

## Original Research Article

# Determinants of anaemia among adolescent girls in rural Varanasi, Uttar Pradesh

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### ABSTRACT

**Background:** India is home to 253 million adolescents 10-19 years of age, among the largest cohorts globally. This age group comprises of individuals in a transient phase of life requiring nutrition, education, counselling and guidance to ensure their development into healthy adults. Adolescent girls are the most vulnerable group of population due to different reasons especially anaemia. Anaemia is a major public health problem worldwide. The aim of this study was to assess the prevalence of anaemia and associated factors among adolescent girls (10-19 years) in rural Varanasi, Uttar Pradesh.

**Methods:** The present study was a community-based cross-sectional study conducted among 369 adolescent girls in rural Varanasi with a semi-structured and pretested questionnaire.

**Results:** Study shows that the overall prevalence of anaemia among adolescent girls was 67.8% out of which 41.5% and 24.4% were mild and moderately anaemic respectively. Anaemia was significantly associated with age groups, birth order, menarche status, no. of days of menstruation, gap between two cycles, use of clothes/sanitary pads and no. of pads used during menstrual cycle.

**Conclusions:** Study found some preliminary factors significantly associated with anaemia like low socio-economic status, higher birth order, and knowledge about menstrual hygiene practices. Anaemia continues to be a major public health problem in India despite multiple initiatives to address it among adolescent girls.

**Keywords:** Anaemia, Adolescent girls, Determinants, Menstrual hygiene

### INTRODUCTION

There are 1.3 billion adolescents in the world, more than ever before, making up 16 per cent of the world's population. Adolescents experience a transition period between childhood and adulthood and with it, significant growth and development.<sup>1</sup> Adolescence-defined by the world health organization (WHO) as the second decade of life (10-19 years of age)-is a time when significant physical, psychological, and social changes occur.<sup>2</sup> This age group comprises of individuals in a transient phase of life requiring nutrition, education, counselling and guidance to ensure their development into healthy adults.<sup>3</sup> During adolescent period, body needs for both

macronutrient and micronutrient are considerably high because of peak pubertal development, menarche, growth spurt, and physical activity.<sup>4</sup> Adolescent girls encounter various health problems; the most significant ones are anaemia and poor menstrual hygiene management (MHM). In adolescents, the most common cause of anaemia is blood loss due to heavy menstruation next to nutritional anaemia.<sup>5</sup> Anaemia and poor menstrual hygiene practices have a considerable impact on all aspects of an adolescent girl's life. Improper MHM leads to urinary or reproductive tract infections (RTI); pelvic inflammatory disease (PID), in turn, leads to blood loss ultimately resulting in anaemia.<sup>6</sup> There is a dire need for

evidence on the burden and its association to provide actionable preventive measures.

Globally, one in four individuals aged 10-24 years (~430 million) suffer from anaemia, with the highest prevalence found in low- and middle-income countries.<sup>9</sup> India is home to 253 million adolescents 10-19 years of age, among the largest cohorts globally. National family health surveys (NFHS) cover only the 15-to 19-year age group and limited nutrition indicators. From 2005~2006 to 2019~2021, NFHS estimates indicate that anaemia prevalence among Indian adolescents aged 15~19 years has slightly increased (girls: 55.8% to 59.1%).<sup>10</sup> Existing studies on factors associated with anaemia in India mostly focus on women of reproductive age and children although there are some small studies on adolescents.<sup>12-17</sup> Studies conducted on anaemia among the adolescent girls (10-19) years are not only few but also did not address societal determinants and the impact of these factors on anaemia prevalence.

Given the data gaps on prevalence and factors associated with adolescent anaemia, the government of India conducted the comprehensive national nutrition survey (CNNS) 2016-2018.<sup>18</sup> This is the first nationally representative survey in India to provide information on genetic, nutritional and non-nutritional factors implicated in the aetiology of anaemia for individuals below 20 years of age. Large nationally representative surveys investigating nutritional and non-nutritional correlates of anaemia in adolescent girls aged 10-19 years have not been available. Existing studies are limited in scope due to their small sample size, lack of representativeness and unavailability of comprehensive data on multiple risk factors of anaemia. To develop solutions for addressing anaemia in India, a country with large subnational variations in diets and living conditions, it is important to understand if factors associated with anaemia vary across geographies.<sup>19</sup>

The present study is aimed to determine the prevalence of anemia and its association with other determinants among adolescent girls (aged 10 to 19 years) in rural Varanasi of Uttar Pradesh. The outcomes of the study can be helpful for formulating effective interventions to prevent occurrence of anemia and its consequences among adolescent girls.

