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# Assessment of Haemoglobin Level in Young Healthy Adults and its Correlation with BMI - A Cross Sectional Study

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***Abstract:***
***Background:*** *Anaemia is one of the major problems of medical practice in our country. In times of epidemic of non-communicable diseases, prevalence of dietary and lifestyle diseases are also on the rise. Obesity and Iron deficiency anaemia have affected many people worldwide. The cases are seen to co-exist across all age groups and gender.Anemia impairs health and working capacity leading to mental, physical and economical loss. In this study we planned to assess the correlation between hemoglobin percentage (Hb %) and Body Mass Index (BMI). This will help us in better understanding of various aspects of anemia and obesity and planning strategies for regular screening of the people with high BMI.*
***Materials and method:*** *A hospital based cross sectional study was carried out among fifty ((50) healthy adults between the age group of 18-45 years in the premises of Agartala Government Medical College & GBP Hospital. Participants with history of anaemia and co-morbidities such as hypertension, hypothyroidism or hyperthyroidism, haemoglobinopathies, bleeding disorders, and having history of recent surgery were excluded from the study. Data were collected from the participants after obtaining their informed consent. A pre-designed case study format was used to collect the data. Data was analyzed using SPSS21.*
***Results:*** *Fifty (50) healthy young adults participated in the study. Mean age group of the study participants were 21.24±0.66 years. Mean weight of the study participants were 59.66±9.28 Kg. Prevalence of anaemia among the participants with higher BMI was 70%. Among the participants with normal BMI, 71% of them had low Hb%. Pearson correlation showed a negative correlation between BMI and Hb% of the participants with r value -0.04. The correlation was not statistically significant (p value 0.75).*
***Conclusion:*** *In this study BMI was found to be negatively correlated with Hb%. People with high BMI should be regularly screened for Hb% to avoid any complication. Further study can be done to identify the cause of decreased Hb% in people with high BMI.*
***Key Word:*** *Anaemia, Body Mass Index (BMI), Hemoglobin level*

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## I. INTRODUCTION

Anemia is one of the most common nutritional disorders in women and children. As per the recent WHO estimates, 29.9% of women in the age group of 15–49 years are anemic world wide and 39.8% children until the age of 10 years is anemic.[1] The most common reason for anemia worldwide is the iron deficiency anemia[2,3.]Studies conducted in different regions of India shown that the prevalence of anemia is 52.5% in Madhya Pradesh, 37% in Gujarat, 41.1% in Karnataka, 85.4% in Maharashtra and in Kerala (19.13% among college students and 96.5% in tribal area)[4-13.]The major risk factors identified from literature to develop anemia are socio-economic status, excessive blood loss during menstruation (in case of female), nutritional status, hand hygiene habits and worm infestations. In a tropical country like India helminthic infestation is very common which can lead to chronic blood loss which in turn results in anemia.[14,15]

Many nutrients play a vital role in the process of erythropoiesis- a process of formation of red blood cells in the bone marrow, such as proteins, iron, copper, vitamin E, riboflavin, pyridoxine, folate and cyanocobalamin and vitamin C. Deficiency in any of these nutrients may retard the process thus contributing to anemia[16]. Young adults are suffering from varying degree of anemia. The reason for this is poor habit of skipping meals, snacking, increased fast food consumptions and obesity. Long hours of studying, excess stress and anxiety also add up to the development of anemia[12,17,18.]

In times of epidemic of non-communicable diseases, prevalence of dietary and lifestyle diseases is also on the rise. India has also seen a steady rise in lifestyle diseases like obesity. Obesity and Iron deficiency anemia have affected many people worldwide. The cases are seen to co-exist across all age groups and gender.Role of hepcidin explains the co-existence of obesity and anemia to a great extent. Hepcidin regulates the absorption of iron from the gut. In central obesity, inflammatory cytokine (IL)-6 released from visceral adipose tissues into portal blood strongly stimulates hepatic hepcidin synthesis.[19]

Although there is a fall in the prevalence of anemia as per the NFHS-2 due to the various interventions taken up such as oral supplementation under national nutritional anemia prophylaxis programme, fortification, dietary diversification and through health communications[20], there is an increasing trend of coexistence of anemia and obesity. Different studies have showed different results about the correlation between obesity and anemia. Especially in Northeastern part of India, no such studies have been taken up. Hence, this study was taken up to assess the correlation between BMI and Hb% among the healthy young adults.

## II. MATERIALS AND METHOD

***Study design:*** Cross sectional study
***Study duration:*** Three months, September 2023 to November 2023
***Study area/location:*** Department of Physiology of Agartala Government Medical College.
***Study population****:* Fifty (50) healthy adults between the age group of 18-45 years from the premises of Agartala Government Medical College & GBP Hospital who suitably fulfilled the selection criteria were included in the study.
***Inclusion criteria:*** Healthy young adults of 18-45 years age who are willing to participate in the study.

