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Health status of college-going girls (female undergraduates) as an expression of anemia and BMI

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ABSTRACT

Anaemia and being underweight are two global public health issues that include the significant population of girls of adolescents, directly affecting one's working capacity and posing a great risk for future motherhood. In this study, a total of 798 college-going girls were observed with their height, weight and haemoglobin level over a period of five years. The mean age of the girls was 18 years, within the range of 17 years to 22 years. Anaemia poses a significant threat on a worldwide scale; in the present study, it was observed that 22% of the girls are severely anaemic, 34% are moderately anaemic, 17% are mildly anaemic, and only 26% are non-anaemia, which is significantly alarming about their health condition. On the other hand, we calculated their body mass index (BMI) with height and weight. It was found that only 36% of girls had a normal BMI, while 44% of the girls were underweight, which also raises concerns about their health issues for the near future. Although no direct relation can be drawn between the severity of anaemia and BMI, the parameters can help to express one's overall health status and can be used to improve health rights from adolescence.

Introduction

Anemia and being underweight are two global public health issues that not only affect one's working capacity but also raise concerns about health conditions in the near future. This is one of the most widespread blood disorders. RBCs carry hemoglobin, an iron-rich protein that attaches to oxygen in the lungs and takes it to tissues throughout the body. Anemia occurs when the body does not have enough red blood cells or the hemoglobin concentration is lower than expected.

Iron deficiency anemia is a highly prevalent and seemingly intractable problem, particularly among females of reproductive age in developing countries. Following early childhood, during the adolescent growth spurts, the risk of iron deficiency and anemia reappears for both boys and girls, after which it subsides for boys but remains for girls because of menstrual loss (Rahman, *et al.,*2023).

Anemia is usually widespread among all age groups in all states of India. College girls contribute a significant portion of the population. Reports state that approximately 80% of the female population has hemoglobin deficiency (Minchekar, 2017).

Anemia and being underweight are two significant problems that are nutritionally related to global public health problems. Adolescent girls are future mothers, and the future generation's health directly rests on their health condition. Studies have shown that anemic girls show a reduced physical and mental capacity and diminished concentration in studies, thus causing a significant threat to future safe motherhood (WHO, UNICEF, &UNU;2001).

"In the academic life of students, academic achievement has been considered an important factor and can be associated with self-confidence and self–esteem, which leads to better adjustment in school and society. Academic achievement upgrades self-improvement, self-actualization, and some degree of competitiveness" (Mehdi *et al.,*2014). A significantly positive relationship between hemoglobin and academic achievement was also found by Sungthong and Mo-suwan (2002). A decreased ability of the blood to carry oxygen to the body's tissues leads to lowered resistance to

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infection, poor cognitive development, fatigue and skin paleness, shortness of breath, fast, irregular heartbeat, low blood pressure, headache, poor memory, difficulty in thinking, cold hands and feet and reduced work productivity, thereby reducing one's work capacity. Therefore, to fight this burning problem in girls, the Iron^{+} initiative program was initiated for newly admitted girl students in the college.

The girls were advised to carry out blood tests, especially HB content, to know their anemic status, as hemoglobin concentration is widely used to measure anemia. Moreover, other parameters, such as height and weight, were considered to calculate their BMI values and age. The study aimed to determine the hemoglobin levels and body mass index (BMI) as an expression of the overall health status of college-going girls (female under graduates).

Material and Methods

Approximately 798 female students aged 17-22 years were estimated for their HB level, and the same was true for the BMI value. Hb count (Hb gm %) was determined by a standard Sahli's apparatus. All precautions that must be taken during blood experiments were taken. Only disposable pricking needles were used for every individual, and the form was filled out to obtain the girl students' height, weight and age.

Following WHO criteria were followed to diagnose anemia.

No anemia	Hb content	≥12 g/dl
Mild Anemia	Hb content	11–11.9 g/dl
Moderate anemia	Hb content	8–10.9 g/dl
Severe anemia	Hb content	<8 g/dl

Body mass index (BMI) was calculated as weight for height using the standard WHO formula:

Weight (kg)/size (m)]^2

BMI	Categories
Underweight	<18.5
Average weight	18.5–22.9
Overweight	23–24.9
Obesity	≥25

The weight was measured by standing in the center of the scale platform or weighing machine and remaining motionless until the measurement could be obtained—weight (kg). The height was measured by a wooden height measuring board that had a sliding head bar to the nearest 0.1 cm on standing straight without wearing shoes. Height: (Feet) (inches).

Results and Discussion

In this study, a total of 798 college girls were observed with their height, weight and hemoglobin level over a period of five years (2013-14 to 2017-18). The mean age of the girls was 18 years, with a range of 17 years to 22 years. With the help of height and weight, the body mass index of the girls was calculated by the formula

BMI=Weight (kg)/Height (Feet) (inches).

