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Prevalence of anemia among adolescent girls: Severity and determinant factors in Rajasthan, India

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Abstract
Objective: The present study was designed to study the prevalence of anemia & associated factors in adolescent girls of Pali District of Rajasthan, India.
Design: All the Government schools of Pali were listed, out of these; three government schools were selected by the multistage random sampling method. Group of 60 adolescent girls (10-19 years) from each selected school were selected. All the girls were screened for anemia by Sahli's haemoglobinometer method for estimating prevalence. Adolescent who had Hb concentration more than 12 g/dl were considered in control group. Hb value of 10.1 – 11.9 g/dl and less than 10 g/dl were come in ID (Iron Deficiency) and IDA (Iron Deficiency Anemia).
Settings: Rajasthan, India
Subjects: Total 180 Adolescent girl (10-19 years) who have attained their menarche.
Results: Respondents were divided into three groups, 98 respondents (54.45%) comes under control group, 49 respondents (27.22%) were in ID group and 33 respondents (18.33%) were in IDA group. Significant differences were detected between ID, IDA and control in regards to her father's and mother's education (p= 0.0403, p= 0.0013), eating vegetables and citrus fruits (p = 0.012), hard physical work/ exercise (p = 0.003), past history of IDA (p=0.001) and pallor as subjective complaint of the girls (p=0.0036).
Conclusion: In this study anemia can be considered of mild public health significance; indeed, it was a public health problem among adolescent girls in the area.

Keywords: Adolescent girl, anemia, iron deficiency anemia, prevalence

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 [1]. It occurs at all stages of the life cycle, but is more prevalent in pregnant women and young children. It affects 24.8% of the world population. In 2002, iron deficiency anemia (IDA) was considered to be among the most important contributing factors to the global burden of anemia [2].

Anemia has been shown to affect mental development and learning capacity. In infancy it may cause a permanent loss of IQ later in life, shortened attention span, irritability, and fatigue, difficulty with concentration, lethargy, weakness and increased susceptibility to infection. Consequently, anemic children tend to do poorly on vocabulary, reading, and other tests [3]. It is a condition characterized by reduction in the number of red blood cells and/or hemoglobin (Hb) concentration. Causes of anemia in developing countries are multi-factorial, which include nutritional (iron, foliate, and vitamin B_{12}) deficiencies, infections (such as malaria and intestinal parasitic infection [IPI]), and chronic illness. Iron deficiency anemia is a condition in which anemia occurs due to lack of available iron to support normal red cell production [4]. The prevalence of iron deficiency and subsequent anemia increases at the start of adolescence. In girls, this is caused by increased requirements of nutrition for growth, exacerbated a few years later by the onset of menstruation, but subsides for boys [5]. The physical and physiological changes that occur in adolescents place a great demand on their nutritional requirements and make them more vulnerable to nutritional deficiencies. Adolescents are at high risk of iron deficiency and anemia. This is due to rapid pubertal growth with sharp increase in lean body mass, blood volume, and red cell mass, which increases iron requirements for myoglobin in muscles and Hb in the blood [6]. Anemia in adolescence has serious implications for a wide range of outcomes, and nearly all of the functional consequences of iron deficiency are strongly related to the severity of anemia.

It causes reduced resistance to infection, impaired physical growth and mental development, and reduced physical fitness, work capacity, and school performance.

