Prevalence and determinants of nutritional anemia in an urban area among unmarried adolescent girls: A community-based cross-sectional study

Abstract

Introduction: Nutrition status prior to pregnancy is of vital importance. Inadequate iron stores before conception is a major cause of iron deficiency. The primary objective of this research was to estimate the prevalence of anaemia and the secondary objective was to assess various epidemiological factors associated with anaemia. **Methods:** A community based, cross – sectional study was carried among 207 unmarried adolescent girls between 10 to 19 years, residing in urban field practice area of tertiary care hospital in Mumbai for one year. All study participants social demographic profile, diet history was collected. Findings of clinical examination, height and weight was recorded. Blood and stools samples were collected after obtaining verbal consent from their parents. Univariate and binary logistic regression analysis was done using SPSS 11.5 version. **Results:** The overall prevalence of anaemia was 78.3%. Prevalence of mild, moderate and severe anaemia was 64.2%, 36.2% and 0.6% respectively. Study participants with BMI < 18.5 Kg/M^2 had significantly higher prevalence of anaemia. 88.9% had no knowledge regarding anaemia. In logistic regression analysis body mass index, per capita income and intestinal parasites in stool were the variables independently associated with anaemia. **Conclusions:** The high prevalence of anaemia among adolescent girls indicates need for additional nutritional support, iron folic acid supplementation including prevention and control of worm infestation in urban communities. It would be desirable that action for improvement is initiated right at the adolescent stage, thereby ensuring adequate body stores of iron even before they marry and become pregnant.

Key words: Epidemiological determinant, India, iron deficiency

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INTRODUCTION

Adolescents aged 10-19 years constitute about 21% of India's population which in absolute numbers translates to 253 million.[1] However, a considerable number of adolescents face challenges to their healthy development due to a variety of factors, including structural poverty, social discrimination, negative social norms, and early marriage and child-bearing, especially in the marginalized and under-served sections of the population.[2]

Adolescent girls are particularly at higher risk of malnutrition because of gender discrimination in distribution of, and access to, food within family.[3] In adolescent girls, nutrition status prior to pregnancy is important. Inadequate iron stores before conception is a major cause of iron deficiency anemia during pregnancy.[3]

As estimated by United Nations, iron deficiency is the most common nutritional deficiency worldwide, affecting 1 billion people, particularly women of the reproductive age and young children.[4]

Investments in adolescent girls will have an immediate, direct, and positive impact on India's health goals and on the achievement of the Millennium Development Goals, especially Goal 1: Eradicate Extreme Hunger and Poverty, Goal 2: Achieve Universal Primary Education, Goal 3: Promote Gender Equality and Empower Women, Goal 4: Reduce Child Mortality, Goal 5: Improve Maternal Health, and Goal 6: Combat HIV/AIDS, Malaria, and other diseases, at the same time, it will enhance economic productivity, effective social functioning, and overall population development. The increasing share of adolescents and youth in India's population can translate into a demographic dividend only if policies and programs focus on the health and well-being of this large, yet very vulnerable population.[5,6]

There are many studies on anemia in pregnancy and in children <5 years old; however, there is inadequate attention to the presence of anemia in adolescent girls, who are future mothers. This study highlights the problem of health, nutritional anemia, and education status of adolescent girls in urban area. The primary objective of this research was to estimate the prevalence of anemia, and the secondary objective was to assess various epidemiological factors associated with anemia.

MATERIALS AND METHODS

Study area

The present study is a community-based cross-sectional study. The study participants were daughters of government class IV employees residing in government housing colony that was the part of an urban field practicing area of tertiary care hospital in Mumbai.

Study duration

The study was carried out from January to December 2004.

Inclusion criteria

Unmarried, nonpregnant, and nonlactating girls in the age group of 10-19 years residing in government colony were included in the study. The questionnaire was administered only if parents gave oral consent for examination of blood and stool samples. If there were more than one adolescent girl in the same household, only the eldest adolescent girl of the family was enrolled in the study.

Sample size

The World Health Organization non — serial publication "the sample size determination" 1993 was relied upon. A table on sample size calculation at page no. 27 was the basis of sample size determination.[7] The formula used was sample size $(n) = \chi^2_{1-\alpha/2}(1-P)/\varepsilon^2$, the quantity χ represents the number of standard errors away from the mean, $\chi^2_{1-\alpha/2}$ is functions of confidence level (95%), P is anticipated population prevalence that was considered as 64%, ε a relative precision of 0.1 (10%), and the sample size worked out to be 207.[8]

Sampling

A two-stage sampling method was followed. Initially, a baseline study was done in all 13 buildings, of class IV employees. The total population of 13 buildings was 6880, of which 540 were the adolescent girls. In the second stage by simple random sampling method, 207 girls were selected using random number table.