The girls' minimum BMI was 11.98 kg/m^{2,} and the maximum was 41.42 kg/m^2. The mean BMI was 19.96 kg/m^2 with a standard deviation of 4.47. Yearwise summary findings are presented in the tables and figures given below.

From Table 1, we can see that the maximum number of girls (65%) was ≥18 years of age. Moreover, each year, the percentage of girls over or similar to 18 years of age is greater than that of girls under age less than 18 years., i.e., a significant population of girls are adolescents (Figure 1).

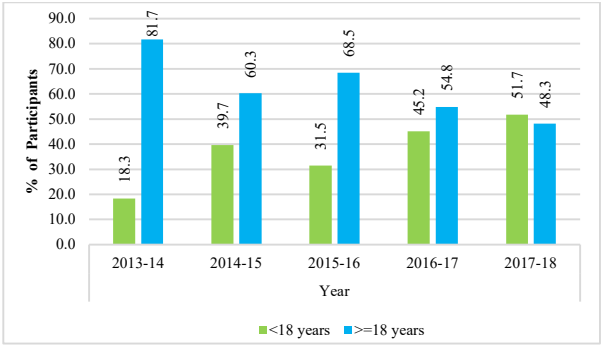

Figure 1: Distribution of age

In the sample of the years 2017-18, a maximum number of girls (31%) were observed with severe anemia. In 2016-17, almost equal numbers of girls

(37%) were moderately anemic, while only 37.9% were nonanaemic. In 2015-16, a similar percentage (26.8%) of the girls were severely anemic, whereas the rest were almost equally distributed among the remaining categories. In 2014-2015, a minimum percentage (13%) of the girls had severe anemia, and 20% had mild anemia, as the rest were almost equally distributed among the remaining categories. In 2013-2014, the lowest percentage (14%) of the girls had mild anemia, and only 19% were nonanaemic. The majority of girls (43%) had moderate anemia. Table 4 shows that 22% of the girls were severely anemic, 34% were moderately anemic, 17% were mildly anemic, and only 26% were nonanaemic (Table 2, Figure 2). From Table 3, we can observe that 44% of the girls are underweight, and 36% have a normal BMI. Only 7% were overweight, and 12% were in the category of obesity. An almost similar distribution pattern was observed through the years concerning body mass index (Figure 3). The results indicate that only 26% of students were found to be Non-Anemic, 17% were Mild Anemic, 34% were Moderately Anemic, and 22% girl students were severely anemic (Table 2), which might result in lower scores on the examination as they become

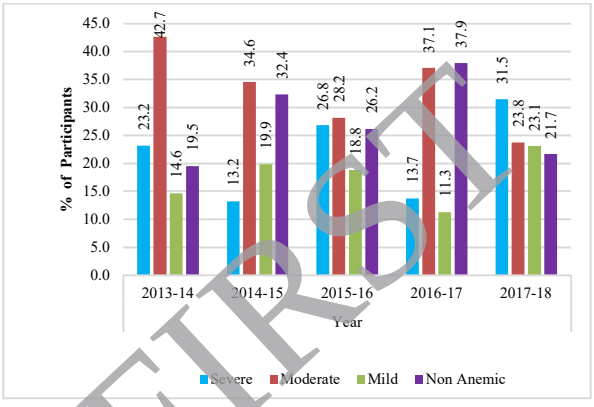

Figure 2: Categorization of anemia level

Table 1: Distribution of age

Age (years)	Year					Total
	2013-14	2014-15	2015-16	2016-17	2017-18	
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
<18	45 (18.2)	54 (39.7)	47 (31.5)	56 (45.1)	74 (51.7)	276 (34.59)
>=18	201 (81.7)	82 (60.2)	102 (68.4)	68 (54.8)	69 (48.2)	522 (65.41)
Total	246 (100)	136 (100)	149 (100)	124 (100)	143 (100)	798 (100)

Table 2: Categorization of anemia level

Anemia (g/DL)	Year					Total
	2013-14	2014-15	2015-16	2016-17	2017-18	
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Severe (<8)	57 (23.1)	18 (13.2)	40 (26.8)	17 (13.7)	45 (31.4)	177(22.2)
Moderate (8-10.9)	105 (42.6)	47 (34.5)	42 (28.1)	46 (37.0)	34 (23.7)	274 (34.3)
Mild (11-11.9)	36 (14.6)	27 (19.8)	28 (18.7)	14 (11.2)	33 (23.0)	138 (17.3)
Non Anemic (>=12)	48 (19.5)	44 (32.3)	39 (26.1)	47 (37.9)	31 (21.6)	209 (26.2)
Total	246 (100)	136 (100)	149 (100)	124 (100)	143 (100)	798 (100)

Table 3: Categorization of Body Mass Index

Body Mass Index (kg/m2)	Year					Total
	2013-14	2014-15	2015-16	2016-17	2017-18	
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Underweight (<18.5)	110 (44.7)	48 (35.2)	71 (47.6)	69 (55.6)	55 (38.4)	353 (44.2)
Normal (18.5-22.9)	86 (34.9)	63 (46.3)	47 (31.5)	42 (33.8)	50 (34.9)	288 (36.1)
Overweight (23-24.9)	21 (8.53)	7 (5.14)	14 (9.39)	6 (4.83)	15 (10.4)	63 (7.9)
Obese (>=25)	29 (11.7)	18 (13.2)	17 (11.4)	7 (5.64)	23 (16.0)	94 (11.8)
Total	246 (100)	136 (100)	149 (100)	124 (100)	143 (100)	798 (100)

exhausted early and could not attend classes with much concentration and energy.

