## **Original Research Article**

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# Adolescent anaemia its prevalence and determinants: a cross-sectional study from south Kerala, India

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#### **ABSTRACT**

**Background:** Anaemia is currently one of the most common and intractable nutritional problems globally. During the period of adolescence, iron requirements increase dramatically in both boys and girls resulting in a higher probability of anaemia. The objective of the study was done to find out the prevalence of anaemia among adolescent boys and girls in Ambalapuzha Taluk and to assess the scholastic performance of the anaemic and non-anaemic in the study group.

**Methods:** The setting was different schools of Ambalapuzha Taluk and the study was cross sectional in nature. Study subjects were children studying in 5<sup>th</sup> -10<sup>th</sup> standards selected from aided, unaided and government schools. The total sample size of the study was 2789 subjects. Statistical analysis: Data was entered in Microsoft excel and was analysed using SPSS 16.0 version

**Results:** The prevalence of anaemia in the whole population was 53.5% (C.I-51.64-55.34%). The anaemia prevalence in females was 62.0% (C.I -59.33-64.6) and in males was 46.1% (C.I -43.55-48.61). Out of the total population 0.4% were severely anaemic [male 0.3% (5) and female 0.5% (6)]. The prevalence of moderate anaemia was 3.4% [male 2.8% (41) and female 4.2% (54)] and that of mild anaemia was 49.7 [male 43% (640) and female 57.4% (746)]. The factors that were found to be significantly associated with adolescent anaemia were female gender (62% vs. 46.1%), being overweight (59.7% vs. 53.2), not taking WIFS regularly (56.5% vs. 51.8% and 28.6% among irregularly taking WIFS and regular takers) and children coming from families with monthly income less than INR 1000.

**Conclusions:** On comparing the academic performance of anaemic and non-anaemic children it was found that the aggregate marks was significantly lower in the anaemic group (178.11 marks) compared to the non-anaemic group (217.63 marks) (p=0.001).

Keywords: Prevalence, Anaemia, Adolescents, Kerala, Scholastic performance

## INTRODUCTION

Anemia is currently one of the most common and intractable nutritional problems globally. WHO estimates the number of anemic people worldwide to be a staggering two billion with approximately 50% of all

anemia attributable to iron deficiency.<sup>1</sup> Iron deficiency anemia occurs at all stages of the life cycle, but is more prevalent in pregnant women and young children. Adolescents, particularly girls, are vulnerable to iron deficiency.<sup>2</sup> For every case of iron deficiency anaemia, it is estimated that 2.5 times is the number of people with

iron deficiency. So anemia is only the tip of the iceberg of iron deficiency people.<sup>1</sup>

Adolescence is a period of most rapid growth second to childhood. Physical and physiological changes that occur in adolescence plays a great demand in their nutritional requirements and make them more vulnerable to anemia. Added to increased requirement in iron, poor dietary intake of iron, high rate of infection and worm infestation as well as the social norm of early marriage and adolescent pregnancy adds to the burden of anemia in adolescence.<sup>2</sup>

During the period of adolescence, iron requirements increase dramatically in both boys and girls as a result of the expansion of the total blood volume, the increase in lean body mass and the onset of menses in young females.<sup>3</sup> The requirement of iron in preadolescent child is approximately 0.7-0.9 but in an adolescent it is 2.2 mg iron per day or more.<sup>3</sup>

Iron from foods can be in two forms, heme and non-heme iron. Heme form is available from non-vegetarian foods like red meat, pork and poultry, non heme iron from dark green leafy vegetables such as spinach, dried fruits such as raisins, apricot and beans. But the data from national surveys such as the united states show that most adolescent males (98%) met recommended dietary intake guidelines for iron, but only about half (56%) of females ages 14-18 had adequate intakes. Two common reasons that are usually indicated for this behavior are poor food choices and restricting food to lose weight. The data from India indicates that the diets of girls aged between 13-18 years provide much lower level of iron than the diets of boys in the same age group.<sup>5</sup> Low consumption of nutrients by adolescents reported from India indicates that over 50% adolescent girls consumed less than 50% RDA for energy while over 70% girls consumed less than 50% RDA of iron.6

The symptoms of iron deficiency in adolescents include weakness and fatigue, dizziness, irritability, headache, tinnitus, shortness of breath and loss of appetite and decreased scholastic performance. The risk of anemia in adolescents not only affects their growth and function but also is a threat to their future health. Iron deficiency may impair cellular response and immune functions and increase susceptibility to infection.<sup>7</sup> It also causes impairment of maximal work capacity and has a great significance on the economy of the country. Research has shown that risk of LBW preterm delivery and perinatal mortality increases among those who continue to be iron deficient in their pregnancy too.<sup>8,9</sup>

In India 20.5% (226 million) out of the total population are adolescents. Among them anemia prevalence ranges from 56% to 90.1%. The prevalence of anemia in India is higher than many other countries due to multiple factors. Predominant vegetarianism, peculiar food habits, cultural practices, low socioeconomic status of majority of

population and absence of sanitary latrine could be attributed as some of the factors.

