Original article:

Association of anemia with BMI in medical students, a cross-sectional study

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ABSTRACT

Background: Anemia has a global impact. It affects the health as well as diminishes work output of the individual. Nutritional deficiency is the most common cause of anemia. Various factors affect the anemia status. Very few studies have been done to know the association of anemia with BMI among medical students in northern part of Karnataka. So the present study is undertaken to evaluate the same.

Objectives: To study the association of anemia with BMI among medical students.

Method: 98 adolescent medical students aged between 17 and 21 years belonging to both the sexes, studying at Belgavi Institute of Medical Sciences, Belgavi were included in the study after obtaining approval from ethical committee. This cross-sectional study was conducted at the Department of Physiology after obtaining informed written consent. Anthropometric measurements were done using the standard protocol. Haemoglobin level was assessed using the Sahli Haemoglobinometer using the standard protocol. The relationship between hemoglobin (Hb) concentration and body mass index (BMI) was examined by calculating Pearson's correlation coefficient and the significance of correlation (*p*).

Result: The study showed among 39 girls, 7(17.9%) were underweight, 19(48.7%) were of normal weight, 3(7.7%) were overweight and 10(25.6%) were obese. Among boys 16(27.1%) were underweight, 28(47.5%) were of normal weight, 5(8.5%) were overweight and 10(16.9%) were obese. 23% females and 2% males were anemic with Hb % <12 gm% as per WHO criteria. The study showed a negative correlation between Hb% and BMI although the correlation is not to the significant level.

Conclusion: There was a positive correlation between anemia and BMI among medical students .The correlation factor is not to the significant level.

Keywords: Body mass index (BMI), Anemia, Hemoglobin level, obesity, nutrition.

INTRODUCTION:

Anemia is characterized by low hemoglobin level or less number of red blood cells [(1)]. It is global health problem affecting both developed and developing countries. Globally prevalence of anemia is 29% in females of 15-49 yrs age group [(2)]. According to national health survey4, the prevalence of anemia is 50.8% in non pregnant females and 19% in males of 15-49 yrs age group in Karnataka State, India [(3)].

Anemia has an impact not only on human health but also on social and economic development. Causes of anemia include blood loss during menstruation, hookworm infestation, chronic infection, and micronutrient deficiencies. In 2002, iron deficiency was an important causative factor for anemia. Anemia is an indicator of poor nutrition and poor health. It affects not only cognitive and physical performance but also work productivity in adults [(4)].

Many low and middle-income countries are facing the double burden of disease. Along with undernutrition, there is a rapid increase in noncommunicable risk factors such as obesity and overweight [5]. Obesity had been reported to be associated with anemia in adults. A significant association had been found between serum iron, soluble transferrin receptors, fat mass and BMI [6, 7].

Adolescence is the stage of the life cycle where rapid spurt in the growth occurs leading to increased nutritional demand. Medical students are vulnerable to nutritional anemia because of their sedentary lifestyle to complete the syllabus, less time for physical exercise and improper diet habit [8].A study on among medical students of Chhattisgarh had shown 30% students were anemic of which 18.96% were males and 47.37% were of female gender [9].Prevalence of anemia was 39% among medical students of Nagpur. The students of female gender were more affected as compared to male gender [8].

A few studies had done to know the association between anemia and BMI. The study had shown 8% female students were anemic in Himalayan Institute of medical sciences and also found a negative association between Hb and Body mass index (BMI) [10]. Whereas study in medical students of Amritsar had shown a positive correlation of hemoglobin with grades of BMI in both boys and girls but none of the correlation was up to significance level of <0.05 [11]. There is the paucity of study regarding the association of anemia with BMI in Northern part of Karnataka. Also, there is the disparity in the previous study results. So the present study is undertaken to know the association between anemia and BMI among medical students.

Objectives: To evaluate the association of anemia with BMI in medical students.

METHODOLOGY:

The present study was conducted among first-year medical students enrolled in the academic year 2015-2016 at Department of Physiology, Belgavi institute of Medical Sciences, Belgavi. Ethical clearance was obtained from Institution's ethical Committee.

Study design: A cross-sectional study of the association of BMI with Hb in medical students.

Sample size: The sample size of 95 was calculated as below:

$n=z^2pq/d^2$

Where z=standard normal deviate

p=anemia prevalence in 17-21 year age group=45.7%

q=100-p

d=absolute error10% of p

n=95 with 10% error

The sample size was estimated to be 95 by allowing 10% error. Hence 98 medical students aged between 17 and 21 years belonging to both the sexes were included for the study. Informed written consent was obtained from all the participants.

