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Research Article

PREVALENCE OF ANEMIA IN ADOLESCENT SCHOOL GOING GIRLS IN RURAL AREA. IS WORM INFESTATION RESPONSIBLE?

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ABSTRACT

Aim: The aim was to find out the prevalence of anemia in the adolescent girls in the schools of rural area and the influence of worm infestation on severity of anemia.
Materials and methods: It was a cross-sectionals study. 1000 school going adolescent girls were enrolled for the study of different school but of same locality after informed consent. Data for demographic profile were collected, followed by blood and stool sample collection for analysis of hemoglobin, iron profile, vitamin B12 and ova and cyst in stool.
Results: We found prevalence of anemia was 48.9% in the study population. Anemia distribution was significantly associated with low socioeconomic class (SEC), low body mass index (BMI), and worm infestation. The prevalence of worm infestation was as high as 48.2% in study population.
Conclusion: Based on this study we can conclude that Annual screening for anemia along with health and hygiene education must be taught. Poverty alleviation program would definitely aid in developing strategies and programs to improve adolescence health and regular deworming is prudent where open field defecation is prevailing due to lack of indoor toilets.

INTRODUCTION

Iron deficiency (Microcytic Hypochromic) Anemia is the most prevalent form of anemia in adolescent girls in rural India with a prevalence rate of more than 80% in major states. The prevalence depicted in this state is above 90%.[1] Adolescence period is highly vulnerable to health issues as this is the transition period from childhood to adulthood and require meeting the health and developmental needs. Social, educational and nutritional negligence has primarily affected the adolescent girls and pushed them for growth retardation, poor physical development, impaired social and mental behavior and poor reproductive growth in future owing to deficient iron and vitamin B12 reserve. Anemia management has been a prime focus of present national program not only for their optimum growth and development but also to reduce the future risk of maternal mortality and morbidity. Screenings for anemia are being carried out by government institution time to time in different geographical areas in different seasonal period. However, very limited data are available in adolescent group from Pune area of India.

For girls, especially in adolescence age which is usually a period of extreme stress and strain. Menarche and menstruation are usually produced tremendous psychological turbulence in them. In conservative society like India more so in rural area where these problems are never or hardly discussed even with mother or anybody freely, they follow some firm customs, practices, and misbelieves, which are detrimental during adolescent period. requirements of girls increase dramatically during adolescence as a result of the expansion of the lean body mass, total blood volume, and the onset of menstruation, these changes make adolescent girls more susceptible to anemia and the later will appear more prominent if child infested with worms. The requirement of dietary iron may be compounded in setup of poor dietary habit, unhygienic condition, low socioeconomical status and over that worm infestation. Hence, the health of adolescent girls demands special attention especially in developing country like India. This country is a home of nearly 113 million adolescent girls-the prevalence of anemia in adolescent girls is estimated at 56%.[1] According to District Level Household Survey (DLHS) which was done in 2002–2006, that showed the prevalence of moderate type of anemia in adolescent girls was found to be 53%, whereas severe type of anemia was 29% in Maharashtra.[2]

Anemia due to Intestinal worm infestations is widely prevalent in tropical and subtropical countries. It occurs where there is

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poverty and poor sanitation prevails. Soil-transmitted helminth (STH) infections form the most important group of intestinal worms affecting two billion people worldwide and the main species which infect are Ascaris lumbricoides, (roundworms), Trichuris trichiura, (whip worms) and Necator americanus /Ancylostoma duodenale (hookworms).[3] According to World Health Organisation (WHO), globally there are 1221 to 1472 million cases of Ascariasis, 740 to1300 million cases of hookworm and 750 to 1050 million cases of Trichuriasis infestation.[4] These STHs are also considered as Neglected Tropical Diseases as they inflict considerable morbidity and mortality, though entirely preventable by maintenance of good hygiene and sanitation and regular deworming program.

This study was undertaken in order to find out the prevalence of anemia in the adolescent girls in the schools of rural area and the influence of worm infestation along with vitamin 12 and iron.

