

Original Research Article

Anemia in relation to body mass index among female students of North Kerala: a pilot study

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ABSTRACT

Background: Anemia among women causes many serious health problems and is pervasive in developing country. Many research studies have documented that malnutrition affects body growth and development, especially during the crucial period of adolescence. The association between anemia and body mass index (BMI) is a measure of nutrition and health status of adults. Aim was to study the association between anemia and BMI among female students.

Methods: An observational study was conducted among first year medical and dental female students (n=109) aged 18-20years. Hemoglobin (Hb) levels (g/dL) by Sahli's hemoglobinometer and BMI (kg/m²) were estimated. Anemia was defined as Hb content <12g/dL. Subjects were classified by BMI categories as underweight (BMI <18.5kg/m²), normal weight (BMI:18.5-24.99kg/m²), overweight (BMI ≥25kg/m²) and obesity (BMI ≥30kg/m²) according to WHO. Then the relation between anemia and BMI were statistically analyzed.

Results: Overall, 48.62% female students were anemic. Of which 43.4% were underweight, 22.6% normal weight and 34.5% were above normal weight (over weight and obese). Mean value of hemoglobin was significantly decreased in underweight and overweight compared to normal weight (p<0.001). Anemia was significantly associated with BMI ($\chi^2=46.48$, p=0.000).

Conclusions: The study concludes the occurrence of anemia in both undernourished and over-nourished individuals which were significantly associated. Further studies are needed with larger sample size to document the factors that may be associated with anemia in females.

Keywords: Anemia, Body Mass Index, Female students

INTRODUCTION

Anemia among women causes many serious health problems and is pervasive in developing country. According to the World Health Organization (WHO) about 30% of the world population was anemic in 1985 and about 37% of women were anemic during 1992.¹

In 2006, WHO global estimates that anemia affects approximately 30-55% of young adults all over the world.² In 2008, WHO reported 24.8% of the world's

population is affected by anemia, of whom 42% were pregnant women, 30% non-pregnant women, and 47% were preschool children.³ In a study conducted by Kassebaum et al, reported the global anemia prevalence at 32.9% in 2010.⁴ A 2011 WHO study estimated global anemia prevalence to be 496 million of non-pregnant women and 32.4 million of pregnant women aged 15-49 years.⁵

Adolescents especially girls are most vulnerable towards the problem of anemia. In this age group, anemia can

result in impaired immune function and cause higher vulnerability to infections; reduction of physical resistance and tolerance to efforts, as well as damages to growth and intellectual capacity, hence, difficulty to concentrate and memorize, which can lead to negative results in the learning development and performance.⁶

When they grow in age this adverse health tendency continue to persist and impairs the health and well-being of women population and increase the risk of maternal, neonatal adverse outcome and child mortality.⁷ Adolescent stage is a period of life marked by specific developmental attribute such as rapid physical growth and development, physical, social and psychological maturity.⁸ Increased iron demands during this stage of growth, excessive menstrual losses and nutritional deprivation, all aggravate and exacerbate pre-existing anemia and its ill effects.⁹

The association between anemia and body mass index (BMI) is a measure of nutrition and health status of adults. Therefore, studying the hemoglobin level and its relationship to BMI highlights the importance of this study.

METHODS

This was an observational type of study. This study was conducted at Department of Physiology, Academy of Medical Sciences, Pariyaram, Kannur, Kerala. This study was conducted in one month. Study was conducted among first year medical and dental female students of ACME Pariyaram, Kannur.

Inclusion criteria

- Female students of age group 18-20 years.
- Subjects willing to participate in the study.

Exclusion criteria

- Those who were absent and sick on the day of study.
- Who were not willing to participate in the study.

The study included 109 first year medical and dental female students aged between 18-20 years. After taking informed consent from the students, Anthropometric parameters like weight in kilogram (kg), height in meters (m) were measured and Body Mass Index was calculated by Quetelet index- weight in kg divided by the square of the height in m (kg/m^2). As per the WHO criteria, BMI $<18.5\text{kg}/\text{m}^2$ was considered as underweight, $18.5-24.9\text{kg}/\text{m}^2$ as normal weight, $25.0-29.9\text{kg}/\text{m}^2$ as pre-obese (overweight), and BMI ≥ 30 was considered as obese. Overweight and obese were combined to a single group. Hemoglobin content in g/dL was estimated using the Sahli's hemoglobinometer. Values of hemoglobin content were recorded. Students with hemoglobin level $<12\text{gm}/\text{dl}$ were considered as anemic according to WHO criteria.¹⁰

Statistical analysis

The data obtained was tabulated and statistically analysed using SPSS version 16. Descriptive statistics like mean, standard deviation and Inferential statistics like Chi-square test was used. A 'p' value of less than 0.05 was considered significant.