## METHODS

A community based cross-sectional study was conducted for assessing anaemia prevalence and its societal determinants among adolescent girls over the period of two years from January 2021 to December 2022. The ethical clearance was approved by the ethical committee of institute of medical sciences, Banaras Hindu university. Informed consent of the respondents and their parents was also obtained before interview. The purpose of the study was orally explained to the respondents and their mothers. Confidentiality of the information and the

privacy of the respondents were also maintained. The study was planned to be conducted in Varanasi of Uttar Pradesh in India. Kashi Vidyapeeth block was selected randomly from the eight blocks of Varanasi district.

The sample size of the study was calculated by the following formula:

$$N = Z^2 \times p \times (1 - p) / d^2$$

Where: -p is 53.4%, prevalence of anaemia among adolescent girls (15-19) years in Uttar Pradesh (NFHS-5)

$$Z = 1.96, \text{ at } \alpha = 5\%, d = 0.075$$

Using design effect of 2 and non-response rate of 10%, calculated sample size was 378 but 9 girls were excluded from the study because of denial for hemoglobin measurement. Thus, final sample was 369.

Girls were selected by stratified random sampling method from the selected block of Varanasi. Data were collected using a pretested interview. To ensure data quality, pre-field activities such as proper question ordering, time and relevancy of questions, and pretesting were performed before data collection. Mechanical weighing machine and measuring tape was used for measuring weight and height of the respondents. Haemoglobin (Hb) level of the respondents was measured using an instrument (HemoCue Hb 301 analyser). Microcuvettes were used for taking capillary blood, which were then inserted into the HemoCue Hb analyser for determining the Hb level of the adolescent girls (10-19 years) of age. Data were checked, coded, cleaned, and entered in SPSS trail version 25. Univariate and bivariate analyses were carried out to provide the unadjusted associations.

## RESULTS

Table 1 shows the distribution of adolescent girls according to anaemia severity determined based on the haemoglobin level (32.2%) respondents were nonanemic, and (67.8%) adolescent girls were suffering from anaemia, which indicates that anaemia is a severe health problem among adolescent girls from the public health perspective (Figure 1). The prevalence of mild, moderate, and severe anaemia is 41.5%, 24.4%, and 1.9% respectively. The mean  $\pm$  standard deviation (SD) of the haemoglobin level for the nonanemic girls was 12.53 $\pm$ 0.51 gm/decilitre (g/dL), and for those suffering from mild anaemia was 11.41 $\pm$ 0.33 g/dL, moderate anaemia 9.96 $\pm$ 0.76 g/dL, and severe anaemia 7.07 $\pm$ 0.58 g/dL. The mean haemoglobin level among all the adolescent girls was 11.33 $\pm$ 1.24 g/dL.

Table 2, shows the distribution of individual, socio-demographics and economic characteristics and their association with the prevalence of anaemia among adolescent girls. More than half (52.0%) of the adolescent girls were belonged to age group 15-19 years followed by

(48.0%) in age group 10-14 years. Study shows that the majority 39.6% of the adolescent girls were of birth order 3 and above, while 30.9% and 29.5% girls of order 1 and 2 respectively. Majority of the girls (66.4%) were getting their education from government/semi government school while only 33.6% from private schools. Most (55.3%) of the study subjects belong to other backward class while (22.5%) belongs to scheduled caste (SC), (15.2%) to General and (7.0%) belongs to scheduled tribe (ST). Nearly 70.0% of the respondents were from nuclear family and only (30.1%) were from joint family. Majority of the subjects (68.0%) family size was >5 and rest of the subjects (32.0%) belonged to the family of size ≤5. Majority (86.3%) of the girls were belonged to the family in which less than three earning members. The maximum (47.7%) of the subjects belonged to lower class, (37.4%) belonged lower middle class, while rest (13.0%) and (1.9%) were classified in middle class and upper class respectively. Nearly half (42.3%) of the adolescent girls completed high school and above level schooling while the proportion of primary and secondary were 23.6% and 34.1% respectively. Study also shows that 35 adolescent girls were school dropout, currently did not enrolled in the any type of schooling.