***Exclusion criteria:***
**1.** History of anaemia
**2.** Co-morbidities such as hypertension, Hypothyroidism or Hyperthyroidism, haemoglobinopathies, bleeding disorders, and having history of recent surgery.
**3.** Candidates not willing to participate in the study.

***Study tools:***
1. Stadiometer
2. Weight Machine
3. Haemoglobin estimation by using Sahli's acid haematin method-:
a. Sahli's Haemoglobinometer contains- Comparator, Haemoglobin tube, Haemoglobin pipette and stirrer.
b. N/10 HCl.
c. Distilled water
d. Dropper
e. Materials for sterile finger prick.

***Data collection procedure:*** Predesigned and pretested case study format was used for data collection. Each consenting participants having recruited for the study was taken through the following procedure.
**1.** ***Age:*** Age was recorded from the birthdays by calendar to the nearest of the years (<6months and >6 months).
**2.** ***Standing height:*** Height was recorded without shoes and with light clothes by a measuring stand with scale to the nearest of centimetres (<5mm and >5mm).
**3.** ***Weight:*** Weight was recorded without shoes and with light clothes on a standard electronic weighing machine with a least count of 500grams.
**4.** ***BMI*** was calculated by the formula[21]: BMI= weight (kg)/{height(m)}$^2$

| Asia Pacific Classification | BMI (kg/m$^2$) |
|---|---|
| Underweight | <18.52 |
| Normal Weight | 18.5 - 22.9 |
| Obese | ≥ 25 |

*5.* ***Procedure of haemoglobin estimation by Sahli's Method***
a. Informed consent was taken from the study participants.
b. Blood was collected using aseptic finger prick method.
c. N/10 HCl was taken into the graduated tube up to 2% mark.
d. 20 microlitre of blood was collected in haemoglobin pipette under aseptic precautions without air bubbles.
e. Tip of the pipette was wiped off to avoid blood adhering to it.

f. Blood was transferred immediately to N/10 HCl in haemoglobinometer tube.
g. Pipette was rinsed several times by drawing N/10 HCl. Without foaming.
h. After mixing contents were left undisturbed for 10 min.
i. The maximum conversion of haemoglobin to acid hematin occurs during that time and gives brown colour to the mixture.
j. Then distilled water was added to dilute acid hematin and continuously mixed with stirrer until colour matched the standards in the comparator.
k. Reading taken at eyelevel under lifting the stirrer up and reading was recorded in g/dl.

Anemia was classified as[2,3]:

| In Case of Female: | In case of Male: |
|---|---|
| • Mild: 11.0 – 11.9g/dl | Mild: 11-12.9 g/dl |
| • Moderate: 8 - 10.9g/dl | Moderate: 8-10.9 g/dl |
| • Severe:< 8.0 g/dl | Severe: < 8 g/d |

***Data analysis*:** Data were analyzed using SPSS 21. Descriptive statistics and other suitable statistical tests were used as per applicability. Data were expressed in terms of mean and standard deviation. Correlation was assessed between BMI and Hb%. A probability value less than 0.05 will be considered as significant.

## III. RESULTS

A total of 50 participants were included in the study. 60% (n=30) of them were females and 40% (20) of them were males. 2% of the participants were underweight, 56% were having normal weight, 26% were overweight and 16% were obese as shown in figure1. 30% of the participants had normal Hb% and 70% of them were anemic as shown in figure 2. The measured parameters are shown in Table 1. There was a negative correlation between Hb% and BMI with correlation coefficient (r value: -0.046). However the correlation was not statistically significant (p value: 0.751).

