

Original Research Article

A study of anaemia and its correlates among adolescent girls in schools of Haldwani, India

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Received: 22 July 2018

Accepted: 28 August 2018

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ABSTRACT

Background: Anaemia, a manifestation of under nutrition and poor dietary intake of iron is a public health problem, not only among pregnant women, infants and young children but also among adolescents. Anaemia among adolescent girls can result in impaired physical growth, poor cognition, reduced physical fitness and work performance and lower concentration on daily tasks.

Methods: A cross-sectional descriptive study was carried out in schools of Haldwani, Uttarakhand, India with the objective studying various socio-demographic characteristics in relation to anaemia among adolescent girls. Multistage random sampling was used to select adolescent girls of 10 to 19 years of age who were interviewed and examined. Statistical analysis was done using Chi-square test and Odds ratios calculated with SPSS v21.

Results: Around 371 girls in present study had varying severity of anaemia and majority had mild to moderate anaemia. Place of residence, type of school, birth order, type of family and mother occupation were significantly associated with presence of anaemia. Girls taking mixed diet were 1.23 times more likely to be non-anaemic as compared to girls taking vegetarian diet. Study showed adolescent girls consuming IFA tablets were less likely anaemic compared to those not consuming (OR=0.09, p<0.001).

Conclusions: Among school going adolescent girls nearly half are still suffering from anaemia in India, despite the efforts of government and it is still a challenging public health problem.

Keywords: Anaemia, Adolescent girls, Haemoglobin, Malnutrition

INTRODUCTION

Globally, anaemia affects 1.62 billion people which corresponds to 24.8% of the population and the population group with the greatest number of individuals affected is non-pregnant women (468.4 million).¹ Anaemia, as defined by low haemoglobin concentration, is a condition in which the number of red blood cells or their oxygen-carrying capacity is insufficient to meet physiologic needs which vary with age, gender,

residential elevation, smoking behaviour, and different stages of pregnancy.²

Being a significant public health challenge in India ($\geq 40\%$ prevalence) too, it is translating into substantial morbidities, particularly among the vulnerable adolescent girls affecting their physical growth, cognitive development, performance in school, work capacity and reproductive functions.³ Anaemic girls become the next generation of anaemic mothers, thus perpetuating this vicious cycle of malnutrition. And adolescent age

provides a best prospect for combating anaemia if appropriately intervened, as iron deficiency and other nutritional deficiencies which are supposed to be most common cause can be intruded. Other causes include parasitic infections, enteropathic inflammation disorders affecting haemoglobin synthesis, red blood cell production/survival (inherited or acquired).⁴

NFHS-4 states that 41.4% of non-pregnant women in age group of 15-49 years are anaemic in Uttarakhand after adjusting the haemoglobin levels for altitude and smoking status.⁵ Very few studies have been conducted in Uttarakhand regarding adolescent anaemia and therefore present study was done to study the magnitude and socio-demographic factors related to anaemia among school going adolescent girls.

METHODS

The present cross-sectional descriptive study was carried out among school going adolescent girls in Haldwani, Uttarakhand using multistage random sampling method to select adolescent girls. In the first stage, list of all schools in Haldwani having grades from class 6th to 12th with enrolment numbers of girls was prepared and in the second stage four schools were selected randomly from list followed by third stage in which requisite number of 770 girl students in the age group of 10 to 19 years were selected using simple random sampling with the help of the school authorities. Informed verbal consent was obtained from the respective school principals and participants. School response rate and student response rate was 100% as all of four selected schools and adolescent girls agreed to participate in the study. A predesigned semi-structured questionnaire with interview and examination was used for obtaining information relevant to study. Total 770 school going adolescent girls were subjected to haemoglobin estimation by using haemoglobin colour scale, which comprises of a small card with six shades of red that represent haemoglobin levels at 4, 6, 8, 10, 12 and 14g/dl respectively. Intermediate shades can be identified, allowing haemoglobin levels to be judged to 1g/dl. The device is simply used by placing a drop of blood obtained by finger prick on test strip provided and matching the colour of bloodspot against one of hues on shade card after 30 seconds exactly. According to HCS, grading of anaemia was done as not anaemic ($\geq 12\text{g/dl}$), mild to moderate anaemia (8-11g/dl), marked anaemia (6-7g/dl), severe anaemia (4-5g/dl) and critical anaemia ($< 4\text{g/dl}$).⁶ Grading of anaemia was also done according to following WHO guidelines as mild anaemia (10 to $< 12\text{g/dl}$), moderate anaemia (7 to $< 10\text{g/dl}$) and severe anaemia ($< 7\text{g/dl}$).⁷

Statistical analysis was done using SPSS v21. Chi-square test was used for assessing statistically significant association. A two-tailed p value less than 0.05 was considered significant. Binary logistic regression to estimate the odds ratios with 95% confidence intervals to assess the possible differences.

