

Original Article**Interrelation of Anaemia with BMI and Socio- Economic Parameters in Mid Adolescent Girls - A School Based Study in Southern Odisha**

Authors

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**Jagatshreya Satapathy**Email: [jagat4u2005@gmail.com](mailto:jagat4u2005@gmail.com), Mobile no: 9776979879**ABSTRACT****Objectives:** To study the prevalence of nutritional anaemia and its socioeconomic correlates in mid adolescent schoolgirls in Berhampur town, Odisha.**Materials and Methods:** This cross sectional study was carried out in three schools in Berhampur town. The haemoglobin levels and other variables in 744 mid- adolescent girls (14- 16 yrs) from the three schools were collected and analysed by Karl Pearson Correlation test and Chi square test in SPSS 20.**Results:** Nutritional anaemia was found to be prevalent in 52.01% of the subjects. Mild, moderate and severe anaemia were found in 29.1%, 19.5% and 3.4% of subjects respectively. Significant association ( $p < 0.05$ ) was found between anaemia and normal & low body mass index ( $r = +0.69$  and  $+0.83$  respectively), anaemia and low & medium income group ( $r = +0.77$  and  $+0.56$ , respectively), attainment of menarche, vegetarianism and without iron supplementation by government program. Even girls belonging to High income group and with high body mass index were found to be anaemic in  $> 40\%$  of cases.**Discussion:** Anaemia was found to be omnipresent across all the categories studied, but significant association was seen with low and normal body mass index, low and mid income groups, vegetarianism, having attained menarche and not receiving iron supplementation. Anaemia in mid adolescence, if left unattended, may have cascading negative influences on future pregnancies and progenies. Hence it is of paramount importance to address it at least before a girl enters into marriage and motherhood.**Keywords:** Haemoglobin, Mid adolescence, BMI, Income group, Menarche, Iron supplementation.**Introduction**Adolescence<sup>1</sup> (10-19 years) is a period of transition between childhood and adulthood. They are the future citizens on whom the progress of the

country depends. 85% of world's adolescents live in developing countries and in India, 50% of the total population belongs to the adolescent group.

During this period, the mortality and morbidity from common diseases are rare. Since approx. 50% of adult weight and 25% of the adult height are achieved during this span of 9 years, the impact of macro and micro-nutrients is quite significant and visible. The major nutritional problems occurring in this period are under-nutrition, stunting, Iron deficiency anaemia and other micro- nutrient deficiencies. Nevertheless, with increasing affluence and changing dietary habits, overweight and obesity have emerged as an important health concern. The government programs of mid- day school meal and adolescent iron prophylaxis are aimed to alleviate the problem of under-nutrition and anaemia to a greater extent.

This study was designed to collect and compile data on prevalence of anaemia and nutritional status of mid- adolescent schoolgirls, reflecting some important parameters from this part of Southern Odisha.

## Materials and Methods

### Inclusion criteria

1. The schoolgirls from 14 to 16 years.

### Exclusion criteria

1. Age < 14 years and > 16 years.
2. Known cases of haemolytic anaemia.
3. Children with frank history of menorrhagia.
4. Any other disease causing anaemia and/ or malnutrition, like chronic liver or kidney disease.

Selection of the subjects or participants for the study

Total no. of 744 mid- adolescent girls of age group from 14 to 16 years were selected from three schools of Berhampur town with grouping of 250, 250 and 244 schoolgirls by simple random sampling for the study.

The study was conducted for the period of 6 months i.e. from January 2017 to June 2017. Consent was obtained from the principals of all

the three schools and parents of all the schoolgirls for the collection of data for the study.

### Design of the study

The investigator used descriptive survey to collect data. First of all, the haemoglobin level of all subjects was done and categorised according to the WHO grading. Variables of the study were BMI, income group, eating habits, menarche and supplemental iron therapy (by national program).

### Measurements

#### Age, height and weight

The age of the girls was obtained from the school registers (birth certificates) and those in mid-adolescent group (14-16 years) were included for study. The weight was measured by using a digital weighing machine without footwear and the height was recorded by stadiometer and converted on meter scale.

#### Body Mass Index<sup>2</sup>

Was calculated from the formula

$$BMI = \frac{Weight}{Height^2} (m^2)$$

#### Haemoglobin Estimation<sup>3</sup>

Cyanmethaemoglobin method on whole venous blood was used for the estimation of Haemoglobin.

#### Socio Economic Status

Income group has been classified into low, medium and high income group approximating the basis of Modified Kuppuswami Scale<sup>4</sup>.

#### Eating Habits, Menarche and Supplemental Iron Therapy

The data about eating habits (veg/ non veg), menarche and supplemental iron therapy provided by the national program of the subjects were obtained through questionnaire in Odia language and then translated to English and coded accordingly. All data obtained during the survey were entered in the Database package and analysis was done by using SPSS 20.