The state of Kerala hailed the gods own country has high human development indices even at par with developed countries. Kerala's HDI (human development index) 0.7117 is the highest in India. In spite of these facts anemia among adolescents in Kerala ranges from 19.13% among college students to 96.5% in tribal areas. Usual belief is that adolescent anemia is more prevalent in females due to their biological differences with males. But studies in Kerala have shown that male adolescent anemia is also unacceptably high as shown by Rakesh et al in Kollam district. In the state of the sta

Factors associated with adolescent anemia especially the dietary factors show geographical differences to a good extent. Very few studies have been done in the area of adolescent anemia especially among both sexes. Thus the present study attempts to find out the prevalence and determinants of adolescent anemia in Ambalapuzha Taluk, Alappuzha district of southern Kerala. The study also attempts to find our difference in scholastic performance of anaemic and non-anaemic in the study.

#### **METHODS**

The study was cross sectional in nature. The study setting was middle, high school and higher secondary schools of Ambalapuzha Taluk, a small town located 14 km south of Alappuzha. Ambalapuzha covers an area of 13.29 sq. km, has 15 wards and has a population of 22593 with 11070 Males and 11523 females.<sup>17</sup> The area is semi urban in nature with most of the people belonging to middle and low socio economic class.

## Sample size

As per the study conducted by Asha et al assessing the prevalence of anemia among adolescent girls (10-19 years) in urban slums of Thiruvananthapuram Corporation, prevalence of anemia was found to be 48%. Applying this data on to the formula  $Z\alpha^2$  PQ/d², taking d- maximum acceptable error as 3% the sample size was found to be 1065. As the method of sampling in the study was cluster sampling, a design effect of 2 was applied and final sample size was calculated to be 2130.

### Sampling technique

Cluster sampling technique was used for data collection. The schools in the Ambalapuzha Taluk were divided into aided, unaided and government. As per the third working day report by the DEO, the proportion of children in government, aided and unaided schools were 14%, 78% and 8% respectively. Against this background 8 aided schools, 3 government schools and 1 unaided school were selected randomly. From each selected school all children between standards 5 and 10 were included in the study irrespective of their age. Thus the total number of

subjects included for the study was 2254 from aided schools, 390 from government and 145 from unaided schools adding to a total of 2789 subjects.

#### Data collection

The data was collected between June to December 2016. After reaching the designated schools the basic data was collected using a semi structured interview schedule. Hemoglobin was estimated using cyanmethemoglobin method using finger prick technique maintaining aseptic precautions during the entire procedure. All blood collections were done by qualified medical professionals alone. Provisions for first aid were also ensured in the vicinity during blood collection.

#### Data -entry and analysis

Data was entered in Microsoft Excel sheet and analysis was done using SPSS version 16. Prevalence of anaemia was expressed as percentage and 95% confidence interval was calculated. Association between various factors influencing anemia was assessed using Chi square test for qualitative variables and t test for continuous variables. The level of statistical significance was set at p value less than 0.05 and high significance as p value less than 0.01.

#### RESULTS

The following results were obtained from the current study on anemia among adolescents in Ambalapuzha Taluk, Alappuzha district. The study population consisted of 1489 males and 1300 females of the age group 10-19 years adding to a total study population of 2789. 58.94% belonged to the early adolescent group (10-13 years), 35.03% in the mid adolescence (14-16 years) and 6.02% in the late adolescent age group (17-19). The other demographic details of the population are shown in Table 1.

As seen in Table 2 and figure 1 the prevalence of anaemia in the whole population was 53.5% (C.I-51.64-55.34%). The anemia prevalence in females was 62.0% (C.I -59.33-64.6) and in males was 46.1% (C.I -43.55-48.61). Out of the total population 0.4% were severely anemic [male 0.3% (5) and female (0.5% (6)]. The prevalence of moderate anemia was 3.4% [male-2.8% (41) and female 4.2% (54)] and that of mild anemia was 49.7 [male 43% (640) and female 57.4% (746)].

The factors that were found to be significantly associated with adolescent anaemia were female gender (62% vs. 46.1%), being overweight (59.7% vs. 53.2), not taking WIFS regularly (56.5% vs. 51.8% and 28.6% among irregularly taking WIFS and regular takers) and children coming from families with monthly income less than INR 1000. Being in a government school (75.0% vs. 52.4% and 51.8% in aided and unaided schools), religion and having menstrual abnormality (71.5% and 62.8%) were also found, but these results were not found to be

statistically significant. These have been shown in Table 3

Table 1: Demographic characteristics of the study population.