In India, adolescent girls, who constitute a sizable segment of its population form a vulnerable group and are at a greater risk of morbidity and mortality. Adolescence has been defined by WHO as the period of life spanning the ages between 10-19 years [7]. It is the formative period of life when maximum amount of physical, psychological and behavioral changes take place. This is a vulnerable period in the human life cycle for the development of nutritional anemia. In India the prevalence of anemia among adolescent girls were 56 per cent and this amount to an average 64 million girls at any point in time [8]. Studies conducted in different regions of India shown that the prevalence of anemia was 83.6 per cent in Rajasthan, 52.5 per cent in Madhya Pradesh, 37 per cent in Gujarat, 41.1 per cent in Karnataka, 85.4 per cent in Maharashtra, 21.5 per cent in Shimla, 56.3 per cent in Uttar Pradesh, 77.33 per cent in Andhra Pradesh, 58.4 per cent in Tamilnadu and in Kerala (19.13% among college students and 96.5% in tribal area) [9–19]. Among adolescents, girls constitute a vulnerable group particularly in developing countries. In a family with limited resources, the female child is more likely to be neglected. The added burden of menstrual blood loss (normal/abnormal) precipitates the crisis too often. This study was planned to assess the magnitude of problem of anemia in adolescent females and its association with other socio -demographic and other factors [20]. Association of anemia with adverse maternal outcome such as puerperal sepsis, ante-partum hemorrhage, post-partum hemorrhage and maternal mortality is no longer a debatable subject. Apart from the risk to the mother, it is also responsible for increased incidence of premature births, low birth weight babies and high prenatal mortality [20, 21]. The prevalence of Iron deficiency anemia (IDA) is high in developing countries than in the developed countries due to poverty, inadequate diet, and high incidence of communicable diseases, pregnancy/lactation and low immunity [22]. Adolescent girls constitute a vulnerable group of iron deficiency anemia, resulting in a reduced physical work capacity and cognitive function, behavioral disturbances, co morbidity and delay in the onset of menarche which leads to cephalopelvic disproportion. Measuring hemoglobin (Hb) concentration is relatively easy and inexpensive, and this measurement is frequently used as a proxy indicator of iron deficiency anemia [23].

Adolescent girls are chosen for the study as by improving anemia & awareness among adolescent girls, maternal morbidity & mortality especially during pregnancy can be improved. There are only few studies focusing on adolescent anemic girls. In view of the above, present study was carried out to find out the prevalence and factors associated with anemia amongst adolescent girls.

Materials and Methods

Study area

The study was conducted in June 2018 to March 2019 in rural Pali district of Rajasthan, western India. This plain agricultural area has a high population density, low female literacy, limited access to health services and is, in these regards, comparable to most parts of the country. The diet is dominated by wheat, pearl millet, green gram, vegetables. It is less frequently added seasonal fruits and occasionally meat. Malaria is not endemic and no case of HIV has been reported in the region.

Sample selection

Three villages (Gundoj, Hemawas and Kharda), situated within 40 km from Pali district, Rajasthan, India, were considered for the study. The villages represented typical Indian village and were largely homogeneous. For the present study, a list of adolescent girls (10 to 19 years) from each house of selected villages, were prepared with the help of gram panchayat office, village leaders and anganwadi workers. The census covered a total population 2,037 individuals and the initial number of eligible adolescent girls (10-19Years) who have attained their menarche was 929. Out of these 360 girls were selected purposely who consented to participate. Most girls were from a subsistence farming community with marginal land holdings and were residing in an extended family.

Data collection

Each girl enrolled in the study was interviewed by researcher in a house-to-house visit, using a field-tested structured questionnaire. Questionnaire was divided into three groups. Group A includes: socio demographic profile of the respondents i.e., age, father's and mother's education, type of family, size of family and monthly family income. Group B includes: nutritional and reproductive health related factors i.e. physical work, smoking, diet history (eating meat and poultry, eating vegetables and fruits and drinking tea/coffee), menstrual history (heavy period, clots with period, length of blood flow and number of sanitary pad usage) and anthropometric measurement (height and weight). Group C includes: chronic diseases (such as asthma and diabetes), blood disorders, past history of IDA, medication (antacid or steroidal anti – inflammatory drugs [NSAID]) and symptoms (headache, pallor and lack of concentration/fatigue). The girl's weight was measured (to the nearest 200g accuracy) using a portable digital weighing balance (ATCO, India) and her height was measured (to the nearest 0.1 cm) using stadiometer.

