



# Anaemia among Adolescents in a Coastal District of India

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## ABSTRACT

**Introduction:** Globally, anaemia affects 1.62 billion people, corresponding to 24.8% of the population and South Asia contributes the highest proportion. As awareness about anaemia and its implication on the health has increased, nations and organizations worldwide are taking steps to combat the problem. This study was formulated with the objective to assess the prevalence of anaemia and the socio demographic, dietary factors associated with anaemia among adolescent boys and girls in a better performing coastal district of India.

**Methodology:** A cross sectional study was conducted in the rural field practice area enrolling 526 adolescent. A pretested, validated semi-structured questionnaire was used. Hemoglobin estimation was done using Hemo cue analyser.

**Result:** The total prevalence of anaemia among boys and girls was 30.7% and 45.7% respectively ( $p < 0.001$ ). The prevalence of anaemia was found to decrease with increasing age among boys whereas it was found to be increasing among girls. Other demographic factors like education and occupation of parents, religion, socio-economic status and dietary pattern had no statistical significance.

**Conclusion:** The problem of anaemia is high among males though comparatively lower than females. Other causes of anaemia need to be identified to overcome the problem of anaemia.

**Key words:** Anaemia, adolescents, Gender, Socio-economic status

## INTRODUCTION

Adolescence is defined as the period of growth and development after childhood and before adulthood (10 to 19 years).<sup>1</sup> During this time period, adolescents not only undergo physical and sexual development but also experience social and economic independence, development of identity, abstract reasoning and acquisition of skill among many others.<sup>2</sup> Anaemia has been linked to be affecting all these developmental process an adolescent experiences increasing the chances of psychiatric disorder, developmental delay and mental retardation besides increasing reproductive morbidities among adolescent girls during their womanhood.<sup>3</sup> According to World Health Organization (WHO) iron deficiency is the most prevalent nutritional deficiency and its timely correction could raise the national productivity by 20%.<sup>4</sup>

The estimated prevalence of anaemia in developing countries is 39% in children <5 years, 48% in children 5-14 years, 42% in women 15-59 years, 30% in men 15-59 years, and 45% in adults >60 years.<sup>5</sup> In India, according to NFHS-4, the prevalence of anaemia is 58% in children <5 years, 53% in women 15-49 years, 23% in men 15-49 years.<sup>6</sup> Indian government has launched various programmes to address this situation. National Nutritional Anaemia Prophylaxis Programme (NNAP) was launched in 1970 which was found to have made very little impact.<sup>7</sup> Amendments were done after the evaluation of the programme to increase its effectiveness.<sup>8</sup> After NFHS 3 suggested a high prevalence of anaemia among pregnant and lactating women, adolescent girls and also adolescent boys and under 5 children, the Iron Plus initiative was launched including them all.<sup>9,10,11</sup>

Numerous studies have been conducted highlighting the problem of anaemia among adolescent girls. It was well documented that anaemia in girls has an enormous impact on their physical capacity and reproductive physiology.<sup>12</sup> It is believed that girl children are more prone to severe anaemia than their male counterpart, because with increasing age, the prevalence of anaemia declines among males.<sup>13</sup> Adolescent period witnesses a dramatic increase in the iron requirement due to expansion of the blood volume, increase in the lean body mass, muscle mass and myoglobin which affects the growth and development of adolescent boys also.<sup>14</sup> There is a scarcity of data on anaemia among adolescent boys compared to girls due to lack of research. This scarcity necessitated us to study the prevalence of anaemia and the socio demographic factors associated with it among both adolescent boys and girls.

## METHODOLOGY

The present study was a cross sectional study carried from 2014 to 2015. The study population were all the adolescents (10 to 19 years) residing in the field practice area of the Department of Community Medicine in Udipi district.

**Sample size:** Using the formula for sample size,  $(1.96)^2 pq/d^2$ , the sample size was calculated for boys and girls separately with absolute precision as 20% at a 95% confidence level and design effect as 1.5. Sample size for boys was 320 (prevalence 31.6 %) and for girls was 176 (prevalence 45.2%).<sup>15</sup>

**Sampling method:** Stratified random sampling with proportionate sample size from each stratum of each Centre of the field practice area according to the e-database was used for sample selection. Firstly stratification was done for total adolescent population as early and late adolescents followed by stratification based on the six field practice areas. Using simple random sampling one locality from one village in each Centre was selected. The centre of the locality was identified and nearest house with an adolescent was taken as the initial house. The subjects were recruited moving in one particular direction till required sample size from that village was attained. If required sample size was not reached, adjacent locality was selected.