MATERIAL AND METHODS

The study was a cross-sectional study conducted in the schools of rural areas of Pune district of Maharashtra, India. The study was approved by the Institutional Ethics Committee and requisite consent was taken from parents/legal heir and also from the management of school including Principals. Total 1000 school going adolescent girls of age group 10-18 years in Pune district whose parents/legal heir signed consent form were enrolled for the study. Semi-structured, predesigned and pre-tested, self-administered questionnaire was used to fill up all required demographic profiles. Blood was collected under all aseptic conditions for evaluating serum iron, total iron binding capacity (TIBC) and vitamin B12 levels. Serum B12 was measured using Electrochemiluminescence method in Cobas e-400 immunoassay auto analyzer, and serum Iron and TIBC measured using Iron- Ferrozine method in Biosystem B 400 fully automated clinical auto analyzer. All other support was provided from our institution, INHS Asvini.

The girls were provided with wide mouthed clean, dry, labeled plastic containers for collection of stool samples a day previous and were asked to provide 5 g of solid or 10 ml of liquid stool. The stool samples were examined next morning when blood sample was collected. Macroscopic examination was carried out to identify structures like adult tapeworm, Ascaris, proglottids, scolices, Enterobius, Trichuris and hookworms. Unstained wet saline mount preparations were done to detect eggs or larvae and Iodine wet mount was done to detect cysts. However cases which were found negative by saline preparation method, Formal-Ether concentration technique were adopted.

Inclusion criteria

1. School going adolescent girls of age group 10-18 years
2. Anemia due to nutritional cause

Exclusion criteria

1. School going adolescent girls of age less than 10 and more than 18 years
2. Anemia due to some other cause like, Hemolytic anemia, Aplastic aneamia, anemia of prolonged illness etc
3. Anemia due to blood dyscrasias, and Coagulopathy, hypothyroidism.
4. Iron supplementation in the form of capsule or syrup was used in by participants

Participants (girls) were selected by two stage random sampling design, four middle and four high schools selected by cluster random sampling as the first-stage unit. At the second stage, school girls were selected by stratified random sampling in each unit.

Data were collected by a designed data gathering form. Investigated variables included age, parent's educational level, family size, age at menarche, history of excessive menstrual bleeding, vegetarian or not vegetarian diet, taking tea just before or after eating food, history of parasitic infestation in the last two to three months. Height and weight of the students were measured and Body Mass Index (BMI) was calculated as weight in kilo-grams divided by square of height in meters. BMI was subdivided into low (<18.5 kg/m2), normal (18.5-24.9 kg/m2) and high (≥ 25 kg/m2), we followed WHO criteria.[5]

Anemia was considered with cut off point for hemoglobin level < 12 g/dL, [6] the severity of anemia was categorized as mild (10-12 g/dL), moderate (7-10 g/dL) and severe (<7 g/dL).[7] Iron deficiency was determined as serum ferritin concentration less than 12 μg/L, and iron deficiency anemia was defined as anemia with serum ferritin concentration less than 12 μg/L.

Correlations between hemoglobin and serum ferritin and TIBC were evaluated by Pearson's correlation test. Independent relationship of hemoglobin concentration with MCV, BMI, age, serum ferritin, and TIBC was assessed by stepwise multiple regression analysis. Logistic regression was performed to determine the association of anemia with various factors including, parents' educational level, family size, status of menarche, type of diet, history of parasite infestation in the last three months or more, *P*-value < 0.05 was considered statistically significant. Statistical analysis in our study was done with SPSS software (v. 19, SPSS Inc).

RESULTS

Mean age of the participants was 14.64±1.75 years. 43.1 % (431) of girls were in late adolescence (15-18 years). Majority of girls were in families with parents' educational level below secondary level. 79.4% (794/1000) of girls attained menarche at the time of study. Among 1000, 829 girls (82.9%) girls were vegetarian. History of parasite infestation in the recent three months was positive in 62.1% (621/1000) of them.

There was not significant correlation between hemoglobin concentration and serum ferritin (r=-0.093, p=0.078), but a significant negative correlation between hemoglobin concentration and TIBC (r=-0.397, p<0.001) as shown in Table 1.

The prevalence of anemia in the study population was found to be 77.1 % (n=771/1000). The distribution of mild, moderate and severe forms of anemia has been illustrated in figure-1. Mild form of anemia was the most prevalent form of anemia and present in 453/ 1000 girls (45.3%). The mean ± SD hemoglobin levels for total anemic girls including mild, moderate and severe (n= 771) was 7.8 ± 1.28 which was

significantly low (p<0.001) as compared to non-anemic subjects (n=229) with Mean ± SD of 12.8 ± 0.97.

