Original Article

Association of Hemoglobin Level with BMI in Adolescent Girls of Rural Area of Pakistan

Hb Level with BMI in Adolescent Girls

Sana Rasheed Ch[1], Komal Iqbal[1], Muniza Saeed[1], Jawaria Ilyas[2], Asma Ashraf[3] and Faiza Rehman[1]

ABSTRACT

Objective: To study the association between iron deficiency anaemia and body mass index in adolescent girls in a rural area of Pakistan.

Study Design: Cross-sectional descriptive study.

Place and Duration of Study: This study was conducted at the primary and secondary school of Nankana Sahib District, Pakistan in December 2022.

Materials and Methods: A self-structured questionnaire was used for data collection to assess the nutritional status of 162 school-going girls in a rural setting of Pakistan. Data comprised of demographic details, their knowledge about healthy food, physical and clinical examination. Blood samples were taken for estimation of hemoglobin levels. As the data collected was not normally distributed, various non- parametric statistical tests were applied to look for association between iron deficiency anaemia and body mass index using SPSS version 25.

Results: The results were interpreted using WHO BMI-for-age chart for adolescent girls (10-19 years) and WHO anemia categorization of mild, moderate, severe and no anaemia. Our study showed that among 162 girls, 67.3% had normal BMI, 8.0% were obese and 24.7% were lower weight. Majority of the girls (69.8%) had no anemia whereas mild and moderate anaemia was observed in 16.7% and 13.6% of the girls respectively. A weak positive correlation (coefficient r = 0.138) although statistically non-significant (p =0.08) was found between BMI and Hb levels in the studied subjects.

Conclusion: High prevalence of anaemia is seen in adolescent girls with lower BMI.

Key Words: Anaemia, Body mass index, Nutritional status.

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INTRODUCTION

The physiological and social development through which a child becomes an adult is termed as adolescence. The United Nations defines adolescents as those aged between 10–19 years. In today's world, they form the largest part of the population, with estimated 1.8 billion adolescents in the world, of which 90% of them resides in low and middle-income countries.[1]

During adolescence, the body has to go through a phase of extreme growth which requires the intake of nutrients that should be sufficient to fulfill the nutritional demands of the body without causing obesity.[2] It provides a chance to amend any nutritional deficiencies that might have occurred in early childhood and allows catch-up growth.[3] Adolescents face a lot of health challenges, including malnutrition and anemia, contributing to morbidity not only in adolescence but also later in their lives. The nutritional status of adolescent girls has a significant impact on the nutritional status of the community as they are the future mothers. If the nutritional requirements of the adolescent girls are not fulfilled, they may give birth to undernourished children.[4] An estimated prevalence of adolescent girls is about 600 million worldwide, with one-third of this population living in South Asia, which is known to have a maximum load of maternal and child undernutrition.[3]

There is a strong association between diet, nutrition, and chronic diseases. Undernutrition and micronutrient deficiency accounts for major disease burden in under-developed countries as stated by WHO in world health report. One of such diseases is anaemia which is a worldwide public health problem that is affecting both the health and socioeconomic development of developed as well as underdeveloped countries.5

[1.] Department of Physiology, Ammer-ud-Din Medical College / Postgraduate Medical Institute, Lahore.
[2.] Department of Physiology, CMH Medical College, Lahore.
[3.] Department of Physiology, Continental Medical College, Lahore.

Correspondence: Dr. Asma Ashraf, Senior Demonstrator Physiology, Continental Medical College, Lahore.
Contact No: 0321-4278157
Email: asma.ashruf@yahoo.com

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Among the anaemias, iron deficiency anaemia is one of the most common nutritional deficiencies. The prevalence of iron deficiency anaemia is higher among adolescent females of underdeveloped countries.1 It is mostly due to increased requirement of iron in pubertal period, lack of dietary intake, and menstrual blood loss.5 Another nutritional disorder particularly in developing countries is abnormal BMI.5 Body mass index is a reliable indicator of health and nutritional status as well as an individual's fatness. According to the World Health Organization weight is classified into categories of underweight having a BMI < 18.5 kg/m2, normal weight with a BMI of 18.5–24.9 kg/m^2, overweight with 25.0-29.9 kg/ m^2, and obese with a BMI ≥30.0 kg/m^2.[5] There is a global increase in the prevalence of overweight and obese subjects as compared to under weights. Whereas in South Asian countries the prevalence of moderate/severe underweight remains higher than that of underweight. Epidemiological studies suggests that in 2016, the mean BMI estimates for adolescents in Southeast Asia was <20 for both male and female adolescents.[1] In Pakistan, one of the largely ignored and under-researched is the adolescent's health and nutrition status which is mainly due to a lack of political interest and financial constraints. The association between age-specific nutrition, anemia, and long-term health effects has always been a matter of interest. So, the current study was designed to find out relation between iron deficiency anemia and BMI of school-going adolescent girls of a public school of Nankana sahib District, a rural setting of Pakistan. The data collected can help the program managers and policy makers to develop specific nutrition strategies for the adolescent population to overcome malnutrition and anemia among this susceptible group of population.

