

## RESEARCH ARTICLE

## Correlation of hemoglobin versus body mass index and body fat in young adult female medical students

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## ABSTRACT

**Background:** Iron deficiency anemia is the most common type of anaemia. Females have higher prevalence of iron deficiency anemia. Hemoglobin (Hb) concentration is used to diagnose iron deficiency anemia along with other test. It is used in screening of anemia too. Increase in body fat may impair the level of Hb in healthy females. **Aims and Objectives:** The aim and objective of this study were to find correlation between Hb versus body mass index (BMI) and body fat percentage in otherwise healthy adult female. **Materials and Methods:** Weight and height were measured to calculate BMI. Body fat was measured by Omron body fat monitor. Hb was measured by colorimetric method from venous blood. Pearson correlation was used to find a correlation between Hb and measured parameters. A  $P < 0.05$  was considered statistically significant. **Results:** Among 232 subjects, 34.6% was found to be suffering from anemia. Correlation between Hb and BMI was  $r = -0.49$ ,  $P < 0.001$ . Correlation between Hb and body fat percentage was  $r = -0.56$ ,  $P < 0.001$ . **Conclusion:** There was a significant negative correlation of blood Hb level with BMI and body fat percentage. Hence, increase in body fat may be considered as an indicator of lower Hb level.


**KEY WORDS:** Anemia; Iron Deficiency; Obesity

## INTRODUCTION

Several steps have been taken for improvement of nutritional status of the world population. Still, nutrition deficiency is a large problem throughout the world, especially in developing countries like India. More than 40% of Indian females of 15–49 years of age suffer from anemia.<sup>[1]</sup> The prevalence of anemia is more in vegetarians as compared to non-vegetarians.<sup>[2]</sup> Across the world, iron deficiency is the most prevalent cause of anemia so also in India. Although there are several tests for the estimation

of iron in the blood, hemoglobin concentration is the most common test to estimate the iron deficiency.<sup>[3]</sup> The concentration of hemoglobin can be used as an indicator to know the severity of iron deficiency.

Females have a higher prevalence of iron deficiency than males.<sup>[4]</sup> Obesity is more prevalent in females than males.<sup>[5]</sup> In developing countries like India, females are more obese than males mostly due to the sedentary lifestyle and lack of exercise. We have taken the subjects from medical students whose physical activity is restricted due to the use of motor vehicles for transport, use of lifts for going to upstairs, etc. The previous study by Bagni *et al.* found a negative correlation between body fat and haemoglobin (Hb).<sup>[6]</sup> However, their sample was taken from adolescent girls. Eftekhari *et al.* showed an inverse relationship between body mass index (BMI) and serum ferritin.<sup>[7]</sup> Correlation between Hb and body fat in young adult females in the state of Odisha has not been ascertained.

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With this background, the objective of this study was to ascertain the hemoglobin level in otherwise healthy adult female undergraduate students and to find a correlation between Hb and obesity parameters (i.e. BMI and body fat percentage).

## MATERIALS AND METHODS

After obtaining clearance from the institutional ethics committee, this cross-sectional study was conducted in the Postgraduate Department of Physiology and Pathology, MKCG Medical College. According to the aim of the study, a convenience sample was chosen from female medical undergraduate students. Subjects with any chronic illness, menorrhagia, pregnancy, or lactation were excluded from the study.

A stadiometer was used to measure the height to the nearest 0.1 cm. Weight was measured by digital weighing scale. Body fat percentage was measured by Omron body fat monitor. Blood Hb was measured by sodium lauryl sulfate-methemoglobin method with automated analyzer.<sup>[8,9]</sup>

Data were presented in mean and standard deviation. Pearson correlation coefficient was used to find a correlation between Hb and the anthropometric parameters including body fat. All the analysis was carried out in Microsoft Excel spreadsheet.<sup>[10]</sup> Two-tail  $P < 0.05$  was considered statistically significant.

## RESULTS

A total of 232 female undergraduate students were participated in the study. Among the sample, 34.6% was anemic when we considered 12 g/dL as the cutoff value.<sup>[11,12]</sup> The measured parameters are shown in Table 1. Correlation coefficient between Hb versus anthropometric parameters and body fat percentage is shown in Table 2.

## DISCUSSIONS

Due to rapid growth and biological rhythms, there is an increase iron requirement in both boys and girls during adolescent period. In girls, the iron deficiency is more

**Table 1:** Age anthropometric parameters and hemoglobin in sample ( $n=232$ )

Parameters	Mean±SD
Age (years)	19.31±1.18
Height (cm)	155.25±6.31
Weight (kg)	55.61±11.00
BMI (kg/m <sup>2</sup> )	23.00±4.03
Fat percentage	31.6±6.23
Hb (g/dL)	11.85±1.46

BMI: Body mass index, Hb: Hemoglobin, SD: Standard deviation

**Table 2:** Correlation between hemoglobin versus height, weight, BMI, and body fat percentage

Parameters	Correlation coefficient (r)	P value
Height	-0.17	0.008*
Weight	-0.51	<0.001*
BMI	-0.49	<0.001*
Fat percentage	-0.56	<0.001*

BMI: Body mass index, \*significant P value

seen due to menstrual bleeding. Nutritional anemia is seen throughout the world but is more seen in the developing countries and among low socioeconomic group. However, iron deficiency anemia is also seen in young girls of urban population due to poor food habit and reduced physical activity. Nutritional anemia is also seen in medical students who have better knowledge of nutrition and have better healthy environment.<sup>[13]</sup>

Decreased Hb content of RBC causes a decreased oxygen carrying capacity of blood, and there is inadequate pumping of the heart. Hence, the persons with anemia have dyspnea, palpitation, and angina-like symptoms on strenuous work.<sup>[14]</sup>

This study was conducted on undergraduate medical students. Moreover, according to the level of Hb, the prevalence of anemia is found as 34.6%. The correlation between Hb and weight and height both showed a statistically significant negative correlation [Table 2]. When we tested the Hb and BMI, it also showed a significant negative correlation. This suggests that obesity, as indicated by BMI, has a negative impact on Hb level in young adult females who are otherwise healthy. When body fat was considered as a variable and tested by Pearson correlation with Hb, we found a higher negative correlation coefficient ( $r = -0.49$  for BMI versus  $-0.56$  for fat percentage). This suggests that body fat may be considered a better parameter to get a rough idea about Hb status of adult female. However, measurement of body fat needs special instruments or higher operator expertise. In contrast, BMI can be easily obtained by height and weight of the subjects.

This result is supportive of recently conducted study by Kumari *et al.* in Bihar who found a prevalence of 47% in the age group of 15–19 years.<sup>[15]</sup> Shams *et al.* from Singapore reported a prevalence rate of 40.9% and Kannan and Ivan showed a prevalence rate of 43%.<sup>[16,17]</sup> A study by Bagni *et al.* also showed that BMI is negatively correlated with Hb.<sup>[6]</sup> The inverse relation has been described by a study of Park and Lee.<sup>[18]</sup>

## Limitations

The study was conducted on a convenience sample from a single medical college. Future study with a large sample would provide generalized result.

## CONCLUSION

We found significant negative correlation between blood Hb and body fat percentage. Correlation between Hb and weight and height and BMI showed lower correlation than the body fat percentage. Hence, increase in body fat may be considered as an indicator of lower Hb level.

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