Table 1 Hematological and iron indices

Variables	Maximum	Minimum	Mean	Standard deviation
Hb (g/dl)	15	5	9.81	3.19
HCT (%)	52.30	12.20	32.38	3.07
MCV (fl)	98.2	31.30	63.87	9.83
MCH (pg)	36.10	18.60	28.85	3.58
MCHC (g/dl)	26.50	21	34.33	1.12
RBC/µ	$7.66^{a}\ 10^{6}$	$3.72^{a}\ 10^{6}$	$4.85^{a}\ 10^{6}$	$0.5^{a}\ 10^{6}$
Serum iron (µg/dl)	167	15	95.82	33.83
Serum ferritin (ng/ml)	265.4	3	31.99	39.74
TIBC (µg/dl)	501	271	498.62	31.02

Foot note: [a]Hb: hemoglobin, HCT: hematocrit, MCV: mean corpuscular volume, MCH: mean corpuscular hemoglobin, MCHC: mean corpuscular hemoglobin concentrate, RBC: red blood cells count, TIBC: total iron binding capacity.

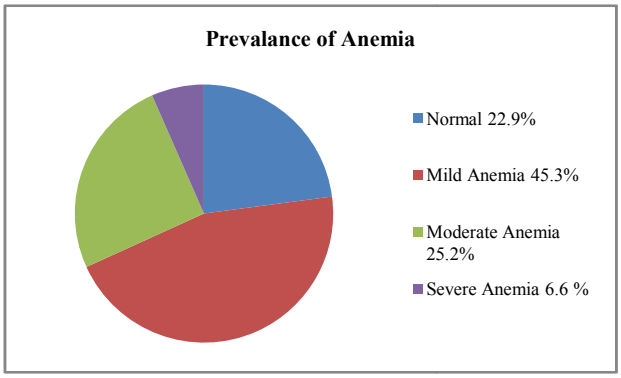

Figure 1 The distribution of Anemia

Table 2 The prevalence of anemia in the study population

Hg	No of girls
Normal	229 (22.9%)
Mild Anemia	453 (45.3%)
Moderate Anemia	252(25.2 %)
Severe Anemia	66(6.6%)

The hemoglobin concentration of the study population depicted significant association with different SE class, with diet pattern and BMI (p<0.001). Though 38.3% (383/1000) of study population preferred mixed diet, however, prevalence of anemia was found to be 72.84% (279/383) in this group.

Table 3 Distribution of Anemia among different socioeconomic class, BMI and dietary pattern

SE Class [a]	Hb (gm %) / degree of Anemia				Total Girls
	Normal (n=229)	Mild(n=453)	Moderate (n=252)	Severe (n=66)	
II	134	279	109	40	562
III	37	82	79	10	208
IV	31	58	51	08	148
V	27	34	13	08	82
			P< 0.01		
BMI					
Below 18.5	134	244	219	61	658
18.5 -25	92	206	32	05	335
25.1-29	03	03	01	0	07
			P< 0.001		
Type of regular diet					
Vegetarian	203	439	239	59	940
Non vegetarian	26	14	13	07	60
			***P*< 0.001**		

[1] Foot Note: Source of SE scale was taken from Revision of Prasad's socioeconomic status classification revised for the year 2016, http://www.prasadscaleupdate.weebly.com. http://www.jiaphd.org

Vitamin B12 deficiency was most prevalent (31.7%) followed by iron deficiency (31.2%) and combined iron and vitamin B12 deficiency (17.1%). The Prevalence of iron and vitamin B12 deficiency among Girls is shown in Figure 2.

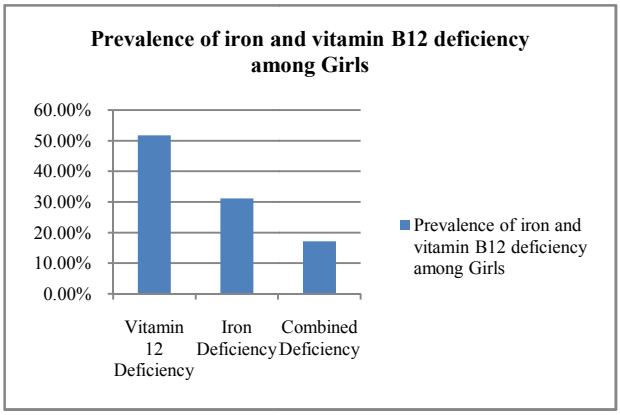

Figure 2 Prevalence of iron and vitamin B12 deficiency among Girls

The highest parasitosis was found in the age group 10 to 15 (83.33%). The overall prevalence of intestinal parasitosis in study population was found to be 48.2% (482/1000). The prevalence of Ascaris Lumbricoides was found to be the highest (44.7%), followed by Taenia (09.1%) and H. nana (1.7%). Relative prevalence of parasites detected in our study is shown in Fig. 3. However most of the positive cases were asymptomatic but absolute eosinophil counts (AEC) were found to be raised in 52.91% of positive cases. The AEC range was recorded between 270 and 1982 cells/cu.mm.