Result of the study reveals that age group and birth order of adolescent girls significantly associated with anaemia (p<0.05). The prevalence of anaemia was high (74.0%) among 15-19 years compared to 61.0% in 10-14 years. Girls of birth order 3 and above were more prevalent (75.3%) to anaemia while in case of 1<sup>st</sup> and 2<sup>nd</sup> birth order proportion was lesser, nearly 62.0%. Finding shows that there is no effect of school type on anemia as in either private/government/semi government school, prevalence of anaemia was nearly same 67.7% among adolescent girls but association is not significant (p≥0.05). Nearly 3/4<sup>th</sup> of adolescent girls of SC category were anaemic while it only 58.9% in general class, but differences were not statistically significant. Proportion of anaemic adolescent girls nearly same in both family type, whether

nuclear (67.8%) or joint (67.6%). Similar types of results were also seen in number of family members and earning members category. There is no effect of father's occupation, mother's occupation and socio-economic class of the family on anaemia status but girls belonging to lower class had highest prevalence 72.7% compared to only 42.9% and 52.9% among upper class and upper middle class respectively.

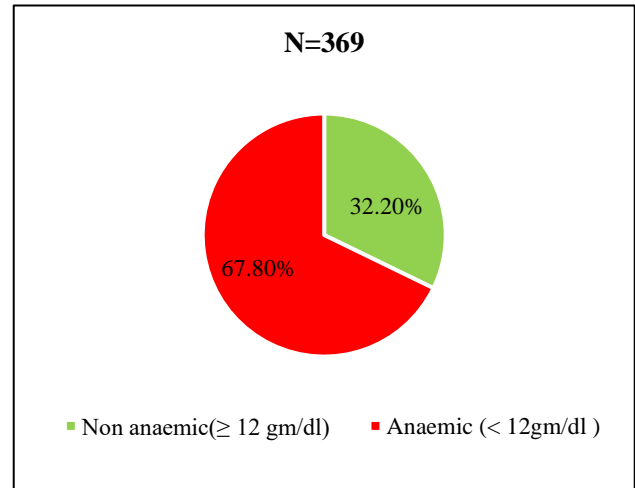


Figure 1: Distribution of anaemia among adolescent girls.

Table 1: Prevalence of anaemia and mean haemoglobin level.

Anaemia classification	N	F (%)	Haemoglobin level, mean ± SD
Normal	119	32.2	12.53±0.51
Mild	153	41.5	11.41±0.33
Moderate	90	24.4	9.96±0.76
Severe	7	1.9	7.07±0.58
Total	369	100.0	11.33±1.24

Reference: WHO classification of anaemia (2011).

Table 2: Association of anaemia with socio-demographic and economic profile of adolescent girls.

Variables	Categories	Non anaemic ≥ 12 Hb		Anaemic < 12 Hb		Total		X <sup>2</sup> , p
		N	%	N	%	N	%	
Age groups (Years)	10-14	69	39.0	108	61.0	177	48.0	7.06, 0.008
	15-19	50	26.0	142	74.0	192	52.0	
Birth order	First	43	37.7	71	62.3	114	30.9	6.399, 0.041
	Second	40	36.7	69	63.3	109	29.5	
	Third and above	36	24.7	110	75.3	146	39.6	
Type of school	Private	40	32.3	84	67.7	124	33.6	0.00, 0.998
	Government/ semi govt.	79	32.2	166	67.8	245	66.4	
Educational status	Primary	28	32.2	59	67.8	87	23.6	0.733, 0.693
	Secondary	44	34.9	82	65.1	126	34.1	
	High school and above	47	30.1	109	69.9	156	42.3	
Caste	SC	21	25.3	62	74.7	83	22.5	3.88, 0.274
	ST	8	30.8	18	69.2	26	7.0	
	OBC	67	32.8	137	67.2	204	55.3	
	General	23	41.1	33	58.9	56	15.2	

Continued.

