

Correlation of Hemoglobin concentration with Body Mass Index among medical students

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Abstract

Introduction: Obesity and anemia are considered as the double burden of malnutrition. Significant changes in life style, stressful working conditions, consumption of quick preserved foods, snacks and soft drinks of low nutritional value, has led to the increasing trend of obesity and nutritional disorders including anemia even among the literate affluent young adults. We aimed at finding the correlation of anemia and BMI among young adults.

Materials and Method: 310 healthy medical students in the age group of 19-25 years volunteered to participate in the study. Height, weight, hip circumference, waist circumference were measured and hemoglobin estimation done according to standard protocol. BMI and Waist hip ratio were calculated.

Results: A total of 310 students in the age group of 19-25 years were included in the study. 136 (44%) were males and 174 (56%) were females. 66 (21.29%) students were anemic. Of the anemic students 54 (81.8%) females and 12 (18.8%) males had anemia based on WHO criteria. Under nutrition was identified among 6 (3.5%) females, and 3 (2.2%) males. The number of Overweight/ Obese females were 49 (28.2%) and males 42(30.9%) respectively. Those with adequate nutritional status were 119 (68.4%) females and 91 (66.9%) males. There was a positive correlation in the group with BMI <18.5 kg/m² in females and a negative correlation in the group which had BMI > 23 kg/m² in both males and females with anemia. There was an inverse correlation between waist circumference and Hb concentration only in the underweight group with an r value of -0.92 (p<0.05).

Conclusion: The findings of the present study revealed anemia and obesity, to be prevalent among medical students. Both overweight/obesity and increased waist circumference are inversely associated with anemia in this representative group of medical students from urban area. We recommend regular screening of adolescents for anemia and obesity to challenge this public health issue.

Keywords: Anemia, BMI, Obesity, Overweight.

Introduction

Obesity and anemia are the markers of imminent health issues in adults. Obesity is multifactorial in origin, with important genetic and environmental etiological factors. Significant changes in life style, stressful working conditions, consumption of quick preserved foods, snacks and soft drinks of low nutritional value, has led to the increasing trend of obesity and nutritional disorders including anemia even among the literate affluent young adults.⁽¹⁾ Anemia in adolescence is dangerous because it affects the physical as well as mental wellbeing. It weakens the behavioral, cognitive development and decreases immunocompetence thereby adversely affecting the productivity. The country has experienced an alarming increase in obesity-related chronic diseases over the past decade⁽²⁾ and obesity could possibly add to the burden of anemia in India. The prevalence of anemia is marginally higher in rural areas but recently studies have highlighted the increasing prevalence of anemia among adolescents living in urban settlements. A recent health survey in Jammu and Kashmir states that 10.8 percent adolescents are obese or overweight and 53.4 percent adolescents are anemic. The overlap of malnutrition existing along with increasing rates of overweight and obesity is known as the double burden

of malnutrition. This presents enormous health, social and economic challenges to countries and action is needed to address this changing face of malnutrition. Few studies^(3,4) that have examined the relationship between BMI and anemia have reported contradictory results. There is a dearth of knowledge on the prevalence of anemia in relation to obesity. Therefore, we aimed at finding the correlation of anemia and BMI among young adults.

Materials and Method

The study was conducted in the department of Physiology at Madras Medical College, Chennai. 310 healthy medical students in the age group of 19-25 years who volunteered were included in the study. Institutional ethical committee approval was obtained and written informed consent taken from the students. Subjects with history of asthma, hereditary cardiac or blood diseases, any ailment for which long term medication was taken were excluded from the study. Height, weight was recorded. Demographic details were collected.

