

Original article

Correlation of hemoglobin level with body mass index in undergraduate medical students

Gita Khakurel¹, Sanat Chalise², Niraj Pandey³

¹Department of Physiology, Kathmandu Medical College, Duwakot, Bhaktapur, Nepal,

²Department of Pathology, Kathmandu Medical College, Sinamangal, Kathmandu, Nepal,

³Department of Anatomy, Kathmandu Medical College, Duwakot, Bhaktapur, Nepal.

Correspondence: Dr. Gita Khakurel, Department of Physiology, Kathmandu Medical College, Duwakot, Bhaktapur, Nepal

Abstract

Introduction: Anemia is a public health problem worldwide and is of major concern in developing countries like Nepal. Iron deficiency anemia is most common among growing adolescents and college going students. The main objectives of the study were to assess the prevalence of anemia in undergraduate medical students and to correlate hemoglobin level with body mass index (BMI) in undergraduate medical students.

Methods: This was a cross sectional study conducted on 200 medical students of age 17-23 years studying at Kathmandu Medical College, Duwakot, Bhaktapur. After taking consent, anthropometry was done using standard protocol. Estimation of hemoglobin (Hb) level was done by Sahli's acid hematin method and hemoglobin was expressed in gram/deciliter (gm/dl). According to the World Health Organization (WHO), hemoglobin level < 12 gram/deciliter was considered as anemic. Statistical analysis was done using mean, standard deviation, student's t test and pearson's correlation.

Results: Among 200 students enrolled, 43.5 % (87) of students were found to be anemic. Out of which 72.41 % (63) were girls. About 46.15 % of overweight students and 50 % of underweight students were anemic. The correlation of haemoglobin to grades of body mass index showed a positive association of hemoglobin with body mass index among underweight and overweight boys. There was a negative association in underweight girls. But neither of the correlation showed significance to < 0.05.

Conclusion: A positive correlation of hemoglobin level with body mass index was found in boys. Anemia is more prevalent in girls which is of concern and has to be addressed.

Key words : anemia, body mass index, haemoglobin, medical students

Introduction

Hemoglobin (Hb) is the iron-containing protein in the red blood cells. The concentration of which provides information about the status of anemia in the population.¹ Anemia is defined by the World Health Organization (WHO) as a condition where hemoglobin present in blood is less than normal due to deficiency of one or more essential nutrients, regardless of the cause of such deficiencies.² Adolescent being a formative year in life are more

prone to major nutritional deficiency.³ Out of estimated 27 million population in Nepal 23 % are adolescent.² Body mass index (BMI) is a known epidemiological marker of nutritional status of adolescents.⁴ The medical students may suffer anemia because of long schedule of work in college, clinical labs and extra-curricular activities.⁵

Screening for the detection of anemia is important in order to identify the at-risk population as well as to determine the treatment modality in individuals.⁶ The

result of association between anemia and body mass index, a measure of nutritional status of adults, has been inconsistent. There is paucity of data correlating hemoglobin with BMI in our context. Thus, present study was done to find out the prevalence of anemia and correlate hemoglobin level with BMI in undergraduate medical students.

Aims and Objectives:

The main objectives of the study were

1. To assess the prevalence of anemia in undergraduate medical students
2. To correlate hemoglobin level with body mass index (BMI) in undergraduate medical students

Material and Methods:

Body mass index (BMI) in kg/m² was calculated by using Quelet formula.⁷

$$\text{BMI} = \frac{\text{Weight (kg)}}{\text{Height (m}^2\text{)}}$$

The International Obesity Task Force (IOTF) has proposed BMI cut offs for Asian adults. The BMI values are < 18.5 kg/m² for underweight, 18.5-23 kg/m² for overweight and >23 kg/m² indicating obesity.⁸

Hemoglobin level was estimated by Sahli's acid hematin method. The hemoglobin tube was filled with N/10 hydrochloric acid up to 2 gram % marking. This graduated tube was placed in Sahli's hemoglobinometer (comparator with brown glass). Capillary blood was collected by the finger prick method, using 22 G disposable needles and blood was drawn into Sahli's pipette up to 20 micro liter marking. The blood sample and hydrochloric acid were mixed by stirrer. The solution in the tube was left as it is for 5 minutes to form acid hematin. The acid hematin was diluted by adding distilled water gradually with the dropper till it matched with the

This cross sectional study was conducted in 200 first and second year medical students of Kathmandu Medical College, Duwakot, Bhaktapur from 1st June 2016 to 30th December 2016. The students with history of cardiovascular diseases and bleeding disorders were excluded. After written consent, the volunteer students were asked to come to the department for estimation of their hemoglobin concentration. Anthropometry was conducted using standard protocol.² Standing height (in centimetres) was recorded without shoes by the measuring tape which was mounted on the wall. Weight was taken on a Krups weighing machine with light clothes and without shoes.

standard colour plates of the comparator. Results were read as gram/dl.

