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Prevalence of anaemia among school going adolescent girls in Bardiya, Nepal: Evidence from a public health screening program

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Abstract

Introduction: Anaemia remains a substantial challenge among adolescent girls in Nepal, resulting in poor physical growth, cognitive impairment, and adverse reproductive health outcomes. This study aimed to determine the prevalence and risk factors associated with anaemia among school-going adolescent girls in Bardiya, Nepal.

Methods: A retrospective cross-sectional study based on secondary data was conducted using data collected during a district-wide anaemia screening program implemented in government schools across Bardiya, Lumbini Province, from 05 Jun 2025 to 29 Jun 2025. Haemoglobin levels were assessed using the cyanmethemoglobin method. Socio-demographic, anthropometric, and menstruation-related data were collected using a Kobo tool and register. Bivariate analysis using Chi-square tests was performed to identify factors associated with anaemia, statistical significance was set at a p-value <0.05 with a 95% confidence interval.

Result: Among 3,334 adolescent girls screened, the prevalence of anaemia was common (80.2%), with mild anaemia 36.1%, moderate 42.4%, and severe 1.8%. of cases. Older (15-19 y) adolescent girls (OR=1.34, p=0.003), from the Tharu ethnic group (OR=3.53, p<0.001), were significantly more likely to be anaemic. Adolescent girls who had taken iron-folic acid tablets (OR=0.46, p <0.001) were significantly less likely to be anaemic.

Conclusions: The prevalence of anaemia among school-going adolescents is alarmingly high. Age, ethnicity, and IFA intake were found to be associated with anaemia. These findings highlight the importance of context-specific interventions, focussing on dietary practices, health education, and adherence to supplementation programs. Focussed measures are needed to address anaemia among adolescents, especially in marginalised ethnic groups.

How to cite

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Introduction

According to WHO, adolescence is defined as a period between 10 and 19 years, a critical phase for growth and development,¹ characterized by distinct physical, psychological, and emotional changes.² This transition period increases their vulnerability to various health and nutritional consequences. Globally, anaemia affected 6% of developed countries and it is comparatively higher in developing countries (26%).³ Anaemia among adolescents is a public health issue in low- and middle-income countries (LMICs).⁴

The Nepal Demographic and Health Survey (NDHS) 2022 reported 39% of anaemia among adolescent girls aged 15–19 years, revealing a persistent and substantial public health burden despite national efforts such as the Weekly Iron and Folic Acid Supplementation program.⁵ Furthermore, Nepal Micronutrient Status Survey revealed 21% of non-pregnant girls aged 10 to 19 years had anaemia.⁶ A study conducted in Dharan found a prevalence of 33.3% of iron deficiency anaemia.⁷ National Adolescent Nutrition Survey (2014) showed that adolescents in Terai had a significantly higher risk of anaemia (adjusted odds ratio 1.80) compared to that of Hill and Mountain regions.⁸

The Ministry of Health, Lumbini province led a province-wide school-based screening initiative for the identification and management of anaemia. As part of this program, Health Office, Bardiya conducted screening camp among school-going adolescent girls to assess their haemoglobin status. In response to the growing concern of anaemia, this present study aimed to determine the prevalence of anaemia and identify its associated factors among school-going adolescent girls in Bardiya district.

Method

This study employed a retrospective cross-sectional design based on a secondary analysis

of data originally collected through a district-wide anaemia screening program.

The dataset used for this study was obtained from a school-based anaemia screening program conducted by the Health Office, Bardiya, in collaboration with the Health Directorate, Lumbini Province, between 05 to 29 Jun 2025. The primary purpose of this program was routine public health screening and management of anaemia among adolescent girls.

Sixteen government schools from eight municipalities were selected for screening through a coordination process involving the Health Office and municipal health and education sections. Schools were purposively selected, prioritizing those with a high proportion of adolescent girls and greater ethnic diversity.