RESULTS

Mean age of study subjects was 14.29 ± 1.81 years. Around 429 (55.71%) were between 10 to 14 years age and 341 (44.29%) in 15 to 19 years.

Table 1: Distribution of adolescent girls according to socio-demographic characteristics (n=770).

Socio-demographic characteristics		Frequency	%
Place of residence	Rural	443	57.55
	Urban	327	42.47
Age category	10 to 14 years	429	55.71
	15 to 19 years	341	44.29
Type of school	Government	514	66.75
	Private	256	33.25
Religion	Hindu	490	63.64
	Muslim/Others	280	36.36
Type of family	Nuclear	487	63.25
	Joint	283	36.75
Birth Order	First	264	34.29
	Second	192	24.94
	Third or more	314	40.78
Education mother	No formal education	278	36.10
	Primary/ Middle	214	27.79
	High school/ Intermediate	216	28.05
	Graduate/Above	62	8.05
Education father	No formal education	139	18.05
	Primary/ Middle	222	28.83
	High school/ Intermediate	309	40.13
	Graduate/ Above	100	12.99
Mother occupation	Homemaker	522	67.79
	Service	174	22.60
	Labourers	74	9.61
Father occupation	Agriculture	89	11.56
	Business	229	29.74
	Service	283	36.75
	Labourers	169	21.95
Socio-economic status	I	31	4.03
	II	117	15.19
	III	151	19.61
	IV	186	24.16
	V	285	37.01
Food habits	Vegetarian	196	25.45
	Mixed	574	74.55
BMI for age	Thinness/ Severe thin	142	18.44
	Normal	592	76.88
	Overweight/ Obese	36	4.68
Consumption of IFA tablets	Present	328	42.60
	Absent	442	57.40
Deworming (last 6 months)	Received	393	51.04
	Not received	377	48.96
History of worm infestation	Present	127	16.49
	Absent	643	83.51

Around 443 (57.55%) of study subjects were from rural area and rest urban. Most of selected girls 514 (66.75%) were from the government schools and remaining 256 (33.25%) from private schools. None of girls in present study was married. Majority of girls 490 (63.64%) were Hindu by religion in this study. Birth order of 264 (34.29%) of girls in present study was first followed by second in 192 (24.94%) and in remaining 314 (40.78%), it was third or more. About 487 (63.25%) girls belonged to nuclear families and 283 (36.75%) to joint families. As stated by them, mothers of 278 (36.10%) have received no formal education, 214 (27.79%) studied up to primary/middle, 216 (28.05%) till high school/intermediate and remaining 62 (8.05%) were graduates and above. Around 522 (67.79%) mothers were homemakers, 174 (22.6%) were doing service and 74 (9.61%) were labourers including both skilled and unskilled.

Likewise the education status of only 100 (12.99%) fathers was graduate/above and 139 (18.05%) fathers have not received any formal education while 222 (28.83%) were studied till primary/middle and 309 (40.13%) till high school/intermediate. Regarding occupation status of fathers of subjects in present study, majority 89 (11.56%) were agriculture workers, 229 (29.74%) were involved in business, 169 (21.95%) were labourers and 283 (36.75%) in service. According to modified BG Prasad classification, majority of girls 285 (37.01%) belonged to social class V followed by class III and IV among 151 (19.61%) and 186 (24.16%) respectively (Table 1).

According to their food habits most of girls 196 (25.45%) were vegetarian and rest 574 (74.55%) were taking mixed diet. In 592 (76.88%) girls BMI for age was normal according to WHO 2007 growth standards for 5-19 years girls. 142 (18.44%) girls were either thin or severely thin and 36 (4.68%) were either overweight or obese. Consumption of IFA tablets were present in 328 (42.60%) girls and deworming was received by 393 (51.04%) girls during last 6 months preceding visit for interview. On asking about history of passage of worms, it was positive in 127 (16.49%) of girls (Table 1).