MATERIALS AND METHODS

This cross-sectional study was conducted to document the effect of nutritional status on hemoglobin levels in school-going adolescent girls. One-Hundred and Sixty-Two healthy girls aged between 10 to 16 years from a primary and secondary school in Nankana Sahib District, Pakistan were included in the study whereas girls having any kind of repeated illness such as infections, bleeding disorders, and history of persistent gastrointestinal symptoms were excluded from the study. The sample size was calculated using the formula for prevalence study ($n=z^2pq/d^2$) considering the prevalence of underweight students from a previous study.[6] After taking the informed consent from the school authorities and participants, data were collected using a structured questionnaire that contained their sociodemographic characteristics, dietary practices, and knowledge about healthy food intake which was determined by showing them the food pyramid. Two well-trained laboratory technicians were recruited for the purpose of blood sampling to assess Hb levels.

The nutritional status of the girls was assessed by calculating BMI (BMI=age in kg/height in meters square) and by interpreting the results using the WHO BMI-for-age chart for adolescent girls (10-19 years).[7] Girls were grouped into the following categories based on their BMI for age as per WHO standards: 1) Overweight/obese: > +1SD (equivalent to BMI 25 kg/m^2 at 19 years); 2) Normal weight; 3) Thinness/severe thinness: < -2SD (equivalent to BMI 16.5 kg/m^2 at 19 years). Categorization of anemia into mild, moderate, severe, and no anemia was done as per WHO guidelines for the classification of anaemia.[8] SPSS Version 25 was used for the analysis of the data.

RESULTS

A total of 162 girls in the age range of 10 to 16 years with a mean age of 13.8 ± 0.132 years participated in this study. The mean height and weight of adolescent girls is shown in Table 1.

Table No. 1: Anthropometric Measures of Adolescent Girls in Nankana Sahib District (n=162)

Category	Mean	SD
Age (years)	13.8	0.132
Height (m)	5.2	0.318
Weight (kg)	41.1	0.793
BMI (kg/m^2)	18.1	0.297
Hb (mg/dl)	12.4	1.337

Values are expressed as mean ± SD.

More than half of the girls in the surveyed sample were within normal limits based on their BMI, whereas 24.7% of the girls out of a total of 162 were either thin or severely thin. The percentage of overweight and obese students was relatively small i.e., 8.0% (Table-2). Table-3 shows the specific distribution of girls based on their Hb status as per WHO guidelines. Out of all adolescent girls, the majority were found to be non-anaemic. Mild and moderate anaemia was observed in 16.7% and 13.6% of the girls respectively.

When the status of HB% and BMI was compared (Table-4), it was found that a large percentage (48.8%) of adolescents had normal nutritional status based on growth and HB%. Only 7.4% of adolescents were thin/severely thin and had moderate anaemia.

Table No. 2: Distribution of Adolescent Girls as per BMI (kg/m^2) for age WHO standard

Category	Thinness/Severe thinness	Normal weight	Overweight/Obese	Total
Girls	40 (24.7%)	109 (67.3%)	13 (8.0%)	162 (100%)

BMI: Body Mass Index, WHO: World Health Organization

Table No. 3: Distribution of Adolescent Girls as per their Hemoglobin (g/dl) status

Hb Levels	Mild Anaemia (11-11.9 g/dl)	Moderate Anaemia (8-10.9 g/dl)	Severe Anaemia (<8 g/dl)	No Anaemia (>12 g/dl)	Total
Girls	27 (16.7%)	22 (13.6%)	0 (0%)	113 (69.8%)	162 (100%)

Hb: Hemoglobin

Table No. 4: Distribution of Adolescent Girls based on BMI (kg/m^2) and status of anaemia.