All data were collected by the screening teams of the Health Office, Bardiya. Information was recorded using a Kobo tool and program registers simultaneously and included socio-demographic characteristics, menstrual history, and anthropometric measurements.

The target population was adolescent girls aged 10–19 years enrolled in the selected schools. Anthropometric measurements including height and weight were taken using a stadiometer and a digital scale (SECA) recommended by UNICEF.⁹ Venous blood samples were collected in EDTA tubes, and haemoglobin estimation was performed on-site by trained and experienced health personnel using the cyanmethemoglobin method.

For this study, the authors obtained the dataset from the Health Office after necessary administrative approval. The authors cleaned, coded, and recategorized variables for analysis. No involvement was made in the original design, participant recruitment, or data collection.

Out of 3,336 girls screened, two were excluded by the study team; one because of age (>20 years) and one due to incomplete information resulting in a final dataset of 3,334 girls.

Data were edited, coded and analysed using SPSS version 25. Descriptive and inferential statistical methods were used to analyse the various characteristics of respondents and to find out the association of anaemia with various independent factors. The categorical data were presented as percentages. Data was summarized using frequency distribution tables and graphical methods of presentation of data. Bivariate analysis was performed using the Chi-square test, and associations were considered statistically significant at a p-value <0.05 with a 95% confidence interval.

The formal permission was obtained from the Lumbini provincial Health Directorate [Ref. No. 77] to utilize the anaemia screening data. Ethical clearance was taken from the Nepal Health Research Council [Ref. No. 856]. Confidentiality and privacy of participants' information were strictly maintained by anonymizing all records used in this analysis.

Anaemia is classified by the World Health Organization (WHO, 2011) based on haemoglobin concentration among non-pregnant adolescent girls aged 10 to 19 years. According to this classification, a haemoglobin level of 12.0 g/dL or higher is considered non-anaemic. Mild anaemia is defined as a haemoglobin level between 11.0 and 11.9 g/dL, moderate anaemia as between 8.0 and 10.9 g/dL, and severe anaemia as a haemoglobin level of less than 8.0 g/dL.¹⁰

For calculation of BMI and nutritional status, based on the Z-score of adolescents and WHO Growth Reference cut-offs nutritional status was categorized into Z-scores into thinness (less than -2 SD), normal (-2 SD to +1 SD) and overweight (greater than +1SD).¹¹

According to the World Health Organization (WHO), adolescents are individuals between the ages of 10 and 19 years. This stage of life is further divided into two subcategories: early adolescence, which includes those aged 10 to 14 years, and late adolescence, which includes those aged 15 to 19 years.¹²

In this study, adolescent girls who reported having ever consumed iron and folic acid (IFA) tablets at least once were classified as having IFA intake.

In this study, ethnicity was categorized according to health management information system caste and ethnic groups (Dalit-1, Janjati-2, Madhesi-3, Muslim-4, Brahmin/Chhetri-5 and Other-6).¹³ As a large proportion of the Bardiya district population belongs to the Tharu ethnic group, we aimed to identify potential ethnic differences in anaemia. Therefore, for the purpose of bivariate analysis, ethnicity was recategorized into two groups: Tharu and Non-Tharu.¹⁴

Result

Out of 3334 participants, more than half of the participants belonged to the younger adolescents (72.9%). The majority of the participants were Janjati (56.1%) in ethnicity. Nearly 80% of participants had normal BMI, 15.7% had thinness and only 4.6% were overweight. Most of the participants (71.5%) had experienced menarche and 86.0% had taken iron folic acid, Table 1. This study found that 80.2% of participants were anaemic. Among them, 36.1%, 42.4% and 1.8% were mild, moderate and severe anaemia respectively, Figure 1 and 2.

Among the local levels, Rajapur showed the highest proportion of mild anaemia (70.1%), while Barbardiya had a high proportion of moderate anaemia (61.6%). While mild and moderate anaemia were more common, severe

anaemia, though less frequent overall (1.8%), was highest in Rajapur (3.4%) and Thakurbaba (2.2%), Table 2.