Hb estimation

A trained technician accompanying the research team drew a venous blood sample (2 ml) from each girl into EDTA tube. The tubes were transported to a pathology laboratory in Pali, taking proper precautions. The samples were immediately analysed for Hb by the cyanmethaemoglobin method and a peripheral smear examination (i.e., colour, size and shape of red blood cells (RBC)) was conducted. The blood smear was prepared, stained with Leishman stain and covered for 2 min; then alkaline buffer solution was added. After 10 min the smear was washed with running distilled water, dried and observed under microscop to classify nutritional and Fe-deficiency anemia. Normocytic normochromic cells were considered as normal, while normocytic hypochromic with the presence of macrocytic cells were considered as nutritional anemia indicative of probable vitamin deficiency. Additionally, hypochromic normocytic cells with anisocytosis were also considered as nutritional anemia. Only hypochromic microcytic cells with anisostosiss/ poikilocytosis were considered indicative of iron deficiency anemia. The peripheral smear was also examined for the presence of malarial parasites.

Statistical methods

Results

Prevalence of anemia

The mean hemoglobin level for the first group (control) was 12.5 g/dl (±0.42), while the mean hemoglobin level of the second group (ID) was 10.8 g/dl (±0.67), whereas the mean hemoglobin level for third group was 8.9 g/dl (±0.98). After hemoglobin testing, the total sample size (180) were divided into three groups, 98 respondents (54.45%) came under control group, 49 respondents (27.22%) were in ID (Iron Deficiency) group and 33 respondents (18.33%) were in IDA (Iron Deficiency Anemia) group.

Socio demographic factors

Table 2 indicates that 70.41 per cent respondents from control group, 85.71 per cent from ID group and 84.85 per cent from IDA group were belonged to late adolescent age group while 29.59 per cent respondents from control group, 14. 29 per cent respondents from ID group and 15.15 per cent respondents from IDA group were belonged to early adolescent age group. Data showed that the respondent's father, 43.88 per cent from control group and 12.24 per cent from ID group were educated up to secondary school while 42.86 per cent respondents' father from control group, 24.49 per cent from ID group and 15.15 per cent from IDA group had primary education. Some of the respondent's father from control group (09.18%) whereas majority of the respondent's father from ID group (63.27%) and IDA group (87.76%) were illiterate. Only 4.08 per cent respondent's fathers from control group were educated above to secondary level. Most of the respondent's mother, 62.24 per cent from control group and only 12.24 per cent from ID group had primary education while 13.27 per cent respondent's mother from control group were educated up to secondary school education. Cent per respondent's mother from IDA group, 87.76 per cent from ID group and 24.49 per cent from control group were illiterate.

Further findings indicated that 57.14 per cent respondents from control group 63.27 per cent respondents from ID group and 63.64 per cent respondents from IDA group belonged to joint family whereas 42.86 per cent respondents from control group, 36. 73 per cent from ID group and 36.36 per cent respondents from IDA group belonged to nuclear family. More than fifty per cent of the respondents, 62.24 per cent from control group, 71.43 per cent from ID group and 69.70 per cent from IDA group belonged to large family while 37.76 per cent respondents from control group, 28.57 per cent respondents from ID group and 30.30 per cent respondents from IDA group belonged to small family. Most of the respondents 64.29 per cent from control group, 73.47 per cent from ID group and 78 .79 per cent from IDA group were fell in the category of low monthly family income while 23.47 per cent from control group, 22.45 per cent from ID group and 21.21 per cent from IDA group were fell in medium income category. Only 12.24 per cent respondents from control group and 4.08 per cent respondents from ID group were fallen in high monthly family income category.

The age, type of family, size of family and monthly income did not show any significant differences between ID, IDA and control group. Significant differences were detected between ID, IDA and control in regards to her father's and mother's education (p= 0.0043, p= 0.0013).

Nutritional and reproductive health related factors

In the present study 64.43 per cent respondents from control group, 65.31 per cent from ID group and 63.64 per cent respondents from IDA group were not doing work and exercise. Some of the respondents, 6.12 per cent from control group, 10.20 per cent from ID group and 9.09 per cent from IDA group were tobacco smokers.