**Observations****Table 3.1:** Correlation of anaemia with BMI and Income Groups

Variables	Total (%)	Girls without anaemia( n & %)	Girls with anaemia (n & %)				Karl Pearson's r	p- value
			Total	Mild	Moderate	Severe		
Body Mass Index								
>85 <sup>th</sup> percentile	149 (20.0%)	89 (59.7%)	60 (40.3%)	44 (29.5%)	14 (9.4%)	2 (1.4%)	+0.11	0.181
5-85 <sup>th</sup> percentile	438 (58.9%)	247 (56.4%)	191 (43.6%)	97 (22.1%)	80 (18.3%)	14 (3.2%)	+0.69	< 0.05
<5 <sup>th</sup> percentile	157 (21.1%)	21 (13.4%)	136 (86.6%)	76 (48.4%)	51 (32.5%)	9 (5.7%)	+0.83	< 0.05
Income groups								
Low	83 (11.28%)	37 (44.6%)	46 (55.4%)	22 (26.5%)	19 (22.9%)	5 (6.0%)	+0.77	< 0.05
Medium	614 (82.49%)	294 (47.9%)	320 (52.1%)	185 (30.1%)	117 (19.0%)	18 (3.0%)	+0.56	< 0.05
High	47 (6.23%)	26 (55.3%)	21 (44.7%)	10 (21.3%)	9 (19.1%)	2 (4.3%)	+0.13	0.383

**Table 3.2:** Relation of anaemia with Eating habits, Iron supplementation and Menarche.

Variable	Total (%)	Girls without anaemia (n & %)	Girls without anaemia (n & %)				Chi square (X <sup>2</sup> )	p Value
			Total	Mild	Moderate	Severe		
Eating Habits								
Vegetarian	126 (16.9%)	48 (38.1%)	78 (61.9%)	49 (38.9%)	23 (18.2%)	6 (4.8%)	5.94	0.014 (p < 0.05)
Non vegetarian	618 (83.1%)	309 (50%)	309 (50%)	168 (27.2%)	122 (19.7%)	19 (3.1%)		
Supplemental Iron therapy (by Govt Program)								
Receiving	230 (30.9%)	131 (56.9%)	99 (43.0%)	46 (20%)	51 (22.2%)	2 (0.8%)	10.73	0.001 (p < 0.05)
Not receiving	514 (69.1%)	226 (44%)	288 (56.0%)	171 (33.3%)	94 (18.2%)	23 (4.5%)		
Menarche								
Attained	678 (91.1%)	315 (46.5%)	363 (53.5%)	205 (30.2%)	136 (20.1%)	22 (3.2%)	7.109	0.007 (p < 0.05)
Not attained	66 (8.9%)	42 (63.6%)	24 (36.4%)	12 (18.2%)	9 (13.6%)	3 (4.5%)		

**Results**

There were 744 subjects in the study. The overall prevalence of anaemia was found in 52.0% of cases. Mild, moderate and severe anaemia were found in 29.1%, 19.5% and 3.4% of the girls respectively.

Maximum of girls belonged to middle income group (82.49%) and normal BMI (58.9%). 83.1 % of the subjects were non vegetarian and 93.8% had attained menarche. A majority of the subjects (69.1%) was not receiving supplemental iron therapy by the program.

In this study, anaemia was present in 43.6% and 86.6% of the girls having normal and low BMI

respectively. Correlation coefficient (r) between these groups and anaemia was high positive, being +0.69 and + 0.83 respectively, and statistically significant (p <0.05). Nevertheless, positive correlation between High BMI and anaemia was also found (r= +0.11), though statistically insignificant (p = 0.181).

Prevalence of anaemia amongst girls belonging to Low and Mid income group was 55.4% and 52.1% respectively, correlation between them and anaemia being +0.77 and +0.56 (high positive) and statistically significant (p < 0.05). Even in high income group, anaemia was present in 44.7% and amongst them, 4.3% had severe anaemia.

It was seen on Chi square test that eating habits had a significant impact on the prevalence of anaemia ( $X^2 = 5.94$ ,  $p = 0.014$ ), with non vegetarianism being protective against it. 50% of non vegetarian subjects had anaemia, while the rest 50% had normal haemoglobin.

Similarly, not receiving iron therapy and having attained menarche were found to have statistically significant association with anaemia ( $p = 0.001$  and  $p = 0.007$  respectively) on Chi square test. Even in those receiving iron therapies, anaemia was prevalent in 43.0%, with 0.8% having severe anaemia. 36.4% of subjects who had not attained menarche were anaemic. While mild anaemia (18.2%) had the highest prevalence amongst such cases, severe anaemia was seen in 4.5% cases.

Overall it is found from the study that low income group, low iron intake, vegetarian diet, menarche and low and normal BMI are significantly correlated with presence of anaemia.

## Discussion

Kulkarni et al<sup>5</sup>, Toteja G S et al<sup>6</sup> and Gawarika et al<sup>7</sup> reported the prevalence of anaemia to be 90.1%, 90.1% and 96.3% in their respective studies. Kulkarni et al studied the prevalence of anaemia in an urban slum in Nagpur and concluded that mild or moderate anaemia was found to be present in majority of the girls (88.6%), while it was seen in only 48.6% of the girls studied by us. Unlike our study, they found no association between status of menarche, menarcheal age and anaemia. The socio economic status of the subjects might have had a telling effect on the different results in the above studies and the present study.

