Original Article

A Study of Clinicopathological Patterns of Anemia in Different Groups of Schoolchildren

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Abstract

Introduction: Anemia is a global public health problem affecting both developing and developed countries with major consequences for human health as well as social and economic development.

Aims and Objectives: This study is intended to be carried out with an aim to determine prevalence pattern and various hematological as well as morphological types of anemia in children.

Materials and Methods: Prospective observational study including children from the age 5 to 15 years from selected day schools and residential schools in Warangal. Period of study was from December 2018 to November 2020.

Discussion: Anemia makes individual susceptible to various health-related risks including infection anemia in childhood and infancy has long-lasting neural and behavioral effects too apart from delaying and impairing the growth.

Aims of Study: The number of subjects was less as compared to other studies as consent to draw blood was given in limited number of children and study was conducted in only few schools.

Results: This study has pointed out that the problem of anemia is widespread especially among residential schoolchildren, especially among boys rather than commonly considered groups of lactating and pregnant women.

Conclusion: In the present study, prevalence of anemia is higher in 5–10 years age group, with a mean age group of 8.6 ± 2.4 years. Male preponderance is observed in our study.

Key words: Anemia, Nutritional status, Prevalence, Risk factors

INTRODUCTION

Anemia is a global public health problem affecting both developing and developed countries with major consequences for human health as well as social and economic development. Anemia is a condition in which the hemoglobin in the blood is below the normal range appropriate for age and sex.[1] Anemia is the most widespread global issue prevalent in the developing nations like India, particularly in children and females.[2,3]

According to estimate carried out between 1993 and 2005 by the WHO, prevalence of anemia in preschool children was 47.4% and school-aged children was 25.4%, while that of preschool children from Southeast Asia as per the WHO region was 65.5%. As per data in 2013, anemia has caused over 183,000 deaths.[4] Etiology of anemia is multifactorial. Although the extent of the developmental difficulty varies with individual child, studies have shown that marked iron deficiency can cause CNS damage.[5] If anemia is left un treated, it will lead to reduced body functions, decreased performance, slow down normal physiology, increased comorbidities, and mortality.[6] As anemia accounts for significant morbidity and mortality and in view of not enough studies done comparing prevalence of anemia among residential schoolchildren and day schoolchildren, there is a need for study to know the prevalence of nutritional anemia.

The present study was undertaken to evaluate the hematological and biochemical parameters to aid in

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understanding clinicopathological patterns of anemia and their causes in schoolchildren and to determine the prevalence of various morphological types of anemia in two different groups of schoolchildren.

Aims and Objectives

Aims

This study is intended to be carried out with an aim to determine prevalence pattern and various hematological as well as morphological types of anemia in children.

Objectives

The objectives of the study were as follows:
1. To assess case burden and various etiologies of anemia
2. To detect morphological types of anemia prevalent among schoolchildren.

MATERIALS AND METHODS

Study Design

Prospective observational study including children from the age 5 to 15 years from selected day schools and residential schools in Warangal.

Study Period

The study period was from December 2018 to November 2020.

Source of Data

Children of age group from 5 to 15 years who are clinically diagnosed as anemic are studied from December 2018 to November 2020 at hostels in Warangal shall be selected for the present study.

Inclusion Criteria

Children of age 5–15 years among day and residential schools were included in the study.

Exclusion Criteria

The following criteria were excluded from the study:
1. Age below 5 years and above 15 years
2. Children with primary hematological disorders involving diseases of WBCs, platelets, and hereditary anemia
3. No consent.

Sample Size

A total of 210 children from the age 5 to 15 years from selected day schools and residential schools were included in the study.

Method of Data Collection

Informed consent was obtained from the parents, and the Institutional Ethical Committee approved the study protocol. The data regarding socioeconomic status, nutritional status, and dietary habit were collected with the help of junior residents and school teachers. The pro forma also included information on the known medical problems of child if any. All children were weighed and taken as under nourished according to Indian Academy of Pediatrics criteria.

During physical examination, the following signs and symptoms were noted: Pallor, edema, clubbing, skin (dryness, rashes, and irritation), abnormal pigmentation, coarse hair, puffiness of face, thinning of eyebrows, nail defects, eyes, and face.

Venous blood was drawn from all the patients with clinical pallor and every sample was analyzed for hemoglobin (Hb) concentration, hematocrit, erythrocyte indices (mean corpuscular volume, mean corpuscular hemoglobin, and mean corpuscular Hb concentration), differential count, erythrocyte sedimentation rate, and red cell distribution width. Serum iron levels, total iron binding capacity, serum ferritin, and serum Vitamin B12 levels were done wherever necessary. Peripheral blood film was prepared using Leishman's stain. The red blood cell morphology was studied. Grading of anemia among different age groups was done using the WHO Hb concentrations for the diagnosis of anemia and assessment of severity criteria. Microscopic evaluation of blood was also done to obtain the microscopic picture. Stool samples were obtained and were evaluated under microscope to rule out intestinal parasitic infections.