Adolescent girls consuming no amount of meat and poultry were 53.06 per cent from control group, 63.27 per cent from ID group and 66.67 per cent from IDA group while only 8.16 per cent respondents from control group, 12.24 per cent from ID group and 6.06 per cent respondents from IDA group were frequently eat meat and poultry. More than half of the respondents, 53.06 per cent from control group, 57.15 per cent from ID group and 57.58 per cent from IDA group were frequently eating vegetables and citrus fruits whereas, 7.14 percent respondents from control group, 12.24 per cent respondents from ID group and 9.09 per cent respondents from IDA group were no eating vegetables and citrus fruits. Majority of the respondents 43.88 per cent of the respondents from control group, 53.06 per cent of the respondents from ID group and 51.52 per cent of respondents from IDA group were having tea/ coffee after meal. Menstrual history of the respondents shows that 26.53 per cent respondents from control group, 34.69 per cent from ID group and 30.30 per cent from IDA group had heavy periods while 46.94 per cent respondents from control group, 57.14 per cent from ID group and 54.55 per cent from IDA group had clots during periods. In this study, 84.69 per cent of the respondents from control group, 65.31 per cent from ID group and 57.58 per cent from IDA group had up to 5 days length of blood flow in each menses and 87.76 per cent respondents from control group, 73.47 per cent from ID group and 72.73 per cent from IDA group were used up to 4 sanitary pads. More than half of the respondents 64.29 per cent from control group, 57.14 per cent from ID group and 57.58 per cent respondents from IDA group had less than 18.5 Kg/ m2 Body mass index.

The two factors, eating vegetables and citrus fruits (p = 0.012) and physical work/ exercise (p = 0.003) showed statistically significant difference between ID, IDA and control group, while other nutritional and reproductive health related factors have no statistical significant correlation (p>0.05) Table 3.

Medical and drug history related factors

In the present study, only 4.08 per cent from control group, 2.04 per cent respondents from ID group and 3.03 per cent respondents from IDA group were suffered from chronic diseases while 2.04 per cent from control and ID group had suffering from blood disorder. A past history of IDA had been reported to be a risk factor for a subsequent recurrence. Results revealed that 17.35 per cent respondents from control group, 18.37 per cent from ID group and 36.36 per cent from IDA group were had medical history of IDA.

In the study, 3.06 per cent of the respondents from control group, 6.12 per cent from ID group and 6.06 per cent from IDA group were having antacid whereas, 13.27 per cent respondents from control group, 10.20 per cent from ID group and 6.06 per cent from IDA group were having NSAID. Results shows that 43.88 per cent of the respondents from control group, 46.94 per cent from ID group and 54.55 per cent respondents from IDA group had headache while 33.67 percent respondents from control group, 28.51 per cent from ID group, 57.58 per cent from IDA group were had lack of concentration/ fatigue. Study revealed that 28.57 per cent of the respondents from control group, 26.53 per cent respondents from ID group and 48.48 per cent from IDA

group were from IDA group had pallor skin and conjunctiva.
The chronic diseases, blood disorders, antacids, anti-inflammatory drugs (NSAID) did not show any significant differences between ID, IDA and the control. Significant differences were detected between ID, IDA and control in regards to past history of IDA (p=0.001). The headache and lack of concentration did not show any significant differences between ID, IDA and the control. Significant difference was detected between ID, IDA and control in regards to pallor as subjective complaint of the girls (p=0.0036).

Discussion

Iron deficiency anemia is the most common nutritional deficiency worldwide. The negative consequences of IDA on the cognitive and physical development of children and on the work productivity of adults are major concern [24]. Anemia, defined as Hob concentration below the established cut- off levels, is a major public health problem with major consequences for human health as well as social and economic development [22]. Focus on adolescent girls is required to reduce prevalence of anemia and could be integrated with Participatory nutrition education [18].