Inclusion criteria: Medical students of the age group of 17-21 years who consented for the study.

Exclusion criteria: Those suffering from chronic diseases like diabetes, hypertension, arthritis, renal disease and who were on medication which would cause weight gain.

Anthropometric measurements were done using the standard protocol. Standard height of students was recorded without shoes and wearing light clothes. The measuring tape was mounted on the wall to the nearest of centimeters (<5 and >5 mm). The weight was recorded with shoes off and with light clothes on a weighing machine with at least count of 500 g. BMI was calculated by the formula: Weight (kg)/Height (m^2).

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BMI is independent of age and sex and is a known an epidemiological marker of nutritional status in adolescents. International Obesity Task Force (IOTF-2000) [12] has proposed the standards for adult obesity in Asia and India as follows:

BMI: > 23 kg/m2**:** Overnutrition

BMI: 18.5–23 kg/m2**:** Adequate nutrition

BMI: < 18.5 kg/m2**:** Undernutrition

A cutoff point of 18.5 kg/m^2 of BMI were used to define thinness or acute undernutrition state, a BMI of 23 kg/m^2 indicated overweight and a BMI of over 25 kg/m^2 indicated obesity [12].

Physiological Parameters: Haemoglobin level was assessed using the Sahli's Haemoglobinometer using a standard protocol. The measured hemoglobin values were tabulated according to the gender difference and compared with the standard values of grading of anemia. According to WHO guidelines hemoglobin concentration of <12 g% was considered as anemia [13].

Statistical Analysis : The Statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1 ,Systat 12.0 and R environment ver.2.11.1 was used for the analysis of the data and Microsoft word and Excel had been used to generate graphs, tables etc**.** Descriptive and inferential statistical analysis was done in the present study.

Results on continuous measurements were presented on Mean ± SD (Min-Max) and results on categorical measurements were presented in number (%). The significance was assessed at 5 % level of significance. Pearson correlation between study variables was performed to find the degree of relationship between hemoglobin (Hb) concentration and BMI. Student t-test (two-tailed, independent) was used to find the significance of study parameters on a continuous scale between two groups (inter group analysis) on metric parameters.

RESULT:

98 students studying in first year MBBS were participated in the study. Table No. 1 shows age and gender distribution of students participated in the study. Out of 98 students, 39% were females and 60% were of male gender. Table no.2 shows the comparison of study variables among male and female gender. The average hemoglobin level in female gender was11.77±1.49g/dl whereas in male gender it was 13.75±1.34g/dl. The difference was statistically significant. The average BMI among female and male gender was 20.99±3.94 kg/m^2, 22.81±5.57 kg/m^2 respectively. Table no.3 shows hemoglobin (g/dl) and BMI (kg/m^2) distribution of the students studied. In the present study 23% female students and 2%, male students were anemic with Hb% <12 gm% as per WHO criteria [2].

Among 39 girls, 7(17.9%) were underweight, 19(48.7%) were of normal weight, 3(7.7%) were overweight and 10(25.6%) were obese. Among boys 16(27.1%) were underweight, 28(47.5%) were of normal weight, 5(8.5%) were overweight and 10(16.9%) were obese. The association between hemoglobin and BMI was evaluated by Pearson's correlation factor which was negative but not up to the significant level. The results are shown in Table no.4.

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Table 1: Age and gender distribution of students studied

Age in years	**No. of students**	**%**
17	22	22.4
18	55	56.1
19	19	19.4
21	2	2.0
Total	98	100.0
Gender		
Female	39	39.8
Male	59	60.2
Total	98	100.0

Table 2: Comparison of clinical variables according to male and female gender.