Data and sample collection

The questionnaire consists of sociodemographic data, menstrual history, dietary intake (was assessed by 24 hours recall method), dietary nutrient intake, and knowledge regarding iron-rich food and clinical examination of the selected participants. Hemoglobin was assessed by Sahli's method. Trained pathologists examined peripheral blood smear on the same day. Stool examination for the assessment of ova and cyst of each study participant was done at the health centers by qualified and trained laboratory technicians. Repeated reminders were given to the girls to submit the stool samples for examination.

Statistical analysis

For the purpose of statistical analysis, those with hemoglobin <12 g/dl were categorized as having anemia and those with hemoglobin more than or equal to 12 g/dl were categorized as not having anemia.

Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 11.5 software (SPSS Inc. Chicago, USA). For assessing difference between proportions in qualitative data, Pearson's Chi-square test was used as a test of significance. $P < 0.05$ is considered as statistically significant. When the expected value in a cell was <5 in a 2 × 2 table, Fisher's exact test was used as a test of significance, and when the expected value in a cell was <5 in other tables, likelihood ratio test was used a test of significance.

Binary logistic regression was done using the dependent variable in the present study that was anemia status. Variables that had $P < 0.1$ in a univariate analysis were considered for entry into the regression model.

Institutional Review Board, of Grant Medical College, Mumbai, approved the study. Oral consent was taken from parents to collect information, blood, and stool samples.

RESULTS

A total of 207 study participants were enrolled in the study.

Sociodemographic profile

Table 1 shows the sociodemographic profile of the study participants. Of 207 study participants, 47 (22.7%) belonged to the 10-12 years age group, 81 (39.1%) were in 13-15 years age group, and 79 (38.2%) were in the 16-18 years age group. Caste-wise distribution of study participants showed that 104 (50%) belonged to open category, 82 (39.2%) belonged to scheduled caste or schedule tribe community, and 21 (10.2%) were from other backward caste and other castes. The majority of the study participants' fathers (100; 48.3%) had completed

secondary education. The majority (191; 92.3%) of study participants' mothers were housewives, and 148 (71.5%) belonged to families with 4 or less members, and 148 (80.7%) belonged to a nuclear family.

Prevalence of Anemia

Table 2 shows prevalence, grade, and knowledge of anemia among study participants. The overall prevalence of anemia was 78.3%.

Table 1: Sociodemographic profile of the study participants

Characteristics	n (%)
Age groups (years)	
10-12	47 (22.7)
13-15	81 (39.1)
16-18	79 (38.2)
Caste distribution	
Open category	104 (50.22)
Scheduled caste/schedule tribe	82 (39.2)
OBC and others	21 (10.2)
Father's education	
Up to primary	4 (1.8)
Primary completed	91 (44)
Secondary completed	100 (48.3)
Higher secondary and above	12 (5.7)
Education status of study participants	
Up to primary	146 (70.5)
Secondary	44 (21.3)
Higher secondary	17 (8.2)
Mothers' occupation	
Housewives	191 (92.3)
Employed	16 (7.7)
Type of family	
Nuclear	167 (80.7)
Joint and extant	40 (19.3)
Total family members	
Up to 4 members	148 (71.5)
More than 4 members	59 (28.5)

n = Total number of participants

Table 2: Prevalence, grade of anemia, and knowledge of anemia among study participants

Characteristics	n (%)
Prevalence of anemia (gm/dl)	
Present (hemoglobin <12)	162 (78.3)
Absent (hemoglobin >12)	45 (21.7)
Grades of anemia (gm/dl)	
Mild (10-11.9)	104 (64.2)
Moderate (7-9.9)	59 (36.2)
Severe (<7)	1 (1)
Prevalence of anemia in different age groups (years)	
10-12	42 (25.9)
13-15	59 (36.4)
16-19	61 (37.6)
Knowledge about anemia	
Yes	23 (11.1)
No	184 (88.9)

The prevalence of mild, moderate, and severe anemia was 64.2%, 36.2% and 1%, respectively. Prevalence of anemia in the 10-12 years age group study participants was 25.9%, 13-15 years age group was 36.4%, and 16-18 age group was 37.6%. Of the 207 participants, 126 (60.8%) had hypochromic microcytic erythrocytes, indicating iron deficiency anemia, 25 (12.3%) participants had dimorphic anemia, that is, hypochromic microcytic with macrocytic erythrocytes, indicating iron and folic acid deficiency state. Around 9 (4.3%) participants had macrocytic anemia, indicating folic acid and vitamin B12 deficiency. 29 (14%) had early iron deficiency indicated by hypochromic normocytic erythrocytes. Only 18 (8.6%) subjects had normochromic normocytic erythrocytes (data not shown). Majority of participants (88.9%) had no knowledge regarding anemia.