Interpretation from readings obtained from HCS revealed that 371 (48.18%) adolescent girls have anaemia in present study. Mild, moderate and severe anaemia was present in 34.55%, 10.13% and 3.52% girls respectively. Mean haemoglobin concentration among all girls in present study, calculated from discrete values obtained was 11.35 ± 2 g/dl. On clinical examination pallor was seen in 297 (38.60%) girls. Mild to moderate, marked and severe anaemia was respectively present in 341 (91.9%), 23 (6.20%) and 7 (1.89%), when severity is graded as recommended on colour scale. None was found with critical anaemia (Figure 1, Figure 2 and Figure 3).

On bivariate analysis it was found that odds of having normal haemoglobin concentration was 1.11 (0.84-1.48)

among the girls in 15-19 years age category as compared to 10-14 years category. It was found that place of residence and the type of school was significantly associated with presence of anaemia, as the girls residing in urban area and belonging to government schools have greater prevalence of anaemia compared to their corresponding counterparts.

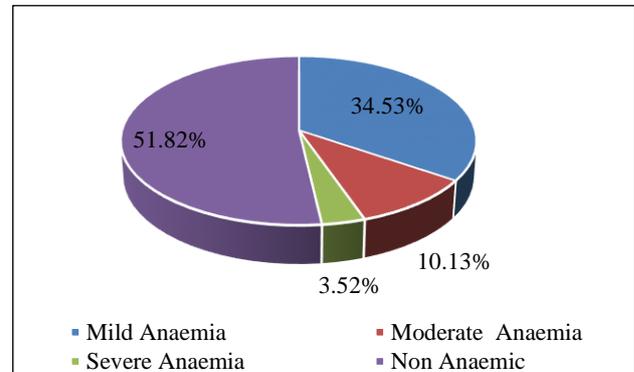


Figure 1: Anaemia among study girls according to WHO recommended grading (n=770).

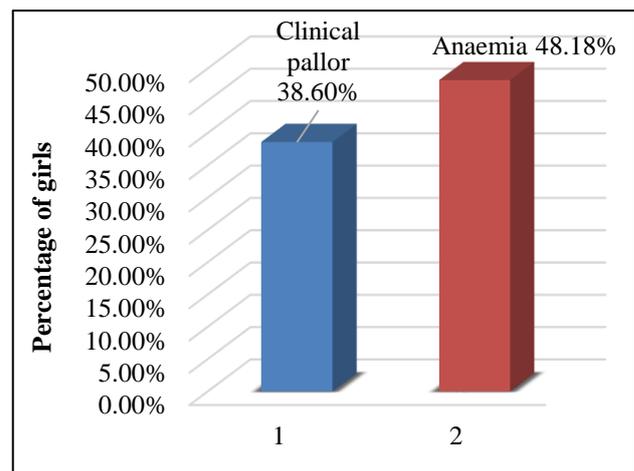


Figure 2: Anaemia among adolescent girls on clinical examination and investigation (n=770).

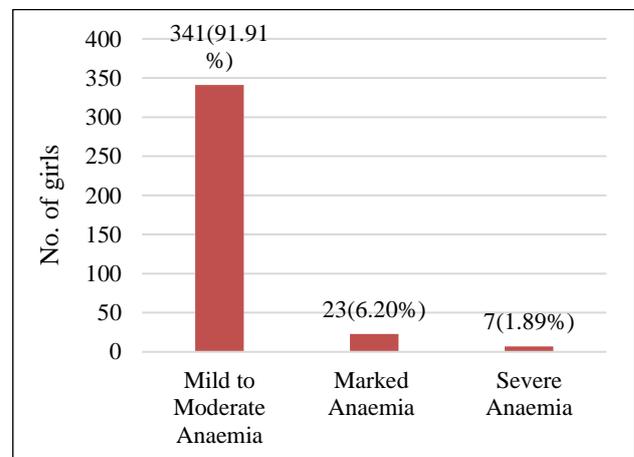


Figure 3: Severity of anaemia graded according to HCS among girls with anaemia (n=371).