Demographic variables (N=2789)	Number of subjects	Percentage (%)
Type of school		
Government	390	14.0
Aided	2254	80.8
Unaided	145	5.2
Religion		
Hindu	1265	45.4
Muslim	28	1.0
Christian	1496	53.6
<b>Education of parent</b>		
Illiterate	31	1.1
Primary	566	20.3
high school	1875	67.2
Technical, degree and above	317	11.4
Occupation of parent		
Unemployed	50	1.8
Casual labor	875	31.4
Skilled labor	1092	39.2
Clerical, shop owner and above	772	27.7
<b>Monthly Income</b>		
<1000	2169	77.8
1000-3000	336	12
3000-4000	98	3.5
>4000	186	6.7

Table 2: Table showing the distribution of the population based on gender and anaemia.

Sex	Anemia		Total (0/)
Sex	Present (%)	Absent (%)	Total (%)
Male	686 (46.1)	803 (53.9)	1489 (100.0)
Female	806 (62.0)	494 (38.0)	1300 (100.0)
Total	1492 (53.5)	1297 (46.5)	2789 (100.0)

On comparing the academic performance of anemic and non anemic children it was found that the aggregate marks was significantly lower in the anemic group (178.11 marks) compared to the non anemic group (217.63 marks) (p=0.001).

The factors found to be associated with adolescent anemia were also analyzed using logistic regression. Enter method was used. The model explained 8.7% of the variants and correctly classified 61.4% of cases. Adolescent anemia was significantly associated with the following factors in logistic regression. Female gender was found to be a risk factor with an odds ratio -1.740 (C.I -1.417-2.136) and regular intake of weekly iron and folic acid supplementation was a protective factor with odds 0.636 (C.I- 0.514 -0.788).

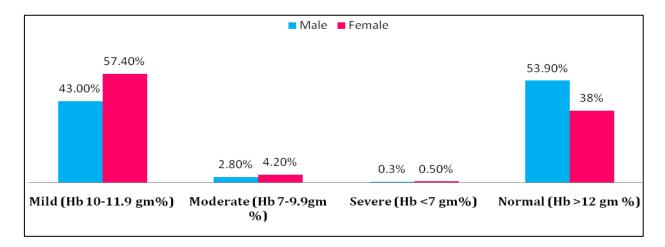


Figure 1: Distribution of the study population based on degree of anaemia and gender.

Table 3: Factors associated with anaemia.

Associated factors (n=2789)	Percentage of anemia among the group	Pearson Chi-square	P value
Gender			
Male	46.1	70.79	0.0001
Female	62.0	_	
BMI			
Normal & underweight	53.2	2.086	0.149
Overweight	59.7	•	
Type of diet			
Vegetarian	41.42	4.203	0.40
Non-vegetarian	53.8		
History of taking WIFS			
Taking WIFS	51.8	14.723	0.001
Not taking WIFS	56.5		
Correctly taking WIFS	28.6		
Monthly income			
<1000	64.3		0.009
1000-3000	46.4	11.633	
3000-4000	54.0		
>4000	54.3		

#### **DISCUSSION**

It can be seen that all the age groups have been adequately represented in the study sample which adds to the validity of the study. The sex ratio of the study sample is 873 females per 1000 males. This is similar to the adolescent sex ratio of Kerala as per census 2011 data 963 females/ 1000 males. <sup>20</sup> In the study sample it can be seen that the number of Christians is much higher than the census data of Alappuzha 2011 which as 20.45%. <sup>21</sup> It could be attributed to the closeness of the sampling area to seashore where large number of Christians especially Latin Catholics live. <sup>22</sup>

The prevalence of anemia in the current study (53.5%) is comparable to other studies that has been done in South

India but is lower than studies from the Northern region. As per the study conducted by Amudha et al in Selam, Tamil Nadu among girls in 10-19 age group anaemia was 83%. 12 But as per the study conducted by Asha et al in Thiruvananthapuram among girls it was lower at 48%.<sup>18</sup> But in a study conducted in Kollam, Kerala by Rakesh et al among 5-17 year old boys and girls the prevalence of anaemia was 72.3%.16 Similarly Anagha et al in Kozhikode among 11-16 girls it was 75.57%.<sup>23</sup> But a study in Kottayam by Siva et al reported a very low prevalence of 21% among adolescent girls.<sup>24</sup> In a study conducted by Vitull et al among 10-20 year olds in rural Punjab it was found to be 88.7%. 11 Other than the study conducted by Siva et al the studies in South India report a prevalence of anemia among adolescents to be at par with the current study.