The study found that anaemia among adolescent girls was significantly associated with adolescent stage, ethnicity, and IFA intake. Older adolescents were 1.34 times more likely to be anaemic compared to younger

adolescents (OR=1.34, $p=0.003$), and girls from the Tharu ethnic group had a 3.5 times higher likelihood of anaemia than Non-Tharu (OR=3.53, $p<0.001$). IFA intake was found to be protective, with those who consumed IFA having significantly lower odds of anaemia (OR=0.46, $p<0.001$), Table 3.

Table 1 Socio-demographics of school going adolescent girls screened for prevalence of anaemia, n=3334

Characteristics	n	%
Adolescent stage		
Younger adolescent (10 – 14 years)	2429	72.9
Older adolescent (15 – 19 years)	905	27.1
Ethnicity		
Brahmin/Chhetri	631	18.9
Janjati	1870	56.1
Dalit	444	13.3
Madhesi & Muslim	299	9.0
Others	90	2.7
BMI status		
Thinness	522	15.7
Normal	2659	79.8
Overweight	153	4.6
Menarche		
No	950	28.5
Yes	2384	71.5
IFA intake		
No	468	14.0
Yes	2866	86.0

IFA= iron folic acid tab

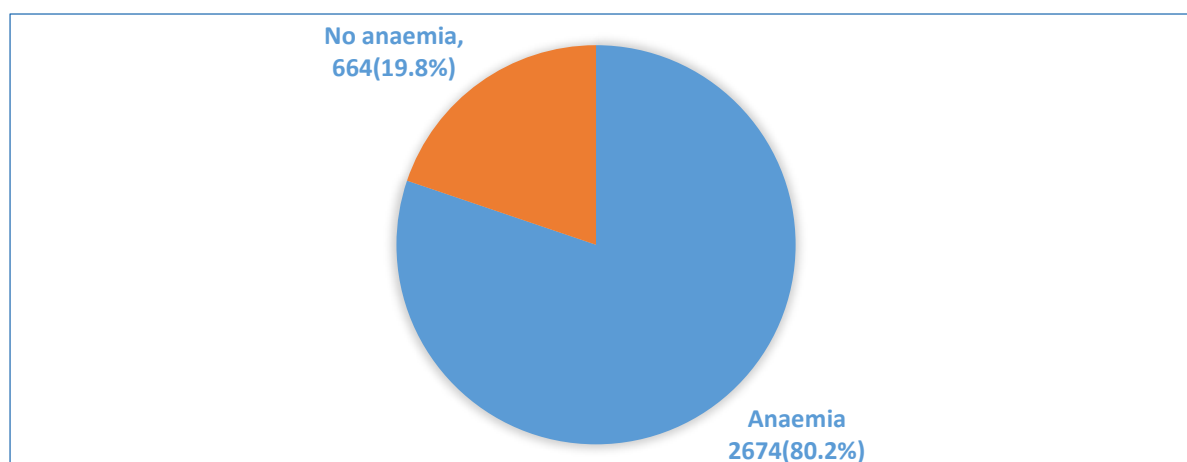


Figure 1. Prevalence of anaemia among school going adolescent girls, n=3334

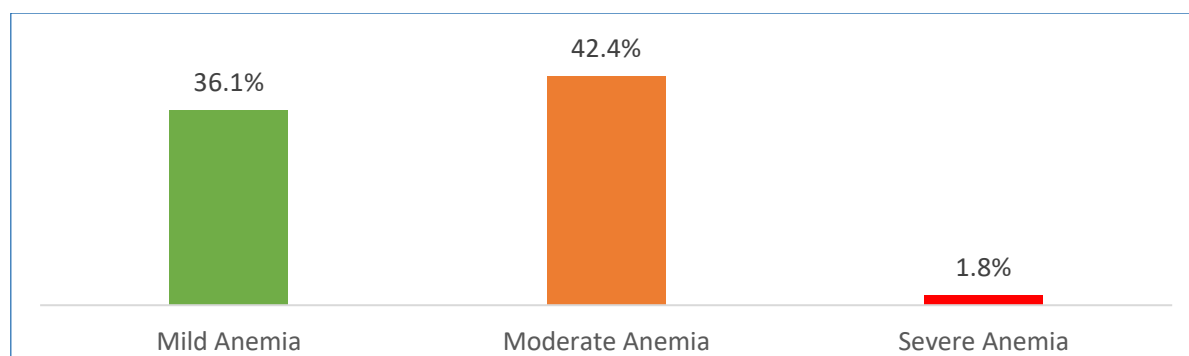


Figure 2. Severity of anaemia among school going adolescent girls, n=3334

Table 2. Prevalence of Anemia among school going adolescent girls and severity by local level of residence, n=3334

Local level residence	Severity of Anaemia			No Anaemia n(%)	Total
	Severe n(%)	Mild n(%)	Moderate n(%)		
Badhaiyatal	7(1.7)	175(43.5)	139(34.6)	81(20.2)	402
Basgadhi	5(1.4)	133(36.2)	125(34.1)	104(28.3)	367
Barbaridiya	5(1.3)	114(29.6)	237(61.6)	29(7.5)	385
Geruwa	4(1.8)	74(33.3)	125(56.3)	19(8.6)	222
Gulariya	7(1.4)	169(33.3)	184(36.2)	148(29.1)	508
Madhuwan	4(0.9)	126(29.9)	162(38.4)	130(30.8)	422
Rajapur	18(3.4)	199(70.1)	245(45.7)	74(13.8)	536