Table 2: Bivariate analysis of factors associated with anaemia among adolescent girls.

Socio-demographic characteristics		Anaemia present (n=371)	Anaemia absent (n=399)	p value*	OR (95% CI)**
Place of residence	Rural	191 (43.12)	252 (56.88)	0.001#	1
	Urban	180 (55.05)	147 (44.95)		0.61 (0.46-0.82)
Age category	10 to14years	212 (49.42)	217 (50.58)	0.442	1
	15 to19years	159 (46.63)	182 (53.37)		1.11 (0.84-1.48)
Type of school	Government	269 (52.33)	245 (47.67)	0.001#	1
	Private	102 (39.84)	154 (60.16)		1.65 (1.22-2.24)
Religion	Hindu	234 (47.76)	256 (52.24)	0.754	1
	Muslim/Others	137 (48.93)	143 (51.07)		0.95 (0.71-1.28)
Type of family	Nuclear	191 (39.22)	296 (60.78)	<0.001#	1
	Joint	180 (63.60)	103 (36.40)		0.36 (0.27-0.50)
Birth Order	First	112 (42.42)	152 (57.58)	0.022#	1
	Second	90 (46.88)	102 (53.13)		0.83 (0.57-1.21)
	Third or more	169 (53.82)	145 (46.18)		0.63 (0.45-0.87)
Education Mother	No formal education	94 (33.81)	184 (66.19)	<0.001#	1
	Primary/ Middle	145 (67.76)	69 (32.24)		0.24 (0.16-0.35)
	High school/ Intermediate	113 (52.31)	103 (47.69)		0.46 (0.32-0.67)
	Graduate/ Above	19 (30.65)	43 (69.35)		1.15 (0.63-2.09)
Education Father	No formal education	46 (33.09)	93 (66.91)	<0.001#	1
	Primary/ Middle	141 (63.51)	81 (36.49)		0.28 (0.18-0.44)
	High school/ Intermediate	157 (50.81)	152 (49.19)		0.47 (0.31-0.72)
	Graduate/ Above	27 (27)	73 (73)		1.33 (0.76-2.35)
Mother occupation	Homemaker	192 (36.78)	330 (63.22)	<0.001#	1
	Service	123 (70.69)	51 (29.31)		0.24 (0.16-0.35)
	Labourers	56 (75.68)	18 (24.32)		0.18 (0.10-0.32)
Father occupation	Agriculture	44 (49.44)	45 (50.56)	0.976	1
	Business	111 (48.47)	118 (51.53)		1.03 (0.63-1.69)
	Service	137 (48.41)	146 (51.59)		1.04 (0.64-1.67)
	Labourers	79 (46.75)	90 (53.25)		1.11 (0.66-1.86)
Socio-economic status	I	18 (58.06)	13 (41.94)	0.005#	1
	II	44 (37.61)	73 (62.39)		2.29 (1.02-5.14)
	III	89 (58.94)	62 (41.06)		0.96 (0.44-2.91)
	IV	82 (44.09)	104 (55.91)		1.75 (0.81-3.79)
	V	138 (48.42)	147 (51.58)		1.47 (0.69-3.12)
Food habits	Vegetarian	102 (52.04)	94 (47.96)	0.211	1
	Mixed	269 (46.86)	305 (53.14)		1.23 (0.88-1.70)
BMI for age	Thinness/ Severe thin	26 (18.31)	116 (81.69)	<0.001#	1
	Normal	335 (56.59)	257 (43.41)		0.17 (0.10-0.27)
	Overweight/ Obese	10 (27.78)	26 (72.22)		0.58 (0.25-1.35)
Consumption of IFA tablets	Present	123 (37.50)	205 (62.50)	<0.001#	1
	Absent	248 (56.11)	194 (43.89)		0.46 (0.35-0.62)
Deworming (last 6 months)	Received	86 (21.88)	307 (78.12)	<0.001#	1
	Not received	285 (75.60)	92 (24.40)		0.09 (0.06-0.12)
History of worm infestation	Present	49 (38.58)	78 (61.42)	0.018#	1
	Absent	322 (50.08)	321 (49.92)		0.62 (0.42-0.92)