Prevalence of anemia

The overall prevalence of anemia was found to be 45.55 per cent of which 27.22 per cent were iron deficiency and 18.33 per cent were iron deficiency anemia. Similar prevalence is reported by Patel *et al*. in Raipur [25]. Siddharam *et al*. found 45.2 per cent anemia among rural area of Karnataka, South India [26]. In the present study prevalence of anemia among the study subjects were found to be 21 per cent. A study which was conducted among undergraduate students of government medical college, Kottayam revealed that the prevalence of anemia was 19.13 per cent [18]. Another study which was conducted among tribal women in Wayanad district shown that the prevalence of anemia was found to be 96.5 per cent (19). Under-nutrition among tribal women was the major cause identified from the study. In a study conducted in Tamilnadu showed the prevalence of anemia among 10-15 year old adolescent girls were found to be 58.4 per cent [17]. Another study conducted in Andhra Pradesh showed the prevalence of anemia among adolescent girls was 77.33per cent 16. Even though prevalence of the present study was at the lower range still it is a moderate public health problem as per WHO classification [23]. Hence, this indicated the importance of adding adolescent girls in the risk group to improve their hemoglobin status.

Socio demographic factors

In our study there was no significant association between prevalence of anemia with age. It coincides the reports of the study done by Kaur [27], Singh [28], Pattnaik *et al* [29], Kulkarni *et al*. [30] and Kotecha *et al*. [31] which stated that age was not correlated factor with prevalence of anemia and contradict with the documentation of Premalatha *et al*. [32]. However Rati *et al* 34found maximum prevalence of anemia at 14 years of age among the adolescent girls while Biradar *et al* quoted a decrease in hemoglobin level with increasing age in adolescents.
Father's and mothers educational status was significantly associated with the prevalence of anemia among adolescent girls in this study. Adolescent who had illiterate father and mother more likely to be anemic as compared to adolescent girls who had educated father and mother. This might be due to the reason that parents who are educated are able to make decisions about his own family and so for his child as compared to his illiterate counterpart. In India, most of the family's decisions are made by father and when they are educated; they might have the power to make decisions in matters related to adolescent health and expected expenses, which had an effect on the anemia prevalence. On the other side, the educated mothers are more likely to adopt a healthier dietary behavior. It coincides with the report of Gupta *et al*. and Tesfaye *et al*. [33, 24].
Type of family and size of family has no relationship with anemia in this study. Results of this study are contrary to the analysis by Premalatha *et al*. [32] which indicates that anemia prevalence higher in nuclear family and Tesfaye *et al*. [24] reported that family size was significantly associated with anemia among school adolescents. School adolescents who had family size of five and more were more likely to be anemic as compared with school adolescents from a family size less than five. Variable monthly family income was also not associated with anemia prevalence in the present study. It coincides with the results of Tesfaye *et al*. [24] and diverges from the reports of the study done by Gupta [33], Kaur [27], Pattnaik *et al*. [29] and Rati *et al*. [34] which revealed that prevalence of anemia was found significantly higher in girls having lower monthly family income.

Nutritional and reproductive health related factors

In our study physical work and exercise capacity had statistical significant association with anemia prevalence. In concordance Dixit revealed that iron deficiency decreases energy and physical strength resulting in reduce physical capacity and work performance of adolescent girls (35). Smoking or tobacco consumption by the respondents was not found significantly associated with prevalence of anemia while cigarette smoking causes elevation of hemoglobin and hematocrit which is explained by elevation of carbon monoxide a major component of cigarette smoke which reduces oxygen tension in the body. This reduction increases production, maturity and release of erythrocytes from blood forming organs and thus elevates hemoglobin and hematocrit levels while serum ferritin may be low [1]. Hem iron (from meat) provides 10 to 20 per cent of iron intake while non heme iron (from vegetables, fruits and cereals) provides 80 to 90 per cent [36, 37]. However, non heme iron absorption is influenced by the iron status of subjects and the balance between enhancers and inhibitors present in the food, much more than heme iron [38]. Vitamin C improves dietary availability of iron as well as avoidance of tea or other iron chelating substances [39]. In present study, meat and poultry eating and tea/ coffee after meal were not found significantly associated whereas eating vegetables and fruits showed significant association with anemia prevalence among adolescent girls [1, 22, 25, 32].
Menstrual history of the respondents was not showed significant correlation with prevalence of anemia. The finding coincide with the findings of Chaudhary and Dhage [40] and denies the report of the study done by Shiva *et al*. [41] and Premalatha [32] which stated that prevalence at anemia was higher among those who used more number of pads, as it indirectly indicates increased amount of blood loss during menstruation [41]. The study also showed that the BMI of the respondents had not significant association with anemia prevalence [26].