Univariate analysis

Table 3 shows univariate analysis of factors associated with anemia. Among socio-demographic variables, the age group of study participants and mothers education were the factors not associated with anemia. However, the family size of more than 4, mothers' occupation as housewife, and per capita income of less than Rs. 1000 per month were associated with anemia.

Among dietary factors, lower consumption of fruits, daily caloric consumption of is <1000 kilocalories per day, and less consumption of green leafy vegetable were strongly associated with anemia.

Body mass index (BMI) <18.5 kg/m^2, presence of pallor, and intestinal parasites were significantly associated with anemia in study participants. Of the 150 participants with clinically apparent anemia, 133 (88.7%) actually had anemia. Of the 32 participants with Ascaris ova in the stool, 27 (84.4%) had anemia. All those with Hookworm, Giardia, and Trichuris infestation were anemic.

To rule out the possible effect of confounding and interaction in univariate analysis, binary logistic regression was used as an analytic tool. Table 4 shows binary logistic regression analysis. Variables found significant in univariate analysis were considered for logistic regression analysis. The dependent variable in the analysis is anemia status. Naglkerke R^2 statistic and the Hosmer and Lemeshow goodness of fit were used to assess the integrity of the mathematical model used. Model diagnostics are given in Table 5a and b.

Model diagnostics (Cox and Snell R^2, Nagelkerke R^2, and Hosmer and Lemeshow test) indicate excellent fit. Thus, the mathematical model used is stable. It is evident from logistic regression analysis that BMI, per capita income, and intestinal parasites in stool were variables that were independently associated with anemia.

DISCUSSION

The overall prevalence of anemia in adolescent girls was 78.3%. Of the 162 study participants with anemia, 104 (64.2%) had mild, 59 (36.2%) had moderate, and only 1 participant (0.6%) had severe anemia. 65.2% had hypochromic microcytic anemia and 14.5%

Table 3: Univariate analysis of covariates of anemia in study participants

Variables	Total	Anemia present (%)	P
Age (years)			
<13	47	42 (89.4)	0.088
13-15	81	59 (72.8)	
16-19	79	61 (77.2)	
Family size			
Up to 4 members	59	40 (67.8)	0.02
>4 members	148	122 (82.4)	
Mothers education			
Illiterate and up to primary	35	28 (80.0)	0.264
Primary completed	122	99 (81.1)	
Secondary and higher secondary completed	50	35 (70.0)	
Mothers occupation			
Housewife	191	154 (80.6)	0.004
Private	16	8 (50)	
Per capita income (Rupees per month)			
<1000	93	82 (88.2)	0.0001
≥1000	114	80 (70.2)	
Variables related to diet			
Fruits consumption per week			
≤1	70	64 (91.5)	<0.0001
>1	137	98 (71.6)	
Daily caloric consumption (Kilo calories per day)			
1000-1500	92	76 (82.6)	0.092
1501-2000	104	80 (76.9)	
>2000	11	6 (54.5)	
Frequency of green leafy vegetables per week			
≤1	44	40 (90.9)	0.021
More than 1	163	122 (74.8)	
Anthropometric and clinical findings			
BMI (kg/m²)			
<18.5	130	115 (88.5)	0.0001
≥18.5	77	47 (61.0)	
Clinically apparent pallor#			
Present	150	133 (88.7)	0.0001
Absent	57	29 (50.9)	
Stool examination			
Intestinal parasites			
Present	65	60 (92.3)	0.00092
Absent	142	102 (71.8)	
Type of intestinal parasite$			
No intestinal parasite	134	96 (71.6)	0.005
Ascaris	32	27 (84.4)	
Hookworm	12	12 (100.0)	
Giardia	10	10 (100.0)	
Entamoeba histolytica	17	15 (88.2)	
Trichuris	2	2 (100.0)	
Total	207	162 (78.3)	

#κ = 0.404, $Likelihood ratio = 16.902. BMI = Body mass index

participants had dimorphic anemia. After logistic regression analysis, it was found that BMI, per capita income, and intestinal parasites in the stool were the factors independently associated with anemia.