OBSERVATIONS AND RESULTS

The present study is carried out in 210 children in the age group of 5–15 years. 5–10 years children were found to be most affected, constituting 72.40% followed by 27.60% of 10–15 years children. The average age effected was 8 years and 6 months with a standard deviation of 2.471.

Out of the 210 children studied, 117 (55.70%) were male and 93 (44.30%) were female. Distribution of male and female children is almost equal in day scholar and residential schools with no statistical significance ($P = 0.0507$).

Economic status is evaluated using modified Kuppuswamy scale. Out of 210 children studied, 109 (51.90%) children have low socioeconomic background and 101 (48.10%) are in middle class. There is no significant difference in socioeconomic status in two groups of schoolchildren ($P = 0.129$).

Out of 95 (45.20%) children of lower upper class, 52 (24.80%) are male, 43 (20.50%) are female. Out of 94

(44.80%) children of lower middle class, 50 (23.80%) are male, 44 (21%) are female. Overall in lower socioeconomic classes, male children were higher in number but statistically *P*-value is not significant (0.388).

In our study, anemia was found to be higher in non-vegetarians constituting 148 (70.50%) than vegetarians 62 (29.50%), in both day and residential schoolchildren. However, this finding is not significant statistically (*P* = 0.901).

Out of 148 (70.50%) children who consume non-vegetarian diet, 85 (40.50%) are male and rest are female constituting 63 (30%). Out of 62 (29.50%) children who are vegetarians, 32 (15.20%) are male, and rest are female constituting 30 (14.30%).

Out of 210 children, 126 (60%) have BMI between 10 and 50th centile, 27 (12.90%) children have BMI between 5 and 10th centile followed by 22 (10.50%) children have BMI of 3rd centile, with no significant difference in BMI among children with anemia in day and residential schoolchildren.

In the present study, the common presenting symptoms were easy fatiguability 174 (82.9%) and pica 20 (9.5%) which is more in females (5.20%) when compared to males (4.30%). Other symptoms such as hair loss, rapid heartbeat, decreased concentration, and headache were found only in few children with moderate and severe grades of anemia.

In the present study, most common sign was pallor constituting 47.6%. Other signs include bald tongue (6.1%), hypopigmented hair (3.33%), and nail changes, that is, koilonychia and platynychia constituting (2.8%).

In the present study, majority of them 82 (39%) had moderate anemia followed by 44 (21%) children had mild anemia and 18 (8.6%) had severe anemia. Incidence of moderate and severe anemia in residential schoolchildren is higher than day schoolchildren, which was found to be statistically significant with *P* = 0.043.

Among 210 children, 144 children had anemia, therefore, in the present study, total prevalence of anemia is 68.57%. Among 102 (48.57%) children of 5–10 years, 31 were found to have mild anemia, 57 had moderate anemia, and 14 had severe anemia. Out of 42 (20%) children among 11–15 years, 13 had mild anemia, 25 had moderate anemia, and 4 had severe anemia. In the present study among all age groups, moderate anemia is more common. Statistically, this association between age and severity of anemia was not found significant (*P* = 0.879) [Tables 1-6].

DISCUSSION

Anemia makes individual susceptible to various health-related risks including infection. Anemia in childhood and infancy has long-lasting neural and behavioral effects too apart from delaying and impairing the growth. A number of studies on anemia in children have been performed; however, they focus on the prevalence and severity of anemia. Moreover, there are limited or almost no studies available comparing this problem in children aged 5–15 years in day and residential schools. Hence, the present study was planned, evaluating the clinic pathological profile of anemia in two groups of schoolchildren and also to know the influence of factors such as age, sex, socioeconomic status, and diet in day schools and residential schoolchildren.

This is a prospective observational study conducted from December 2018 to November 2020 among 5–15 years anemic children from randomly selected schools in Warangal.

A total of 210 children free of any hematological disorder affecting white blood cell and platelet counts were enrolled in the study. In the present study, we used the WHO criteria for the assessment of severity of anemia.

Data analysis done, results depicted in tables and figures. At the completion of the study, results were tabulated and analyzed. The results are compared with other studies on anemia in schoolchildren and discussed as below.

The age group included in our study was similar to the study done by Kumar *et al*. Male:female distribution is similar to studies done by Muthuraman *et al*. and Jain *et al*.

In the present study, maximum number of cases were aged 5–10 years followed by those aged 11–15 years. Mean age of children affected with anemia was 8.6 ± 2.4 years.

Comparison of Prevalence of Anemia

Studies	Muthuraman *et al*.	Jain *et al*.	Present study
Prevalence	20%	56.5%	68.57%

In our study, the prevalence of anemia was 68.57% which was similar to the prevalence of Jain *et al*. study. In Muthuraman *et al*. study, the prevalence was 20%, including wide age group and more number of subjects.