The subject was considered anemic if the haemoglobin level was < 12 gram/dl.² Ethical clearance for the study was obtained from the Institutional review board of Kathmandu Medical College, Sinamangal, Nepal.

The data analysis was done using the Statistical Package for Social Science (SPSS) version 17. The correlation between hemoglobin level and BMI was done by using the Pearson's correlation coefficient (r) and 95% CI has been considered for the significance of test.

Results

Of the total 200 students participating in the study, 55.5 % (111) were boys and 44.5 % (89) were girls. The students were in the age group 17-23 years. The

prevalence of anemia according to the WHO cut off value was found to be 43.5 % (87). Among which 27.58 % (24) were boys and 72.41 % (63) were girls. The mean hemoglobin value in boys was 13.38 gm/dl(\pm 1.70) and 11.75gm/dl (\pm 1.15) in girls. Correlation of hemoglobin level with grades of body

mass index showed a positive association of BMI with Hb among underweight and overweight boys. There was a negative association of BMI to hemoglobin level among underweight girls and girls within normal BMI. But neither of the correlation showed significance to < 0.05 (Table 1).

Table 1. Correlation of hemoglobin level with grades of BMI in boys (n=111) and girls (n=89) undergraduate medical students.

| BMI (kg/m ²) | Boys | | Girls | | Significance (p) |
|--|-----------------------------|------------------|-----------------------------|--|------------------|
| | Correlation coefficient (r) | Significance (p) | Correlation coefficient (r) | | |
| Underweight (<18.5 kg/m ²) | 0.16 | 0.65 | -0.14 | | 0.60 |
| Normal (18.5 kg/m ² -23 kg/m ²) | -0.23 | 0.08 | -0.22 | | 0.10 |
| Overweight (> 23 kg/m ²) | 0.10 | 0.11 | 0.36 | | 0.11 |

*Significance set at $p < 0.05$.

Applied Physiology & Anatomy Digest

Now indexed in Google scholar & Index Copernicus

Dedicated speciality Journal for Anatomy & Physiology

Internationally Indexed

www.apad.co.in

According to the IOTF classification for BMI, among 200 students, 13 % (26) were underweight, 54.5 % (109) were within normal BMI and 32.5 % (65) were overweight. 45.5 % of students are malnourished. However undernutrition was seen in 18 % (16) girls with the BMI < 18.5 kg/m². 40.5 % (45) boys were overweight as compared to only 22.5 % (20) girls who were categorized as overweight by IOTF classification.

Out of 24 total anemic boys 66.7 % (16) were overweight and 33.3 % (8) were within normal BMI. Whereas among 63 anemic girls, 20.6 % (13), 57.1 % (36) and 22.2 % (14) were underweight, normal and overweight respectively. 50 % (13/26) of underweight students and 46.15 % (30/65) of overweight students were anemic.

Discussion

The present study was done to assess the correlation of hemoglobin level with body mass index in undergraduate medical students. In this study we focused the problem of anemia in medical college students. The overall prevalence of anemia was found to be 43.5 % (87) in our study. Among which 27.58 % (24) were boys and 72.41 % (63) were girls. In study done by Sinha AK et al amongst adolescents in Morang district of Nepal, the prevalence of anemia was found to be significantly higher in girls 52.3 % than boys which was 47.7 %.² Whereas the prevalence of anemia is 39 % in the study done by Khan B et al among undergraduate medical students of Central India.⁹ Similar findings of higher anemia prevalence (55.3 %) was observed in Bangladesh during year 2011 and majority of them were girls (63.3%)¹⁰. The reasons for high prevalence of anemia in girls in our study could be because of the adverse effect due to lower intake of dietary iron along with

the menstrual blood loss as well as the lack of awareness on the healthy food habits.

The mean hemoglobin value among girls was 11.75 gm/dl (\pm 1.15). Similar finding with mean hemoglobin 11.71 gm/dl (\pm 1.19) was seen in study done by Chaturanga G et al among female undergraduate of Srilanka.¹¹ However, a research done at the University of Sharjah reported a mean hemoglobin of 12.5 gm/dl among girls.¹²

In boys a positive association was observed between BMI and hemoglobin among underweight and overweight students. This finding was similar to the finding observed in study done by Saxena Y et al among medical students of India.³ There was a negative association of BMI to hemoglobin level among underweight girls and girls within normal BMI. Whereas in study done by Saxena Y et al, there was a negative association among overweight girls (r -0.59, p = 0.24).³ The negative association seen in our study could be due to the decrease in levels of estrogen binding protein with increasing BMI. So the free estrogen rises which suppresses the process of erythropoiesis in females.¹³ Whereas in study done by Hanafi MI et al there was no significant association between anemia and BMI status among studied population.¹⁴ While Waseem SM et al in their studies have reported significant correlation of BMI with hemoglobin in males, but non-significant negative correlation between BMI and hemoglobin in females.¹⁵