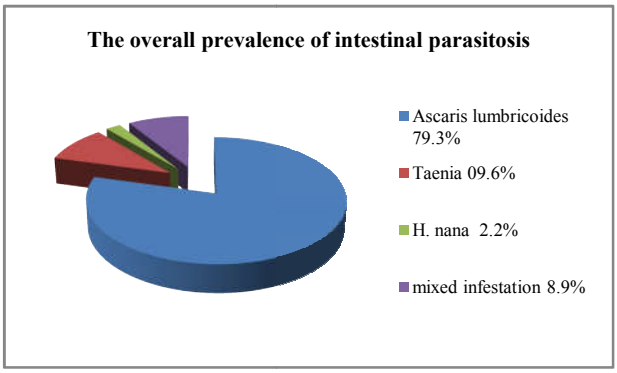

Figure 3 The overall prevalence of intestinal parasitosis

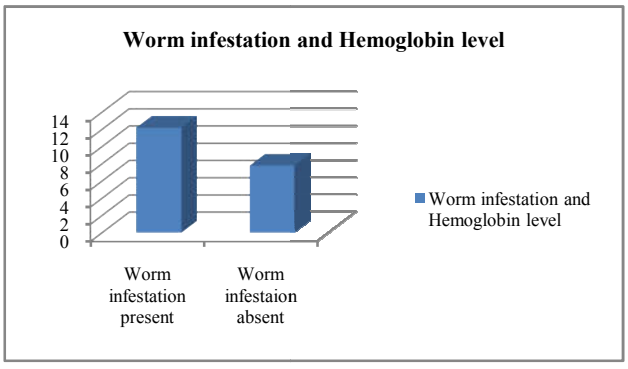

Figure 4 The mean hemoglobin level with / without worm infestation

The overall prevalence of intestinal parasitosis in study population was found to be 48.2% (482/1000). Out of 1000 girls population 48.2% (482/1000) revealed history of worm infestation and the prevalence of anemia in them was as high as 89.2 %. The mean hemoglobin level (7.8±1.2) was found to be significantly low (p<0.01) in these subjects as compared to the

subjects without worm infestation (12.2±1.4) as shown in figure-4.

Table 4 Univariate logistic regression analysis for risk factors of Anemia in adolescent school going girls

Variables	Total N=1000	OR	CI for OR lower-upper	P-value
Parents education level				
Mother – higher secondary & above	293	0.919	0.228-3.21	0.891
Secondary & below	707	0.382	0.778-5.09	0.219
Father – higher secondary & above	401	1.06	0.12- 4.77	0.943
Secondary & below	599	2.31	0.098-1.791	0.213
Family size				
1-3 children	691	Reference	-	-
>3 children	309	2.15	0.96-5.48	0.08
Status of menarche				
Yes	894	0.775	0.261-2.891	0.689
No	106	Reference	-	-
Menstruation duration:				
<5 days	759	Reference	-	-
>5days	241	1.78	0.64-4.83	0.297
Diet:				
Non vegetarian	60	0.9	0.12-7.18	0.911
Vegetarian	940	Reference	-	-
Worm infestation:				
Yes	482	7.89	1.66-28.11	0.008
No	518	Reference	-	-

The associations of socioeconomic and demographic factors with anemia (Hb%) evaluated by Univariate logistic regression analysis is shown in Table 4. From all factors, only parasite infestation in the last three months or more was found to contribute with a 7.89 times more risk of anemia than those without a history of worm infestation in the last three months (95% CI, 1.66-28.11).