Thakurbaba	11(2.2)	212(43.1)	195(39.6)	74(15)	492
District	61(1.8)	1202(36.1)	1412(42.4)	659(19.8)	3334

Table 3. Association of anaemia status with socio-demographic characteristics among school going adolescent girls, n=3334

Variables		Anaemia Status		p-value	OR (95% CI)
		Normal	Anaemic		
Adolescent stage	Older adolescent	149(16.5)	756(83.5)	0.003*	1.34(1.103–1.649)
	Younger Adolescent	510(21.0)	1919(79.0)		
Ethnicity	Tharu	179(10.5)	1521(89.5)	<0.001*	3.53(2.9–4.26)
	Non-Tharu	480(29.4)	1154(70.6)		
Menarche	Yes	457(19.2)	1927(80.8)	0.171	1.13(0.94–1.37)
	No	202(21.3)	748(78.7)		
IFA intake	Yes	511(17.8)	2355(82.2)	<0.001*	0.46(0.378–0.583)
	No	148(31.6)	320(68.4)		
BMI status	Thinness	105(20.1)	417(79.9)	0.769	0.965(0.76–1.22)
	Overweight	34(22.2)	119(77.8)		
	Normal	520(19.6)	2139(80.4)		

*Significant at p-value <0.05

Discussion

The study determined the prevalence of anaemia and its associated factors among school-going adolescent girls. In this study, out of 3334 adolescent girls, majority (80.2%) were found to be anaemic. This finding aligns with a

study conducted in India (56.2%),¹⁵ Bangladesh (51.6%).¹⁶ However other studies conducted in different parts of Nepal have reported lower rates of anaemia, 18% in Dhankuta, 17.4% in Kathmandu, and 31% in a national-level

study.^{3,12} This variation may be due to differences in study settings and locations.

The study found that moderate anaemia was more common among adolescent girls, consistent with the findings from a cross-sectional survey in Karnataka, South India.¹⁷ Conversely, other studies conducted in India showed mild degree of anaemia was the most common type of anaemia among adolescent girls.^{15,18} These inconsistencies may be influenced by variations in iron supplementation practices, and awareness levels among adolescent populations in different settings.