In the present study, 50 % (13/26) of underweight students and 46.15 % (30/65) of overweight students were anemic which meant that 47.25 % (43/91) anemic subjects were malnourished. In the study done by Waseem SM et al anemia was found in 44.9 % underweight, 10 % overweight subjects and 34.78 % anemic subjects were malnourished.¹⁵ Similar

finding was observed in the study done by Vanajakshi BJ et al in which anemia was more prevalent among underweight students than the overweight students.¹⁶ This suggests that the prevalence of anemia decrease with the increase in the nutritional status of the subject. As 46.15 % of overweight subject were anemic in our study. This could be because of the protein hepcidin, an acute-phase reactant, which is elevated in obesity. It can

suppress the absorption of iron from the diet and its further storage which in turn leads to anemia.¹⁷

Conclusion

Our study revealed that 43.5 % (87) of undergraduate medical students were found to be anemic. Among which anemia was more prevalent in girls accounting for 72.41 % (63). A positive correlation of hemoglobin level with body mass index was seen in boys.

Acknowledgements

The authors would like to thank Kathmandu Medical College for cooperation to conduct the study. We would like to acknowledge paramedical staffs and all the participants for their sincere contribution to the study.

References

1. Patil PJ, Thakare GV, Patil SP. Variability and accuracy of Sahli's method in estimation of hemoglobin concentration. *Natl J Integr Res Med.* 2013; 4(1): 38-44.
2. Sinha AK, Karki GMS, karna KK. Prevalence of anemia amongst adolescents in Biratnagar, Morang Dist. Nepal. *Int J Pharm Biol Arch.* 2012; 3(5): 1077-1081.
3. Saxena Y, Shrivastava A, Saxena V. Effect of gender on correlation of anemia with body mass index in medical students. *Indian J Physiol Pharmacol.* 2011; 55(4): 364-369.
4. Kaur M, Singh A, Bassi R, Kaur H. Nutritional status and anaemia in medical students of SGRDIMSAR, Amritsar. *Natl J Physiol Pharm Pharmacol.* 2015; 5(1): 35-49.
5. Sehgal S, Kapoor R, Khan MM. Prevalence of anemia among the first year MBBS students in a medical teaching institution in Lukhnow. *J Biol Chem Research.* 2015; 32(2): 466-470.
6. Maeda M, Yamamoto M, Yamauchi K. Prevalence of anemia in Japanese adolescents: 30 years' experience in screening for anemia. *Int J Hematol.* 1999; 69(2): 75-80.
7. Park K. *Park's Textbook of Preventive and Social Medicine.* 20th edition. 2009, Jabalpur: M/S Banarsidas Bhanot
8. WHO/IASO/IOTF. *The Asia Pacific Perspective: Redefining Obesity and its treatment.* Health Communications Australia Pvt Ltd. 2000.
9. Khan B, Sukhsohale ND, Jawade P. Prevalence of anemia among undergraduate medical students of Central India. *Glob J Res Anal.* 2015; 4(5): 13-14.
10. Shill KB, Karmakar P, Kibria MG, Das A, Rahman MA, Hossain MS, et al. Prevalence of iron-deficiency anaemia among university students in Noakhali region, Bangladesh. *J Health PopulNutr.* 2014; 32(1): 103-110.
11. Chaturanga G, Balasuriya T, Perera R. Anemia among female undergraduate residing in the hostels of University of Sri Jayewardenepura, Sri Lanka. *Anemia.* 2014.

12. Sultan Ah. Anemia among female college students attending the University of Sharjah, UAE: prevalence and classification. J Egypt Public Health Assoc. 2007; 82(3-4): 261-271.
13. Lukanova A, Lundin E, Zeleniuch-Jacquotte A, Muti P, Mure A, Rinaldi S, et al. Body mass index, circulating levels of sex-steroid hormones, IGF-I and IGF-binding protein-3: A cross-sectional study in healthy women. Eur J Endocrinol. 2004; 150(2): 161-171.
14. Hanafi MI, Abdallah AR, Zaky A. J Taibah Univ Med Sci. 2013; 8(3): 160-166
15. Waseem SM, Bano R, Ahmad N, Kumar J, Khan A. Study of haematological profile and body mass index in undergraduate medical students in Lucknow, Uttar Pradesh. Int J Health Sci Res. 2015;5(6):257-262.
16. Vanajakshi BJ, Vijaykrishna K, Namita. Gender correlation of hemoglobin and hematocrit with body mass index in medical students. J Med Sci Clin Res. 2015; 3(8): 7310-7314.
17. Sanad M, Osman M, Gharib A. Obesity modulate serum hepcidin and treatment outcome of iron deficiency anemia in children: A case control study. Ital J Pediatr. 2011; 37: 34.

MediEdunet

You tube Channel

*Series of Physiology lectures & concepts for
medical students*

Subscribe & share

Very very useful for undergraduate medical students.....

Medworld asia