DISCUSSION

Prevalence of anemia in the adolescent school going girls in rural areas of Pune was observed to be nearly 77 %. The mean age group of study subjects was 14 years who presented with anemia with mean hemoglobin concentration of 8.8 ± 1.16 gm/dl. Goyal *et al* [8] in their study showed prevalence of anemia was 43.11% in adolescent girls in rural area of Nainital, India, with mean age group of 14.29±1.81 years and mean hemoglobin concentration of 11.35gm/dl. In other study similar prevalence was reported by Kapoor *et al*.[9] (60%), Rana *et al*.[10] (60%), Singh *et al*.[11] (50%), and a higher prevalence has been reported in various other studies, namely, Bharati *et al*.[12] (99.9%) and Chaturvedi *et al*.[13] (73.7%). These differences probably due to the difference in area in different district of India, where difference was in basic facility like road, electricity drinking potable water, and sanitation facility may also vary.

A significant association was seen between girls being anemic and their socioeconomic status ($P < 0.01$). A higher proportion of girls were anemic in lower classes (IV and V) as compared to higher class (I, II, and III). These findings were similar to those studies conducted among adolescent girls by Rawat *et al*.[13] and Chaturvedi *et al*.[14] When the dietary history of these girls was taken it was seen that these nuclear families were consuming under diet less in protein, fat, vitamin and minerals because of low socioeconomical status and they were living in unhygienic condition where water born disease are likely to occur.

The prevalence of anemia was higher in those who have attained menarche in our study. Kaur *et al[15] and* Rajaratnam *et al*.[16] also reported a higher prevalence of anemia in girls who had attained menarche in their study. Heath *et al* [17] in their study reported that a high menstrual blood loss was associated with increased risk of anemia if not compensated with regular iron supplements and balanced diet. The additional nutritional requirements for growth and development during puberty and extra losses during menstruation might cause a higher prevalence of anemia in those who attained menarche and this anemia may aggravate more if they harbor worm infestation too.

Intestinal worm infestation is a global health problem and is a matter of serious concern for the third world countries. In developing country like India where overcrowding, poor sanitation, lack of safe potable water, outdoor defecation and contamination of water greatly favour transmission of parasitic infection resulting in high endemicity. Soil-transmitted helminth (STH) infections form the most important group of intestinal worms and account for 27% of entire school-age and preschool-age children population in the World, who are in need of anthelminthic treatment.[18] Present study revealed 48.2% parasitosis in the study population with Ascaris lumbricoides as the commonest parasite (79.3%), followed by Taenia (9.6%). Wani *et al* in 2009 [19] in their study in an adjoining district in Kashmir valley, India, also reported high prevalence of intestinal parasitic infection as high as 73.36% with the highest prevalence of A. Lumbricoides (69.84%), T. Trichiura (31.65%), Enterobius Vermicularis (16.80) and T. Saginata (3.01%).

Prevalence of intestinal parasites as reported by many authors in India and neighboring countries is summarized for ready reference. (Table 5)

Time to time Government of India is providing iron and folic acid supplementation along with deworming program with Albendazole 400 mg tablet given twice yearly to each school going children under supervision. Successful implementation of the program in those region where low prevalence of severe form of anemia, low worm infestation rate and high frequency of vitamin B12 deficiency without significant decrease in hemoglobin concentration. Folic acid supplementation is known for masking effect of vitamin B12 deficiency. [24] This might explain the reason why hemoglobin levels in vitamin B12 subjects did not show significant difference to the non-deficient group as the iron deficient subjects revealed.

Table 5 Summary of prevalence of parasitosis reported by other authors

Author name / country and year	Prevalence of parasitosis	Prevalence of Ascariasis infestation
Raghunathan *et al*[20] - Sri Lanka (2010)	34.56	14.93
Vinod Kumar *et al* (2003)[21]	71.73	23.73
Khanal L K *et al*[22] - Nepal (2004)	17.60	03.52
Wani *et al*[19] - India (2009)	73.36	69.84
Bisht *et al*[23] - India (2011)	38.20	6.25
Current study	48.2	79.3

In our study majority of population in the study region were vegetarian and eat over cooked food and less frequent meat intake might be the major contributory factor for vitamin B12 deficiency.

CONCLUSION

The present study revealed a comprehensive picture of sociodemographic factors, menstrual factors, dietary, and worm infestation has a direct effect of increasing prevalence and severity of anemia. The contributing factors of anemia seen in our study are: Low socioeconomic status, early onset of menarche, worm infestation and poor sanitation and lack of basic facility.

High prevalence of parasitosis (helminthic infection) in our study population may be attributed to their prevailing low standards of living conditions, poor sanitation, lack of personal hygiene, paucity of potable water, open defecation due to lack of proper indoor toilet and lack of proper disposal of sewage leading to soil contamination and high endemicity of intestinal helminthiasis.

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