A digital weighing scale that could measure to the nearest 0.1kg was used to record weight, and height was measured to the nearest centimeter using a stadiometer, in the Frankfurt plane position. Body mass

index (BMI) was calculated based on Quetelet index.⁽⁵⁾ According to International obesity task force 2000 standards for adult obesity based on BMI are <18.5kg/m² under nutrition, 18.5 to 23kg/m² adequate nutrition, >23 kg/m² overweight and >25kg/m² as obesity.⁽⁶⁾ Waist circumference was measured in centimeters (cms) midway between the uppermost point on the iliac crest and the lowermost margin of the ribs with the measuring tape parallel to the ground and patient in inspiration. Hip circumference was measured in cms at the maximum circumference of the buttocks at the level of the greater trochanter.⁽⁷⁾ Waist hip ratio was calculated as waist circumference in cms divided by hip circumference in cms.

The hemoglobin (Hb) estimation was done with a finger prick sample of capillary blood using the Sahli's hemoglobinometer using the standard protocol. All the data were entered and analyzed using SPSS version 19. The mean values between groups were assessed using independent sample t test. The relationship between BMI, waist circumference, waist hip ratio and haemoglobin (Hb) concentration, was examined by calculating the Pearson's correlation coefficient (r) and the significance of correlation (p).

Result

A total of 310 students in the age group of 19-25 years were included in the study. 136 (44%) were males and 174 (56%) were females. 66 (21.29%) students were anemic based on WHO criteria, of them 54 (81.8%) were females and 12 (18.8%) were males. Under nutrition was identified among 6 (3.5%) females, and 3 (2.2%) males. The number of Overweight/Obese females were 49 (28.2%) and males 42(30.9%) respectively. Those with adequate nutritional status were 119 (68.4%) females and 91 (66.9%) males according to the IOTF 2000 criteria. The descriptive statistics of the study population is given in table 1. The BMI, waist circumference, waist hip ratio were significantly higher in male students compared to females. The hemoglobin concentration also was higher in males. The correlation between the different nutritional group and hemoglobin (Table 2) showed a positive correlation in the group with BMI <18.5 kg/m² in females and a negative correlation in the group which had BMI > 23 kg/m² in both males and females. The percentage of students having anemia in different age groups is shown in Table 3. To find a correlation between waist circumference and Hb concentration Pearson correlation was applied, and only in the under nutrition group there was a statistical significant correlation with an r value of -0.92 (p<0.05) which again ascertains that as the central obesity increases the hemoglobin levels decreases.

Table 1: Descriptive statistics of study population

Parameters	Male	Female	P value
Age	19.35 ± 2.9	19.24 ± 2.6	0.3
Hemoglobin (gm%)	13.08 ± 0.9	12.6 ± 1.0	0.05*
Height (cm)	164.7 ± 7.4	160.7 ± 8.4	0.2
Weight (Kg)	75.15 ± 9.8	64.04 ± 14.3	0.0*
BMI (Kg/m ²)	26.74 ± 3.2	24.67 ± 4.4	0.0*
Hip circumference (cm)	110.04 ± 9.9	107.98 ± 10.6	0.2
Waist circumference (cm)	88.95 ± 7.9	83.75 ± 8.5	0.0*
Waist Hip ratio	0.78 ± 0.1	0.80 ± 0.1	0.0*

*p<0.05 significance

Table 2: Correlation between BMI groups and Hb

Grades of nutrition	Females		Males	
	Correlation coefficient (r)	Significance (p)	Correlation coefficient (r)	Significance (p)
BM <18.5 kg/m ²	0.965	0.04*	0.47	0.5
BMI 18.5 -23 kg/m ²	0.171	0.27	0.19	0.25
BMI > 23 kg/m ²	-0.27	0.02*	-0.24	0.03*

*p<0.05 significance

Table 3: Percentage (%) of male and female having anemia in different nutritional groups

Grades of nutrition	Boys (N =136)		Girls (N =174)	
	Anemia N=12 (%)	Normal N=124 (%)	Anemia N=34 (%)	Normal N=140 (%)
Under nutrition	2 (66.6)	1 (33.3)	5 (83.3)	1 (16.6)
Adequate nutrition	2 (2.19)	89 (97.8)	21 (17.6)	98 (82.4)

Overweight	8 (19.04)	34(80.9)	15 (30.6)	34 (69.3)
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Discussion