Figures in parentheses denote row percentages, *Chi-square test, Fisher exact test; OR=Odds Ratio, CI=Confidence Interval, ** Reference category is first, # Statistically significant, p value (two-tailed) <0.05

Around 234 (47.76%) of Hindu girls and 137 (48.93%) girls in Muslim/others category were anaemic (OR 0.95, 95% CI 0.71-1.28). Birth order was significantly

associated with anaemia and 53.82% girls with birth order third or more were anaemic in present study as compared to 112 (42.42%) and 90 (46.88%) with first

and second birth order respectively. About 180 (63.6%) of girls belonging to joint families were anaemic which was significantly higher than 191 (39.22%) from nuclear families. Education status of both mother and father has been found to be significantly associated with presence of anaemia among girls. Adolescent girls whose mothers and fathers were graduates/above were 1.15 and 1.33 times more likely to be non-anaemic respectively compared to girls whose mothers and fathers had not received any formal education. Father's occupation was insignificantly related with anaemia in present study. On the other hand, mother occupation was significantly associated with anaemia and 75.68% girls whose mothers were labourers were anaemic compared to only 36.78% whose mothers were homemakers. Socioeconomic status was significantly related to anaemia. This study revealed that food habits were not significantly related with anaemia and girls taking mixed diet were 1.23 times more likely to be non-anaemic as compared to girls taking vegetarian diet (OR=1.23, 95%CI=0.88-1.70) (Table 2).

Around 56.59% of girls with normal BMI for age were anaemic as compared to 27.78% and 18.31% among overweight/obese and thin/severe thin respectively, the difference being statistically significant. 38.58% of girls with positive history of passage of worms were anaemic. Study showed adolescent girls consuming IFA tablets were less likely anaemic compared to those not consuming (OR=0.09, $p<0.001$) and similarly the girls who have not received deworming were more likely anaemic compared to their counterparts (Table 2).

DISCUSSION

The Government of India is addressing the issue of anaemia amongst adolescents through Weekly Iron and Folic Acid Supplementation (WIFS) under National Iron+Initiative. For adolescent girls especially, this is important to replenish existing iron deficiencies to improve own health and pregnancy outcomes later in life, as anaemia is most common 'indirect cause' of maternal deaths. However, previous research advocates multifactorial aetiology and only 50% cases of anaemia nearly, can be considered to be due to iron deficiency.² Yet another important fact shown in a report by National Nutrition Monitoring Bureau (NNMB) is that adolescent girls consume only 32-45% of the recommended daily allowance (RDA) of iron in our country.³ Folate deficiency is being addressed by WIFS but Vitamin B₁₂ deficiency is masked as it has distinctive role in folate coenzyme synthesis, and should also be given attention.

Haemoglobin colour scale was developed by WHO to address the vital need of screening for anaemia as a simple and inexpensive device providing a reliable indication of presence and severity of anaemia comparable to other methods like Sahli's, Drabkin's and HemoCue etc. Pooled sensitivity of HCS to diagnose anaemia was 80% (95%CI: 68-88) and specificity 80% (95%CI: 59-91) when compared with clinical screening

with gold standard which was HemoCue in nine studies in this review.⁸ Colour scale enabled haemoglobin estimation in all girls in present study.

The results revealed that 48.2% were anaemic in study group. Majority of girls 266 (34.55%) in present study were mildly anaemic and this is consistent with findings of Siva PM et al in Kerala, Singla N et al in Ludhiana, Upadhye JV et al in Nagpur and other studies in different parts of India where mild anaemia is found to be most prevalent.⁹⁻¹¹ Using HCS, Verma R et al found similar magnitude of problem of anaemia among adolescents including boys in Rohtak.¹² However, in a study by Deshpande NS et al in Pune, majority had moderate anaemia.¹³ Mild anaemia is not an early manifestation of ongoing insufficiencies and results in loss of concentration in studies, reduced attention span, fatigue, headaches and inability to make sustained physical effort.¹⁴ Moderate and severe anaemia was present in 10.13% and 3.52% girls respectively in present study. Similar studies conducted in other countries also found that anaemia is a major health problem among adolescent girls and most of them are suffering from mild to moderate anaemia.¹⁵⁻¹⁷