The prevalence (78.3%) of anemia of our study was within the range of prevalence reported by ICMR multicenter study, that is, ranging from 58.2% to 100%.[9] Verma et al.[10] reported prevalence of anemic among adolesenct girls as 81.8%.

However, the prevalence of anemia was 98.1% for urban areas of Thane district of Maharashtra as reported by Reproductive and Child Health Survey 2002-2003,[11] which is much higher than what is being found in our study.

Mehta,[8] Rajaratnam et al.,[12] and Vasanthi et al.[13] have reported prevalence of 64%, 48.8% and 25%, respectively. These prevalences were less than the prevalence of our study. These variations in prevalence are because of difference in the geographical areas of study and minor differences in the age groups.

A study conducted by Chaturvedi et al.[14] (1996) revealed that 93.4% of study participants had BMI <18.5 kg/m². Kaur et al.[15] had reported that 60% of study participants were aware of anemia as a health problem and sources of iron-rich foods. In our study, only 6.8% participants were aware of sources. Thus, there was definite difference in the knowledge of anemia and awareness regarding sources of iron-rich foods.

As per study of Verma et al., the most common blood picture was hypochromic microcytic (55.5%). The prevalence of dimorphic anemia was only 1.7%.[10] In our study, the prevalence of hypochromic microcytic anemia and dimorphic anemia was 60.8% and 12.3%, respectively.

This indicates that one of the causes of high prevalence of anemia among participants in our study was deficiency of iron and folic acid in their diet.

Another cause of anemia in our study was high prevalence (31.4%) of the intestinal parasite in the stool. Mahajan et al.[16] reported that the prevalence of intestinal parasites was 21.5% and this is lower (31.4%) than what we found in our study.

As reported by World Health Organization,[17] chronic fecal blood loss due to hookworm infection is a significant contributor to anemia (particularly moderate and severe anemia) among certain populations. In the present study, one of the participants who had severe anemia also had hookworm infection. This indicates worm infestation is still the important cause of severe anemia.

In this study, a kappa value of 0.404 and 0.403 indicated moderate agreement (P < 0.0001, very highly significant). It is clear that clinical examination of conjunctiva and nail bed can be a very good indicator of anemia. This finding is similar to a study conducted by Chandrasekhar et al.,[18] who reported that the most common clinical presentation of study participants with anemia was paleness of eyes.

A study was conducted by Kapur et al. who reported that the sensitivity and specificity of clinical screening for anemia using

Table 4: Binary logistic regression analysis

Variable	Coefficient	SE	OR	95% CI		P
BMI	1.516	0.379	4.555	2.166	9.578	0.001*
Per capita income	1.156	0.406	3.178	1.433	7.05	0.004*
Intestinal parasites in stool	1.44	0.522	4.219	1.518	1.518	0.006*

*Statistically significant. SE = Standard error of mean, OR = Odds ratio, CI = Confidence interval

Table 5a: Model summary

Step	−2 log-likelihood	Cox and Snell R²	Nagelkerke R^2
1	195.943	0.096	0.147
2	186.211	0.137	0.211
3	176.423	0.176	0.271

Table 5b: Hosmer and Lemeshow test

Step	χ^2	Degree of freedom	Significance
1	0.00	0	0.0
2	4.158	2	0.125
3	8.190	6	0.225

conjunctival pallor was 49% and 79%, respectively, for identifying children who were severely anemic (<7 gm/dl).[19]

Banerjee *et al.* reported that the average caloric intake among adolescent girls was 1438 kcal/day that is lower than the mean caloric intake of 1542.15 kcal/day, of 10-12 years age group study participants of our study.[20]

The Ministry of Health and Family Welfare, Government of India, has launched the Weekly Iron and Folic Acid Supplementation Program to reduce the prevalence and severity of nutritional anemia in adolescent population (10-19 years). Under this program, IFA tablet and albendazole tablets for de-worming are being administered twice a year to the same target groups.[21]

This study had limitations, as Sahli's method was used for estimation of hemoglobin, which is not a gold standard method; however, this is a most common method that is still being used in public health facilities for estimation of hemoglobin and hence it was used in this study.

CONCLUSIONS

High prevalence of anemia among adolescent girls indicates the need for additional nutritional support of iron and folic acid supplementation and prevention and control of worm infestation in urban communities. The knowledge regarding anemia and iron-rich food is low. Thus, specific Information Education and Communication to improve their knowledge on anemia in community can also contribute toward reducing the prevalence of anemia. It would be desirable that action for improvement is initiated right at the adolescent stage, thereby ensuring adequate body stores of iron even before they marry and become pregnant.

Conflicts of interest

There are no conflicts of interest.

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