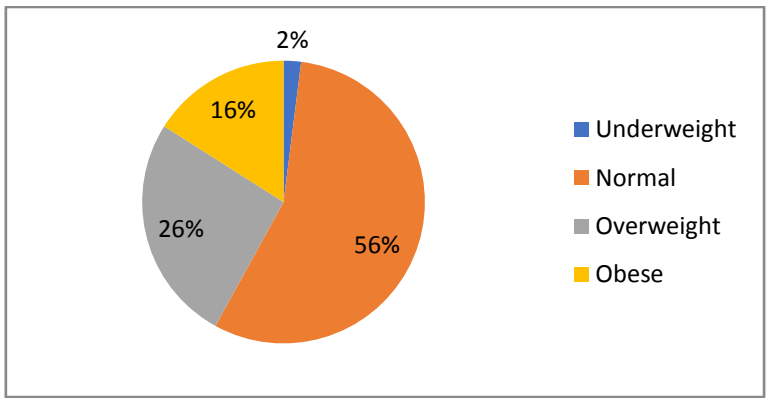


**Fig. 1: Pie chart showing the BMI status of the participants**

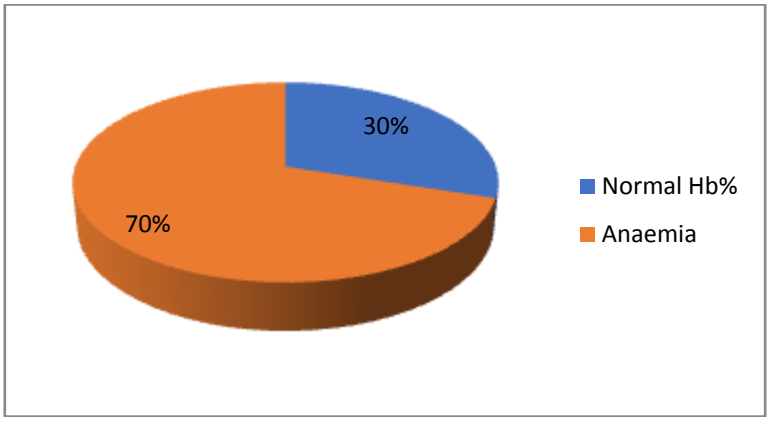


**Fig. 2: Pie chart showing the Hb% status of the participants**

| Variables | Mean ± Std. deviation |
|---|---|
| Age (Years) | 21.24±0.66 |
| Height (m) | 1.63±0.09 |
| Weight (Kg) | 59.66±9.28 |
| Hb (gm/dl) | 22.41± 2.83 |
| BMI ($Kg/mt^2$) | 10.77 ± 1.7 |

**Table1: Variables recorded among the study participants**

## IV. DISCUSSION

In the present study prevalence of anaemia among the participants with higher BMI was 70%. Among the participants with normal BMI, 71% of them had low Hb%. Pearson correlation showed a negative correlation between BMI and Hb% of the participants with r value -0.04.

Study conducted by Vitull Gupta S. et al supports the findings of this study[22]. In their study prevalenceof anaemia in males was 89.9%. Prevalence of anaemia in females was 89.5%. Both males and females who were in the younger age group and who had a low activity life style, had a higher prevalence of anaemia.Another study conducted by Acharya S et al.found that overweight/obesity was inversely associated with Hb% of the participants.[23]

Stoffel N. U et al showed in their study that body fat distribution affects iron metabolism: women with greater central adiposity have higher serum hepcidin level, greater impairments in iron homeostasis, and reduced iron absorption from a supplemental iron dose.[19]

An observational study of 619 women aged 20-49 years had shown that iron deficiency was present in 23.5, 41.9, and 45.6% of women with normal weight, overweight and obesity, respectively[24]. In another study iron deficiency anaemia was detected among 13.5, 13.6, 23.5, and 21.7% of male adolescents (n=772) with underweight, normal weight, overweight and obesity, respectively[25]. Egwurugwu et al (2018) reported that mean serum iron was less in adult men with overweight and obesity.[26]

However, study conducted by Ghose B et.al showed that women with overweight/obesity had lower likelihood of being anemic, while underweight women were more likely to be anemic[27].In another study conducted by Qin Y, et al in China among 1,537 women aged 20 years and above showed the prevalence of overweight, obesity and central obesity was 34.2%, 5.8% and 36.2%, respectively. The obese group had the highest concentrations of Hemoglobin compared with other BMI groups. Central obesity was inversely associated with anaemia[28]. Study conducted by Dutta A et al, found no significant difference ($P > 0.05$) in the prevalence of anemia among different BMI groups.[29]

Study conducted by Pal A et al among 253 adolescent students in West Bengal in the age group of 12-15 years, showed that the prevalenceof anaemia was the lowest in the overweight (male 19.05%; female 25.0%) and significantly higher prevalence was noted in normal groups (male 45.98%; female 62.67%) and underweight group (male 62.5%; female 80.65%).[30]

It is believed that hepcidin level and low grade chronic inflammation play a central role in the relationship between obesity and anaemia**.** Hepcidin regulates the absorption of iron from the gut. In central obesity, inflammatory cytokine (IL)-6 released from visceral adipose tissues into portal blood strongly stimulates hepatic hepcidin synthesis which impairs the iron absorption from the gut.[31]Thus, it is recommended for regular screening for anemia in people with higher BMI to challenge this public health issue.

## V. CONCLUSION

In this study BMI was found to be negatively correlated with Hb%. Because of the high prevalence of overweight and obesity in recent era, it is important to develop public health strategies to manage obesity relatedanaemia. People with high BMI should be regularly screened for Hb%, particularly in population groups who are at high risk for developing iron deficiency anaemia, including children, adolescents, and women of childbearing age.

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