**Ethical clearance:** The study proposal was approved by Institutional Ethics Committee.

### Data collection:

A home visit was conducted and the purpose of the visit was explained. Written consent of the parents and assent from the adolescents was taken from 10 to 17 year old adolescents. Informed and written consent was taken directly from 18 and 19 year olds. A face to face interview was conducted with the participant by the investigator using a pretested semi-structured questionnaire after explaining the objective of this study. Socio economic status was assessed using modified Udai-Pareek scale<sup>16</sup>. Dietary history was collected based on the 24 hour recall. The frequency of intake of each food items was collected as  $\geq 3$  times a week or  $< 3$  times a week.

**Haemoglobin estimation:** Haemoglobin estimation was done at the time of the visit using HemoCueHb 301.<sup>17</sup> After every 100 samples tested in the field, the machine was calibrated in the Department of Clinical Haematology. Any patient found to be anaemic was referred to the nearest peripheral health centre for management according to the grade of anaemia.

### Definitions-

**Adolescence<sup>1</sup>** - Individuals in the age group of 10-19 years is defined as adolescent. 10 years to 14 years age group considered as Early Adolescence and 15 years to 19 years age group considered as Late adolescence.

**Anaemia** - Haemoglobin cut-offs used to define anaemia as per the WHO criteria<sup>11</sup> (Table 1)

### Statistics

Data was analyzed using Statistical Package for Social Sciences (SPSS) version 16.0. Prevalence of anemia is presented as percentage. Chi square for trend was used for association between anaemia among different age group. To study the association of socio demographic correlates, dietary pattern, and other risk factors with anaemia, univariate logistic regression model was performed. A  $p < 0.05$  was considered statistically significant. Odds ratio was computed with 95% confidence interval.

**Table 1: Haemoglobin cut offs for anaemia as per WHO criteria<sup>11</sup>**

Age or gender group	No anaemia (g/dl)	Mild anaemia (g/dl)	Moderate anaemia (g/dl)	Severe anaemia (g/dl)
Children (10.00-11.99 yrs)	$\geq 11.5$	11 - 11.4	8 - 10.9	$< 8$
Children (12.00-14.99 yrs)	$\geq 12$	11 - 11.9	8 - 10.9	$< 8$
Non-pregnant women ( $\geq 15.00$ yrs)	$\geq 12$	11 - 11.9	8 - 10.9	$< 8$
Men ( $\geq 15.00$ yrs)	$\geq 13$	11 - 12.9	8 - 10.9	$< 8$

**RESULT**

A total of 526 adolescents participated in the study. The non-response rate was <1% (17). The proportion of males and females were in accor-

dance to the sample size calculated for each. The proportions of early and late adolescents were almost equal. Only 1.3% of the adolescents were un-employed.

**Table 2: Age and Gender distribution of prevalence of anaemia**

Variables	Non anemic	Mild Anaemia	Moderate Anaemia	Severe Anaemia	Total anaemia
<b>10 - 14 (yrs)</b>					
Male	103 (65.6)	33 (21)	20 (12.7)	1 (0.6)	54 (34.4)
Female	62 (61.4)	19 (18.8)	20 (19.8)	0 (0)	39 (38.6)
Total	165 (64)	52 (20.2)	40 (15.5)	1 (0.4)	93 (36)
<b>15 -19 (yrs)</b>					
Male	116 (73)	39 (24.5)	3 (1.9)	1 (0.6)	43 (27)
Female	52 (47.7)	24 (22)	29 (26.6)	4 (3.7)	57 (52.3)
Total	168 (62.7)	63 (23.5)	32 (11.9)	5 (1.9)	100 (37.3)