Variables	Categories	Non anaemic ≥ 12 Hb		Anaemic < 12 Hb		Total		X <sup>2</sup> , p
		N	%	N	%	N	%	
<b>Religion</b>	Hindu	118	32.2	249	67.8	367	99.5	0.29, 0.59
	Muslim	1	50.0	1	50.0	2	0.5	
<b>Type of family</b>	Nuclear family	83	32.20	175	67.80	258	69.9	0.002, 0.961
	Joint family	36	32.40	75	67.60	111	30.1	
<b>Fathers' occupation</b>	Agriculture	12	34.30	23	65.70	35	9.5	6.58, 0.25
	Private	41	40.60	60	59.40	101	27.4	
	Government	2	28.60	5	71.40	7	1.9	
	Business	46	30.70	104	69.30	150	40.7	
	Daily labourer	15	25.90	43	74.10	58	15.7	
	Death/others	3	16.70	15	83.30	18	4.9	
<b>Mothers' occupation</b>	Agriculture	12	34.30	23	65.70	24	6.5	6.34, 0.38
	Private	41	40.60	60	59.40	22	6.0	
	Government	2	28.60	5	71.40	8	2.2	
	Business	46	30.70	104	69.30	11	3.0	
	Labourer	15	25.90	43	74.10	22	6.0	
	Housewife	3	16.70	15	83.30	273	74.0	
<b>Socio economic status*</b>	Upper class	4	57.10	3	42.90	7	1.9	8.06, 0.08
	Upper middle class	8	47.10	9	52.90	17	4.6	
	Middle class	14	45.20	17	54.80	31	8.4	
	Lower middle class	45	32.60	93	67.40	138	37.4	
	Lower class	48	27.30	128	72.70	176	47.7	
<b>Total</b>					369	100		

\*Socio-economic status of respondents was classified according to B.G. Prasad classification (2016), lower, lower middle and middle, upper middle and upper class.

**Table 3: Association of anaemia with menstrual hygiene practices.**

Menstrual hygiene practices		Non anaemic ≥ 12 Hb		Anaemic < 12 Hb		Total		X <sup>2</sup> , p
		N	%	N	%	N	%	
<b>Status of menarche</b>	Yes	68	26.50	189	73.50	257	69.6	12.92, 0.000
	No	51	45.50	61	54.50	112	30.4	
<b>Age at menarche (Years)</b>	≤12	32	21.9	114	78.1	146	56.8	3.58, 0.058
	>12	36	32.4	75	67.6	111	43.2	
<b>Pre knowledge about menarche</b>	Yes	24	31.60	52	68.40	76	29.6	1.454, 0.228
	No	44	24.30	137	75.70	181	70.4	
<b>Source of information</b>	Teacher/ health worker	8	47.1	9	52.9	17	22.4	6.435, 0.092
	Mother/friends	16	27.1	43	72.9	59	77.6	
<b>Days of menstruation (Days)</b>	3	9	20.00	36	80.00	45	17.5	13.06, 0.011
	4	13	22.40	45	77.60	58	22.6	
	5	31	43.10	41	56.90	72	28.0	
	6	9	18.00	41	82.00	50	19.5	
	7	10	31.30	22	68.80	32	12.5	
<b>Gap between 2 cycles</b>	Regular	50	43.10	66	56.90	116	45.1	30.10, 0
	Irregular	18	12.80	123	87.20	141	54.9	
<b>Absorbent used during menstruation</b>	Only napkins	42	41.60	59	58.40	101	39.3	19.60, 0.000
	Only clothes	7	17.90	32	82.10	39	15.2	
	Both	19	16.20	98	83.80	117	45.5	
<b>Napkins used in a day</b>	≤2 times	40	21.9	143	78.1	183	71.2	6.91, 0.009
	>2 times	28	37.8	46	62.2	74	28.8	
<b>Disposal of used napkins</b>	Burns clothes/napkins	11	31.4	24	68.6	35	13.6	0.778, 0.678
	Bury in the ground	8	22.2	28	77.8	36	14.0	
	Throw in the thrash/ponds	49	26.3	137	73.7	186	72.4	

Continued.