The study reported adolescent stage, ethnicity and IFA intake were significantly associated with anaemia. Older adolescents (aged 15–19 years) were found to have a significantly higher risk of anaemia compared to younger adolescents (aged 10–14 years) (OR=1.34, 95% CI: 1.103–1.649, $p=0.003$). This aligns with findings from studies in India and other South Asian countries, which reported increased anaemia prevalence in older adolescents due to greater iron demands from rapid growth, menstruation, and potential dietary inadequacies during this critical developmental phase.^{19,20} The cumulative physiological demands and onset of menstruation in late adolescence may contribute to depleted iron stores, explaining the higher anaemia burden in this group.

Ethnicity was also found to be significantly associated with anaemia in our study. This finding is supported by previous research from the Nepal Health Research Council, which highlighted ethnic disparities in anaemia prevalence, particularly in the Terai region.²¹ Contributing factors may include socioeconomic disadvantages, lower dietary diversity, cultural dietary restrictions, and reduced access to health education and services among marginalized ethnic groups.

These findings emphasize the need for targeted interventions that are culturally appropriate and equity-focused.

Regarding IFA intake, adolescent girls who took IFA (Iron and Folic Acid) supplements had a lower rate of anaemia compared to those who did not (OR=0.46, 95% CI: 0.378–0.583, $p=0.001$). Similar results were found in studies carried out in Nepal and India.^{22–24}

This study has several methodological limitations. First, as a secondary data analysis, the dataset lacked important confounding variables such as dietary intake, parasitic infections, socioeconomic status, and detailed information on IFA adherence, dosage, and duration and considering single IFA intake as yes or no for supplement is inadequate. Because these essential variables were not available, a multivariate logistic regression model could not be performed. Analysis without key confounders could have produced misleading adjusted estimates. Therefore, all odds ratios presented in this study are unadjusted and should be interpreted with caution. Additionally, the purposive selection of school limits generalizability of the findings to all adolescent girls in Bardiya. The cross-sectional design also prevents causal interpretation of the associations observed.

Findings highlight the need for targeted public health intervention program for adolescent girls. Priority should be given to strengthen IFA supplementation and nutrition education. Regular screening and management of anaemia should be integrated into school health nutrition program for effective control of anaemia.

Conclusion

This study reveals an alarmingly high prevalence of anaemia (80.2%) among school-going adolescent girls in Bardiya, Nepal. Older age, Tharu ethnicity, and self-reported iron–

folic acid (IFA) intake was significantly associated with anaemia. While causal relationships cannot be established due to the cross-sectional design, purposive sampling, and secondary data (lacking confounders) obtained from health screening program; even so, the findings highlight a critical public health burden and underscore the need for targeted, equity-focused interventions, including strengthened IFA supplementation, nutrition education, and regular school-based anaemia screening, particularly among older adolescents and marginalized ethnic groups.

Author contribution

Concept design: NPC, SP, Spa Literature Search: NPC, SP, SPA, Data Collection: SP, SPA, Draft manuscript: NPC, SP, SPA, Final Manuscript and Accountability: All

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Conflict of Interest

None

Funding

None

Supplementary material

The data and supplementary material that support the findings of this study are available from the corresponding author upon reasonable request.

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Tools/Questionnaire

1. Date of Sample Collection:	
2. Name of School:	
3. Municipality Name:	
4. Ward No:	
5. Grade:	
6. Name of Participant:	
7. Parents Name:	
8. Parents Phone Number:	
9. Principal Name:	
10. Principal Phone Number:	
11. Name of Teacher (Health Education):	
12. Phone Number of Teacher (Health Education):	

Questionnaire

General Information

Part I: Socio-demographic Variables	
Variables	Answers
Age	In Completed Years
Ethnicity	1. Dalit 2. Janjati 3. Madhesi and Muslim 4. Brahmin/Chhetri 5. Others

Part II: Reproductive and Nutritional Variables	
Variables	Answers
Have you ever had a Menarche?	1. Yes 2. No
Weight in Kg
Height in cm
Have you ever consumed IFA?	1. Yes 2. No
Haemoglobin Level (Hb/dl) (g/dl)