**Table 3: Univariate Logistic Regression for association of anaemia and socio demographic correlates**

Variables	Total number in the group	Anaemia n (%)	P value	OR (95% CI)
<b>Age group (in years ) (N = 526)</b>				
10 - 14	258	93 (36)	0.76	0.94 (0.66 - 1.35)
15 - 19	268	100 (37.3)		1
<b>Gender (N = 526)</b>				
Male	316	97 (30.7)		1
Female	210	96 (45.7)	<0.001	1.9 (1.3- 2.7)
<b>Religion (N = 526)</b>				
Hindu	460	165 (35.9)		1
Muslim	61	27 (44.3)	0.20	1.4 (0.82 - 2.43)
Christians	5	1 (20.0)	0.47	0.45 (0.05 - 4.03)
<b>Occupation (N = 526)</b>				
Student	492	187 (38)	<b>0.02</b>	2.86 (1.16 - 7.04)
Working / Unemployed	34	6 (17.6)		1
<b>Type of Institute (N = 492)</b>				
Private	292	105 (36)		1
Government and Aided	200	82 (41)	0.25	1.23 (0.85 - 1.79)
<b>Type of family (N = 526)</b>				
Nuclear	291	108 (37.1)	0.82	1.04 (0.73 - 1.48)
Joint Family/ Extended	235	85 (36.2)		1
<b>SES (N = 526)</b>				
Low	65	22 (33.8)	0.61	0.86 (0.50 - 1.5)
Middle/High	461	171 (37.1)		1
<b>Card type (N = 526)</b>				
APL	196	67 (34.2)		1
BPL/ Antyodaya	330	126 (38.2)	0.40	1.17 (0.80 - 1.69)
<b>Mothers education (N = 526)</b>				
Illiterate	42	18 (42.9)	0.40	1.42 (0.62 - 3.24)
Primary and Middle school	211	79 (37.4)	0.69	1.13 (0.61 - 2.11)
High school	218	77 (35.3)	0.91	1.03 (0.56 - 1.92)
Higher secondary / College	55	19 (34.5)		1
<b>Fathers education (N = 487)</b>				
Illiterate	24	10 (41.7)	0.90	0.94 (0.36 - 2.47)
Primary and Middle school	203	66 (32.5)	0.14	0.63 (0.35 - 1.15)
High school	202	79 (39.1)	0.58	0.85 (0.47 - 1.53)
Higher secondary / College	58	25 (43.1)		1
<b>Mother s occupation (N = 526)</b>				
Working	246	89 (36.2)	0.81	0.96 (0.67 - 1.37)
Home maker	280	104 (37.1)		1
<b>Fathers occupation (N=481)</b>				
Unkilled/ Unemployed	93	39 (41.9)	0.73	0.85 (0.35 - 2.10)
Skilled / Semi skilled	364	126 (34.6)	0.27	0.63 (0.27 - 1.44)
White collar / Professional	24	11 (45.8)		1
<b>Diet (N = 526)</b>				
Vegetarian	16	9 (56.3)	0.11	2.28 (0.83 - 6.22)
Mixed	510	184 (36.1)		1

The total prevalence of anaemia was 36.7%. The prevalence of mild anaemia was higher among males compared to females whereas moderate and severe anaemia was more among the females. Table 2 shows the distribution of anaemia in different age group stratified by gender. The prevalence of anaemia among females is more than males in both the age groups. Here, it also depicts the decrease in the prevalence of anaemia among males as the age is increasing whereas among females the prevalence of anaemia is increasing.

Univariate logistic regression model was run to assess the association of anaemia with the socio demographic variables of the study participants (Table 3). Gender was found to be a significant predictor of anaemia. Females (50.7%) were at a higher risk of developing anaemia compared to males (30.7%) (OR - 1.9, P <0.001). Occupation of the adolescents was also found to be significantly associated with anaemia. Students were found to be having more anaemia compared to adolescents working or at home. The proportion of adolescents in the two categories (student and working or unemployed) was not equally distributed. In our study, adolescents on vegetarian diet had higher proportions of anaemics (56.3%) (9 out of 16) compared to those who were following mixed diet (36.1%). The prevalence of anaemia among adolescents who consumed meat products everyday was less (35%) compared to those consumed <3 times a week (38.7%), (P=0.39) or did not consume meat products (56.2%), (P=0.20). The proportion of adolescents who consumed Vitamin C rich food (like tomato and lemon) >3 times a week (36.1%) was less anaemic compared to those who consumed <3 times a week (50%) (p= 0.19).

## DISCUSSION

This cross sectional survey conducted in a coastal district of South India found the prevalence of anaemia to be high in both adolescent girls and boys (45.7% and 30.7% respectively). The NFHS 4 survey estimated the prevalence of anaemia among adolescent girls and boys at around 53% and 30% respectively<sup>6</sup>. A study done in 2006 to estimate the prevalence of anaemia in 16 districts of India found the total prevalence of anaemia among adolescent girls to be 90.1% ranging from 58% in Dehradun to 99% in Srinagar.<sup>18</sup> Various studies done all over the country have reported a wide range of prevalence anaemia. The prevalence of anaemia among adolescent girls ranged from 21.4% in Shimla<sup>19</sup>, 90.1% in Nagpur<sup>20</sup>, 41.1% in Belgaum<sup>21</sup>, 52.8% in Meerut<sup>4</sup>, 92.5% in Darjeeling<sup>23</sup>. Our results were almost similar to Belgaum, a district in the same state. The varied results over the different geographical region could be attributed

to the different eating patterns, socio economic status, health care programmes and its impact. Unlike adolescent girls not much data is available for adolescent boys. The study done in Meerut<sup>4</sup> reported a prevalence of 31.6% almost equal to our results. Another study done in Darjeeling<sup>22</sup> estimated the prevalence of 76.9%. The variation in the result could be due to the geographical variation and also the different health care and other facilities in the border areas compared to the other part of the nation. Another study from China<sup>23</sup> reported the prevalence of anaemia among adolescent boys and girls as 4.2% and 10.5% respectively. The prevalence of anaemia although varied, all found higher anaemia among girls compared to boys. In our study also the prevalence of anaemia was higher among adolescent girls than boys (p <0.001). The prevalence of mild anaemia was high among both boys and girls. Moderate anaemia was substantially higher among girls. Similar results were seen in other studies done in Darjeeling<sup>22</sup> and Meerut<sup>4</sup>.