RESULTS

The mean age of the participants (n=109) was 19 ± 1.03 years. Out of 109 students, 48.62% (n=53) were anemic, of which 43.4% were underweight, 22.6% normal weight and 34.5% were above normal weight (over weight and obese). Mean value of hemoglobin was significantly decreased in underweight and overweight compared to normal weight ($p<0.05$). Anemia was significantly associated with BMI ($\chi^2 =46.48$, $p=0.000$) (Table 1).

Table 1: Association between anemia and BMI.

BMI (kg/m^2)	Hemoglobin content(g/dL)		Total
	$< 12\text{g}/\text{dL}$	$\geq 12\text{g}/\text{dL}$	
Underweight (BMI $< 18.5 \text{ kg}/\text{m}^2$)	23 88.5% 43.4%	3 11.5% 5.3%	26 23.85%
Normal weight (BMI= $18.5-24.9 \text{ kg}/\text{m}^2$)	12 19.7% 22.6%	49 80.3% 87.5%	61 56.5%
Overweight and Obese (BMI $\geq 25\text{kg}/\text{m}^2$)	18 81.8% 34.5%	4 18.2% 7.1%	22 20.23%
Total	53 48.62%	56 51.48%	109 100%

Chi-square value (χ^2) =46.68, df=2, $p=0.000$

DISCUSSION

In the present study, 53 students were anaemic, of which 43.4% were underweight, 22.6% normal weight and 34.5% were above normal weight (over weight and obese) and there was a significant association between anemia and BMI (Table 1). The overall prevalence of anemia among adolescent girls was found to be 45.2% in a study conducted by Siddharam S M et al.¹¹

Verma et al, have reported significant lower level of Hb among girls (82.4%) having BMI of 18.5 or low as compared to higher BMI.¹² Studies conducted by Saxena et al observed a negative association between hemoglobin concentration and BMI in medical students of Himalayan Institute of Medical Sciences.¹³

Diet and health are synonymous with the well-being of an individual. Anemia and abnormal BMI are two nutritional disorders worldwide and particularly in developing countries. Underweight, overweight and obese adolescents are prone to anemia especially in adolescent girls.¹⁴

The association between anaemia and body mass index, a measure of nutritional and health status of adults has been controversial.¹⁵ While earlier studies have shown the occurrence of Anaemia in both undernourished and over-nourished individuals, representing the low and high socioeconomic classes, respectively, studies elsewhere have associated anaemia with low body mass index.¹⁶⁻¹⁹

Adolescents especially girls are most vulnerable towards the problem of anemia and when they grow in age this adverse health tendency continue to persist and impairs the health and well-being of women population and increase the risk of maternal, neonatal adverse outcome and child mortality. Anemia during adolescence severely impairs the physical and mental development; weakens behavioral and cognitive development; reduces physical fitness; decreases the work performance and even contributes to the adverse pregnancy outcome.²⁰⁻²³ Mild anemia can adversely affect the productivity and is also known to reduce the immunocompetence.²⁴

Obesity has been reported to be associated with anemia in adults in some countries. This may be due to up-regulated hepcidin expression that hampers iron absorption.²⁵ Hepcidin is a homeostatic regulator of iron metabolism that restricts intestinal iron absorption and is known as a mediator of inflammation.²⁶ The rate of anemia among obese and overweight adolescents are twice the rate of the adolescents with normal weight. Seltzer and Mayer and Pinhas-Hamiel O et al.²⁷ Observed similar relationship between iron deficiency anemia and weight status.

This study has several limitation including small sample size, serum ferritin, serum iron and total iron binding capacity (TIBC) levels could not be measured.

CONCLUSION

The study concludes the occurrence of anemia in both undernourished and over-nourished individuals which were significantly associated. Because of the potentially harmful effects of iron deficiency, underweight, overweight and obese adolescents should be routinely screened and treated as necessary. The final message of this study is move for health. Exercise keeps BMI feasible. BMI maintains normal iron status and adequate hemoglobin; in addition, iron status encourages adolescents to do more activities.

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