BMI categorization	Anaemia categorization			Total
	Mild Anaemia	Moderate Anaemia	No Anaemia	
Thinness/Severe thinness	4 (2.5%)	12(7.4%)	24 (14.8%)	40 (24.7%)
Normal Weight	21 (12.9%)	9 (5.6%)	79 (48.8%)	109 (67.3%)
Overweight/Obese	2 (1.2%)	1 (0.6%)	10 (6.2%)	13 (8.0%)
Total	27 (16.7%)	22 (13.6%)	113 (69.7%)	162 (100%)

BMI: Body Mass Index

Table No. 5: Frequency percentage of girls having knowledge about healthy food intake.

Knowledge about healthy nutrition	Sufficient Knowledge	Less Knowledge
Girls	132 (82%)	30 (18%)

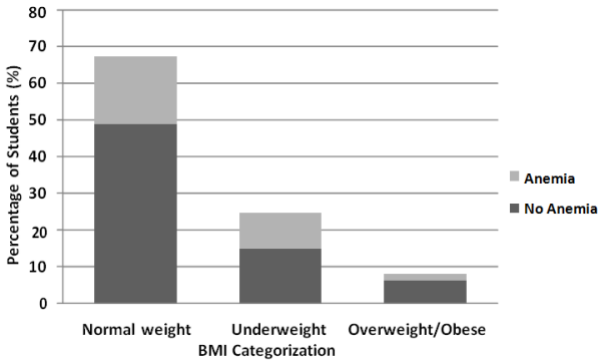

Figure No. 1: Distribution of Adolescent Girls based on BMI (kg/m^2) and status of anaemia.

DISCUSSION

The present study is conducted in one of the rural areas of Punjab; Nankana Sahib District to assess two major determinants of nutritional status i.e., BMI and Hemoglobin levels in Adolescent girls and its association with each other. Anemia has now become a global public health problem with the most common variant being Iron deficiency anemia. Poor nutrition leads to low iron stores of body resulting in Iron deficiency anemia and it adversely affects intellectual performance, physical activity, growth, immunity, and neurological function. Another important nutritional indicator is BMI, also used to determine health policies. Abnormal BMI and hemoglobin levels represent important nutritional disorders especially in developing countries like Pakistan[5].

In the present study, more than half of the study population had normal BMI while one fourth of the adolescents were in low BMI group and only a few were in high BMI group. On the other hand, more than two thirds of the study population had normal Hemoglobin and less than one third had either mild, moderate, or severe anemia. A positive association was found between BMI and Hemoglobin which clearly indicated that adolescents with low BMI had some degree of anemia and hence were nutritionally compromised and vice versa.

Present study indicated that about half of the study population had satisfactory nutritional status as they were in normal BMI and hemoglobin category. This indicates that awareness levels regarding health, nutrition and hygiene is increasing in rural areas. Some important contributing factors may be eating simple but nutritious food, non-availability of energy rich but nutritionally poor junk food, awareness regarding use of clean water, better health care facilities and infection control etc. On the contrary, a study by Akram et al found no association between BMI and anemia[6,7]. When BMI and Hb status of overweight/obese group was compared, most of the overweight adolescents had normal Hb levels, which again supported the positive association between Hb and BMI that if one factor increases, the other also increases. Another previous study conducted on Chinese women found the same association between overweight, obesity and anemia.[8]

In thin/low BMI group, it was found that slightly less than half of the thin girls had mild to moderate anemia and there was weak positive association between Hb and BMI in this group thus showing that with decrease in BMI, chances of anemia are increased. Many previous studies also support the results of this current study and have concluded this positive association between low BMI and low Hb levels.[9] This higher prevalence of anemia among underweight adolescents in the present study may be due to poverty related to dietary deficiency, poor dietary patterns with least intake of vitamins and iron nutrients, menstrual blood loss, high rate of worm infestation as well as lack of awareness of healthy food habits.

Limitation of the study that must be taken into account is that the hemoglobin was considered as the only hematological biomarker without pondering other indices like serum iron, transferrin, ferritin as well as CRP, hepcidin and other inflammatory biomarkers.

CONCLUSION

This study concludes that two major determinants of nutritional status i.e., BMI and Hb were normal in about half of the adolescents in rural areas of Nankana sahib. The highest prevalence of anemia was found in low BMI group followed by normal BMI group and least number of anemics was found in high BMI group which indicated a positive association between BMI and Hb levels although not statistically significant.

Author's Contribution:

Concept & Design of Study:	Sana Rasheed Ch
Drafting:	Komal Iqbal, Muniza Saeed
Data Analysis:	Jawaria Ilyas, Asma Ashraf, Faiza Rehman
Revisiting Critically:	Sana Rasheed Ch, Komal Iqbal
Final Approval of version:	Sana Rasheed Ch

Conflict of Interest: The study has no conflict of interest to declare by any author.

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