Menstrual hygiene practices		Non anaemic ≥ 12 Hb		Anaemic < 12 Hb		Total		X <sup>2</sup> , p
		N	%	N	%	N	%	
<b>Having information on disposal</b>	Yes	42	29.60	100	70.40	142	55.3	1.586, 0.208
	No	26	22.60	89	77.40	115	44.7	
<b>Source of information</b>	Friend	2	50.00	2	50.00	4	2.8	0.957, 0.620
	Mother	32	28.30	81	71.70	113	79.6	
	School teacher	8	32.00	17	68.00	25	17.6	
<b>Getting sanitary napkins</b>	From market	61	27.70	159	72.30	220	85.6	1.263, 0.261
	Not getting from anywhere and don't buy it	7	18.90	30	81.10	37	14.4	

In this study 69.6% of adolescent girls were experienced menarche with 12.4 years mean age of menarche. Table showed that more than half (56.8%) of the adolescent girls reached their menarche up to 12 years of age. Majority (70.4%) of the girls didn't much aware about menarche before experiencing it. Only 29.6% girls had some knowledge about menarche; the most common source of knowledge about menarche was their mother (64.5%) while only 21.1% and 13.2% were getting information from their school teacher and friends respectively. Study also showed that the contribution of health workers in spreading awareness about menstrual health and practices was very less as only 1.3% girls getting information about menarche by them. The mean duration of menstrual cycle was 4.86±1.26 days. More than half (54.9%) of adolescent girls had irregular menstrual cycle. Study also revealed that nearly half (45.5%) of adolescent girls were using both sanitary pads and clothes during their menstrual period while the proportion of sanitary pads and clothes users were 39.3% and 15.2% respectively. Questions were also asked about the reason behind clothe using during menstrual days, 82.1% girls responded that they can't afford pads while 84.6% were in favour of using clothes because they think that clothes are more comfortable to use. Majority (65.0%) of the adolescent girls were changing pads/clothes two times in day while only 3.9% were changing more than 3 times. The most common method of disposal of used pads/clothes was throwing in trash as nearly 70.0% adolescent girls practicing this, whereas 14.0% and 13.6% girls were burying in the ground and burn the used pads/clothes after using it respectively. Study also shows that more than half (55.3%) girls were getting information about different disposal method from their family members (79.6%) and school teacher (17.6%). Among the adolescent girls, 42.0% were getting information about menstrual problems and major source of the information was their mother (81.5%).

Table shows that anaemia status among adolescent girls was significantly associated with status of menarche (p<0.05). The prevalence of anaemia was high among the girls who reached their age of menarche as 73.5% girls were anaemic in comparison to those girls who did not reach their age of menarche; the prevalence was only 54.5%. Adolescent girls whose age of menarche was ≤12 years, 78.1% among them were anaemic in comparison to

67.6% in those girls where age of menarche was more than 12 years. When the adolescent girls did not know about menarche the prevalence of anaemic was 75.7%, comparatively 68.4% among those girls having some knowledge about menarche but the difference was not significant. Duration of menstrual cycle was significantly associated with anaemic status among the adolescent girls (p<0.05). The proportion of anemic girls lowest (56.90%) when the duration of menstrual cycle was 5 days. Anemia status was strongly associated with gaps between two menstrual cycles, whether regular or irregular. Prevalence of anaemia was very high 87.20% in case of irregular menstrual cycle; comparatively it was only 56.90% among those having regular menstrual cycle. Table also shows that anaemia status was significantly associated with use of pads/clothes. The prevalence was lowest 58.4% among only pads users while it was 82.1% and 83.8% among only clothes users and using both pads/clothes respectively.

## DISCUSSION

Our study reports on the prevalence and societal factors associated with anaemia in the present study, the prevalence of anaemia was found to be 67.8%; out of this (41.5) and (24.4) had mild and moderate anaemia respectively, indicating a severe public health problem (prevalence ≥40%) according to cut offs recently recommended by the WHO (2011).<sup>20</sup> The mean ± SD Hb of adolescent girls who participated in the study was 11.3±1.24 which was similar to one reported by Kamble et al, Kumar et al and Kaur et al.<sup>32-34</sup> A higher prevalence similar to this study was reported from other states also such as by Ahankari et al in Maharashtra (87%), Rati and Jawadagi in Karnataka (80%), Koushik et al in Andhra Pradesh (77.3%), Gupta et al in Chhattisgarh (76.3%), Subramanian, Malhotra, Kant et al. in Haryana (71.7%).<sup>21-26</sup> Among community-based rural Indian studies, the reported prevalence of anaemia varies from 21% to 90%.<sup>27-29</sup> Considering grades of anaemia, in our study majority of subjects with anaemia were having mild (41.5%) followed by moderate (24.4%) and severely anaemic (1.9%) respectively. Study findings are similar to the findings of Rawat et al and Kaur et al in which distribution of different levels of anaemia were same as present study.<sup>31,36</sup> In the present study age-wise prevalence of anaemia shows that prevalence of anaemia