Medical and drug history related factors

Diseases conditions can also limit iron absorption; this can happen as a result of insufficient stomach acid, lack of intrinsic factor (hormone needed to absorb vitamin B12), celiac disease, inflammatory conditions such as crohn's disease, and in auto immune diseases and hormone imbalances [25, 37]. In present study, chronic disease and blood disorder were not significantly associated with prevalence of anemia among adolescent girls. In this study, past history of IDA was significantly associated with anemia. Iron deficiency anemia is usually resolved after eight weeks to six months of treatment. Inadequate response may be related to continued blood loss (e.g. heavy menses or poor analgesic use), ineffective absorption, or poor compliance. After the hemoglobin has returned to normal, continuing to take a low dosage of iron for an additional one to two months will replace iron stores and decrease the likelihood of recurrence of anemia [43, 44]. Consuming certain medications can interfere with the absorption of iron. Medications that inhibit iron absorption include antacids, proton pump inhibitors (to treat acid reflux) or calcium supplements but results of the study depicts that in our study medication (antacid and NSAID) had not significant association.

Iron deficiency usually develops slowly and insidiously. Many patients have no specific complaints; others have vague symptoms of tiring easily, headache, irritability or depression [42]. Probably the single most important clinical clue to anemia is the symptom of chronic fatigue and lack of concentration [37]. The physical examination reveals usually a range of symptoms such as tachycardia, shortness of breath, lack of concentration, fatigue and pallor of the conjunctiva and skin [1, 34]. In this study, pallor physical symptom was found significant association while head ache and lack of concentration / fatigue were not found significant association with anemia prevalence among adolescent girls [26].

Table 1: Distribution of respondents according to their Hb (g/dl) level.

Groups	Number (N=180)	Per cent	Mean	SD
Control	98	54.45	12.5	0.42
ID	49	27.22	10.8	0.67
IDA	33	18.33	8.9	0.98

Table 2: Distribution of respondents according to their socio demographic factors.

Factors	Control (n= 98)		ID (n= 49)		IDA (n= 33)		p- value
	n	%	n	%	n	%	
Age							
Early adolescent (10-14 years)	29	29.59	7	14.29	5	15.15	0.617
Late adolescent (15-19 years)	69	70.41	42	85.71	28	84.85	
Father's education							
a. Illiterate	09	09.18	31	63.27	28	84.85	0.0043
b. Primary	42	42.86	12	24.49	5	15.15	
c. Secondary	43	43.88	6	12.24	-	-	
d. Above	4	04.08	-	-	-	-	
Mother's education							
a. Illiterate	24	24.49	43	87.76	33	100	0.0013
b. Primary	61	62.24	6	12.24	-	-	
c. Secondary	13	13.27	-	-	-	-	
d. Above	-	-	-	-	-	-	
Type of family							
a. Joint	56	57.14	31	63.27	21	63.64	0.086
b. Nuclear	42	42.86	18	36.73	12	36.36	
Size of family							
a. Small family (up to 5 member)	37	37.76	14	28.57	10	30.30	0.061
b. Large family (above 5 members)	61	62.24	35	71.43	23	69.70	
Monthly family income							
a. Low (≤ 19,600 Rs)	63	64.29	36	73.47	26	78.79	0.791
b. Medium (23,600 – 29,800)	23	23.47	11	22.45	7	21.21	
c. High(≥ 29,800 Rs)	12	12.24	2	04.08	-	-	

Table 3: Distribution of respondents according to their nutritional and reproductive health related factors

Factors		Control (n=98)		ID (n= 49)		IDA (n= 33)		p- value
		n	%	n	%	n	%	
Physical work/exercise	Yes	35	35.57	17	34.69	12	36.36	0.003
	No	63	64.43	32	65.31	21	63.64	
Smoking /tobacco	Yes	6	06.12	5	10.20	3	09.09	0.367
	No	92	93.88	44	89.80	30	90.91	
Meat and poultry eating	No	52	53.06	31	63.27	22	66.67	0.375
	Infrequently	38	38.78	12	24.49	9	27.27	
	Frequently	8	08.16	6	12.24	2	06.06	
Eating vegetables and citrus fruits	No	7	07.14	6	12.24	3	09.09	0.012