In the univariate model, age group did not have an association with anaemia. On stratification by age group and gender (Table 2), the prevalence of anaemia was found to be increasing with age among girls (p - 0.04) whereas the prevalence decreased among boys. This could be attributed to the physiological blood loss after attainment of puberty among girls in contrast to no such blood loss seen in boys. This is also supported by the fact that the prevalence of anaemia among boys and girls in early adolescent was almost equal whereas the prevalence was disproportionate in late adolescent. The prevalence of anaemia was found to be almost similar over the age groups in a study done among adolescent girls in rural Tamilnadu. This could be because their study subjects were from 13 to 19 years missing out the 10 to 12 years of adolescents.<sup>24</sup> Similarly, a study done in Belgaum by Birdar SS et al found the prevalence of anaemia higher among the age group of 15 to 19 years compared to 10 to 14 years.<sup>21</sup> A study done in Haryana, on 110 adolescent girls belonging to low socio economic groups also supported our results.<sup>25</sup>

Occupation of the adolescent was also found to be associated with anaemia. Among the students, the prevalence of anaemia was 38% whereas among those who were either working or unemployed the prevalence was 17% (p - 0.02). This could be explained by increased prevalence of hookworm infestation and irregular meal frequency among school going adolescents. In our study, adolescents on vegetarian diet had higher proportions of anaemics (56.3%) (9 out of 16) compared to those who were following mixed diet (36.1%). Iron found in meat products, poultry and fish has haem



iron which has better absorption and bioavailability compared to non-haem iron found in rice, cereals etc. This explains the reason for proportion of anaemics among mixed diet subjects to be less compared to subjects who were vegetarian. Similarly other studies done by Kaur S. et al and Patnaik S et al have also reported the prevalence of anaemia higher among the vegetarian compared to those on mixed diet.<sup>26,27</sup>

The other factors which were not found to be statistically significant were age group, religion, socio-economic scale, type of family, parent's education and occupation. In contrast a large nationwide survey conducted in India to find the prevalence of anaemia found that the prevalence of moderate or severe anaemia among girls was higher in those belonging to Hindus compared to other religion.<sup>28</sup> Another study done in Surat, Gujarat found the prevalence of anaemia higher among the Jain population compared to Brahmins and Muslims ( $p < 0.05$ ).<sup>29</sup>

The present study was conducted in Udupi, a coastal district of India. According to DLHS-4, the mean household size of rural Udupi is 5.1, the mean age of marriage for girls and boys is 23.7 and 30.4 respectively, currently married women who are illiterate as 11.6%, births to women aged 15 to 19 years out of total births is only 0.9%. All these indicators point to Udupi being one of the better performing districts compared to other districts in India.<sup>30</sup> Yet the prevalence of anaemia among Udupi district is no better than other parts of India. The prevalence of anaemia among adolescents in our study was considerably less compared to the estimated of DLHS-4 (girls -72.3% and boys -59.9%).

## CONCLUSION

The prevalence of anaemia is high among both adolescent boys and girls even though literacy and socio economic status of the study area is high. Education, occupation and socio economic status of parents was not found to be associated with anaemia. It is not a poor man's disease anymore and steps need to be taken to address this situation. Gender disparity is present in the proportion of anaemia among boys and girls but care needs to be taken for the boys also especially early adolescent boys.

## RECOMMENDATIONS

More measure needs to be identified irrespective of socio demographic factors. These measures should be put into operation at the earliest age

when the prevalence of anaemia is high among both boys and girls.

## Limitations

The sample size was calculated according to the primary objective of the study to estimate the prevalence of anaemia. The power of the study to find risk factors associated with prevalence of anaemia was low. Anaemia status among the adolescent may not be contributed to the 24 hour recall diet but on a long term dietary intake. Other methods of dietary intake could not be assessed.

## Relevance of the study

The prevalence of anaemia among early adolescent boys and girls is high. Preventive measures like health education, behavioural change communication and screening among both boys and girls could be our way forward.

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## Authors' contribution:

Dr Ayushi Agrawal contributed to conception and design of the study, acquisition of the data, analysis and interpretation of data, drafting the article and final approval of the version to publish. Dr Avinash Shetty, Dr George P Jacob and Dr Asha Kamath contributed to conception and design of the study, analysis and interpretation of the data, revising the article critically for important intellectual content and final approval of the version to publish.

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