was highest (74%) in 15 to 19 years age group and the difference in prevalence of anaemia between different adolescent age group was found to be statistically significant. The higher prevalence of anaemia in late adolescents could be due to the reason that late adolescents experience physical and biological changes following puberty that increase the demand for nutrients. Failure to provide the increased demand for iron could lead to anaemia among late adolescents. Gupta et al in a similar study which was conducted in Haryana on 110 adolescent girls, observed a similar prevalence among girls who were more than 14 years of age compared to early adolescent age.<sup>35</sup> Present study shows that lower class had highest prevalence 72.7% compared to only 42.9% and 52.9% among upper class and upper middle class respectively. These findings were concordant with other similar studies conducted to study anaemia among girls belonging to Uttar Pradesh, Nagpur, Chandigarh, and Delhi, showing high prevalence rate among lower socioeconomic groups.<sup>36-39</sup> Present study also shows that birth order of adolescent girls was significantly associated with anaemia; similarly, findings were also seen in studies by Chandrakumari et al, Selvarani.<sup>7,36</sup>

Individual's factors such status of menarche, age at menarche, duration of menstrual cycle, gap between menstrual cycle, and use of sanitary pads showed a significant association with anaemia among adolescent girls. The findings are in line with numerous studies conducted.<sup>5,39-41</sup> The study showed that nearly three-fourth (73.50%) of the respondents whose menstrual cycle had started were significantly associated with anaemia. In the present study, adolescent girls with long menstrual cycles and having irregular menstrual cycles are more susceptible to iron deficiency anaemia. A study in Kerala found the number of pads used per day during menstruation ( $p=0.004$ ) was associated with the presence of anaemia.<sup>40</sup> The study showed that the use of absorbents in a day was also strongly associated with anaemia ( $p=0.000$ ) likewise, findings of a systematic review and meta-analysis, a higher proportion of girls reported using cloth in rural India (pooled prevalence: 63%).<sup>41</sup> A study in Kerala found the number of pads used per day during menstruation ( $p=0.004$ ) was associated with the presence of anaemia, as like findings of the present study as number of pads used per day during menstruation ( $p=0.009$ ) which indirectly indicates the amount of blood loss during menstruation.<sup>40</sup> Findings of this study also reveals that the mothers identified as the most frequent information source related to menstrual hygiene. A menstrual health management and practices package thus needs to strengthen mothers' practical MHM knowledge to support their girls, this finding also supported by a meta-analysis done by Van et al.<sup>41</sup>

The use of a standardised digital hemoglobinometer (HemoCue 301) and the WHO classification of anaemia reference (2011) for Hb estimation and anaemia prevalence respectively gave our study its strength. This study also sheds critical light on how crucial it is for

adolescent girls to manage their menstrual health. Our study was limited by the detriment of a few significant predictive factors for anaemia, including diet history, hand hygiene, parent education, family history of chronic illness, and programmatic factors like deworming and IFA distribution at schools and Aaganwadi centres. Addressing these multiple determinants of anaemia requires a comprehensive and multisectoral approach, which can be challenging to implement and coordinate.

## CONCLUSION

The present study revealed higher prevalence of anaemia among adolescent girls in rural Varanasi. Prevalence of mild and moderate anaemia was higher compared to severe anaemia. Factors like late adolescent age, higher birth order and low socio-economic status, absorbents used in day found to be associated with anaemia among adolescent girls. Anaemia continues to be a major public health problem in India despite multiple initiatives like Anaemia Mukh Bharat, SAG, WIFS services, to address it among adolescent girls. There is urgent need of comprehensive preventative interventions for the whole adolescent girl population.

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