Comparison of Gender Distribution in Anemic Children

Studies	Muthuram an *et al*. (%)	Ramanas astry *et al*. (%)	Kumar *et al*. (%)	Present study (%)
Male	61.2	36.37	53.36	55.7
Female	38.8	63.63	46.64	44.3

In the presents study, majority of anemic children were male (55.7%), similar findings are seen in Sumanth Kumar and Muthuraman study. However, no significant association between anemia severity and gender could be seen. Saba *et al.* in their study have shown 58.4% of males being affected. Muthusamy *et al.* in their study had 55.6% affected males. Chhabra *et al.* in their hospital-based study reported the dominance of males (64.4%). However, Sharma *et al.* found majority of anemic children to be girls (51.4%).

Comparison of Socioeconomic Status in Anemic Children

Study	Kumar *et al*. (%)	Present study (%)
Upper class	3.37 (class 1)	-
Middle class	33.17 (class 2+3)	44.8 (class 3)
Lower class	63.46 (class 4+5)	45.20 (class 4)

In this study, the prevalence of anemia was more in lower socioeconomic class, as a total number of children in Class 3 and Class 4 socioeconomic classes are more in our study. These findings are comparable with Sumanth Kumar study.

The lower socioeconomic status of the parents also has been reported as a major risk factor for the development of anemia. Rani and Bandrapalli (2017) have also reported that with the improvement of socioeconomic status, the prevalence of anemia decreases, the high prevalence of anemia was reported in children belonging to class 4th contrast, Chopra *et al.* (2011) have observed a high prevalence of anemia among children belonging to the upper and upper middle socioeconomic class.

Dietary factors play an important role in the development of iron deficiency anemia. A significant correlation has been reported between severe malnutrition and less protein consumption with iron deficiency anemia.

In our study, it was noted that among anemic children, 22.8% take vegetarian diet while majority of them 45.7% take non-vegetarian diet. Reason for this could be less frequent intake of non-veg food or habit of drinking tea or coffee along with major meals. Studies have shown that patients who take less than 2 servings of the red meat per week are more prone to develop IDA. The inhibitory effect of tea and coffee on absorption of iron is well proven. Desalegn *et al.* (2014) have reported that children who do not consume protein rich food are more likely to develop iron deficiency anemia than those who consume protein-rich foods. In a study of Chaturbedi *et al.* (2017), have observed that in vegetarians, anemia was higher than non-vegetarians. In addition, they have also pointed out that post-meal consumption of tea and coffee had increased association with anemia.

In the present study, major presenting complaints included easy fatiguability (82.9%), pallor (47.6%), and pica (9.5%).

Similar to our study, weakness and pallor have been reported to be the common findings in different studies similar to our study, Nalli *et al.* also reported pallor and fatigue as the presenting symptoms in a large majority (87.5% and 72.5%) of their cases. Pica is found in 50% of children in a study conducted by Crosby *et al.* However, according to the WHO, clinically visible pallor appears in children when the Hb level falls below 7–8 g.

The common sign of anemia is characterized by pallor because of reduced oxyhemoglobin concentration in the skin and in the mucous membrane. In severely anemic individual troubled breathing, lightheadedness and hair loss have also been reported. Unnikrishnan *et al.* (2017) classified the study subjects primarily based on the physical examination. In their study, they have shown that depending on the presence of mucosal and conjunctival pallor, nail changes, and associated symptoms, 30% of girls and 20% of boys were successfully identified clinically as having anemia.

In our study, we found that mild, moderate, and severe anemia were 21%, 39%, and 8.60%, respectively. Studies conducted by Sumanth Kumar and Abhay Prakash also had predominant distribution of moderate anemia.

Compared to the findings of the present study, Saba *et al.* in their study also showed mild, moderate, and severe grades of anemia in 12.7%, 75.82%, and 11.43% of patients, respectively, thus showing a dominance of children with moderate anemia as observed in the present study. While, studies conducted by Muthuraman and Ramanasastry had predominant distribution of severe anemia.

The role of socioeconomic factors, regional differences, and other demographic factors could also affect the profile of severity of anemia in different studies.