In present study, no significant association of anaemia was found with either age categories or attainment of menarche and this can be explained by the fact that amount of blood flow varies among girls. Findings are similar to Mistry SK et al in Bangladesh, Patel S et al in Raipur India, Premalatha T et al in Tamil Nadu and Pattnaik S et al in Odisha.¹⁷⁻²⁰ On contrary Biradar SS et al in Belgaum, India has reported prevalence to be higher of in late adolescent girls (15-19yrs) compared to early adolescent girls (10-14yrs).²¹ Few studies had shown high prevalence of anaemia among girls who have attained menarche and this discordant with findings of present study.^{22, 23}

Place of residence and the type of school was significantly associated with presence of anaemia in this study and higher percent prevalence among urban and government school girls may be due to known facets of urban lifestyle and less compliance for iron supplements in government schools respectively. In present study girls with higher birth order are more likely to be anaemic, and this is corroborated by findings of Sachan B et al in Lucknow among urban girls.²⁴ This could be due to distraction of mother attention and attenuation of provided care. In this study, girls belonging to joint families have significantly higher percent prevalence compared to nuclear families and this is similar to finding of Kulkarni MV et al in Nagpur.²³ This may be due to attenuation of resources and care as family size increases. This finding is inconsistent to Premalatha T et al in Tamil Nadu where anaemia was more prevalent among girls in nuclear families compared to joint.¹⁹

This study revealed that food habits were not significantly related with anaemia and girls taking mixed

diet were 1.23 times more likely to be non-anaemic as compared to girls taking vegetarian diet and this is consistent with findings of Dutt et al in Raigad, Maharashtra where as compared to non-vegetarians, more vegetarians were anaemic.²⁵ Variation may be due to better bioavailability of heme iron from mixed diet although its absorption is altered by enhancing (e.g. vitamin C) and inhibiting (e.g. calcium, phytates) factors.

Education status of both mother and father has been found to be significantly associated with anaemia among girls in our study which may be due to better awareness of educated parents and similar findings are reported in other studies.^{10, 11} Father's occupation was insignificantly related with anaemia in present study. On the other hand mother occupation was significantly associated with anaemia and 75.68% girls whose mothers were labourers were anaemic compared to only 36.78% whose mothers were homemakers as they can look after their daughters in better manner and this finding is similar to previous study in Nagpur.²³

In our study, 56.59% of girls with normal BMI for age were anaemic as compared to 27.78% and 18.31% among overweight/obese and thin/severe thin girls respectively with the difference being statistically significant. This is consistent with results of Siva PM et al in Kerala, India.⁹ Higher percent prevalence among overweight and obese girls as compared to thin and severe thin girls may be due to reduced intake in an attempt to reduce weight. Moreover, iron requirements are increased too respective to weight and absorption of consumed iron is reduced due to hepcidin expression. Mistry SK et al, in Bangladesh identified that BMI for age <2SD with similar growth reference, is a significant risk factor of anaemia among adolescent girls.¹⁷ Similarly Deshpande NS et al in Pune, India found that thin and severely thin adolescent girls were at higher risk of anaemia.¹³

We find that compliance of government school girls was not good and those from private schools have been found deprived of any iron supplements in schools, and adolescent girls consuming IFA tablets were less likely anaemic compared to those not consuming with significant difference. This is similar to other studies in India.²⁶⁻²⁸ Positive history of passage of worms was significantly related to anaemia, this is consistent with findings of other studies.^{20,25,26} Girls who have not received deworming were more likely anaemic compared to those received and this is similar to a study done in Kerala.⁹

CONCLUSION

This study concluded that nearly half of school going adolescent girls are still suffering from mild, moderate to severe anaemia. Efforts are needed to prevent it by approaches focusing on behaviour change communication to promote healthy dietary practices among girls which can alone has the potential to combat

iron deficiency and can eliminate the need of prophylactic supplementation to all in schools in future if dealt pragmatically. This should be provided to students through special nutrition and health education session in schools with involvement of parents also. Weekly iron and folate supplementation should also be extended to private schools.

ACKNOWLEDGEMENTS

Authors would like to acknowledgements for valuable support provided by the school authorities and participants during the study.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Goyal N, Rawat CMS. A study of anaemia and its correlates among adolescent girls in schools of Haldwani, India. *Int J Res Med Sci* 2018;6:3320-6.