7 (11.3%)	9.653 (3.908-23.845)	<0.001**
Absent	35 (44.9%)	55 (88.7%)		

Confidence Interval; * Statistically significant; ** Statistically highly significant

TABLE 5 ASSOCIATION OF VARIOUS SIGNS AND SYMPTOMS WITH BODY MASS INDEX

Signs/Symptoms	Underweight (n=18)	Normal (n=58)	Overweight/Obese (n=64)	p-value
Palpitation				
Present	3 (16.7%)	5 (8.6%)	8 (12.5%)	0.603
Absent	15 (83.3%)	53 (91.4%)	56 (87.5%)	
Dyspnea				
Present	0 (0%)	8 (13.8%)	6 (9.4%)	0.228
Absent	18 (100%)	50 (86.2%)	58 (90.6%)	
Fainting				
Present	5 (27.8%)	14 (24.1%)	6 (9.4%)	0.052
Absent	13 (72.2%)	44 (75.9%)	58 (90.6%)	
Fatigue				
Present	7 (38.9%)	18 (31%)	15 (23.4%)	0.379
Absent	11 (61.1%)	40 (69%)	49 (76.6%)	
Pallor				
Present	9 (50%)	25 (43.1%)	16 (25%)	0.046*
Absent	9 (50%)	33 (56.9%)	48 (75%)	

* Statistically significant

Figures

FIGURE 1 DISTRIBUTION OF STUDENTS ACCORDING TO GENDER AND HAEMOGLOBIN LEVEL