In the current study females were found to have a higher prevalence of anemia compared to males (62% vs. 46.1%). This difference that was found may be attributed to the higher biological requirement of iron among females in adolescence, lower total food intake and due to menstrual blood loss. Similar results have been described by Rakesh et al in Kollam Kerala where 77.5% of female adolescents were anemic compared to 67% in males. This difference was also seen in logistic regression analysis where female had an odds ratio of 1.740 (C.I - 1.417-2.136) of being anemic. In a study in south west Ethiopia among school going adolescent girls the odds of anemia was 3.04 (1.41-6.57) among females compared to males. The compared to males.

Another important finding of the study was the decreased scholastic performance of anemic children compared to non-anemic children. Micronutrient deficiencies, especially those related to iodine and iron, are linked to different cognitive impairments, as well as to potential long-term behavioral changes. Among the cognitive impairments caused by iron deficiency, those referring to attention span, intelligence, and sensory perception functions are mainly cited, as well as those associated with emotions and behavior, often directly related to the presence of iron deficiency anemia.<sup>26</sup> Similar results have been obtained in the study conducted by More et al in Maharashtra which showed scholastic performance, IQ and scores of mental balance, attention and concentration, verbal memory and recognition were decreased in iron deficient girls, both anemic and non anemic as compared to the non-iron deficient girls.<sup>27</sup> Effect of improvement of grades has also been noted in the study by Reddy et al in Bellary in Karnataka who showed that following iron supplementation, 48% of anemic children showed improvement the grades (p<0.05), 44.4% children in the iron deficiency without anemia group showed improvement in the grades (p<0.05) whereas 6.3% of the non anemia, non-iron deficiency group showed improvement in grades.<sup>28</sup> Thus it can be seen that scholastic performance in anemia is reversible given proper iron therapy.

Obesity was found to be another risk factor for anemia in the current study. The prevalence of anemia among obese and overweight was 59.7 vs. 53.2 in the non-obese group. Obesity associated inflammation is tightly linked to iron deficiency and involves impaired duodenal iron absorption with low expression of duodenal ferroportion (FPN) along with elevated Hepcidin concentrations.<sup>2</sup> Similar findings were found in the study conducted b Siva et al where prevalence of anemia among obese was 37.5%, 26.1% in overweight and in normal was 21.4%. Hamiel in Israel also reported iron levels below 45 mcg/dL, were noted in 38.8% of obese children, 12.1% of overweight children compared with 4.4% of the normal weight group (p<0.001).<sup>30</sup> Some studies also report a converse relationship as in the case of Kordas et al who reported a lower prevalence of anemia among overweight and obese Columbian women of reproductive age.<sup>3</sup>

Weekly Iron and Folic acid Supplementation programme was an ambitious programme started by the Government of India for reduction of anemia among adolescent boys and girls through supervised weekly ingestion of IFA and biannual deworming. Our study also shows the relevance of WIFS program. As per the current study 56.6% vs. 28.6% were found to be anemic among irregular and regular takers WIFS. Effectiveness of WIFS in reducing anemia has also been shown by the study conducted by Shobha P Shah who reported prevalence of anemia to have reduced from 79.5% to 58% among adolescent girlsand, from 64% to 39% among boys.<sup>32</sup> As per the study conducted by Mohan Joshi et al in Nagpur, the mean rise of Hb in the daily iron and folic acid supplementation compared to weekly WIFS programme was comparable and the adverse drug reactions were lower in the daily regimen.<sup>33</sup> Thus weekly regimen can be considered more promising than daily regimen with better treatment compliance.

Monthly income in the family was another factor that was significantly associated with anemia among the study subjects with lesser income categories showing higher burden. These results are consistent with the findings of Gawarika et al who conducted a study in Madhya Pradesh among adolescent girls belonging to different economic group and reported a higher overall prevalence of anemia of 96.5% among lower income group and 65.18% among girls belonging to middle and higher income groups.34 This may be because of better availability of high quality foods and better health awareness for children with better socio-economic status. Corroborating findings was reported by Kim et al in the study to find the relationship between socioeconomic status and anemia prevalence in adolescent girls in Korea.<sup>35</sup> He reported that higher socioeconomic status leads to decreased prevalence of anemia and IDA in Korean adolescent girls.

## **CONCLUSION**

The study reports a high prevalence of anaemia among adolescents both male and female in the study population. The major risk factors found associated were female gender, obesity and overweight, not taking weekly iron and folic acid and income less than 1000 INR in the family. The scholastic performance of the anaemic were significantly lower that non anaemic

#### Recommendations

The authors strongly recommend the overall strengthening of the WIFS programme and induct novel techniques to improve the compliance of the programme.

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Ethical approval: The study was approved by the

Institutional Ethics Committee

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