In academic life, academic achievement is an essential factor. Sungthong and Mo-suwan (2002) found an appreciably positive relationship between hemoglobin and academic achievement. "The optimal hemoglobin concentration needed to meet physiologic needs varies by age, sex, etc. The most shared sources of anemia are nutritional deficiencies, particularly iron deficiency, although deficiencies in folate, vitamins B12 and A are also important causes; hemoglobinopathies; and infectious diseases, such as malaria, tuberculosis, HIV and parasitic infections" (https://www.who.int health-topics /anaemia#tab=tab_1.)

All the above observations found a need to create more awareness about eating habits among girl students, as they have a habit of eating junk food rather than nutritional food. Moreover, each year, the percentage of girls over or equal to 18 years of age is more than the percentage of girls aged less than 18 years. A significant population of girls were adolescents (Table 1).

Prevention of anemia is effective when the strategy is focused right from adolescence for their future reproductive life. Very few studies have focused on anemic adolescent girls (Rawat *et al.*, 2001; Kaur *et al,*2006; Kakkar *et al.,* 2011; Gupta *et al.,*2012; Deshpande *et al.,* 2013). The study's main objective was to determine an individual's health status in a correlation between the level of Hb and BMI in a healthy body. Previous studies have also reported a higher prevalence of anemia in underweight individuals (Pandey and Singh, 2013) (Sarathaet *al.,* 2010). This may be attributed to being malnourished, predisposing to iron depletion and increasing the risk of anemia. There is a significant association between nutritional status and anemia, as anemia is more prevalent among underweight students than expected and overweight students. However, the severity of anemia is not associated with body mass index (Khan *et al.,* 2018). From Table 5 above, we can observe that only 36% had a normal BMI. In comparison, 7% were overweight, 12% were in the category of obesity, and 44% of the girls were underweight; an almost similar distribution pattern was observed through the years concerning body mass index. A percentage of girls, only 36%, have an average BMI, and 44% are underweight, which raises concerns about their health status with respect to various diseases. BMI for age was the main predictor of anemia. Anemia is significantly associated with low BMI for age. Adolescent girls with a low BMI were 3.2 times more likely to be anemic than those with a high BMI. Comparable findings were also reported in Bonga Town; those with low BMI were 2.54 times more likely to develop anemia than those with high BMI (Bano *et al.,* 2012).

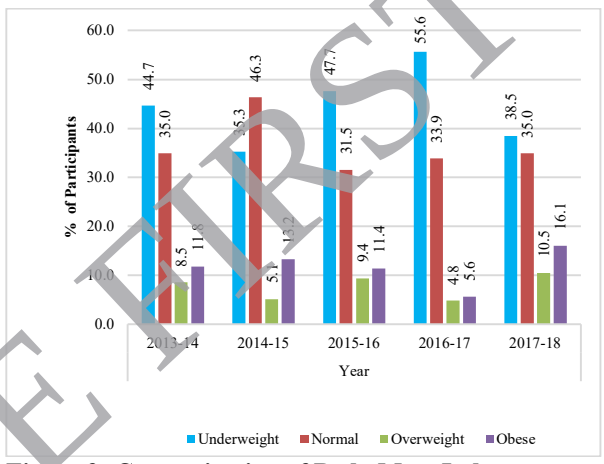

Figure 3: Categorization of Body Mass Index

Conclusion

A positive correlation between being underweight and anemia has been established, especially in iron deficiency anemia. According to the WHO, nutrition-related problems are the leading causes of anemia in developing countries. Although no association can be drawn between anemia and BMI but can help to express one's overall health status, the occurrence of different risks can be prevented by using BMI as an effective tool not only during adolescence but also during pregnancy, childbirth and further. Anemia can be prevented to some extent by having a diet that includes iron-rich food and a variety of vitamins and minerals consisting of iron, folate, vitamin B-12, and vitamin C. (Ref Mayoclinic). The results will be better if good nutritional food habits are maintained. There is a need to create awareness of healthy eating habits and avoid junk food among them to improve their lifestyle and practice deworming programs along with Hb detection. Along with creating awareness about the importance of maintaining their BMI and

hemoglobin regularly, not only for energy to concentrate on studies during their college life but also to prevent health risks in the near future and to do well in life.

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Conflict of interest

The authors declare that they have no conflicts of interest.

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