Various other studies (Bulliyy G et al<sup>8</sup>; Rana T. et al<sup>9</sup>; Seshadri et al<sup>10</sup>; & Siddharam et al<sup>11</sup>) have reported the prevalence of anaemia to be between 45.2% and 60%.

Kaur et al<sup>12</sup> found from their study that in univariate analysis, low socioeconomic status, low iron intake, vegetarian diet among other factors showed significant association with anaemia. This concurred with the present study. But, unlike this

study, they concluded that BMI had no significant role in the occurrence of anaemia.

Prevalence of anaemia was found even in high income group of society. It might be due to changing lifestyles, food habits and western diet.

This study found a strong relationship between attainment of menarche and anaemia. This was similar to the findings by Kaur et al. But severe anaemia was still present in those who had not attained it.

50% of those girls who preferred non-vegetarian diet were anaemic. Therefore non-vegetarian diet is protective against anaemia as compared to vegetarian diet. Also, it revealed that penetration of govt. programs for supplementation of iron therapy was poor. While in a majority, iron supplementation was undoubtedly beneficial in preventing anaemia, all grades of anaemia were still found in the girls receiving it.

## Conclusion

Anaemia was found in 52.01% of all mid adolescent school-girls enrolled. Significant association was found between anaemia and low BMI, attainment of menarche, vegetarian diet and not receiving iron therapy. In contrast, anaemia was also prevalent in girls with high BMI and belonging to high income group in significant percentage.

Anaemia and under-nutrition during adolescence can persist through pregnancy and motherhood, leading to adverse pregnancy outcomes along with higher morbidity and mortality of the newborn baby. This perennial and perplexing problem can only be solved by health education and counselling for good nutrition, iron supplementation and lifestyle modifications, starting at least and at best from adolescent period.

## Conflicts of Interest

The authors have no conflict of interests.

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## References

1. Agarwal,R, Sankhyan, N., Jain, V., Normal growth and its disorders. In: Paul, V.K., Bagga, A, editors. Ghai Essential Pediatrics. Eighth Edition. Delhi: CBS Publications; 2013. p. 9.
2. Division of Nutrition, Physical Activity, and Obesity NC for CDP and HP. Healthy Weight [Internet]. 2015. Available from: [https://www.cdc.gov/healthyweight/assessing/bmi/childrens\\_bmi/about\\_childrens\\_bmi.html](https://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html)
3. Lokeshwar, M.R., Shah, N.K. Nutritional Anaemia in Infancy, Childhood and Adolescents. In: Lokeshwar, M.R., Shah, N.K., Agarwal, B.R., editors. Textbook of Pediatric Hematology and Hemato-Oncology. First Edition. Delhi: Jaypee Brothers Medical Publishers (P) Ltd.; 2016. p. 100.
4. Park, K. Park's Textbook of Preventive and Social Medicine. 23<sup>rd</sup> edition. Jabalpur: m/s Banarasidas Bhanot; 2015 p. 690.
5. Kulkarni, M. V., Durge, P. M., & Kasturwar, N. B. (2012). Prevalence of anaemia among adolescent girls in an urban slum. National Journal of Community Medicine , 108-111.
6. Toteja, G., Singh, P., Saxena, B., Ahmed, F., Dhillon, B., & Singh, R. (n.d.). Prevalence of anaemia among pregnant women and adoloscent girls in 16 districts of India. Food Nutr Bull 2006 , 311-5.
7. Kaur, S., Deshmukh, P., & Garg, B. (2006). Epidemiological Correlates of Nutritional Anemia in Adolescent Girls of Rural Wardha. Indian Journal of Community Medicine , 255-258.
8. Toteja, G., Singh, P., Saxena, B., Ahmed, F., Dhillon, B., & Singh, R. (n.d.). Prevalence of anemia among pregnant women and adoloscent girls in 16 districts of India. Food Nutr Bull 2006 , 311-5.
9. Rana T. Age at menarche; Nutritional status and other associated factors in urban Hyderabad girls. Ph.D Thesis submitted to National Institute of Nutrition, Hyderabad-1983.
10. Seshadri: a data base iron deficiency anaemia in India. Prevalence, etiology, consequences and strategies for control, task force for micronutrients malnutrition control, Department of Women and Child Development, Ministry of Human Resource Development, New Delhi-1996.
11. Siddharam S, Venketesh G, Thejeshwari H. A Study of Anaemia Among Adolescent Girls in Rural Area of Hassan district, Karnataka, South India. Int J Biol Med Res J. 2011;2(4):922 – 924.
12. Kaur, S., Deshmukh, P., & Garg, B. (2006). Epidemiological Correlates of Nutritional Anaemia in Adolescent Girls of Rural Wardha. Indian Journal of Community Medicine , 255-258.