Table 1: Age-wise distribution in study population

Age group (years)	Frequency	Percentage
5–10	152	72.40
10–15	58	27.60
Total	210	100

Table 2: Gender-wise distribution in study population

School	Gender (%)		Total (%)	Chi-square	*P*-value
	Male	Female			
Residential school	55 (26.20)	48 (22.90)	103 (49)	0.44	0.507
Day scholar	62 (29.50)	45 (21.40)	107 (51)		
Total	117 (55.70)	93 (44.30)	210 (100)		

Table 3: Socioeconomic status distribution in study population

Socioeconomic status	School (%)		Total (%)	Chi-square	P-value
	Residential	Day scholar			
Middle upper (class 2)	4 (1.90)	3 (1.40)	7 (3.30)	5.663	0.129
Middle lower (class 3)	45 (21.40)	49 (23.30)	94 (44.80)		
Lower upper (class 4)	43 (20.50)	52 (24.80)	95 (45.20)		
Lower lower (class 5)	11 (5.20)	3 (1.40)	14 (6.70)		
Total	103 (49)	107 (51)	210 (100)		

Table 4: Association between socioeconomic status and gender

Socioeconomic status	Gender (%)		Total (%)	Chi-square	P-value
	Male	Female			
Upper middle	6 (2.90)	0.50 (14.30)	7 (3.30)	3.064	0.388
Lower middle	50 (23.80)	44 (21)	94 (44.80)		
Lower upper	52 (24.80)	43 (20.50)	95 (45.20)		
Lower lower	9 (4.30)	5 (2.40)	14 (6.70)		
Total	117 (55.70)	93 (44.30)	210 (100)		

Table 5: Distribution of dietary habits in schoolchildren

Food	School (%)		Total number and %	Chi-square	P-value
	Residential	Day school			
Veg	30 (14.30)	32 (15.20)	62 (29.5)	0.015	0.901
Non-veg	73 (34.80)	75 (35.70)	148 (70.50)		
Total	103 (49)	107 (51)	210 (100)		

Table 6: Association between gender and dietary habits

Food	Gender		Total	Chi-square	P-value
	Male	Female			
Veg	32 (15.20)	30 (14.30)	62 (29.50)	0.6	0.439
Non-veg	85 (40.50)	63 (30)	148 (70.50)		
Total	117 (55.70)	93 (44.30)	210 (100)		

The majority of children in this study is found to have iron deficiency anemia constituting for 137 (65.23%) out of 210 and 7.6% megaloblastic anemia. The prevalence of iron deficiency anemia in the present study is similar to prevalence in studies conducted by Gomber *et al.*, Kuamr *et al.*, and Muthuram *et al.* and Sastry *et al.* studies have slight higher prevalence than the present study.

Serum ferritin levels are low in iron deficiency anemia children, this finding correlates with the studies done by Shine *et al.* who concluded that low serum ferritin is the best single laboratory parameter to diagnose iron deficiency.

Limitations of the Study

1. The number of subjects was less as compared to other studies as consent to draw blood was given in limited number of children and study was conducted in only few schools
2. The descriptive diet assessment was not possible in this study. A detailed analysis of the dietary assessment was needed to point out the exact association between the diet and the anemia
3. Only few stool samples were evaluated as the parents and children were reluctant to provide the stool sample for the study
4. The small study sample had made the scope of his study limited. A prospective longitudinal study multicenter study is needed to validate the findings observed in this study.

CONCLUSION AND SUMMARY

- In the present study, the prevalence of anemia is higher in 5–10 years age group, with a mean age group of 8.6 ± 2.4 years
- Overall prevalence of anemia was 68.57%
- Male preponderance is observed in our study
- Non-vegetarian children are more affected compared to their vegetarian counterparts
- Children belonging to middle and lower socioeconomic class (Class 3 and 4) have higher prevalence of anemic
- Easy fatiguability is most common symptom which is more observed in female children than males and pallor is the most common sign
- Among anemic children in all age groups, moderate anemia is more common. Proportion of mild-moderate and severe anemia was 39%, 21%, and 8.6%, respectively
- Among day school and residential schoolchildren, who are anemic, majority are non-vegetarians with moderate grade anemia

- Residential schoolchildren are more anemic than day schoolchildren
- Among residential schoolchildren, males are more affected than females
- Mean Hb among day schoolchildren is 10.7 ± 1.6 and residential schoolchildren is 9.9 ± 1.6
- Mean MCV among day schoolchildren is 75.8 ± 6.9 and residential schoolchildren is 73.7 ± 6.8
- Mean MCH among day schoolchildren is 24.9 ± 3.6 and residential schoolchildren is 24.3 ± 3.3
- Microcytic hypochromic anemia is most common morphological form followed by normocytic normochromic anemia
- Iron deficiency anemia is most common cause of anemia among schoolchildren.

SUMMARY

1. This study has pointed out that the problem of anemia is widespread especially among residential schoolchildren, especially among boys rather than commonly considered groups of lactating and pregnant women
2. Awareness of anemia is very poor in school-going children. Nutrition and health education session should be conducted in school with teachers and parents' involvement to raise awareness regarding anemia and WIFS program
3. Awareness creation on water and sanitation and nutritional counseling to parents on consumption of iron-rich foods and iron supplementation to prevent anemia among young children with special emphasis on those from low-income group and socioeconomic deprived communities.

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