The World Health Organization's (WHO) latest global projections indicated that in 2005 approximately 1.6 billion adults (age >15) were overweight and at least 400 million adults were obese. It is regarded as one of the most serious public health problem in the world that can affect young adults. In countries such as India that undergo nutritional transition, a rapid increase in obesity and overweight is observed.⁽⁸⁾

Kaur et al⁽⁹⁾ in a study on Medical students from Punjab reported 67 (60%) boys were overweight as compared to 54 (29%) girls. Under nutrition was more common in girls 34 (18%) compared to the boys 5 (4%). Saxena et al,⁽¹⁰⁾ observed that more than one third of the boys (42.4%) were overweight and 25.75% girls were underweight. In our study, the proportion of obese females and males were 28.2% and 30.9% respectively. Under nutrition was identified in 3.5% females and 2.2% males. Weight, BMI and Hb concentration were higher in males that are expected physiologically. It has been suggested that increased testosterone concentration in adult men is associated with an increase in the concentration of erythropoietin and hemoglobin.⁽¹¹⁾ The higher prevalence of overweight boys and girls from Punjab could be because of the difference in the dietary pattern in them compared to students from South India.

The World Health Organization (WHO) global estimates prevalence of anemia in the range of 35–75% depending on the geographic location. Anemia affects approximately 30–55% of young adults all over the world. The prevalence of anemia among female university students in Saudi Arabia has been observed to be 23.9%⁽¹²⁾ and in rural adolescent girls of Wardha, Maharashtra, India, as 59.8%. The prevalence of anemia among young adults in Hyderabad has been reported to be 55.6%.⁽¹³⁾ In our study, 21.3% of the students were anemic. 31.03% of females and 8.8% males were anemic. The higher prevalence of anemia reported in other studies could be due to the reason that they have included girls from both college and rural area.

Obesity has been reported to be associated with anemia in adults in some countries.⁽¹⁴⁾ Study done among college going girls aged 16-30yrs at Haryana observed that overweight and obese girls (BMI >23 kg/m²) showed an inverse relationship to hemoglobin (gm %) but the correlation was insignificant. Underweight girls in rural group also showed positive correlation to hemoglobin.⁽¹⁵⁾

Shadia et al⁽¹⁶⁾ observed that 17% of female medical students were anemic, 15.5% had undernutrition. When grades of Body mass index were correlated with hemoglobin status, undernutrition showed a positive correlation and an inverse relationship in overweight and obese adolescent girls

when age was controlled both in boys and girls, however none of the correlation showed significance to the levels of <0.05. From our results it is evident, that the correlation between the different nutritional group and hemoglobin had a positive correlation in the group with BMI <18.5 kg/m² in females and a negative correlation in the group which had BMI > 23 kg/m² in both male and females. We also tried to find a correlation between waist circumference, waist hip ratio and Hemoglobin concentration. Waist circumference is a preferred and practical method for assessing abdominal obesity in a clinical setting.⁽¹⁷⁾ As waist circumference increases, disease risks increase. Some researchers use the waist-to-hip ratio when studying disease risks though it does not offer any additional information. From our results, it is evident that only waist circumference had an inverse relation to Hb in the under nutrition group with an r value of -0.92.

Anemia and obesity represent opposite ends of the spectrum of over- and under-nutrition, they appear to be associated. Possible reasons for this relation could be dilutional hypoferrremia, poor dietary iron intake, increased iron requirements, and/or impaired iron absorption in obese individuals. Recently, researchers suggest that obesity-related inflammation play a central role through its regulation of hepcidin. Hepcidin levels are higher in obese individuals and are linked to subclinical inflammation reducing iron absorption leading to iron deficiency anemia.⁽¹⁸⁾

Conclusion

From this cross-sectional study, it is concluded that both overweight/obesity and central obesity are inversely associated with anemia in a representative group of medical students from urban area. Emphasis is laid upon the necessity of awareness regarding obesity and anemia.

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