Variables	**Gender**		**Total[Mean** ±SD]	**P value**
	Female[Mean ±SD]	**Male[Mean** ±SD]		
Age in years	17.97±0.85	18.13±0.66	18.03±0.78	0.316
Hemoglobin (g/dl)	11.77±1.49	13.75±1.34	12.96±1.70	<0.001**
Height (m)	1.70±0.06	1.57±0.10	1.65±0.10	<0.001**
Weight (kg)	61.12±13.14	55.08±9.60	58.71±12.17	0.015*
BMI (kg/m^2)	20.99±3.94	22.81±5.57	21.72±4.72	0.061+

+ Suggestive significance (P value: 0.05<P<0.10)

* Moderately significant (P value: 0.01<P ≤ 0.05)

** Strongly significant (P value: P≤0.01)

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Table 3: Hemoglobin (g/dl) levels and BMI (kg/m^2) distribution of students studied

Hemoglobin (g/dl)	**Number of students**		**Total number of students**
	Female gender	**Male gender**	
<12	23(59%)	2(3.4%)	25(25.5%)
>12	16(41%)	53(89.8%)	69(70.4%)
Total	39(100%)	59(100%)	98(100%)
BMI (kg/m^2)			
<18.5	7(17.9%)	16(27.1%)	23(23.5%)
18.5-22.9	19(48.7%)	28(47.5%)	47(48%)
23-24.9	3(7.7%)	5(8.5%)	8(8.2%)
>25	10(25.6%)	10(16.9%)	20(20.4%)
Total	39(100%)	59(100%)	98(100%)

Table 4: Pearson Correlation between hemoglobin concentration and BMI of students studied

Pearson Correlation	**r value**	**P value**
Hemoglobin (g/dl) **vs.** BMI (kg/m^2)	-0.087	0.393

DISCUSSION:

Anemia has the global impact. It is a major health problem in both developed as well as developing countries. It is not only limited to low socioeconomic class but also affects the opulent society. Anemia denotes poor nutrition and poor health. Etiology of anemia is vast. But the most common cause is iron deficiency. So, most of the time the terms iron deficiency and anemia are used simultaneously. The risk factors for iron deficiency include less dietary intake of iron, poor iron absorption, increased demand during adolescence and pregnancy, menstrual blood loss and parasitic infestation. Anemia affects work productivity in adults which is of major concern [(2)].

In the present study, the prevalence of anemia was 25.5%. 59% (23 no. of students) females and 3.4% (2 no. of students) male students were anemic. Our study results were correlated with the previous study done among medical students of Amritsar which had found 45.7% girls and 1.7% boys as anemic. This less prevalence of anemia in male students could be due to increased testosterone concentration which is associated with increased concentration of

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erythropoietin and hemoglobin [11]. In contrast to the present study, the previous study done in medical students of central India found prevalence of anemia as 39%, out of which 39% were females and 22% were male students[8]. Anemia prevalence was 30.20% among medical students of Chhattisgarh, affecting 19% of male gender and 18% of female gender [9]. 8% of female students were found to be anemic with none of the boys having <12gm%Hb at Himalayan institute of medical sciences [10].

In present study, 17.9% girls and 27.1% boys were underweight, 3% girls and 5% boys were overweight whereas 25.6% girls and 16.9% boys were obese. Our finding in female gender correlated with the previous study, which had shown 18% girls as underweight. Our study findings were in contrast with the prevalence of over nutrition among boys which was 60% [11].

In the present study, there is a negative correlation between BMI and Hb% although the correlation is not significant. This negative association between BMI and Hb% may be due to inflammation-induced increase in hepcidin in obesity. It has been suggested that hepcidin excess decreases dietary iron absorption and increases iron sequestration from reticuloendothelial macrophages due to its inhibitory actions on the expression of ferroprotein. Ferroprotein exports iron from the cell to plasma [6]. Our study results are in consistent with the previous studies done. A negative association between BMI and Hb concentration was observed among overweight and obese students [14, 15]. Increased urbanization has limited outdoor activity in adolescents who are spending more time in front of television. This along with more availability of energy dense and low iron content food results in an increase in obesity and iron deficiency in adolescents [14].

Our study results are in contrast with the previous studies done which had shown that anemia was more prevalent in the underweight students compared to the overweight and obese students [16, 17, and 18].A study done in rural Punjab had shown a high prevalence of anemia in both genders of underweight, low socioeconomic status and a low activity lifestyle [17].

The limitation of our study: We had measured only hemoglobin as an indicator of anemia status. Other parameters of iron status and inflammation were not included. Some variables that influence iron status such as physical activity, common infections and other micronutrient deficiencies were not included. Intake of ascorbic acid, calcium, and fiber that affect iron status is not evaluated among students.

CONCLUSION:

We found a negative association between BMI and hemoglobin concentration though the association is not up to the significant level. Frequent screening for the prevalence of anemia should be done among the target group. The students should be motivated and educated to take a balanced diet rich in green leafy vegetables and fruits. We suggest a further evaluation with large sample size to find out the association between BMI, iron status and inflammatory marker.

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