	Infrequently	39	39.80	15	30.61	11	33.33	
	Frequently	52	53.06	28	57.15	19	57.58	
Tea/coffee after meal	No	27	27.55	13	26.53	7	21.21	0.879
	Within meal	28	28.57	10	20.41	9	27.27	
	After meal	43	43.88	26	53.06	17	51.52	
Menstrual history								
Heavy period	Yes	26	26.53	17	34.69	10	30.30	0.286
	No	72	73.47	32	65.31	23	69.70	
Clots with period	Yes	46	46.94	28	57.14	18	54.55	0.300
	No	52	53.06	21	42.86	15	45.45	
Length of blood flow in each menses	Up to 5 days	83	84.69	32	65.31	19	57.58	0.326
	Less than 5 Days	15	15.31	17	34.69	14	42.42	
Sanitary pad usages per day	Up to 4	86	87.76	36	73.47	24	72.73	0.386
	Less than 4	12	12.24	13	26.53	9	27.27	
Body mass index (Kg/m2)	Up to 18.5	35	35.71	21	42.86	14	42.42	0.406
	Less than 18.5	63	64.29	28	57.14	19	57.58	

Table 4: Distribution of respondents according to their medical history

Factors		Control (n= 98)		ID (n= 49)		IDA (n= 33)		p-value
		n	%	n	%	n	%	
Chronic diseases	Yes	4	04.08	1	02.04	1	03.03	0.308
	No	94	95.92	48	97.96	32	96.97	
Blood disorders	Yes	2	02.04	1	02.04	-	-	0.408
	No	96	97.96	48	97.96	33	100	
Past history of IDA	Yes	17	17.35	8	18.37	12	36.36	0.0001
	No	81	82.65	40	81.63	21	63.64	
Medication								
Antacid	Yes	3	03.06	3	06.12	2	06.06	0.256
	No	95	96.94	46	93.88	31	93.94	
NSAID	Yes	13	13.27	5	10.20	2	06.06	0.368
	No	85	86.73	44	89.80	31	93.94	
Headache	Yes	43	43.88	23	46.94	18	54.55	0.104
	No	55	56.12	26	53.06	15	45.45	
Lack of concentration/ fatigue	Yes	33	33.67	14	28.51	19	57.58	0.0783
	No	65	66.33	35	71.43	14	42.42	
Pallor	Yes	28	28.57	13	26.53	16	48.48	0.0036
	No	70	71.43	36	73.47	17	51.52	

Conclusion

Adolescent girls are at a high risk for anemia and malnutrition. Inadequate nutrition during adolescence can have serious consequences throughout the reproductive years of life and beyond. Very often, in India, girls get married and pregnant even before the growth period is over, thus doubling the risk for anemia. The nutritional anemia in adolescent girls attributes to the high maternal mortality rate, the high incidence of low birth weight babies, high prenatal mortality and the consequent high fertility rates. This phase of life is also important due to the ever-increasing evidence that the control of anemia in pregnant women can be more easily achieved if a satisfactory iron status can be ensured during adolescence. About 43% of the adolescent deaths are related to pregnancy. Pregnancy during adolescence deprives the girls from achieving their full growth according to their genetic potential. In conclusion, the present study revealed anemia to be a major health problem among the adolescent girls in rural areas.

- There was a higher prevalence of iron ID (Iron Deficiency) as compared to IDA (Iron Deficiency Anemia).
- There was a significant differences detected between ID, IDA and control in regards to her father's and mother's education from socio demographic factors.
- The two factors nutritional and reproductive health, eating vegetables and citrus fruits and hard physical work/ exercise showed statistically significant difference between ID, IDA and control group.
- Only past history of IDA from medical and drug history related factors showed significant difference between ID, IDA and control group.

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